Bidi Smoking and Public Health

Editors

Prakash C. Gupta

Samira Asma

Partners

Ministry of Health and Family Welfare, Government of India
World Health Organization
Healis-Sekhsaria Institute for Public Health
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Editors

Prakash C. Gupta is the Director of Healis-Sekhsaria Institute for Public Health, Navi Mumbai. He is a long standing researcher on tobacco control issues and recepients of several awards.

Samira Asma is the Associate Director for the Global Tobacco Control Program at the Office on Smoking and Health, Centers for Disease Control & Prevention. She provides strategic leadership & coordination on global tobacco research, surveillance & policy initiatives.

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भारत सरकार
स्वास्थ्य एवं परिवार कल्याण मंत्रालय
निर्माण भवन, नई दिल्ली - 110011
Government of India
Ministry of Health & Family Welfare
Nirman Bhavan, New Delhi-110011

Naresh Dayal
Health & FW Secretary
Tel.: 23061863 Fax : 23061252
e-mail : secyfw@nb.nic.in
ndayal@nic.in

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FOREWORD

India is among the worlds largest tobacco consuming societies.

Tobacco usage in India is also contrary to world trends since chewing tobacco and the bidi are the dominant forms of tobacco consumption, whereas internationally the cigarette is the most prominent form of tobacco use. About 19% of tobacco consumption in India is in the form of cigarettes, while 53% is smoked as bidis, the rest is used mainly in smokeless form. Bidis tend to be smoked by lower economic classes and have a level of social acceptance in different cultures.

Available evidence indicates that tobacco consumption is the single most preventable cause of disease and death. It also imposes very high socio-economic costs on the society. Government of India has enacted "The Cigarettes and other Tobacco Products (Prohibition of Advertisement and Regulation of Trade and Commerce, Production Supply and Distribution) Act 2003", with a view of protect public health by prohibiting smoking a public places, banning advertisement of tobacco products, banning sale of tobacco to minors and within 100 yards radius of educational institutions, prescribing pictorial health warnings etc.

There are a number of studies, reports and reviews on cigarette use and its harmful effects. Similar studies on other tobacco forms, including bidi are very few. The bidi monograph bridges a very important gap in the area of public health as it provides a comprehensive review on impact of bidi consumption. The compilation of scientific studies on bidis provides a plethora of information on the consumption patterns and associated usage risks. Since the problem of bidi usage is unique to South Asia, the monograph would be extremely useful for public health managers both in India and neighboring countries, to promote effective initiatives for curbing bidi usage. The monograph has been prepared by the Healis-Sekhsaria Institute of Public Health, Navi Mumbai, in collaboration with the Centers for Disease Control and Prevention, Office on Smoking & Health, USA and with active support from Government of India and the World Health Organization.

I congratulate the editors Dr. P.C. Gupta and Dr. Samira Asma, for the efforts put in by them and also acknowledge the valuable contributions made by individual experts.

This monograph may be disseminated among all stakeholders, both within Government and outside to enable framing of positive public health policies. This monograph would also be useful in countering misinformation campaigns and propaganda regarding the health effects of bidi, as it is now clearly evident that bidi is as harmful as any other tobacco product.

(NARESH DAYAL)
Secretary to the Government of India

Preface

Bidis are small hand-rolled cigarettes which are very common in India, seven or eight times more so than cigarettes. Although primarily an Indian product, bidis are exported abroad and have recently become popular in the United States, especially among young people. This is a cause for public health concern both in the U.S. and globally. Just like cigarette smoking, bidi smoking causes vascular disease, lung disease and cancers. On standard smoking machines bidis produce equal or higher levels of nicotine, tar and other toxic chemicals, when compared to cigarettes.

Although many studies have been reported in the scientific literature, until now there had been no attempt by any national or international agency to consolidate information about bidi smoking. For this reason, a collaborative project was proposed between the Centers for Disease Control and Prevention, Office on Smoking and Health, USA and the Healis-Sekhsaria Institute of Public Health, Navi Mumbai, India, to bring together comprehensive information on bidi smoking in one single publication.

Scientists who have made original contributions towards understanding bidi smoking, mainly in the USA and India, were asked to contribute a state-of-the-art paper in their specific area of expertise. The resulting papers fell into six broad categories, which form the main sections of this publication: **Product Description; Prevalence of Bidi Smoking; Chemistry, Toxicology, Pharmacology and Abuse Potential; Disease Consequences; Economics; and Public Health Policy Strategies.**

Drafts of papers were subjected for peer review and authors were given the opportunity to revise their papers based on reviewers' comments. Then each paper was presented by the authors during a three-day workshop in New Delhi in August 2004. In addition to authors and reviewers from the USA and India, the workshop was attended by representatives from the Indian Council of Medical Research; Ministry of Health and Family Welfare, Government of India; and the World Health Organization's India Office and South East Asian Regional Office. After the authors summarized their papers, considerable time was dedicated to discussion, questions and comments. Lead authors were then able to modify their papers in light of the discussion that emanated from the workshop. The final papers were peer reviewed once more before being returned to their authors for finalization.

The introductory section on **Product Description** has two papers. **Chapter 1.1: History and Culture of Bidis in India: Production, Employment, Marketing and Regulations** provides an overview of the bidi industry in India and suggests areas for future action, research and policy change towards safeguarding bidi smokers and finding alternate employment for bidi workers.

Chapter 1.2: Marketing, Promotion and Availability of Bidis in the United States examines what is currently known about the presence, perceptions, marketing and promotion of bidis in the United States, with special attention to risk factors that lead to bidi smoking and popular perceptions about the relative risk of bidis compared to Western-style cigarettes, and

marketing strategies of bidi distributors and the extent to which overt advertising messages may mislead American youth into thinking bidis are a safe alternative to cigarettes.

Three papers address the **Prevalence of Bidi Smoking**. **Chapter 2.1: Prevalence of Bidi Smoking among Youth in India** summarizes the issues on the prevalence of bidi smoking among youth in India and the knowledge, attitudes and behavioral aspects of bidi smoking among youth, which should be useful for interventions aimed at curtailing their bidi smoking habits.

Chapter 2.2: Prevalence and Patterns of Bidi Smoking in India paints a picture of the prevalence of bidi smoking among adults in different parts of India relative to other competing tobacco products and identifies patterns and trends, through a review of large-scale surveys from the 1960s onwards, including country-wide prevalence and state-wide consumption data from the National Sample Survey.

Chapter 2.3: Prevalence of Bidi Cigarette Use in the United States, 2000 to 2004 describes the epidemiology of bidi use in the USA from 2000 to 2004, based on data from the National Youth Tobacco Survey (NYTS) and the Behavioral Risk Factor Surveillance System (BRFSS). This information should encourage further monitoring of bidis in vulnerable populations and the development and implementation of evidence-based policies to prevent their use.

The **Chemistry, Toxicology, Pharmacology and Abuse Potential of Bidis** is discussed in two papers. **Chapter 3.1: Chemistry and Toxicology** outlines product characteristics, from curing and processing to wrapping and additives. It describes protocols to machine measure bidi smoke, *in vitro* studies of the toxicology of bidi smoke and chemical constituents, and studies of product modifications to reduce the tar and nicotine. Greater detail is provided of cytotoxicity studies, *in vivo* animal studies of acute, subchronic and chronic exposure, epidemiological and occupational studies of human exposure outcomes, and needs for future research.

Chapter 3.2: Laboratory Studies of Bidi Smoking in Humans explores the effects of bidi smoking in laboratory studies that employed volunteers who smoked bidi cigarettes in a highly controlled experimental environment. It begins with a brief discussion of the advantages and disadvantages of laboratory studies frequently used to characterize the effects of abused drugs and to probe human cigarette smoking behavior, then focuses on small-sample within-subject clinical laboratory studies.

The section on **Disease Consequences** covers research on adverse health events that can be attributed to smoking bidis. **Chapter 4.1: Overall Mortality Associated with Bidi Smoking** summarizes available data about excess mortality among bidi smokers, since it has already been established that mortality rates are significantly higher among cigarette smokers than non-smokers. Findings from population-based cohort studies and case-control studies in India have established bidi smoking as no less hazardous than cigarette smoking.

Chapter 4.2: Smoking and Pulmonary Tuberculosis: Mortality and Morbidity in India reviews seven epidemiological studies that showed an association between smoking and pulmonary tuberculosis. Higher risk was seen with bidi smoking compared to cigarette smoking.

Chapter 4.3: Bidi Smoking and Lung Diseases examines available information on the association of bidi smoking with lung diseases, such as chronic obstructive pulmonary disease

(COPD), bronchial asthma and cancer. Although results were not previously separated for cigarette and bidi smoking, a majority of smokers in India smoke bidis and presumptions can be made about the prevalence of lung disease among bidi smokers compared to cigarette smokers.

Chapter 4.4: Cardiovascular Disease Consequences of Bidi Smoking focuses on bidi smoking and cardiovascular diseases (CVD). It uses research on the association between tobacco use and CVD, and points to the need to look more specifically into deleterious health effects of bidi smoking. Research is also required to evaluate various cessation methods for smokers who are already addicted.

Chapter 4.5: Bidi Smoking and Cancer presents several case-control studies that provide evidence of an association between bidi smoking and cancers of the upper aero-digestive tract and of the lung, esophagus and stomach, as well as dose-response relationships with respect to frequency, cumulative dose and total duration of bidi smoking. Biological evidence complements these findings. Mention is made of studies that show that bidi workers also run an increased risk of developing cancer.

Chapter 4.6: Oral Mucosal Lesions and Diseases reviews several epidemiological studies that confirm that bidi smoking is deleterious to oral health. While the most serious oral health consequence of bidi smoking is cancer, the authors also discuss precancerous lesions, such as leukoplakia and erythroplakia, as well as oral mucosal lesions and adverse periodontal health consequences. Knowledge of lesions would help oral health care specialists with diagnosis and proper management before they progress to cancer, as well as encouraging smoking cessation.

The **Economics of Bidis in India** chapter covers production of bidi tobacco, bidi manufacturing, marketing, employment, taxation, consumption, export and import, and the Indian government's policy and approach towards the bidi sector. It points to the need for taxes on bidis to reduce demand, promotion of alternative economic activities for bidi growers and workers, and development of a comprehensive national database as the basis for concrete policy decisions.

The final section on **Public Health Policy Strategies** has three papers. **Chapter 6.1: Indian Bidi Industry and Related Policies** discusses legislation and policies developed by the Indian government aimed at protection of consumers and society, monitoring working conditions and providing social security benefits for the welfare of laborers, and fiscal policies with regard to tobacco control. It argues that the absence of policies on pricing and taxation of bidis has helped increase popularity and consumption, and that government and other stakeholders need to consider avenues for providing alternative employment to bidi workers.

Chapter 6.2: Policy Implications for Bidis in the United States examines policy issues related to the importation of bidis from India into the USA, including tariff, taxation and labeling issues, youth access, advertising and marketing policies, product regulation implications, as well as state legislation and federal regulation activity regarding the importation, sale, and use of bidis. It details how these policies have been applied, sometimes inadequately, and how public attention led to increased awareness and enforcement of the laws and regulations.

Finally, **Chapter 6.3: Global Policy for Regulating Bidis** focuses on bidis as a 'global' tobacco product, with concerns that unless clear control mechanisms are identified and

implemented, bidis may become a global public health problem. It recommends that a policy framework for bidis should incorporate the various demand-side and supply-side measures for tobacco control addressed in the Framework Convention on Tobacco Control that are both specific to 'the Indian cigarette' and to the local circumstances in countries where bidis are already widely used.

It is expected that this publication will become a standard reference on bidis, which would encourage further research and become a tool for promoting policy strategies for the prevention and control of bidi smoking.

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Prakash C. Gupta
Samira Asma

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Prakash C. Gupta
Samira Asma

Contributors

Bidi Smoking and Public Health was developed under the editorial direction of Samira Asma and Prakash C. Gupta. The editors gratefully acknowledge the many researchers and authors who made this monograph possible. Attributions for each chapter are as follows:

Chapter 1.1:	History and Culture of Bidis in India: Production, Employment, Marketing and Regulations	Shoba John Programme Director for South East Asia HealthBridge Foundation of Canada CPAA, King George Memorial E Moses Road Mahalakshmi Mumbai 400011, INDIA
Chapter 1.2:	Marketing, Promotion and Availability of Bidis in the United States	Michelle O'Hegarty Health Scientist Office on Smoking and Health Centers for Disease Control and Prevention, 4770 Buford Highway M K50 Atlanta, GA 30341, USA Mark Nichter Regents' Professor Department of Anthropology University of Arizona PO Box 210030 Tucson, AZ 85721-0030, USA
Chapter 2.1:	Prevalence of Bidi Smoking among Youth in India	Dhirendra N. Sinha School of Preventive Oncology A/27 Anandpuri Boring Canal Road Patna 800001 Bihar, INDIA Rajesh Dikshit Epidemiologist Department of Biostatistics and Epidemiology Tata Memorial Center, Parel Mumbai - 400012, INDIA

Chapter 2.2:	Prevalence and Patterns of Bidi Smoking in India	Cecily S. Ray Senior Research Assistant Healis, Sekhsaria Institute for Public Health 601, Great Eastern Chambers, 6th Floor, Plot No. 28, Sector 11 CBD Belapur (E) Navi Mumbai 400614, INDIA Prakash C. Gupta Director, Research Healis, Sekhsaria Institute for Public Health 601, Great Eastern Chambers, 6th Floor, Plot No. 28, Sector 11 CBD Belapur (E) Navi Mumbai 400614, INDIA
Chapter 2.3:	Prevalence of Bidi Cigarette Use in the United States, 2000 to 2004	Sara Mirza Epidemiologist Office on Smoking and Health Centers for Disease Control and Prevention, 4770 Buford Highway Atlanta, GA 30341, USA Corinne G. Huston Chief, Epidemiology Branch Office on Smoking and Health Centers for Disease Control and Prevention, 4770 Buford Highway Atlanta, GA 30341, USA
Chapter 3.1:	Chemistry and Toxicology	Patricia Richter Toxicologist Office on Smoking and Health Centers for Disease Control and Prevention, 4770 Buford Highway Atlanta, GA 30341, USA Cliff Watson Research Chemist National Center for Environmental Health, Centers for Disease Control and Prevention, 4770 Buford Highway Atlanta, GA 30341, USA

Chapter 3.2:	Laboratory Studies of Bidi Smoking in Humans	Wallace Pickworth Battelle Centers for Public Health Research & Evaluation 6115 Falls Rd Baltimore, MD 21209, USA Jennifer L. Malson Battelle Centers for Public Health Research & Evaluation 6115 Falls Rd Baltimore, MD 21209, USA
Chapter 4.1:	Overall Mortality Associated with Bidi Smoking	Mangesh Pednekar Scientific Officer Healis, Sekhsaria Institute for Public Health 601, Great Eastern Chambers, 6th Floor, Plot No. 28, Sector 11 CBD Belapur (E) Navi Mumbai 400614, INDIA Prakash C. Gupta Director, Research Healis, Sekhsaria Institute for Public Health 601, Great Eastern Chambers, 6th Floor, Plot No. 28, Sector 11 CBD Belapur (E) Navi Mumbai 400614, INDIA
Chapter 4.2:	Smoking and Pulmonary Tuberculosis: Mortality and Morbidity in India	Gajalakshmi Vendhan Director Epidemiological Research Center New No. 27, Canal Road Kilpauk Garden Colony Chennai 600010, Tamil Nadu, INDIA Richard Peto CTSU, Oxford University Richard Doll Building Old Road Campus, Roosevelt Drive Oxford, OX3 7LF, UK
Chapter 4.3:	Bidi Smoking and Lung Diseases	S.K. Jindal Professor and Head Department of Pulmonary Medicine Postgraduate Institute of Medical Education and Research (PGIMER) Chandigarh-160012, INDIA

Chapter 4.4:	Cardiovascular Disease Consequences of Bidi Smoking	K. Srinath Reddy Professor and Head Department of Cardiology All India Institute of Medical Sciences Ansari Nagar New Delhi - 110029, INDIA G. S. Ramakrishna Plot No. 6, Venkatram Nagar Colony Kharkhana, Secunderabad-500009, INDIA
Chapter 4.5:	Bidi Smoking and Cancer	Surendra Shastri Professor and Head Department of Preventive Oncology Tata Memorial Centre, Parel Mumbai - 400012, INDIA
Chapter 4.6:	Oral Mucosal Lesions and Diseases	Mihir N. Shah Profesor and Head, Dept. of Periodontics & Public Health Dentistry Ahmedabad Dental College & Hospital, Ahmedabad 382115 Gujarat, INDIA P.R. Murti Professor of Oral Pathology & Acting Director School of Dentistry Faculty of Medical Sciences The University of West Indies Eric Williams Medical Sciences Complex Uriah Butler Highway Champs Fleurs, Trinidad & Tobago, WEST INDIES Kinnari B. Rajpura Tutor, Department of Oral Pathology Government Dental College and Hospital Ahmedabad, Gujarat, INDIA
Chapter 5.0:	Economics of Bidis in India	P.R Panchamukhi Director Centre for Multi-Disciplinary Development Research (CMDR) R.S.No. 9A2, Plot No. 82 Dr. B.R.Ambedkar Nagar, Near Yalakki Shettar Colony, Lakamanahalli, Karnataka 580001, INDIA

		Trevor Woollery Health Scientist Office of the Chief Science Officer Centers for Disease Control and Prevention, Mailstop D72 Atlanta, GA 30329-4018, USA
		S.N. Nayanatara Centre for Multi-Disciplinary Development Research Jubilee Circle Dharwad Karnataka 580001, INDIA
Chapter 6.1:	Indian Bidi Industry and Related Policies	Monika Arora Director, HRIDAY-SHAN C-1/52, 3rd Flr, Safdarjung Development Area New Delhi-110016, INDIA
		Bejon Misra Executive Director Voluntary Organization in Interest of Consumer Education (VOICE) 441 Jangpura, Mathura Road, New Delhi-110014, INDIA
		S. Shrihari Senior Project Officer Center for Global Health Research, St.John's Research Institute (SJRI), Opp BDA Complex, Koramangala, Bangalore 560034, INDIA
Chapter 6.2:	Policy Implications for Bidis in the United States	Nicole Kuiper Health Scientist Office on Smoking and Health Centers for Disease Control and Prevention, 4770 Buford Highway Atlanta, GA 30341, USA
		Jack Henningfield Adjunct Professor of Behavioral Biology Department of Psychiatry and Behavioral Sciences John Hopkins University School of Medicine 600 N Wolfe St. Meyer 3-142 Baltimore, MD 21287, USA

Chapter 6.3: Global Policy for Regulating Bidis

Vera Luiza da Costa e Silva,
Senior Public Health Consultant
Rua Pinheiro Guimarães,
149 Casa 145
Rio de Janeiro/RJ22281 - 080, BRAZIL

Poonam Dhavan
Public Health Foundation of India
PHD House, 4/2,
Siri Fort Institutional Area
August Kranti Marg,
New Delhi 110016, INDIA

Khalilur Rahman
Regional Advisor
Tobacco Free Initiative
I P Estate, New Delhi, INDIA

We gratefully acknowledge the following scientific experts who contributed critical reviews. Many of the authors listed above also reviewed other chapters.

- Rajani A. Bhisey
  7, Yug Prabhat CHS
  Sitladevi Temple Road
  Mahim, Mumbai 400016, INDIA

- R.B. Bhonsle
  The Manipal-Goa Cancer and General Hospital
  Dental Department
  Dr. E. Borges Road
  Dona Paula
  Goa - 403004, INDIA

- Klaus Brunnemann
  Biochemist, USA

- Kishore Chaudhry
  Deputy Director General
  Social and Preventive Medicine
  Indian Council of Medical Research
  Ansari Nagar, New Delhi, INDIA

- Rohini Chowgule
  Pulmonary Physician
  Professor of Medicine
  Bombay Hospital Institute of Medical Sciences
  Bombay University, INDIA

- Dinesh Daftary
  Oral Pathologist
  Dental Clinic
  Kapoor Mansion
  49 Hughes Road
  Mumbai 400007, INDIA

- Mirjana Djordjevic
  Program Director
  National Cancer Institute,
  Division of Cancer Control and Population Sciences,
  Tobacco Control Research Branch,
  Bethesda, Maryland, USA

- Renu Khanna
  Advocate, New Delhi

- C.K. Kolappan
  Deputy Director
  Tuberculosis Research Centre
  Mayor V.R. Ramanathan Rd.
  Chetput, Chennai 600031, INDIA

- Michon Mabry
  Emerging Leader
  Office on Smoking and Health
  Centers for Disease Control and Prevention
  Atlanta, Georgia, USA

- Prem Pais
  Professor of Medicine and Vice Principal
  St. John's Medical College
  Koramangala, Bangalore
  Karnataka 560034, INDIA

- Vinayak Prasad
  Director
  Ministry of Health and Family Welfare
  Government of India
  New Delhi, INDIA

- Sreevidya Subramoney
  Senior Research Scientist
  Healis-Sekhsaria Institute for Public Health
  601/B Great Eastern Chambers
  Plot no. 28, Sector 11, CBD Belapur
  Navi Mumbai 400614, India

- Charles W Warren
  Distinguished Fellow/Statistician
  Office on Smoking and Health,
  Centers for Disease Control
  Atlanta, Georgia

- B.B. Yeole
  Deputy Director
  Bombay Cancer Registry
  Indian Cancer Society
  74 Jerabai Wadia Rd.
  Parel, Mumbai - 400012, INDIA

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CHAPTER 1

1.1

History and Culture of Bidis in India: Production, Employment, Marketing and Regulations

1.2

Marketing, Promotion and Availability of Bidis in the United States

1.1 History and Culture of Bidis in India: Production, Employment, Marketing and Regulations

Shoba John

INTRODUCTION

This chapter provides an overview of the bidi industry in India and suggests some areas for future action, research and policy change towards safeguarding bidi smokers and finding alternate employment for bidi workers.

Product Description

"Bidis" or "beedis" are slim, hand-rolled, unfiltered cigarettes. They are also called "beeris" in countries such as Bangladesh. A bidi consists of about 0.2 gram of sun-dried and processed tobacco flakes, rolled in a tendu leaf (*Diospyros elanoxylon*) or temburni leaf and held together by a cotton thread. The tobacco rolled in bidis is different from that used in cigarettes and is referred to as bidi tobacco.[1] Dark and sun-dried tobacco varieties are used in bidi production.[2] Bidis are available branded and unbranded.

The tendu leaf constitutes 60% of the weight of the bidi.[3] The bidi is four to eight cm in length. The diameter at the closed end is 0.6 - 0.8 cm and the width at the smoking end is 0.7-0.9 cm.[4]

The relatively low combustibility and non-porous nature of the tendu leaves requires more frequent and deeper puffs by the smoker to keep bidis lit, and is therefore harder on the smoker's lungs than cigarettes rolled in paper.[4] Tar levels delivered by bidis are high, at 45-50 mg/bidi.[3] One study found that bidis produced approximately three times the amount of carbon monoxide and nicotine and approximately five times the amount of tar as cigarettes.[5] In India, a bidi costs as little as 15 paise (100 paise = one rupee) and a bundle of 25 bidis costs three to four rupees (1 US dollar = Indian rupees 46.15). Thus bidis are known as the "poor man's cigarettes", as they are smaller and cheaper than cigarettes.

Emergence of Bidis in India

Tribal people of ancient India used to smoke tobacco in a pipe made from leaves of trees, from whence the practice of wrapping tobacco in a leaf probably originated.[6] Bidi smoking was mentioned as early as 1711. The description referred to a product the size of the little finger, containing a small quantity of tobacco wrapped in the leaf of a tree and sold in bundles.[7] Bidis first appeared along the east coast of India in the early part of the eighteenth century and were sold in bundles of 20 to 30.[4]

There is no definite information as to when and how manufacture of bidis started in India. According to a report of the Labor Investigation Committee appointed by the Government of India in 1946, merchants from Gujarat introduced manufacture of bidis in Madya Pradesh in the first

decade of the twentieth century. The Court of Inquiry into Labor Conditions in Bidi report published by the Government of Madras in 1947 says the oldest bidi-making unit was established as early as 1887.[7] This agrees with the International Labor Organization's estimate that the Indian bidi industry started around 1900.[8]

Domestic Business

The share of bidi tobacco production in India rose during the nineties.[9] Production of bidi tobacco increased from 138.5 million kg in 1987-88 to 190.7 million kg during 1997-98.[10] According to the Directorate of Tobacco Development in the Ministry of Agriculture, Chennai, bidi tobacco accounted for 29.5% of the overall tobacco production in India in 1997-98, the highest of all types of tobacco.[2] In 2002-03, bidi tobacco production stood at 200 million kg as reported by the Tobacco Board.[11]

According to the All Bidi Industry Federation of India, annual sales are around US$1.4 billion, with exports accounting for less than one percent of the total.[12] Brands like No. 207 claim a user base of over 1.5 million smokers.[13] The All India Bidi Federation estimates that over 550 billion bidis are produced every year.[14]

Export

Bidi export has vast potential, since a pack of 20 bidis costs four to six dollars in the U.S. as against eight cents in India. In 1997-98, 1.1 million kg of bidis worth US$6.5 million were exported to 36 countries.[8] Recent estimates report export to more than 122 countries. They are also marketed internationally on the Internet. Export quality bidis are not available for use in India.[3]

Use in India

About 19% of tobacco consumption in India is in the form of cigarettes, while 53% is smoked as bidis. The rest is used mainly in smokeless form.[15] Roughly eight bidis are sold for every cigarette.[16] The total number of bidi smokers was estimated to be around 100 million in 1994, the majority of whom were adult males.[17] In 1996, the annual bidi consumption was estimated to be around 700 billion sticks.[17]

National Sample Survey (NSS) data from 1987 to 2000 indicate a downward trend in overall bidi consumption, but less so in the rural areas. While the rural per capita consumption decreased by nearly 23%, the fall in the urban consumption was 43%.[18] Bidis tend to be smoked by the lower economic classes and those with limited funds, such as college students, but not by the upper classes.[19]

Social Ethos

Tobacco in general and bidis in particular have long enjoyed social acceptance and respectability in some parts of the culture. Bidis were offered at wedding ceremonies in honor of the guests. Hookahs were shared to reinforce social and caste identities, predominantly among males. Although not specific to bidis, the social perception of tobacco use in general is changing, as more women are using tobacco in response to advertising, and there is increased acceptance of smokeless tobacco even by children.[1]

MANUFACTURING AND PRODUCTION

Production Process

Processing of bidi tobacco does not require much technology and involves four stages: drying, flaking, storing, and blending. First the farmer sun-dries the tobacco leaves. Agents begin to purchase dried tobacco leaves in February and March. Tobacco processors, usually women, tear the stalks out of the leaves, after which the tobacco is pounded into flakes and winnowed to separate out the ribs. In factories, machines pound the leaves. Otherwise, women manually beat the dried leaves into flakes. The crushed leaves are sieved to obtain various sizes of flakes. The agent stores the processed tobacco for 6-12 months for ageing. Before dispatching the flakes to the bidi manufacturer, the processor blends tobacco flakes from different cultivars and grades them in fixed proportions according to the manufacturer's requirements for the desired composition and flavor. A small amount of crushed stems and ribs is added to improve combustibility.[2, 20]

Bidi making essentially involves six steps. The first three are wetting, drying and cutting the tendu leaves. These are followed by placing tobacco inside the tendu leaf, rolling the leaf and securing it with a thread.

Figure 1.1.1: **A girl rolling bidis in tendu leaves at her home in Karnataka State, India** (from Efroymson D. Editor. Tobacco and poverty: observations from India and Bangladesh. 2nd ed. Mumbai: PATH Canada; 2003.)

Box 1.1.1. Bidi Tobacco Processing and Bidi Rolling Pose Occupational Hazards

Processing of tobacco leaves for bidi manufacture releases copious amounts of coarse particulates and dust into the work environment. Since tobacco processors do not wear protective clothing, gloves or masks, they are exposed to tobacco dust via cutaneous and nasopharyngeal routes.[40] Tobacco processing workers often suffer from chronic bronchitis,[41] and significantly greater chromosomal damage has been found in their circulating white blood cells compared to unexposed workers.[42] There is an urgent need to minimize tobacco dust exposure among tobacco processors.[40]

Bidi rollers handle tobacco flakes and inhale tobacco dust and volatile components of tobacco in their work environment (often their homes) and are at risk for genotoxic hazards.[43]

Bidi rolling began in the organized sector during the early 20th century, but gradually shifted to the unorganized sector, consisting of households, small unincorporated units and workshops. This was primarily to evade government regulations enacted to protect workers' welfare, which also had tax implications.[21] Now essentially a cottage industry, only ten percent of bidis are produced in factories.[10] Based on degree of organization and location, bidi production could be classified into three categories: home-based production (cottage industry), cooperatives, and factory-based production.

Cooperatives reportedly help reduce discrimination and exploitation of workers. Dinesh Bidi Workers Central Cooperative in Kannur district of Kerala state, the largest workers cooperative in Asia, pays Rs. 75 for every 1000 bidis rolled, while private bidi units in the same vicinity are reported to pay as little as Rs. 50 for the same work.[22]

At the other end of the spectrum is highly organized, factory-based production, which is increasingly mechanized. Some of the factory-manufactured bidi brands, such as No. 30, are protected by sophisticated anti-counterfeiting devices, including holograms, usually found only in luxury cigarettes.

Factories often outsource bidi rolling. Contractors distribute the raw materials, which include tendu leaves, tobacco flakes and thread, and collect the finished product from home-based rollers. Bidis are then sorted, graded, roasted, labeled and packaged in small-scale production units. The wage for branded bidis is 40-55 rupees (approximately a dollar) for every 1000 bidis rolled.

Box 1.1.2 Beyond the Cottage Walls

Sopariwala & Co., India's largest exporter of sun/air-cured tobacco, owns four leaf processing factories with a processing area of 1,250,000 square meters. They export around 2.5 billion bidis per year, mostly to Indian expatriate communities in the Middle East and increasingly in the United States, where bidis have become popular.

Sopariwala & Co. focuses only on marketing; bidis are produced by a huge manufacturer that employs thousands, mostly families rolling bidis at home. Europe, the Middle East, Russia, the United States and South Africa are its largest markets. The company's main export is a brand called No. 30, which is one of the most prestigious bidi trademarks in India. In fact, the brand is so sought-after that manufacturers have to worry about counterfeiting, a rarity in the otherwise unglamorous world of bidi production. The company aims to double its volume by 2006, which should be easy considering the expanding foreign market.[39]

Geographic Layout of the Industry

Over the last century, Indian tobacco cultivation and trade began to expand, with Andhra Pradesh, Gujarat and Karnataka producing over 70% of the total. Nearly 85% of the world's bidi tobacco is grown in India. It occupies about 35% of the area under tobacco cultivation, mostly in Gujarat, Karnataka and Maharashtra.[1]

Annually, 150,000 tons of tobacco and 30,000 tons of tendu leaves are used to manufacture bidis.[3] Currently, the major suppliers of bidi tobacco leaves are the western states of Gujarat and

Maharashtra. Virginia tobacco grown in the South Indian states of Karnataka and Andhra Pradesh is primarily used in cigarettes or exported. Madhya Pradesh and Rajasthan states supply tendu leaves.[23]

Sagar, Damoh and Jabalpur districts in Madhya Pradesh accounted for nearly half the country's production of bidis until the late 1980s, reaching a peak of 7,700 crore (77 billion) sticks in 1984.[13] By 1997, the bidi production from Madhya Pradesh plummeted to 5,200 crore (52 billion) sticks owing to a rise in labor costs. The new epicenters of bidi rolling are poor pockets of West Bengal, Bihar, Orissa, Andhra Pradesh, Tamil Nadu and Karnataka, where labor is cheaper and workmanship is better.[13]

EMPLOYMENT

The Food and Agriculture Organization estimates there are 290,000 growers of bidi tobacco in India.[2] Bidis are manufactured largely in the independent small-scale and cottage industry sector. The few large manufacturers of branded bidis tend to be closely held, family-run businesses.

The home-based nature of the industry makes it difficult to determine actual numbers of people engaged in manufacturing bidis, most of whom work part-time or seasonally. However, according to the best government estimates, there were 4.4 million bidi workers in India in 1997.[24,25] It is further estimated that of the total employment generated in all types of tobacco-related activities in India, 72% is in bidi manufacture.[26]

Role of Women in the Bidi Industry

There are varying estimates of female involvement in bidi rolling. One source estimated that women constitute 76% of the total employment in bidi manufacture.[27] The All India Bidi, Cigar and Tobacco Workers Federation pegs the figure at 90% to 95%.[21] In some regions of India, bidi making is largely regarded as "women's work", with the exception of young boys.[28] In other areas, men roll bidis if and when other work is not available or they are unable to engage in manual labor.

The bidi industry is male-dominated, where the manufacturer, the contractor and the consumers are male and only the bidi rollers are female. This often makes women subject to economic exploitation. Some middlemen reportedly supply low quality leaf, and reject bundles of bidis on grounds of poor standards, but then eventually take them without paying. Female bidi rollers also report verbal and physical abuse based on gender and caste differences.[29]

In areas where the bidi cottage industry is pervasive, some women engage in bidi rolling as a full-time occupation and are able to roll 800–1200 bidis during an 8-12 hour day. Other women work part-time while caring for children and attending to household duties and roll 300–500 bidis a day. In many cases, several women from the same household will pool their efforts to fill quotas. Nichter observes that bidi rolling is often preferred to other manual labor, particularly in communities where going "outside" the home to work in the fields of "others" is considered lower status than working at home, especially if one can earn cash.[30] Bidi wages are generally higher than those for manual labor and in some areas, such as southwest coastal Karnataka, the siphoning off of women into the bidi cottage industry has raised local agricultural wages and affected cropping patterns.

The upside of bidi work for women is that it pays in cash on a daily basis and provides small benefits. Regular workers on a local bidi branch (outlet) list may receive minor loans, and be eligible for layaway plans and bonuses, perks designed to retain women's loyalty to contractors and maintain a steady supply of bidis.[30] The downside is that raw materials are not always available, especially in rainy season when poverty is worst.[30] Women who primarily rely on bidi work for survival have difficulty at this time. Households that rely strictly on bidi work are sometimes forced to go into debt to bidi contractors who then gain control over them.[31] For this reason, some households have diversified, with some members rolling bidi and others doing manual labor. The increasing shift of bidi rolling from the factory to a home-based setting and the constant relocation of bidi companies in search of cheap transport and labor also cause insecurity and instability among bidi workers.[10]

Child Labor

Women and children are primarily engaged in filling tendu leaves with tobacco, rolling bidis and tying threads, tasks that demand patience, persistence and nimble fingers.[29]

Since child labor under 14 years is illegal in hazardous industries, according to the Child Labor Regulation Act, 1956, figures relating to the employment of children tend to be unreliable. According to Sudarshan & Kaur, roughly ten percent of all female bidi workers and five percent of male bidi workers are under 14 years of age.[27]

A higher proportion of girls (34%) work as family helpers, compared to boys (23%).[29] In the Mangalore region of Karnataka, one of the major bidi producing areas in India, the industry engages over 10 lakh (1,000,000) laborers, predominantly women, but 25,000 to 30,000 are children.[31]

Section 3 of the Child Labor Act exempts employment of children from home-based work. Bidis production units exploit this provision by giving work to families, thus enabling them to employ children under the guise of "helping out" their parents.

Occupational Hazards

Some of the health effects experienced by bidi workers include pain and cramps in the shoulders, neck, back and lower abdomen.[22] The incidence of tuberculosis and bronchial asthma is higher than that among the general population, according to research by the Factory Advisory Services and Labor Institute in Bombay, a unit of the Labor Ministry of India.[12] The International Labor Organization cites ailments such as exacerbation of tuberculosis, asthma, anemia, giddiness, postural and eye problems, and gynecological difficulties among bidi workers.[8] Reports from as early as the 1970s relate the concerns of trade union leaders in Maharashtra that 50% of bidi workers eventually died from tuberculosis or asthma.[32]

Diseases such as tuberculosis are more easily transmitted when ventilation is poor and many bidi workers work inside smoky households with open hearths, exposed to tobacco dust as well as indoor air pollution. Tuberculosis is also associated with poor nutritional status. Bidi rollers often complain of loss of appetite, due to monotony as well as the smell of the raw materials. Bidi workers recognize the negative health effects and some women attempt to reduce harm by drinking small amounts of nutritional supplements (tonic) or taking multi-vitamin injections, a popular practice in some areas of South India.[33,34]

FLAVORED AND HERBAL BIDIS

Flavored and herbal bidis have a very small market in India but they are marketed aggressively in the West. Some of the leading Indian manufacturers export bidis in as many as 18 flavors to the large U.S. importers, such as Kretek International Inc. In the first half of 1999, Kretek reported a 500% increase in retailer requests for flavored bidis.[35]

Herbal bidis, largely popular in the U.S., claim to contain mixtures of herbs rolled in tendu leaves and are marketed as safer, healthier alternatives to cigarettes. A recent entrant in the Indian bidi market is "Vardaan", which claims to be "the world's first non-tobacco alternative that stimulates the pleasures of tobacco and mimics tobacco smoke". Its Web site presents it as a mix of natural plants specially treated without chemicals and rolled in tendu leaf, targeting "urban consumers with a rural mindset".[36] No independent study assessing the relative harm in using this product has been found.

Priced at Rs. 4 for a bundle of 20, Vardaan is currently retailed in 300 towns and cities in India, with a target of 1250 additional locations by 2005.[37] Ironically, Dalmia Consumer Care, which is marketing Vardaan, is an FMCG start-up company of the Sanjay Dalmia group, a large player in the cigarette industry through the Golden Tobacco Company.[38] The latter recently revived its heritage brand, Panama, pitting it against various bidi brands and "hoping to get converts from bidis and thereby let the cigarette category grow".

MARKETING AND PROMOTION

Nature and Magnitude of the Indian Market

In India, bidis are distributed primarily through as many as a million retail stores. Bidi companies ensure that a steady supply of their products is made available to even the most remote villages. They are available at street corner shops and restaurants all over India, giving ready access to users during work breaks. Most bidi companies have developed an intricate distribution and delivery network, with supplies replenished on a regular basis.

Brands*, Labels and Design

Bidi brands play off the popular imagination of consumers and compete for brand loyalty. Some brands carry the names and pictures of Hindu gods, such as Ganesh (the Elephant God) or Dinesh (the Sun God) on the package and in advertisements. Similarly, Karim (meaning kind-hearted) and Kaja (devotee of Allah) are brands that appeal to those who follow the Islamic faith. Popular brands in rural areas rely on easily recognizable symbols such as Sher (lion) and Phool Chap (flower). In towns, names that strike a chord with the urban mindset, such as Azad (freedom) and Pataka (firecracker), are in vogue.

Advertising and Promotion

The advertising agency AdEx India estimated that bidis accounted for only 1.9% of total tobacco advertising revenue for the first three quarters of 2003,[26] suggesting that the bidi industry uses non-traditional promotional media. In an attempt to promote bidis as "the poor man's

* The use of company and product names is for informational purposes only and in no way implies endorsement by the U.S. Government, the U.S. Department of Health and Human Services, or the Centers for Disease Control and Prevention.

cigarettes", companies typically employ media with maximum reach and exposure to the lower socio-economic segments and to rural India. These include the following:

- **Radio advertising:** Since the early 1980's the bidi industry has exploited the extensive reach of radio to rural India and its presence in low-income households to promote products to niche customers. Radio programs in Indian languages, particularly family dramas, are interspersed with bidi advertisements.
- **Print media:** Parallel to local radio, Indian language newspapers and magazines also carry advertisements of locally popular bidi brands.
- **Wall advertising** (graffiti): Walls lining main roads in smaller towns are often filled with bidi advertisements.
- **Point-of-sale advertising:** Retail stores in rural areas carry billboards, banners and advertisements of local bidi brands.
- **State-abetted promotion:** Until the recent advertising ban, states such as Maharashtra and Delhi abetted bidi promotion. State-owned transport buses traveling routes between the capital city and remote villages carried advertisements of popular bidi brands, such as Sambhaji, Rajkamal, Pathaka and No. 501.
- **Internet sales:** Bidi are also available from the Internet. Brands promoted on the net include Ganesh, Sher and Shiv, Sambhaji, No. 30, Train and Kerala Dinesh.
- **Promotional items:** Cloth bags displaying the brand names of bidis with related pictures are common in India. They are available in local street markets and are often used for household shopping.
- **Sponsorship of cultural events:** Capitalizing on the popularity of local and regional festivals, bidi companies sponsor social and cultural events. For example, in Mumbai they sponsor the annual Ganesh Chaturti mandals (platforms where the idol of Lord Ganesha is placed for public worship), an important socio-religious festival that draws huge crowds.
- **Image advertising/outdoor advertising:** In Rajasthan it has been reported that camels are engaged to promote Oont Chap bidis. Camels are used extensively as a means of transport and this strikes a chord with the common man.

REGULATORY POLICIES

Indian policy seems to favor the bidi industry. The International Labor Organization cites at least eight laws that promote the welfare of bidi workers and therefore the industry.[8] Until recently bidi production evaded policy regulation on the basis of purported difficulty in enforcing laws in a cottage industry.

The Cigarette (Regulation of Production, Supply & Distribution) Act of 1975 required all cartons or packets of cigarettes and cigarette advertisements carry a statutory warning, "Cigarette smoking is injurious to health". Since 1990, the scope of the Prevention of Food Adulteration Act has been expanded to cover smokeless tobacco and pan masala, whereby these products need to bear similar statutory warnings. However, both of these laws were not considered applicable to the largely home-based bidi industry.

While bidis are rolled primarily at home, they are roasted and packaged in attractive papers with multi-color logos and pictures in small-scale industrial units, which can be regulated with relative ease. The Cigarettes and Other Tobacco Products (Prohibition of Advertising, Regulation of Trade, Commerce, Supply and Distribution) Act, 2003 encompasses all tobacco products including bidis. It bans all forms of tobacco advertising and sponsorship of sports and cultural events, requires pictorial warnings and display of tar and nicotine contents on tobacco packages, and bans smoking in certain public places. Under the new packaging rules, bidis would bear health warnings, including pictorial messages, in the language that appears in the label or on the package.

DEDICATED TAXES

Bidis and smokeless tobacco together account for 81% of the national tobacco consumer market, but contribute only 12% of the excise tax collected.[26] Bidi manufacturers producing fewer than two million pieces annually do not have to pay excise tax. However, the Bidi Workers' Welfare Fund Act (1976) provides for the levy and collection of taxes by way of cess, a duty on manufactured bidis that is dedicated to financing welfare measures for bidi workers. It establishes precedence for ear-marked taxation in India; a similar tax on all tobacco products could be levied to advance tobacco control measures and help with disease consequences of tobacco use.

At present, bidis produced without the aid of machines are assessed five rupees per thousand pieces. For bidis manufactured by machine the tax is 15.5 rupees per thousand.[15]

CONCLUSION

The low price, wide distribution, and marketing and promotional strategies of bidis contribute to their popularity in India. Among the poor, bidi smoking is one of the few affordable sources of immediate gratification. The industry has been highly effective at supplying a highly addictive product at an affordable price. In so doing, the population is exposed to yet another risk factor that perpetuates the cycle of poverty and ill health.

Increasing taxes on bidis and requiring easily understandable health warning labels might discourage use and save lives. Taxation of bidis at par with other tobacco pro-ducts could also contribute significantly to prevent tobacco use and promote quitting.

In areas where women and children roll bidis in the absence of other income generation strategies, research is needed on developing a diverse array of alternative income-generating opportunities. Policies aimed at holding the industry accountable for ensuring an education for all children in any way associated with bidi work, even within the home, is central to addressing the child labor issue.

Finally, there is a need to reconsider regulating the bidi industry in light of the regulation of other tobacco products and to question its favored status from the vantage point of public health. With increasing demand for bidis as an export product, it is also crucial to hold the industry accountable to international standards of trade that assure the welfare of workers.

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1.2 Marketing, Promotion and Availability of Bidis in the United States

Michelle O'Hegarty and Mark Nichter

INTRODUCTION

The purpose of this chapter is to describe bidi prevalence, perceptions among youth, and marketing and promotion gleaned from reports in the scientific and popular press, and from the Internet. By evaluating these data, the authors have identified possible ways in which bidi marketing and promotion strategies have contributed to bidi use among youth and young adults and suggest critical areas for tobacco-related research.

Imported bidis first appeared in the United Sates in the 1970s[1] as part of a more general rise in the availability of tobacco products of foreign origin. Readily available at ethnic grocery stores and markets, bidis were initially popular with Indian and South Asian immigrants.[2] It was not until the mid 1990s that bidi use began to appeal to youth and racial/ethnic minority adolescents.[3] Anecdotal reports suggest that trend-seekers (e.g., college students, hip-hop devotees, surfers, and skaters) view bidis as an "exotic conversation piece."[4] In some areas of the country like Los Angeles and San Francisco the popularity of bidis appeared to be associated with a "wave of Indian chic, which ushered in mendhi body art and sari-print fashions."[4] In 2004, the overall U.S. national prevalence rates were highest among Hispanic middle (4.3%) and high school (4.8%) students.[5]

Aside from being an "exotic" product from India, bidis have additional attributes that appealed to youth. They were seen as "natural" and "herbal" (CDC unpublished data, 2003). Flavored bidis were introduced in the U.S. market in the mid 1990s, and their flavor and taste was appealing to youth.[3,6] They reportedly provided the user with a feeling of dizziness[6] or "buzz" sensation,[4] and resembled marijuana joints.[7,8] Bidis also appeared to be somewhat similar to marijuana joints in that both had to be relit often and demanded deep inhalation to stay lit. All of these attributes may have contributed to the popularity of bidis as a novel tobacco product among some groups of youth.

Bidi Use and the Characteristics of Users

In 1997, a group of young tobacco control youth advocates from the Booker T. Washington Community Services Center and the African American Tobacco Free Project in San Francisco noticed a proliferation of bidi use among their peers and decided to investigate the growing trend. In January 1998, funded by the San Francisco Department of Public Health's Tobacco Free Project, these community-based researchers administered questionnaires to 461 youth and young adults in San Francisco. The purpose of the surveys was to assess the prevalence of bidi use, brand preference, accessibility, and knowledge of the health risks associated with bidis in San Francisco. A convenience sample was used for the study. Fifty-eight percent of the participants reported trying bidis and two-thirds said they know someone younger than 18 who smoked bidis (Booker T. Washington Tobacco Free Project, unpublished data, 1998). Researchers also found that 24% of

the stores sampled sold bidis to underage youth (Booker T. Washington Tobacco Free Project, unpublished data, 1998). In addition, 41% of the bidis purchased displayed no tax stamp and 7 out of 10 bidi packages purchased displayed no health warning label (Booker T. Washington Tobacco Free Project, unpublished data, 1998).

Bidis meet the definition of a cigarette; according to the Federal Cigarette Labeling and Advertising Act, the term "cigarette" means: "(A) any roll of tobacco wrapped in paper or in any substance not containing tobacco, and (B) any roll of tobacco wrapped in any substance containing tobacco which, because of its appearance, the type of tobacco used in the filler, or its packaging and labeling, is likely to be offered to, or purchased by, consumers as a cigarette described in subparagraph (A)."[9] Therefore, for taxation purposes, bidi packages must display the U.S. Surgeon General's health warning and state excise tax stamps.[10]

The San Francisco study's findings that bidi packages did not display such warnings were released to the local media and CNN International, drawing public attention to the potential harm associated with bidi use among youth. Soon, state and federal government organizations began to monitor the growing trend of bidi use nationally, by including questions on bidi use in the National Youth Tobacco Survey (NYTS).

In September 1999, the U.S. Centers for Disease Control and Prevention (CDC) reported findings from a Massachusetts Tobacco Control Program study of bidi use among 642 urban youth.[3] Researchers who conducted this study used a convenience sample. Similar to the San Francisco study, the purpose of the community-based study was to assess adolescents' knowledge and use of bidis. Forty percent of the youth reported that they had smoked bidis at least once during their lifetime and 16% were current bidi smokers.[3] Reasons for using bidis reported by youth included that they taste good and they are relatively cheap, safe, and easy to buy compared to Western-style cigarettes.[3]

National prevalence rates of bidi use among youth were assessed in 1999, 2000, 2002, and 2004 using the school-based NYTS. Results from the 2004 NYTS indicated that the overall prevalence rate for youth in middle school was 2.4%.[5] The prevalence rate among males (3.0%) was higher than among females (1.8%) and Hispanics (4.3%) and blacks (2.9%) were more likely to report using bidis compared to whites (1.9%) and Asians (1.1%).[5] The overall prevalence rate for bidi use among high school students was 2.7%.[5] Again, males (3.7%) were more likely to report bidi use compared to females (1.6%) and, although not statistically significant, Hispanics (4.8%) and whites (2.4%) reported higher rates of bidi use compared to blacks (2.1%) and Asians (2.1%).[5]

A 2003 study assessed the characteristics of users of cigars, bidis, and kreteks, and the relationship of using these tobacco products to Western-style cigarette use among middle and high school students. Researchers selected a convenience sample of schools in Massachusetts that was representative of schools from urban, suburban, and rural communities. They found that bidi users were more likely to be students from urban communities,[11] which may be attributed to accessibility. When the researchers examined trajectories of tobacco use, they found that 70% of youth reported smoking Western-style cigarettes first, 10.9% smoked bidis first, and 19.1% began smoking Western-style cigarettes and bidis at the same age.[11]

Another study, published in 2004, examined the prevalence rates of different types of tobacco products among adults and young adults (18 to 24 years old) using 2001 data from the Behavioral Risk Factor Surveillance System. Of the 63,728 adults surveyed, 4.7% reported ever using bidis and

0.3% reported current bidi use across all states. Of 5,324 young adults (aged 18-24) surveyed, 16.5% reported ever using bidis and 1.4% reported current bidi use across all states.[12] Notably, higher rates of ever and current bidi use were reported for young adult males, blacks, and current cigarette smokers.[12] Additionally, there were higher rates of ever bidi use among those who had some college education or a college degree.[12]

These studies are important because they show that bidi users are more likely to be males than females, to have already tried smoking cigarettes, and to reside in metropolitan rather than rural areas. Young adult white bidi smokers are also more likely to have some college education or a college degree. Anecdotal reports indicate that bidi users frequent hip and trendy neighborhoods like San Francisco's Haight or Tenderloin districts, Atlanta's Little Five Points, and New York's East Village.[6]

Perceptions of Bidis among Youth and Young Adults

One factor that may contribute to the popularity of bidi smoking among youth and young adults is the perception that bidis are natural or herbal. In April 2002, the CDC and ORC Macro, an opinion research company, conducted 16 focus groups, eight in Chattanooga, Tennessee and eight in Dallas, Texas (CDC, unpublished data, 2003). The participants were 137 young adult smokers, aged 18 to 22, who had tried or who were current users of nontraditional products, including bidis. Several focus group participants believed that bidis are simply a rolled-up leaf with tobacco and some herbs. When asked to compare the risk of smoking bidis to Western-style cigarettes, participants thought bidis were a little safer or about the same risk as Western-style cigarettes. Notably, many believed that bidis contain no nicotine or harmful additives. Many participants also perceived them to be "raw" and purer than cigarettes. Although focus group participants were not asked specifically about herbal bidis, they perceived bidis to be herbal in nature. Researchers have also suggested that youth may mistakenly think that bidis are tobacco-free herbal cigarettes.[1]

It is interesting to juxtapose U.S. and Indian perceptions of bidis and the relative harm of bidi smoking to Western-style cigarette smoking among youth. In South India, college students report that bidis are only smoked as an alternative to Western-style cigarettes when they have no money to purchase cigarettes.[13] Bidi smoking among college students is rare, and those who do smoke bidis often do not do so in public because of the lower social class status associated with bidi smoking.[13] In the United States, the status of bidis among youth is much higher, with bidi use at clubs reported as fashionable (CDC, unpublished data, 2003). Bidis are viewed by U.S. youth as safer (CDC, unpublished data, 2003), less expensive (CDC, unpublished data, 2003),[10] accessible (CDC, unpublished data, 2003), a trend,[10] something different to try,[14] and similar in appearance to marijuana joints,[14] whereas in India they are viewed as more harmful to health than non-filter or filter tip cigarettes.[13,15,16]

It is not clear whether educational efforts (e.g., classroom discussions, fact sheets, educational brochures)[17] aimed at increasing awareness about the health risks associated with bidi use have led to changes in the attitudes and perceptions among those younger than 18 in the United States. However, attitudes and perceptions might be changing among young adults. Young adults (aged 18 to 22) participating in focus groups on non-traditional products, including bidis, reported that bidis were a little safer or about the same risk as cigarettes (CDC, unpublished data, 2003). However, it's important to note that these focus group results are not generalizable to all young adults in the United States.

PRODUCT CHARACTERISTICS

Flavored Bidis

Bidis sold in India are not flavored or typically packaged in packets, cones, cartons or tins as colorful as those found in the United States or Europe.[18] Bidis exported for sale in the United States are available in brightly colored packages and a variety of flavors (Tables 1.2.1 and 1.2.2), such as cherry, honey, strawberry, chocolate, mango, and lemon-lime. Packets and cones typically hold 20 Indian-style bidi cigarettes. Cartons contain multiple packages and are only available for purchase on the Internet. Bidis that are wrapped in paper cones resemble the packaging seen in Indian markets, but the U.S. packaging or the color of the thread used to tie the bidis together is distinctive, often reflecting the flavor.

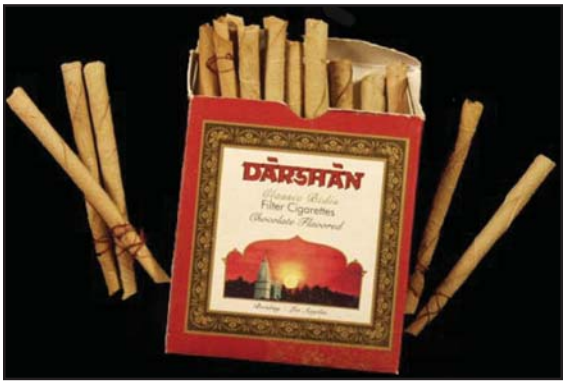


Figure 1.2.1: **Darshan's cinnamon bidi.**

Adding flavors to tobacco products that may appeal to youth and young adults is not a new concept among tobacco manufacturers. Cigarette companies are utilizing flavorings in their tobacco products. In 2004, R.J. Reynolds's Camel brand was advertising a full range of exotically named and flavored Western-style cigarettes.[19] Several tobacco products (e.g., American Spirit cigarettes, smokeless tobacco and shisha) available on the market are also flavored. The Campaign for Tobacco-Free Kids Web site reported, "Tobacco industry documents have long suggested that flavored tobacco products might appeal specifically to young teenagers. In fact, cherry flavoring was added to one spit (smokeless) tobacco starter product in 1993."[20] Furthermore, "As early as 1972, a Brown & Williamson document on the project 'Youth cigarette-new concepts' listed cola, apple, and sweet flavor cigarettes as suggestions and stated, 'It's a well-known fact that teenagers like sweet products.'"[20] Reports indicate that the flavoring of bidis has contributed to their popularity among youth and young adults.[3]

Price and Availability

In the United States, the retail price of bidis varies from $3 to $6 for a packet of 20, which is similar to the price of a packet of Western-style cigarettes ($4 to $5.82, depending on the state). Packets of bidis are available at convenience stores, ethnic food stores, markets, gas stations, and record shops in most metropolitan cities. Cartons (10 packets/200 bidis) from U.S. distributors on the Internet are approximately $20.00, and the shipping and handling costs differ from state to state.

One Internet distributor, Sunderlal Moolchand Jain Tobacconist (P) Ltd. in India, advertises 200-500 bidis for US $5.00 or a sample variety of 275 unfiltered and filtered bidis for US $6.00, and charges $25.00 for shipping and handling. Anecdotal evidence suggests that minors (under the age of 18) have little difficulty purchasing bidis (CDC, unpublished data, 2003), which may contribute to their use of bidi cigarettes. Studies have reported that youth are price sensitive, and Western-style cigarettes that are available and affordable are more likely to attract their attention.[21] It is possible that young smokers may be inclined to purchase Western-style cigarettes online because some vendors do not require age verification and the price may be considerably lower than prices at local stores.[21] These same inclinations may encourage them to purchase bidis online. It is important to note that bidis sold at convenience stores are comparable in price to Western-style cigarettes.

Brands

Of the approximately 14 brands of bidis (filtered and unfiltered) found in the U.S. market in 2005, five were classified as herbal. The brands sold in the United States, and their manufacturers and distributors, are displayed in Tables 1.2.1 and 1.2.2. In 2006, the following bidi brands also became available in the United States: Sadhu (Special), Sadhu (Regular), Sumo, 8 A.M., Diamond, Green Forest, and A-One. Many of the names and logos of bidi sold in the U.S. employ icons associated with Eastern religions. For example, brand names like "Om," "Vishnu," and "Shiv" are readily identified by youth as associated with Hinduism.

Herbal Bidis

Some common brands of herbal bidis (Table 1.2.2) are Darshan, Ecstacy, Yogi Mint, Azad (meaning 'free'), and Sadhu (meaning 'a sage'). The contents of herbal bidis are not listed on their packages. To date, no scientific studies have provided descriptive information on herbal bidis.

Herbal bidis are promoted differently than herbal cigarettes. While promotional campaigns for herbal Western-style cigarettes might focus on cost (e.g., "buy one and get one free"), herbal bidis are often promoted on the basis of their natural, organic, exotic, or even mystic qualities, as is illustrated by the following statement: "Ecstacy Bidi contain a very special blend of rare and exotic smoking herbs, carefully gathered by holy men high in the mountains of India."[22]

In 2004, an herbal entrant in the Indian market was Vardaan, which claims to be the "world's first non-tobacco alternative that stimulates the pleasure of tobacco and mimics tobacco smoke." It specifically targets "Indian consumers with a rural mindset." In 2004, Vardaan was only being retailed in large towns and cities in India, with a target of 1,250 additional locations by 2005.[23]

Implied Advertising Claims

Some Internet sites that sell bidis display advertising claims such as, "Bidi cigarettes have 100% natural ingredients,"[24] and "Tendu leaves used in bidi cigarettes have herbal properties."[24] Labels on bidi packets also note that bidis contain "no chemicals." On the front of packets of Darshan herbal bidis is the phrase "Natural Herbal Bidis, 100% Natural Filtered Cigarettes, No Tobacco and No Chemicals." All such claims may mislead consumers into believing there are minimal health risks associated with bidi smoking.

Table 1.2.1: **Flavored bidis**

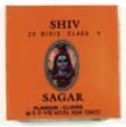
Image	Brand	Type	Flavor	Manufacturer	U.S. Distributor
	Darshan	Unfiltered	Strawberry, Cardamom, Chocolate, Cinnamon, Clove, Grape, Lemon Lime, Mango, Mint, Regular, Vanilla, Wild Cherry, Black Licorice, Mandarin Orange, Honey, Coconut, Raspberry	Dhanraj International	Kretek International
	Shivsagar (Sagar, Shiv)	Unfiltered	Vanilla, Mango, Orange, Pineapple, Raspberry, Regular, Cardamom, Cinnamon, Dewberry, Grape, Menthol, Strawberry	Sable Waghire & Co.	Smokers Choice Inc.
	OM	Unfiltered	Vanilla, Honey, Chocolate Natural, Strawberry, Cherry	Unavailable	http://www.amishshop.com/
	White Rhino	Filtered	Strawberry, Wild Cherry Vanilla, Mint, Grape, Chocolate	Unavailable	Kretek International
	Appu Bidis	Unfiltered	Natural	S.B. Bidi Co.	Pure Tobacco Inc.
	Soex	Filtered	Strawberry, Wild Cherry, Raspberry, Lemon Lime, Vanilla, Menthol, Coffee, Chocolate, Clove, Black Licorice, Grape	Soex India. Pvt. Ltd.	G.A. Andron & Co. Ltd.
	Sher	Unfiltered & Filtered	Natural	Mohanlal	http://www.amishshop.com/
	Irie	Unfiltered	Cinnamon, Vanilla, Clove, Strawberry	Unavailable	Smokers Choice Inc.
	Vishnu	Unfiltered	Menthol	Unavailable	Unavailable
	Kailas	Unfiltered	Strawberry, Clove	Unavailable	Unavailable

Table 1.2.2: **Herbal bidis**

Image	Brand	Type	Flavor	Manufacturer	U.S. Distributor
	Darshan	Unfiltered	Honey, Vanilla	Dhanraj International	Kretek International
	Ecstacy	Unfiltered	Regular	Unavailable	http://www.esctacymelrose.com/
	Yogi Mint	Unfiltered Bidis	Mint	Unavailable	http://www.casadeluigi.com/
	Azad	Filtered Bidi	Cinnamon, Clove, Menthol, Licorice, Natural, Pineapple, Chocolate, Vanilla, Herbal	Sunderlal Moolchand Jain Tobacconist (P) Ltd	http://www.azadbidi.com/
	Sadhu	Unfiltered	Regular	Unavailable	Unavailable

Studies from India have shown that bidi smoking is associated with increased risk for oral cancer,[25,26] cancer of the lung,[26] stomach,[26] and esophagus,[26,27] coronary heart disease and myocardial infarction,[26,28] and chronic bronchitis.[26] No research studies on the health effects of bidi smoking have been conducted in the United States.[1] Reports have suggested that bidis produce higher levels of tar, carbon monoxide and nicotine than Western-style cigarettes.[31,29] In addition, researchers have reported that bidis are more dangerous than Western-style cigarettes because low combustibility contributes to deeper inhalation of bidi smoke.[8]

There are no research studies on adverse health effects from smoking herbal bidis. However, in 2000, the U.S. Federal Trade Commission (FTC) required Santa Fe Natural Tobacco Company Inc., manufacturer of Natural American Spirits, and Alternative Cigarettes Inc., manufacturer of Herbal Gold and Magic herbal cigarettes, to include the following warning on their herbal cigarette packaging and advertising: "Herbal cigarettes are dangerous to your health. They produce tar and carbon monoxide."[30] Although herbal bidis and herbal cigarettes differ in that bidi filler is wrapped in a tendu leaf and herbal cigarette filler is wrapped in paper, it is to be expected that combustion of herbs and other organic non-tobacco content in an herbal bidi would similarly produce tar and carbon monoxide. Furthermore, an advertising claim such as that found on one brand of herbal

Table 1.2.3: Advertising claims

Brand:	Advertising claims:
OM	"Spiritually enlightening experience."
Soex:	"This citrus flavor is known to soothe heart-burn, since it checks the excessive problem. It is also very effective in treating colds and influenza, being very rich in vitamin C."
Darshan:	"100% Natural", "No Tobacco","No Chemicals"
Ecstacy:	"Ecstacy bidis contain a very special blend of rare & exotic smoking herbs. Carefully gathered by holy men high in the mountains of India. The purity of these herbs, along with the power of these sacred places, insures a profound smoking experience."
Yogi Mint Bidis:	"Imported directly from India. Yogi Mint Bidis have become the most popular herbal cigarette in America...and for good reason! Mint Bidis contain an ancient Indian blend of cured herbs and are wrapped in tiny mint leaves. Within a short time Yogi Mint Bidis have become a sensation at raves, concerts and parties, as well as among people who have kicked the habit but still feel drawn towards an occasional toke. The taste of mint permeates each and every breath."
Azad Bidis:	"More and more people are shifting to bidi cigarette smoking because of the herbal qualities and they also have less harmful properties. • Bidi cigarettes have no paper. • Tendu leaves used in bidi cigarettes have herbal properties. • Bidi cigarettes are cheaper than any other tobacco product. • Bidi cigarettes have a unique lingering taste • Tobacco content in bidi cigarettes is very less as compared to any other tobacco product. • Tobacco in bidi cigarettes is not processed, it is used in natural form. • Bidi cigarettes have 100% natural ingredients • Smoking a bidi is a very satisfying experience"
Sadhu Bidi:	"Our special blending never gives any kind of effects on throat, or cough like other bidis sometimes leaves this impressions and symptoms." "It's very less harmful because we grow our own tobacco from natural means with bio-natural fertilizers and natural means."

bidis of "no chemicals" may lead consumers to believe that they are consuming a healthy or safe product. Advertising claims that appear on bidi packets are listed in Table 1.2.3.

MARKETING

Two main marketing techniques are used to promote bidis. The first is their attractive packaging, which serves as its own advertisement when displayed in shops, and the second is placement on Internet sites. Unlike Western-style cigarettes, cigars, and smokeless tobacco, bidis are rarely promoted in the United States. Cost-related promotions (e.g., two for the price of one, or free gifts) are not used to market bidis, as is often seen with Western-style cigarette advertising. Instead, retailers rely on the colorful design of packets depicting Hindu gods and temples to attract consumers. An informal observation of seven tobacco shops in the Atlanta area revealed that the retailers promote bidis by displaying them in clear glass cases strategically positioned where youth will see them. The Soex brand is advertised at Trinkets and Trash, a Web site that archives tobacco products and tobacco industry marketing materials. The advertisement, taken from an in-store display, claims that Soex are "MSA Compliant Handcrafted Flavored Bidis."[31] Promotion of bidis also occurs on Web sites that sell counterculture products (e.g., body piercing, tongue bolts, etc.), drug paraphernalia, kretek cigarettes, and water pipes. The following section describes several Internet sites that promote bidi use.

Internet Marketing and Access to Youth

The Internet has become an avenue for minors to purchase Western-style cigarettes.[32] Although several studies examine Internet sales of Western-style cigarettes, [32-34] limited information exists on Internet sales of bidis. A study published in 2001 found that 8.0% of Internet Western-style cigarette vendors sold bidis.[33] An unpublished study of bidi Internet sales found that 14 out of 16 sites allowed purchasers to buy directly online and 9 out of 16 accepted mail or fax orders (Jones, unpublished data, 2002). The majority of these vendors accepted credit card payments (81.3%), as well as money orders (50%) and cashiers' checks (25%). Fifty-six percent (9 out of 16) of the Web sites did not feature an age warning and none displayed health warning messages.

Internet sites selling bidis further contribute to the misperception among youth that bidis are safer than cigarettes. For example, on the homepage for Sunderlal Moolchand Jain Tobacconist (P) Ltd., a bidi manufacturer in India, the company proposes a list of reasons tobacco users are shifting to bidis.[35] It mentions that, "Tobacco in bidi is not processed, it is used in natural form; bidi cigarettes have 100% natural ingredients; and the tendu leaves in bidi have herbal properties."[35] The site offers the unfiltered brand 51 Deluxe Azad and the filtered brand Herbal Azad. In collaboration with the Department of Justice and the U.S. Customs Service, the FTC requires Surgeon General's warnings on bidi cigarettes imported from India.[36]

OM bidis are available in the U.S. market at http://www.smokes-spirits.com/. This brand comes in a variety of flavors. Customers must be 21 to purchase bidis on the Web site, but no age verification is required. The Surgeon General's warning appears in very small, light-colored print at the bottom of the Web site.

At Bio-Buzz Botanica, an online retail store, visitors might think the Web site sells herbal or psychedelic drugs. At first glance one sees psychedelic colors and a female butterfly that appears intoxicated.[37] If one scrolls down a little farther, one might discover that it's indeed Ecstacy bidis that give this cool buzz. Not only can one purchase bidis at this Web site, one can click on links for shopping, body piercing, tanning, stickers, and herbs to name a few. The Web site appears to target a younger audience. It features no health warnings or verification of age at the time of purchase. Purchasers are only required to pay by credit card for direct online sales.[37]

An "herbal cigarettes" link at http://www.healthymagnets.com/ features a butterfly with images inside the wings that resemble bidis.[38] At first glance, the bidi images could be mistaken for marijuana joints, especially after reading the description, "Look cool with these little Indian herbal joints."[38] And for those who want more exotic products, there are links to "Cannabis-free cigarettes," "ecstacy cigarettes," "embrace," "Kama sutra," and "erotic" at the bottom of the page.[38]

At Casa de Luigi, an herbal cigarette wholesaler's Web site, consumers who are trying to quit smoking are encouraged to try mint herbal bidis as an alternative to Western-style cigarettes.[39] The Web site states that, "Smokers and non-smokers alike enjoy herbal cigarettes, which have a taste ranging from sweet to smooth and give off a pleasant aroma. And they are cheap - cheaper than tobacco cigarettes in most places."[39] A Surgeon General's warning, "Cigarette smoke contains carbon monoxide," is displayed at the bottom of the page.[39] Most Internet sites that offer herbal bidis may be trying to target youth and young adults who would be attracted to illegal drugs or counterculture products. The descriptive drug language on the www.healthymagnets.com Web site entices users to try herbal bidis to gain the same rush or "high" experience.

Kretek International in Moorpark, California, is one of the principal importers of the Darshan brand. In 2002, Kretek was the only bidi distributor that reported on its Web site that it does not sell directly to consumers. However, customers can simply click the "store indicator" link at the top of the homepage, provide their name, zip code, and e-mail address, and check a box that states, "I certify that I am 21 years of age or older." Kretek's homepage displays a warning on the bottom, which states "Surgeon General's Warning: Cigarette Smoke Contains Carbon Monoxide." Currently, consumers need to enter a user name and password to enter the Kretek International's Web site.[40]

Studies on Internet Western-style cigarette purchasing have reported that very few adolescent smokers (less than 3.5%) under the age of 18 are purchasing Western-style cigarettes over the Internet.[34,41,42] Data on bidi sales do not exist, although anecdotal reports describe Internet sting operations conducted by several state Attorney General offices linking the sale of bidis to minors via the Internet (CDC, unpublished report, 2003). It is unlikely that bidi sales on the Internet are very high because bidis are relatively easy to obtain in person and because the price for bidis sold on the Internet is approximately the same as for those sold in stores. Moreover, most Web sites have a minimum order of 10 packages, which may deter youth from purchasing bidis. Regardless of actual sales, however, one fact remains: despite efforts made at the federal and state levels to decrease the sales of Western-style cigarettes and other tobacco products over the Internet, it remains a little monitored venue for underage youth to purchase bidis.

The 2004 NYTS found that less than 3% of youth in middle school and high school in the United States were current bidi smokers.[5] Despite an apparent decline in bidi use among middle and high school students in 2004, the recent popularity of flavored Western-style cigarettes, cigars, and hookahs suggests that flavored forms of smoked tobacco need to be further investigated. These products should be examined as a special category of tobacco products attractive to young people, who see them largely as fun products to be enjoyed in social contexts. Looking at this category of tobacco products as an aggregate, it is important to examine how perceptions of one product influence perceptions of other products seen as similar. If one flavored product (such as bidis) is seen as less risky to consume than Western-style cigarettes, then other flavored tobacco products might be seen as safer by association. This hypothesis needs a closer examination. Further research is needed to examine which bidis are consumed as a starter product by those experimenting with tobacco, as distinct from a form of tobacco consumption that complements Western-style cigarette use by established smokers. If bidis are used as a starter product like other flavored forms of tobacco,[43] such as smokeless tobacco and flavored Western-style cigarettes,[44,45] research on flavored bidis is suggested to explore possible transitions from experimentation to use of other tobacco products, and then to more regular tobacco use.

Cigarette companies continue to increase their marketing expenditures each year to promote tobacco products and many of their marketing efforts influence underage populations.[19] R.J. Reynolds has been marketing candy-flavored Western-style cigarettes with names like "Twisty Lime," "Winter Warm Toffee," and "Kauai Kolada".[19] Brown & Williamson's Kool cigarettes also have flavorful names like "Midnight Berry" and "Mintrigue," which could potentially entice a young consumer.[19] Flavored bidis offer youth yet another alternative to Western-style cigarettes, which may set them on a tobacco use trajectory that leads to trying other tobacco products. This may be because they are curious to experiment with other tobacco products once they begin smoking or because they respond to offers by friends who identify them as smokers once they see them smoking bidis. On

the other hand, it is possible that use of flavored tobacco products (bidis, cigars, hookah, etc.) is largely confined to particular social occasions and certain emotive states, and does not lead to more generalized tobacco use and dependency.

CONCLUSION

This chapter summarizes what is known about bidi use, marketing, and perceptions of health risk by reviewing available survey research and newspaper articles on bidi smoking and by systematically assessing Web sites that sell bidis to the public. It suggests that youth and young adults are attracted to bidis because they appear exotic, are flavored, are accessible, and are perceived by youth to be safer than Western-style cigarettes.

Bidis are readily available to youth and young adults in U.S. urban cities at tobacco shops and ethnic markets, and to all on the Internet. They are not advertised in magazines and newspapers as are Western-style cigarettes and small cigars. Colorful and exotically named bidi packets are prominently displayed and constitute their own form of advertisement. Bidi distributors on the Internet further attract potential consumers by strategically placing bidi ads on sites where an array of counterculture products is offered, such as body piercing, drug paraphernalia, and other alternative forms of tobacco.

Bidis are often represented as being natural, pure, and herbal. Such subtle and not-so-subtle advertising claims on bidi packs and Web sites contribute to the misperception among youth and young adults that bidis are a safe alternative to Western-style cigarettes. Research should more rigorously examine the perceived risk of smoking different amounts of bidis and herbal bidis, as well as the perceived risk of bidis compared to Western-style cigarettes, cigars, cloves, and shisha (also known as water pipe). Also in need of further study are the marketing strategies used by manufacturers and distributors of bidis both in shops and on the Internet. Another area of research suggested by accounts of bidi smoking is co-substance use in party and club environments. Is bidi smoking more likely to occur during special events? Are bidis and other substances being used simultaneously in party and club environments?

The case of bidis underscores the importance of continually monitoring youth culture for emerging trends in tobacco use. New tobacco delivery devices are being designed by the tobacco industry and piloted in U.S. test markets almost every year. In addition to these products are forms of tobacco and tobacco substitutes that are being imported from abroad. In the global marketplace, not only are Western tobacco products penetrating developing nations, but foreign tobacco products are being adapted for the U.S. market.

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CHAPTER 2

2.1

Prevalence of Bidi Smoking among Youth in India

2.2

Prevalence and Patterns of Bidi Smoking in India

2.3

Prevalence of Bidi Cigarette Use in the United States, 2000 to 2004

2.1 Prevalence of Bidi Smoking among Youth in India

Dhirendra N. Sinha and Rajesh Dikshit

INTRODUCTION

This chapter summarizes issues on the prevalence of bidi smoking among youth in India and the knowledge, attitudes and behavioral aspects of bidi smoking among youth, which should be useful for interventions aimed at curtailing bidi smoking among youth.

There are few sporadic school/college-based[1-9] and sentinel community-based[10,11] data on bidi smoking among youth in India. Information on national estimates on youth attending school, ages 13-15, has been drawn from Global Youth Tobacco Survey (GYTS) data for 26 states where over 93% of the Indian population lives. Those states are Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Utaranchal and West Bengal.

METHODS

The GYTS is a school-based cross-sectional survey that was independently conducted in different states of India, using a uniform methodology. The details of survey procedures and analysis are published elsewhere. [12-16] GYTS employed a two-stage cluster-sample design to produce a representative sample of students in grades eight to ten in both government and private schools. At the first stage, the probability of schools being selected was proportional to the number of students enrolled in the specific grades. At the second stage, classes within the selected schools were randomly selected. All students in selected classes attending the school the day of the survey were eligible to participate. The survey was conducted through trained survey administrators during leisure class hours. For estimating the prevalence rates, weighting factors were applied to each student record to adjust for non-response (school, class and student) and variation in the probability of selection at the school, class and student levels, to calculate prevalence estimates for each state. EPI-Info 2000 software was used to compute 95% confidence intervals and weighted prevalence estimates.

A current bidi smoker was defined as a smoker who mainly smoked one or more bidis on one or more days during the past 30 days. Bidi smokers reporting smoking in multiple forms (besides bidi) have not been included. Frequent bidi smokers were those who smoked bidis on 20 or more days of the 30 days preceding the survey. Nicotine dependence was assessed by one question asking whether they needed tobacco first thing in the morning. Positive responses were marked as dependence. Current bidi smokers who smoked more when they drank alcohol or used other drugs were defined as drug-abuser bidi smokers.

This study was conducted in India during 2000-2004. For the GYTS data included in the present article the school response rate was 98.60% (1,118 out of 1,134); the student response rate was 84.80% (62,399 out of 73,574) and the overall response rate was 82.7%.

RESULTS

Prevalence

- **Current any smoking and current bidi smoking:** Current smoking was reported by 8.3% of students in India (Table 2.1.1). It ranged from 2.2% in Himachal Pradesh to 34.5% in Mizoram. Current bidi smoking was reported by 2.3% of students, from 0.3% in Goa to 14.2% in Manipur (Table 2.1.2). The prevalence of current cigarette smoking was significantly higher than current bidi smoking among students.
- **Current frequent bidi smoking:** Among current bidi smokers, frequent bidi smoking was reported by 12.5% of students. Current frequent bidi smoking ranged from 0% in Arunachal Pradesh & Uttar Pradesh to 48.6% in Sikkim (Tables 2.1.1 and 2.1.2).
- **Dependence developing bidi smokers:** Among current bidi smokers, over half (53.5%) of the smokers indicated developing dependence on nicotine. It ranged from to 54.5% in Bihar to 98.9% in Sikkim (Tables 2.1.1 and 2.1.2).
- **Drug-abuser bidi smokers:** Among current bidi smokers, over one tenth (11.2%) reported using other drugs or alcohol. It ranged from 0.6 % in Manipur to 41.0% in Assam (Tables 2.1.1 and 2.1.2).
- **Media and advertisements:** The GYTS revealed that among participants 68.9% (38.3%, frequently and 31.3%, sometimes) reported watching pro-bidi advertisements on billboards and 79.7% (30.3%, frequently and 49.4%, sometimes) in community events. Among the participants, 14% reported having some object with a brand logo of bidis or pan masala (Table 2.1.3). About 8% of students had been offered free samples of bidis by tobacco companies.
- **Access and availability:** Among current bidi smokers, 54.3% purchased bidis in a store. Among students who bought bidis in a store, over half (57.4%) were not refused purchase because of their age (Table 2.1.3).
- **Cessation:** GYTS results for the country revealed that over 69.2% of students who smoked bidis wanted to stop smoking, whereas 53.3% tried to stop smoking during the past year.

Factors Associated with Current Bidi Smoking

The following determinants of bidi smoking were found in the India GYTS:

- **Gender:** Boys were more likely to be current smokers compared to girls.
- **State:** Current bidi smoking prevalence was low (1% or less) in Goa, Tamil Nadu, Uttar Pradesh, Delhi, Karnataka, Gujarat, Himachal Pradesh and Punjab; intermediately low (1.1%-2.9%) in Maharashtra, West Bengal, Andhra Pradesh, Tripura, Orissa, Uttaranchal, Rajasthan, Madhya Pradesh and Haryana; intermediately high (4.6%-9.2%) in Arunachal Pradesh, Assam, Bihar, Chandigarh and Meghalaya, and high (10.6%-14.2%) in Manipur, Mizoram, Nagaland and Sikkim (see Figure 2.1.1 and Table 2.1.2).
- **Environment:** GYTS results from Bihar were available by urban/rural residence and these revealed that current bidi smoking in rural areas (5.0%) was significantly higher than in urban areas (2.4%) of Bihar (not shown in tables).

Table 2.1.1: **Current bidi smoking among students in India stratified by sex.**

Variable	Age 13-15 (India) % and (CI)	Maximum (State) % and (CI)	Minimum (State) % and (CI)
Current any smoking	8.3 (±1.2)	34.4 (±4.6)[1]	1.7 (±0.7)[2]
Current cigarette smoking	4.2 (±1.2)	22.8 (±3.3)[1]	0.4 (±0.5)[3]
Current bidi smoking			
Combined	2.3 (±0.3)	14.2 (±4.3)[4]	0.3 (±0.3)[5]
Boys	2.9 (±0.5)	22.0 (±7.3)[4]	0.5 (±0.5)[5,6,7]
Girls	1.1 (±0.3)	10.6 (±10.2)[8]	0.0 (±0.0)[9]
Current frequent bidi smoker*	12.5 (±3.1)	48.6 (±13.8)[10]	0.0 (±0.1)[11,12]
Dependence developing bidi smoker	53.5 (±7.0)	98.9 (±1.0) [10]	54.5 (±13.4)[13]
Drug abuser bidi smoker	11.2 (±4.1)	41.0 (±22.3)[14]	0.6 (±1.2) [4]

Figures in parentheses denote 95% confidence interval. [1]Mizoram, [2]Himachal Pradesh, [3]Madhya Pradesh, [4]Manipur, [5]Goa, [6]Delhi, [7]Punjab, [8]Chandigarh , [9]Gujrat,
[10]Sikkim, [11]Arunachal Pradesh, [12]Uttar Pradesh, [13]Bihar, and [14]Assam . *Among current bidi smokers.
Source: India GYTS 2000-04.

Table 2.1.2: **Current bidi smoking among students in India aged 13-15 years stratified by state.**

States	Combined	Boys	Girls
Andhra Pradesh	2.0 (±1.0)	2.2 (±1.2)	1.6 (±1.7)
Arunchal Pradesh	7.7 (±3.0)	12.3 (±5.8)	1.7 (±1.3)
Assam	4.6 (±1.8)	7.4 (±3.3)	1.3 (±0.9)
Bihar	8.2 (±2.1)	9.7 (±2.3)	3.2 (±1.6)
Chandigarh	9.2 (±7.8)	7.3 (±7.3)	10.6 (±10.2)
Delhi	0.4 (±0.3)	0.5 (±0.5)	0.3 (±0.7)
Goa	0.3 (±0.3)	0.5 (±0.6)	0.1 (±0.2)
Gujarat	0.5 (±0.7)	1.0 (±1.1)	0.0 (±0.0)
Haryana	1.8 (±1.5)	1.9 (±2.3)	1.1 (±1.3)
Himachal Pradesh	0.8 (±0.5)	0.8 (±0.8)	0.6 (±0.7)
Karnataka	0.8 (±0.7)	0.9 (±1.3)	0.7 (±0.7)
Madhya Pradesh	1.1 (±1.0)	2.0 (±2.0)	0.2 (±0.4)
Maharashtra	2.4 (±1.3)	2.4 (±1.5)	2.2 (±1.8)
Manipur	14.2 (±4.3)	22.0 (±7.3)	5.3 (±2.9)
Meghalaya	7.2 (±3.8)	11.3 (±6.0)	2.6 (±1.2)
Mizoram	10.6 (±2.5)	13.0 (±4.3)	8.3 (±4.0)
Nagaland	12.7 (±4.5)	14.9 (±6.0)	10.2 (±4.4)
Orissa	1.8 (±0.8)	2.3 (±1.2)	1.2 (±0.9)
Punjab	0.4 (±0.4)	0.5 (±0.5)	0.4 (±0.5)
Rajasthan	2.4 (±1.0)	2.7 (±1.3)	0.7 (±0.7)
Sikkim	12.4 (±3.7)	14.6 (±5.4)	9.7 (±4.4)
Tamil Nadu	1.0 (±0.4)	1.2 (±0.7)	0.5 (±0.4)
Tripura	2.9 (±1.7)	2.6 (±2.3)	3.3 (±2.7)
Uttar Pradesh	1.0 (±0.6)	1.2 (±0.9)	0.6 (±0.5)
Uttaranchal	1.9 (±1.8)	2.7 (±2.8)	0.3 (±0.4)
West Bengal	1.9 (±0.8)	2.3 (±1.0)	0.7 (±1.0)

Source: India, GYTS 2000-04.

Table 2.1.3: Cessation, access and availability and bidi promotion.

Variable	% of current bidi smokers
Cessation:	
Who want to stop smoking now	69.2 (±6.3)
Who tried to stop smoking during the past year	53.3 (±6.9)
Access and availability:	
Who usually get their tobacco by purchasing it in a store	54.3 (±7.2)
Who bought bidis and were not refused purchase because of their age	57.4 (±7.8)
% of students	
Who possess something with a bidi or pan masala brand or symbol on it	14.6 (±1.4)
Who say a bidi company person or bidi vendor has offered them a free bidi	8.0 (±1.3)
Who have seen a bidi advertisements during the past 30 days:	
Frequently on billboards	38.3 (±1.6)
Sometimes on billboards	31.3 (±1.2)
Frequently during community events	30.3 (±1.4)
Sometimes during community events	49.4 (±1.6)

(Figures in parentheses denote 95% confidence intervals.)
Source: GYTS 2000-04.

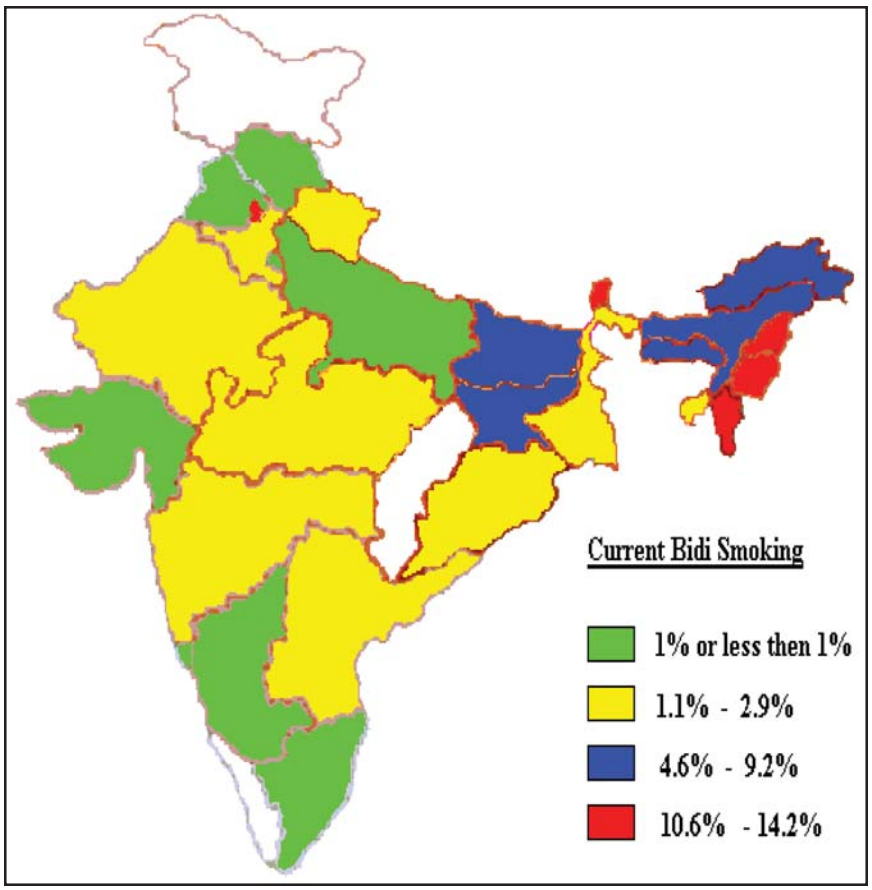

Figure 2.1.1: Prevelance of bidi smoking by state among students in grades 8 to 10 (aged mostly 13-15 years) in India, from the Global Youth Tobacco Survey, 2000-04. (No data were available from the white areas.)

- **Family, friends and school:** Comparing GYTS data from 26 states, current bidi smoking was significantly correlated with variables such as, 1) the percent of students who have one or more parents using tobacco ($p<0.001$); 2) the percent of students who have most or all friends who smoke ($p<0.001$); 3) exposure to secondhand smoke inside ($p<0.001$) and outside ($p<0.001$) their homes; 4) attitudes towards tobacco use by others, such as, 'A smoking man is successful, intelligent or macho,' 'A smoking woman is successful, intelligent or sophisticated.' 'Boys who smoke or chew tobacco have more friends.' 'Girls who smoke or chew tobacco have more friends' ($p<0.001$), 'Smoking or chewing tobacco makes boys look more attractive' ($p<0.001$), Smoking or chewing tobacco makes girls look more attractive ($p<0.001$); and 6) social beliefs such as, 'Smoking or chewing tobacco helps people feel more comfortable at parties', and 'Chewing tobacco is of some help in relieving toothache, morning motions, etc.' ($p<0.001$). The level of curricular teaching on the dangers of smoking ($p<0.001$), the effect of smoking ($p<0.001$), knowledge that 'Smoking is definitely harmful to their health' and 'Smoke from other people's cigarettes or bidi is harmful to them' ($p<0.001$) and beliefs like 'Smoking or chewing tobacco makes you lose weight' were inversely associated with current bidi use (Table 2.1.4).

Table 2.1.4: **Students' ETS exposure, parental and friends' tobacco use and students' knowledge and attitudes, stratified by never tobacco users and current bidi smokers.**

Variable	Never Tobacco Users (%)	Current Bidi Smokers (%)
Reported one or more persons smoking in their presence:		
In their home	31.5 (±1.3)	65.6 (±5.7)
Outside home	44.5 (±1.4)	73.5 (±4.1)
Who say:		
One or both parents smoke, chew or apply tobacco	36.6 (±1.4)	63.8 (±4.4)
Most or all of their closest friends smoke	6.1 (±0.9)	28.2 (±4.4)
Who think that:		
Smoking is definitely harmful to your health	70.1 (±1.5)	38.3 (±5.4)
Smoke from other people's cigarettes or bidis is harmful to you	74.6 (±1.2)	40.4 (±5.4)
A smoking man is successful or intelligent or macho	5.5 (±0.7)	36.3 (±5.0)
A smoking woman is successful or intelligent or sophisticated	12.4 (±1.0)	36.7 (±5.7)
Boys who smoke or chew tobacco have more friends	30.3 (±1.5)	43.3 (±5.3)
Girls who smoke or chew tobacco have more friends	17.0 (±1.1)	30.7 (±4.8)
Smoking or chewing tobacco makes boys look more attractive	30.4 (±1.5)	44.2 (±4.8)
Smoking or chewing tobacco makes girls look more attractive	21.2 (±1.3)	35.7 (±4.7)
Smoking or chewing tobacco helps people feel more comfortable at parties	29.4 (±1.6)	44.1 (±6.1)
Smoking or chewing tobacco makes you lose weight	74.5 (±1.3)	61.4 (±5.8)
Chewing tobacco is some help in relieving toothache, morning motion, etc.	19.3 (±1.2)	37.1 (±5.2)

(Figures in parentheses denote 95% confidence interval)
Source: GYTS 2000-04.

Other Studies

Studies other than GYTS have limitations regarding sample selection, representativeness and power. However, these studies also clearly demonstrate that the prevalence rate of bidi smoking is high among youth in some parts of country and that the rates may be higher in rural areas. In a study of 467 schoolboys aged 8-20 years conducted in Jawla village of Rajasthan by Singhi et al.[1] in 1987, prevalence of bidi smoking was observed to be 19.3%. This study also observed a significant association between the smoking habits of boys and the smoking habits and educational levels of their fathers.

A study of 335 youths from rural areas of Tamil Nadu (284 students and 51 non-students) conducted in 1996 by Krishnamurthy et al.[2] observed the prevalence of bidi smoking to be 18% among boys. A survey of non-school attending children in a suburban area of West Bengal[3] indicated a very high prevalence of bidi smoking among boys (70.3%). A survey of 1000 urban schoolboys (age 8-16 years) in 1980 in Ajmer (Rajasthan) conducted by Lall et al.[4] observed the prevalence of bidi smoking to be 1.9%. George et al.[5] conducted survey in a coastal village near Trivandrum, Kerala in 1990. The prevalence of bidi smoking was observed to be 2.0% in this study. The prevalence of bidi smoking among schoolboys from tribal areas (aged 7-17 years) in western Madhya Pradesh was reported to be 14%-35%.[9] Studies in some urban areas also show a high prevalence of bidi smoking. The studies conducted in Patna Medical and Dental colleges,[7,8] and among male college students in Karnataka (ever smoking 36%)[6] revealed high smoking prevalence, but none of them reported smoking bidis. In a community study from a rural area in Kerala in 1991, Kannan et al.[10] observed 3.4% prevalence of bidi smoking among 15-20 year old youth. The inverse relationship between socioeconomic status and bidi smoking was quite pronounced in this study. In another large cross-sectional study [11] from Uttar Pradesh and Karnataka, current bidi smoking among 10-14 year old males was reported to be 0.5% (10 out of 1,920) and 0.2% (2 out of 1,206), respectively.

CONCLUSION

The knowledge about harmful effects of secondhand smoke exposure differed significantly between current smokers and never smokers among students aged 13-15 in India. This might lead to the conclusion that a large proportion of Indian youth start smoking without knowing the possible consequences. Youth and adolescents should be alerted to the high toxicity and harmful effects of bidis. School policies prohibiting tobacco use among students and school personnel, curricula that teach the harmful effects of tobacco products and build practical skills to avoid peer pressure have been effective in Indian schools. These need to be formulated and implemented in all schools to prevent bidi smoking and other tobacco use.

Over one third of bidi smokers think that tobacco use makes boys/girls look more attractive. This suggests that false images of tobacco users promoted by the tobacco industry may lead to initiation of tobacco use. The present study also demonstrated that the majority of students had easy access to bidi through public stores. The relatively new law, "The Cigarettes and Other Tobacco Products (Prohibition of Advertisement and Regulation of Trade and Commerce, Production, Supply and Distribution) Act, 2003 No. 34 of 2003", needs to be implemented vigorously to prevent access to bidis and exposure to bidi advertisements.

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2.2 Prevalence and Patterns of Bidi Smoking in India

Cecily S. Ray and Prakash C. Gupta

INTRODUCTION

The objective of this chapter is to characterize the prevalence of bidi smoking among adults in different parts of India and nationally, and to identify patterns. It aims to paint a picture of the importance of bidi smoking in India relative to other tobacco products that compete with it today, and on its own, through a review of surveys of tobacco use in limited geographic areas as well as national surveys.

Most reports on smoking prevalence in India give prevalence as a whole, without separating bidi smoking from other types of smoking. Nevertheless, several high quality cross-sectional studies in limited areas reporting prevalence of bidi smoking have been available over the last several decades, as well as the National Sample Surveys, which report bidi consumption (number per capita per day) for various years. Also reported are data from the Global School Personnel Survey (GSPS) conducted in various states. Most of the available surveys report on smoking in the age groups of 10 years and above or 15 years and above. Prevalence in the 10+ age group can be considered overall prevalence and that in the 15+ age group, adult prevalence.

In order to provide reliable information on bidi smoking prevalence for this chapter, only articles on large-scale studies with over 1000 participants and appropriate methodologies have been described. Three recent studies that did not distinguish the different types of smoking but were conducted in areas where bidi smoking is the predominant form of smoking (Kerala, Tamil Nadu and Delhi) were also included, since no other recent local surveys were available from those areas.

Studies are described in approximate chronological order and the date of study is given if known. Most, but not all, studies give a male-female breakdown of smoking prevalence; where given it is reported here.

LOCALIZED SURVEYS

Surveys in limited areas have shown bidi smoking to be practiced in all areas surveyed, but with prevalence varying from area to area.

Rural Surveys

House-to-house surveys on oral precancers and tobacco habits carried out during 1966-67 in the rural districts of Bhavnagar in Gujarat, Ernakulam in Kerala, Srikakulam in Andhra Pradesh, and Singhbhum and Darbhanga in Bihar found bidi smoking to be the predominant form of smoking practiced among men aged 15 years and above, with prevalence ranging roughly from 40% to 60% in four of the areas (highest at 62% in Ernakulam), while in Srikakulam, Andhra Pradesh, it

was 12% (Table 2.2.1). Tobacco chewing prevalence among men amounted to 15% in Bhavnagar, 36% in Ernakulam, 11% in Srikakulam, 31% in Singhbum, and 54% in Darbanga.[2,3,4]

In Srikakulam, the smoking of *chuttas* (coarsely prepared cigars) among men was 57%, two thirds of whom smoked them in reverse fashion. In all the other areas, other forms of smoking were practiced at low levels: cigarettes (< 0.5% to 6%) and other local traditional forms such as the *chillum* (a straight, conical clay pipe) in Bihar. Multiple smoking forms were used by 2% to 5% of men.[4]

Among women, smoking was uncommon (as low as 1% in two areas), except in Srikakulam and Darbanga. Bidi smoking among women reached its highest prevalence in Darbanga (Bihar), at 13%. Other smoking habits were by far more prevalent among women than bidi smoking in some areas, including reverse chutta smoking, 62% in Srikakulam (Andhra Pradesh), and *hookah*, 28% in Darbanga. Tobacco-chewing among women was more common than smoking, with 15% in Bhavnagar, 39% in Ernakulam, 3% in Srikakulam, 28% in Singhbum, and 11% in Darbanga.[4]

A survey carried out during 1968-71 among 101,761 villagers in Poona district of Maharashtra found that only 4.6 % of men and < 0.05% of women were bidi smokers. Only 1.0 % of men smoked other products. Overall tobacco use reached 61.6% in men, but it consisted mainly of smokeless forms.[5]

In a house-to-house survey of 5,449 villagers in 11 villages in Goa conducted in 1974, roughly 53.5% of men and 8.7% of women smoked bidis. About 6% of women were *dhumti* (user-made, leaf-wrapped conical tobacco smoking product) smokers. About 30% of women were chewers, whereas only about 4% of men were chewers.[6]

A cross-sectional study on respiratory ailments in Uttar Pradesh among residents aged 30 and above in five villages was carried out from house to house within a three km radius of the experimental teaching health sub-center of the K.G. Medical College, Lucknow. Of the 1267

Table 2.2.1: **Prevalence of various smoking habits among men > 15 years in five rural areas of India.**

Smoking Practice	Bhavnagar, Gujarat		Ernakulam, Kerala		Srikakulam, Andhra P		Singhbhum, Bihar		Darbhanga, Bihar	
	No.	%	No.	%	No.	%	No.	%	No.	%
Bidi	2283	44	3046	62	662	12	2950	61	2043	42
Cigarette	13	<0.5	286	6	132	2	23	<0.5	46	<0.5
Multiple	260	5	–	–	254	5	114	2	199	4
Hookli	569	11	–	–	–	–	–	–	–	–
Chilum	86	2	–	–	–	–	31	1	92	2
Hookah	21	<0.5	–	–	–	–	5	<0.5	87	2
Chutta	–	–	–	–	1030	19	–	–	–	–
Reverse chutta	–	–	–	–	2042	38	–	–	–	–
Pipe	–	–	–	–	–	–	–	–	–	–
Others †	–	–	3	0.5	–	–	6	<0.5	2	<0 .5
No smoking	1995	38	1576	32	1229	23	1671	35	2390	49
Total	5227	100	4911	100	5349	100	4800	100	4859	100

† Others: Cigar, cheroot, etc.
Source: Mehta FS et al. 1969.[2]

eligible residents (1140 were interviewed), 45.6% were smokers and 6.67% were ex-smokers. Among males, 74.2% were smokers (467) and among females, 10.4% (53) were smokers. Among the total of 520 smokers, 61.9% were bidi smokers, while 27.1% smoked *hookah* and 11.0% smoked *chilum*. Thus the prevalence of bidi smoking was 28.2% in the total population 30 years and above. It was estimated that one bidi contained 0.2 grams of tobacco and one sitting of *hookah* smoking consumed 4 gms. Most smokers were light smokers, i.e., smoked less than 15 gms per day. Among male smokers, 79.9% were light smokers, the rest heavy smokers; among female smokers, 45 out of 53 (84.9%) were light smokers. The *hookah* smokers were said to all be heavy smokers (4-5 sittings, equivalent to 15 gms of tobacco per day).[7]

In another rural cross-sectional study in Uttar Pradesh, designed to study respiratory diseases, 1424 residents aged 20 and above were interviewed out of an original sample of 1496 individuals in three villages within five km from a primary health center of the M.L.B Medical College, Jhansi (U.P.). In this population, 45.4% were smokers, 73.3% of males, and 12.0% of females. Out of the 646 smokers, 60.1% smoked bidis, 32.8% smoked *chilum* or *hookah* and 7.1% smoked cigarettes. Among male smokers, 65.5% were light smokers (less than 10 gms per day) and the rest heavy smokers; 47.4% of female smokers were light smokers. It was estimated that there were 3.6 gms in 20 bidis (or 0.18 gms per bidi) and 4 gms in one sitting of *hookah* smoking.[8]

A house-to-house survey on risk factors for heart disease carried out in rural Punjab (in the districts of Pohir, Lehra and Khera, screening 1101 individuals over 30 years of age) found 8.9% were smokers, of whom two thirds smoked bidis and the rest cigarettes. This population had a majority of Sikhs (88.2%).[9]

In a later survey in Bhavnagar district of Gujarat, where a survey had been carried out earlier, 31% of men were bidi smokers, whereas in the earlier survey 44% smoked bidis.[1] In the interim period, a smokeless tobacco product, *mawa,* prepared by vendors and containing areca nut and tobacco, became popular among youth and by the second survey it was chewed by 18.9% of male respondents aged 15 years and above, and by 0.07% of females. In the earlier study from the 1960s, chewing habits of men (prevalence 15%) consisted of *paan* with or without tobacco or tobacco with lime. It appeared that more youth in the new generation took up *mawa* instead of bidis or *paan* with tobacco.[10]

A recent house-to-house survey in a village of Sitamarhi district of Bihar, adjacent to Darbanga, the district surveyed about 30 years earlier,[2] collected information on 5,496 individuals aged 15 years or above during June-July, 2000. Among males, 31.6% were smokers and among females the proportion was 23.4%. Bidi smoking prevalence was 25.9% among males and 19.7% among females. Others smoked cigarettes or the *hookah*. Exclusive smokeless product use was practiced by 42.6% of males and 21.7% of females. Some smokers also used smokeless products. Tobacco toothpowder (*gul*), *paan masala*, *khaini* (mainly as user prepared tobacco and lime mixture), *gutka* (tobacco, areca nut, lime, magnesium carbonate and condiment mixture) and betel quid were the smokeless products used.[11]

Urban Surveys

In the mid-1970s a random sample survey on respiratory ailments and risk factors in the urban locality of Karol Bagh, New Delhi, contacted 774 males ages 15 years and older and found 338 (43.7%) ever smokers among them. (Among the females of that age group in the same households only one smoker was found.) In the age group three years and above (979 males and 859

females), 31.2% of males and 2.1% of females were ever smokers. Cigarette smoking predominated. Out of 359 smokers (age group not stated), 216 (60.2%) smoked cigarettes, 84 (23.4%) smoked bidis, and 8 (2.2%) used the *hookah*, while 51 (14.2%) smoked in combinations. While this study reported detailed results on products smoked for a wider age group than desired for this review, it is useful because it shows that in a part of urban Delhi cigarette smoking predominates over bidi smoking.[12]

In a large cross-sectional survey in Delhi conducted during 1985-86, of 13,723 adults aged 25-64 years, 45% of men and 7% of women were smokers. Among smokers, about half, i.e., 47.4% of men and 95.1% of women, smoked bidis or chuttas and the rest smoked cigarettes.[13]

In a large urban house-to-house survey in Mumbai, Maharashtra, of 99,598 persons aged 35 years and above, 11.9% of men (and 0.3% of women) smoked bidis and 9.9% of men smoked cigarettes (< 0.05% of women). By contrast, smokeless tobacco was used by 45.7% of men and 57.1% of women.[14] The results of this urban survey are reminiscent of those of the study in rural Maharashtra a few decades earlier, where smokeless tobacco use predominated over any form of smoking.[5]

In a sample survey in a northern suburb of Thiruvananthapuram, Kerala, consisting of 25,453 men and 34,441 women aged 35 years and above, 55.8% of men and 2.4% of women were smokers, and bidis were the predominant smoking product used in this mostly lower-middle and lower-income population.[15]

Surveys in Both Urban and Rural Areas

The Tobacco Use Sentinel Survey of the ICMR and WHO was conducted by cluster random sampling in villages and urban wards in three districts among nearly 30,000 individuals of Karnataka and Uttar Pradesh states. Bidi smoking among respondents aged 10 years and above in Uttar Pradesh was 25.9% among males and 2.2% among females. In Karnataka, 28.8% of males and 0.6% of females were bidi smokers. Out of all smokers, 91.7% in Karnataka and 84.5% in Uttar Pradesh were bidi smokers.[16]

A recent survey in South Arcot district, Tamil Nadu, among men aged 35-69 years, found nearly 47% were regular smokers. A survey in urban Chennai in the same period found 38% men were ever smokers. Bidi smoking predominated in the rural area, while cigarette smoking predominated in the urban area.[17]

Reports of the Global School Personnel Survey (GSPS) conducted in Orissa, Bihar and the Northeastern states of India using a self -administered, anonymous questionnaire, are enlightening regarding the extent of bidi and cigarette smoking among school personnel, who are among the more educated adults in these areas. The surveys were conducted in different types of high schools.

In the Orissa GSPS, current daily bidi smoking was reported by 19.7% of men and 1.4% of women respondents.[18] In Bihar, among 637 respondents in 50 schools, smoking was found to be more common in Bihar State schools than Central Government or other types of schools. Bidi smoking was practiced by nearly 17.4% (95% CI = ± 4.6) of men and 4.3% (95% CI = ± 4.7) of women, but cigarette smoking was considerably more prevalent (40.5% men; 26.9% women) and smokeless tobacco use predominated.[19]

In the GSPS in the Northeastern states, the prevalence of daily plus occasional bidi smoking varied from around 10% to 40% in men and women.[19] In four of the eight Northeastern states, bidi smoking predominated, as shown in Table 2.2.2 by the highlighted cells, while in the other four states, cigarette smoking predominated. In addition to cigarettes and bidis, smoking of *ganja* (marijuana), mainly by men, was also quite common, especially in Manipur (23.5% of men). In some areas *hookahs* and *kamchung* pipes (a small curved pipe with a very small container of water in the middle) were used by a small percentage for smoking tobacco.[20]

NATIONAL SURVEYS

No national survey with the sole specific objective of collecting tobacco use prevalence or smoking prevalence data has been conducted, but two national surveys conducted with broader objectives provide some prevalence information on smoking and other forms of tobacco use in India. These are the National Sample Survey (NSS), repeated periodically since 1950, and the National Family Health Survey, in its second round (1998-99). The NSS collects information on household consumption, expenditure and employment. The NFHS gathers health-related information. The sampling unit in both surveys is the household. In these national surveys, one adult household member is interviewed for the entire household. In the NSS, the respondent is usually the male head of household and in the NFHS, it is the female head of the household.

The National Sample Survey Organization (NSSO) has reported smoking preva-lence figures among persons 10 years of age and above for the 50th round, i.e., that of 1993-94,[21] but an independent calculation for the 52nd round gives smoking prevalence on persons aged 15 years and above: 35.3% of males and 2.6% of females were smokers in 1995-96.[22] A similar analysis of National Family Health Survey-2 data reported 29.3% of males and 2.4% of females as smokers in 1998-99.[21,22]

Table 2.2.2: **Prevalence of current smoking and smokeless practices among school personnel in eight Northeastern states of India – Global School Personnel Survey (GSPS), 2001.**

State	Total	Men			Women		
	N	Bidi Smoking %	All Smoking %	Smokeless %	Bidi Smoking %	All Smoking %	Smokeless %
Assam	782	18.6	55.3	44.4	*	33.8	50.5
Arunachal Pradesh	533	10.7	45.2	47.9	*	34.4	49.0
Manipur	395	27.0	79.5	75.0	20.1	61.4	75.8
Meghalaya	447	27.2	69.6	51.3	13.6	31.6	56.6
Mizoram	307	38.4	75.3	79.2	43.1	76.2	87.2
Nagaland	426	15.1	55.1	49.8	*	18.1	32.5
Sikkim	342	15.7	52.5	54.2	37.4	39.7	73.6
Tripura	562	13.4	56.6	55.5	*	9.2	24.5

*The number of women smokers was less than 35 in these cells. All smoking includes bidi, cigarette, *ganja, kamchung* (pipe), *hookah*, combination, and other forms. Forms of tobacco use were not mutually exclusive and values include both daily and occasional users.
Shaded cells show states where bidi smoking predominated over cigarette smoking.
Source: Sinha et al., 2003b.[20]

The National Sample Survey collected information on the types of tobacco products the respondents smoked, which the National Family Health Survey-2 did not. While the NSS for 1999-2000 did not report individual prevalence of bidi smoking, it reported the number of bidis, cigarettes and finished *paan* quids consumed per capita in the last 30 days prior to the interview based on consumption data from household. These are shown for four NSS rounds in Table 2.2.3. (Leaf tobacco and *hookah* tobacco consumption by weight were also collected but not reported here). Bidi consumption (number of bidis smoked) is clearly much higher than cigarette consumption (number of cigarettes smoked), especially in the rural areas. A decline in per capita bidi consumption is seen from 1987-88 onwards: 22.8% in rural areas and 42.9% in urban areas.[23, 24] (No corresponding figures have been published on data collected between the 17th and 43rd rounds.)

Table 2.2.3: Per capita consumption (all ages) of bidi, cigarette and *paan* (quantity in numbers of pieces) by household members in the last 30 days prior to interview, for four rounds of the National Sample Survey during four surveys from 1961-62 to 1999-2000.

Item	17th Round (1961-62)	43rd Round (1987-88)	50th Round (1993-94)	55th Round (1999-2000)
	No.	No.	No.	No.
RURAL				–22.8% change from 1987-88
Bidis	28.9	49.5	45.7	38.2
Cigarettes	1.0	1.1	0.8	0.96
Paan (finished no.)	NR	0.7	0.6	0.8
URBAN				– 42.9% change from 1987-88
Bidis	47.5	38.7	32.4	22.1
Cigarettes	7.7	4.9	3.7	3.2
Paan (finished no.)	NR	1.7	1.4	1.2

Geographical area for 1999-2000 included all of India except Ladakh and Kargil of Jammu and Kashmir, as well as 768 interior villages of Nagaland, and 172 villages in Andaman and Nicobar Islands that remained inaccessible throughout the year.
Source: NSS reports (ISI, 1970; NSSO, 2000).[23,24]

The prevalence of tobacco use has been reported in an independent analysis of household level data from the National Sample Survey, 55th round (during 1999-2000) showing the percentage of households consuming bidis and cigarettes in rural and urban India.[25, 26] This type of analysis was most appropriate since the sampling unit was the household. According to this analysis, bidis were the most popular tobacco products, consumed by 36.5% of households in rural areas and 19.8% of households in urban areas during 1999-2000. Other forms of tobacco smoking, such as the *hookah*, the Indian water pipe, and the *cheroot*, a small cigar, were used by small proportions of households (Table 2.2.4). Prevalence of household bidi smoking by state is still unavailable.

PATTERNS

Patterns of bidi smoking prevalence according to gender, age, rural or urban residence, geographic region, education, income, caste, religion, and use of *paan* or alcohol have been analyzed in different studies. The main analysis referred to here is on household consumption of bidis, cigarettes and other tobacco products in the NSS 55th Round (1999-2000),[26] using a Multinomial Logit Model (MNLM).[25] This takes India data as a whole; since India is a vast country with diverse patterns, the conclusions may not be applicable to every part of India. Certain findings are generalizable, for example, bidis are smoked more by males than females.

Table 2.2.4. **Percentage of households consuming tobacco products in rural and urban India, from National Sample Survey data of 1999-2000.**

Item	Sample (N=119,554 households)		Population	
	Rural (%)	Urban (%)	Rural (%)*	Urban (%)*
None	37.8	60.3	37.4	60.3
Bidi	35.3	18.9	36.5	19.8
Cigarette	5.5	11.3	3.7	9.6
Hookah	3.3	0.8	2.6	0.4
Cheroot	0.9	0.4	1.0	0.6
Tobacco Leaf	18.7	7.4	19.4	7.4
Snuff	1.5	0.6	1.4	0.6
Zarda	4.1	2.8	4.2	3.4
Others	6.2	4.1	5.7	3.6
Total % households consuming tobacco	62.3	39.7	62.6	39.7

*These percentages were calculated using inverse sampling probabilities as weights.
The categories add up to more than the total because some households consumed more than one type of product.
Source: Computed by John (2006)[25] from NSSO (2000b).[26]

Gender

In the analysis of household consumption data from the NSS, as the number of adult males in a household increased, the likelihood of consuming one or more tobacco products (including bidis) increased compared to not consuming tobacco.[25] This corresponds to findings of all surveys conducted in limited populations at different times that bidis are mainly smoked by men.

Age

Where tobacco use is concerned, age is of interest in several respects: age of initiation, duration at a certain age, age group of maximum use and average age of users. Initiation of bidi smoking may begin as low as eight to ten years of age in disadvantaged groups, like tribal and street children. The mid to late teens years are another vulnerable age range for initiation of bidi smoking.[27,28]

In the Sentinel Survey, more than half of both male and female bidi smokers 10 years and over had been smoking for more than ten years by the age of 30-34 years in both Uttar Pradesh and Karnataka. The age group in males with the peak prevalence of bidi smoking was 55-59 years: 41% in Uttar Pradesh and 50.8% in Karnataka. For female bidi smokers, the peak age group was also 55-59 years in Uttar Pradesh, but it was 50-54 years in Karnataka. In contrast, the age group with the highest prevalence of cigarette smoking among males was 45-49 years of age in both Uttar Pradesh (5.2%) and Karnataka (6.39%). This would seem to indicate a gradual shift in preference for cigarettes versus bidis among younger cohorts. (There were not enough female cigarette smokers for any analysis in the surveyed population of the two states).[16]

Analysis of the average ages of users of different tobacco products can help to discover trends in usage patterns. In three of the five areas surveyed during 1966-67, the average age of men who smoked (31.2-33.5 years) was lower than the average age of men in the entire area's study population (35.1-36.0 years) in Ernakulam, Dharbanga and Srikakulam (conventional smokers), as shown in Table 2.2.5. This would indicate that smoking was becoming more popular in young

males in those areas.[3] The suggested increasing popularity of smoking among males in three rural study areas in the late mid 1960s agrees with NSS data that show an increase in per capita consumption of bidis in rural areas from the early 1960s to the late 1980s (Table 2.2.3). In all five areas, the average age of women smokers (38.1-44.3 years) was higher than that of the women in the entire study population (35.0-35.9 years), possibly indicating that smoking was becoming less popular among younger women in all the areas or that initiation took place at later ages. On the basis of similar age considerations, chewing (or any smokeless tobacco use) appeared to be becoming less popular among both men and women in Ernakulam and Darbhanga, and among women in Bhavnagar at that time. From these data it appears that smoking and smokeless tobacco use tend to fluctuate in relation to each other over time. Current trends in these areas may differ from earlier ones.

Rural or Urban Residence

It is clear from published NSS data for 1993-94 that regular smoking was more common in rural versus urban areas: 24.8% of rural males and 2.3% of rural females aged 10 years and above, versus 19.1% of urban males and 0.7% of urban females, were regular smokers.[21] Household prevalence of bidi consumption according to the NSS 1999-2000 data was 25.2% in rural and 14.5% in urban areas (See Table 2.2.3). The prevalence of households consuming both bidi and tobacco leaf was also higher in rural than urban areas (3.7% vs. 0.9%). The percentage of households consuming both bidis and cigarettes was more common in urban areas (1.5% vs 1.8%).

The Sentinel Survey showed a rural-urban differential, with 29.2% of rural males and 16.7% of urban males as current bidi smokers (aged 10 years and above) in Karna-taka. In Uttar Pradesh, 24.4% of rural males (2.3% of rural females) and 17.8% of urban males (1.0% of urban females) aged 10 years and above were current bidi smokers.[16]

Table 2.2.5: **Average ages (in years) of tobacco users and non-users in five areas of India, surveyed in 1966-67.**

Study population	Smokers		Chewers	Mixed use	No tobacco use	Total population
Bhavnagar, Gujarat						
Male	38.9		37.4	35.3	33.2	36.7
Female	44.3		46.0	–	34.8	36.4
Ernakulam, Kerala						
Male	31.2		52.1	43.8	26.0	36.0
Female	43.9		46.6	49.3	29.0	35.8
Srikakulam, A.P.	Rev.	Ord.				
Male	39.1	33.6	38.5	38.5	29.0	35.2
Female	38.4	38.5	33.4	38.7	31.2	35.9
Singhbhum, Bihar						
Male	35.7		36.1	38.3	27.4	34.4
Female	43.5		33.0	36.5	35.0	35.0
Dharbanga, Bihar						
Male	32.7		41.1	36.7	29.0	35.1
Female	38.1		43.9	42.3	32.4	35.8

A.P. Andhra Pradesh; Rev.= Reverse; Ord. = Ordinary.
Source: Mehta et al, 1971[3]

State and Region

Reports of overall smoking prevalence by state, but not specifically of bidis, are available from the NSS and NFHS. According to NSS-50th round data for 1993-94,[19] regular smoking prevalence among males 10 years and above was highest in Mizoram of the Northeast (rural: 54.8% among males, 41.7% among females; urban: 55.6% among males; 31.6% among females) and lowest in Punjab (rural: 8.7% among males; 0.2% among females; urban: 15.7% among males; 0.1% among females). In Punjab the traditional anti-tobacco stance of the Sikh religion prevails, more strongly so in rural areas. Other states in the highest smoking prevalence category (40.0% or more among males in rural areas and over 20.0% in urban areas) were in the Northeast (Meghalaya and Tripura), North (Haryana), West (Rajasthan and Gujarat), Eastern states (West Bengal) and Southeast (Andhra Pradesh). Other states in the lowest smoking prevalence category for males included: Bihar (4.4% rural; 4.9% urban), Orissa (8.9% rural; 12.1% urban) and Maharashtra (10.4% rural; 10.6% urban). In this survey, Delhi and Goa were in intermediate categories: Delhi (36.6% rural; 31.7% urban) and Goa (19.7% rural; 17.5% urban) as were Jammu and Kashmir (36.5% rural; 18.7% urban).

Since almost all studies show that bidi smoking is by far the predominant smoking practice, it might be assumed that wherever smoking prevalence is high, bidi smoking would also be high, however this should be verified.

A compilation of per capita annual consumption by state (numbers of bidis and cigarettes) from NSS surveys of 1993-94 and 1999-2000[29,30] is shown in Table 2.2.6. The highest per capita consumption of bidis during 1999-2000 was in Haryana, Rajasthan and Tripura, in both rural and urban areas. These states were followed by Gujarat, Himachal Pradesh and West Bengal. The lowest values were for Bihar, Mizoram (high in cigarette consumption), Orissa and Punjab. It must be remembered that per capita consumption may not always vary in tandem with prevalence, as in some lower-income areas, per capita consumption might be lower, even though prevalence is high. From this analysis it is clear that in some of the states with the highest smoking prevalence, bidi smoking accounts for the bulk of smoking. In other states, such as the Northeastern ones, other forms of smoking are important, especially cigarettes.

Declines in per capita monthly consumption of bidis from 1993-94 to 1999-2000 were registered in all but three states (Table 2.2.6): rural Haryana, where the level remained unchanged at 80 bidis per capita, rural Meghalaya, where there was an increase of 32.6% (from 37.1 to 49.2), and rural Tamil Nadu where consumption increased by 30.2% (from 26.9 to 35.0). In Union territories there were significant declines, except in Dadra & Nagar Haveli. The largest negative percent change in per capita bidi consumption was a decrease of 77.8% in rural Delhi (from 125.3 to 27.8) and the next highest decline was in rural Sikkim, of 60.5%, from 20.5 to 8.1. A decrease of 55.6% in per capita bidi consumption occurred in rural Jammu and Kashmir, where per capita monthly consumption by males fell from 72.7 to 32.3 bidis. Declines in bidi consumption of 50% or more were also registered several other states, e.g., Arunachal Pradesh, Assam, and Goa. A slightly lower reduction in bidi consumption was observed in Kerala (41% in rural and 46% in urban areas). Punjab and Nagaland also had substantial declines. A simultaneously high increase in per capita cigarette consumption, as reported from the NSS data in both rural and urban areas, is noted for Jammu and Kashmir and Mizoram.[30]

Table 2.2.6. **State-wide per capita monthly tobacco consumption (rural and urban) in India from National Sample Survey data of 1993-94 and 1999-2000.**

State	Rural India				Urban India			
	Bidi (no.)		Cigarette (no.)		Bidi (no.)		Cigarette (no.)	
	1993–94	1999–2000	1993–94	1999–2000	1993–94	1999–2000	1993–94	1999–2000
Andhra Pradesh	48.06	38.95	2.80	3.52	25.47	14.27	7.86	8.03
Arunachal Pradesh	28.46	14.43	1.71	0.37	22.30	5.59	7.52	4.91
Assam	33.19	13.83	1.16	0.57	17.07	7.29	8.31	4.01
Bihar	10.63	6.92	0.13	0.14	6.57	3.92	1.15	0.93
Goa	34.84	16.55	4.54	3.78	31.01	14.14	4.21	1.78
Gujarat	74.17	63.84	0.16	0.26	47.12	31.57	0.90	0.41
Haryana	80.50	80.01	0.12	0.42	58.86	51.73	1.81	1.67
Himachal Pradesh	72.67	62.60	0.93	1.66	50.01	29.15	6.68	7.35
J&K	70.72	32.30	3.04	7.45	33.79	10.44	7.79	10.60
Karnataka	51.55	42.63	0.65	0.67	32.09	19.70	2.59	2.31
Kerala	45.09	26.35	3.35	4.95	32.70	17.65	5.27	5.66
Madhya Pradesh	52.46	42.23	0.17	0.24	38.38	30.00	1.58	1.27
Maharashtra	22.17	16.43	0.39	0.01	15.52	9.84	2.81	1.99
Manipur	51.05	27.85	2.40	2.39	39.97	19.98	3.16	4.08
Meghalaya	37.07	49.24	4.67	2.37	24.31	19.52	23.17	9.24
Mizoram	10.12	9.08	0.98	5.17	1.04	2.03	6.37	12.57
Nagaland	63.07	37.53	5.78	0.85	47.39	36.05	12.87	2.67
Orissa	14.24	9.45	0.17	0.23	14.64	5.69	3.70	1.06
Punjab	22.77	13.40	0.82	0.63	32.02	22.25	2.22	0.94
Rajasthan	87.34	78.60	0.43	0.44	56.95	40.74	1.99	1.55
Sikkim	20.48	8.12	2.85	1.95	13.82	9.21	3.87	3.67
Tamil Nadu	26.90	35.03	1.77	2.32	21.73	12.70	4.26	5.49
Tripura	94.66	79.29	3.32	2.11	57.76	55.40	15.02	15.18
Uttar Pradesh	54.94	46.52	0.26	0.31	36.21	31.56	2.00	1.23
West Bengal	65.96	61.61	0.89	0.66	45.57	42.79	8.20	8.43
A&N Island	24.09	13.73	4.29	0.84	18.65	6.61	9.78	2.54
Chandigarh	84.32	54.93	0.15	2.49	79.71	35.71	3.92	3.57
D.& N. Haveli	26.37	28.02	0.37	0.84	–	–	–	–
Damen & Diu	63.93	11.16	0.72	0.98	34.54	21.08	1.14	1.35
Delhi	125.29	27.84	4.36	2.43	56.31	19.72	5.43	3.81
Lakshadweep	–	–	–	–	43.12	30.60	4.77	9.57
Pondichery	16.09	15.36	0.28	1.29	7.33	3.89	2.40	5.26
All India	45.74	38.18	0.80	0.96	32.39	22.13	3.65	3.24

Sources: Sarvekshana October–December 1996 for the year 1993–1994[29]; NSS Report No. 461 (2000a); in[24] John, 2005[30]

Education

In the Delhi survey,[13] education was the strongest negative predictor of smoking in both men and women ($P < 0.001$) in a stepwise multiple logistic regression model. Men with no education were 1.8 times more likely to be smokers than men with college education and uneducated women were 3.7 times more likely to smoke. Two sub-populations of smokers were identified: laborers, who smoked bidis and *chuttas,* and white-collar workers, who were more likely to smoke cigarettes.[13]

Similarly the Mumbai survey found that prevalence of any type of tobacco use, except cigarette smoking, was inversely proportional to level of education.[14] After correcting for age and occupation, the odds ratio for bidi smoking among the illiterate compared to college educated was 38.64, but when comparing smoking of cigarettes among the illiterate compared to the college educated, the OR was only 1.73.[31] In John's analysis of NSS data on households, an increase in years of education of the most educated member in the household turned the odds against consuming bidis in the household.[25]

Economic Status and Occupation

The analysis of NSS data on income found that the percentage of households consuming bidis in rural areas was highest in the middle-income group (40.6%) and lowest in the lower-income group (29.3%). In urban areas it was highest in the lower-income group (24.1%) and lowest in the higher-income group (11.6%).[25] Incomes in urban areas being higher than those in rural areas, more low-income urban dwellers feel they can afford to smoke bidis.

In the Sentinel Survey, the prevalence of bidi smoking was highest among indi-viduals in the lowest strata of monthly family income: Rs. 2000 or less (over 30% in Karnataka and over 25% in Uttar Pradesh).[16]

The highest prevalence of bidi smoking in the Mumbai survey was found among the unemployed and unskilled workers (bidi smoking was somewhat more than three times more prevalent among the unskilled and unemployed than among professionals).[31] In Sitamarhi, Bihar, bidi smoking decreased with increasing economic status.[11]

Religion

According to the household analysis of NSS data for rural areas, bidi consumption is high among Muslim households (45.1% in rural and 28.4% in urban areas) and Hindus (36.3% in rural and 19.3% in urban areas) and low in Sikhs (8.8% in rural and 4.6% in urban areas) and Jains (10.6% in rural and 4.2% in urban areas). Among Christians, bidi smoking is moderately high in rural areas (27.7%), but low in urban areas (9.7%). Bidi smoking is moderately high among Buddhists in both rural (20.5%) and urban areas (17.5%).[25]

In Uttar Pradesh, in the Sentinel Survey, current bidi smoking prevalence was moderately high among Muslims, at 27.9% of males aged 10 and above (1.0% of females), and among Hindus at 22.4% of males (2.3% of females). The numbers of Christians and Sikhs were too small for evaluation (a total of six individuals). In the Karnataka survey, bidi smoking prevalence was fairly similar in all religious groups, but highest among Hindus (27.0% of men, 0.5% of women) followed by Muslims (24.7% of men, 1.1% of women), Christians (25.0% of men [7/28], 0.0% of women) and Sikhs (27.3% of men [3/11], 0.0% of women).[16]

A few other surveys in limited populations have examined smoking by religion and have shown results fairly similar to the national surveys and the Sentinel Survey. In the urban Delhi survey mentioned earlier, prevalence of smoking was highest among Muslims (58.6% in men; 21.0% in women); next highest in Hindus (47.9% in men; 5.6% in women), and next highest among Christians (39.6% in men; 4.2% in women). It was lowest among Sikhs at 2.6% in men and nil among women.[13] In the Mumbai study, smoking prevalence was highest among Muslim men (42.4%) and Christian men (35.1%). Smoking was comparatively low among Hindu men (13.2%) and Buddhist men (9.3%), both of whom tended to chew or apply tobacco in this city. Smoking

among the women of the various religions in the survey was very rare and proportions were not reported.[11] In a case-control study from Mumbai on lung cancer, it was found that among both cases and controls, Muslims or Hindus who smoked were more likely to smoke bidis, but Christians were more likely to smoke cigarettes than bidis.[32]

Caste

In the same household analysis of NSS data, the percentage of households con-suming bidis was highest in the Scheduled Caste households in both rural (43.3%) and urban areas (33.9%). This was followed by the household prevalence in the Scheduled Tribes (38.0% in rural and 24.7% in urban areas), other Backward Castes (33.5% in rural and 21.7% in urban areas) and all others (34.5% in rural and 14.7% in urban areas). Clearly the caste-related gradient is more pronounced in urban areas.[25]

Paan and Alcohol Consumption

John's analysis of NSS data found that tobacco use, including bidi smoking, was more common in households consuming *paan* (betel quid) or alcohol. The gradient was stronger for *paan* in rural areas and for alcohol in urban areas.[25] This finding is important in the health context because use of alcohol or *paan* acts synergistically with bidi smoking in causing cancer at sites in the upper aero-digestive system.

CONCLUSION

Bidi smoking is clearly a predominantly male practice and is more prevalent in rural than urban areas. It is associated with lower incomes in urban areas, and middle incomes in rural areas and is more common among the least educated. It tends to be most common among Muslims, closely followed by Hindus. In rural areas it is also common among Christians. It is almost unknown among Sikhs, and low among Jains. Bidi consumption is very high among the Scheduled Castes. Per capita monthly consumption of bidis has been reported highest in Haryana, Rajasthan and Tripura.[30]

From the available surveys, bidi smoking appears to be the predominant form of smoking in most parts of India, but in areas where other local forms of smoking have long-standing popularity, bidi smoking is comparatively low, such as parts of Andhra Pradesh (*chutta*) and Bihar (*hookah*). Somewhat analogously, in Maharashtra, where smokeless forms of tobacco have been popular for a long time, smoking prevalence is lower than smokeless tobacco use.

An analysis of the National Family Health Survey-2 data on smoking by various demographic and socioeconomic variables (gender or number of males in the household, rural residence versus urban, state, years of education, household wealth, religion, and caste) is consistent with all similar findings on NSS data for household bidi consumption. Since bidi smoking predominates over other smoking forms in the country, this was to be expected.[22, 30]

The low level of bidi smoking in Punjab may be explained not only by the religious proscription against tobacco use by the Sikh religion (to become a Sikh the individual must vow not to smoke), which is widely followed in that state, but also by the fact that Punjab schools widely teach about the dangers of tobacco use, both smoking and smokeless. In the Global Youth Tobacco Survey of 2001, 75% of the students aged 13-15 years had been taught about the dangers of smoking.[33]

The influence of religion on tobacco smoking behavior does not seem to be strong in India, except among the Sikhs. The Muslim religion is also officially against smoking, but overall smoking prevalence is highest among Muslims. Almost all sects of Hinduism discourage smoking, yet smoking is highly prevalent among Hindus. The Parsee religion, which is a small minority, discourages its followers from smoking and the community is known for low smoking prevalence.[14] There is clearly an opportunity to use religion to persuade people to abstain from bidi and cigarette smoking and other forms of tobacco use.[34,35]

Cigarette smoking has begun to have an edge on bidi smoking in some areas, such as Delhi, Kerala and the Northeastern states. In the Northeast this may be partly attributed to lower prices, where cigarettes are exempt from excise taxes. Possible reasons for large variations and trends by state provide fertile areas for research, especially marketing practices by bidi manufacturers. A decline in bidi smoking has been registered by the National Sample Survey since 1987-88 in almost all states. There is evidence from the Sentinel Survey that cigarette smoking is slowly replacing bidi smoking among youth who take up smoking, as cheaper varieties of cigarettes are now available. In addition, use of smokeless tobacco appears to be increasing among the poor, although bidi and cigarette consumption has been decreasing in the country since 1987-88.[36] This may be due in part to economic factors, such as increases in the cost of living, since unbranded smokeless tobacco (i.e., leaf tobacco), commonly used in rural areas, is cheaper than bidis and cigarettes.

In most states where there was a decline of 50% or more in monthly per capita bidi consumption (Table 2.2.6) between 1993 and 2000, at least in rural areas, a state law had been enacted banning smoking and advertisement of smoking products in places of public work, public use or public service vehicles in or before 1997 (Delhi, Goa, Jammu and Kashmir and Sikkim:), or introduced in 1999, as in Assam (enacted in 2001). There was a reduction of 41.6% in Kerala, where a Court Order was given in 1999.[37] It is possible that the tobacco control activity leading up to passage of these laws (or a Court Order), as well as the laws themselves, have had some impact on the smoking of bidis in these states, apart from various economic factors. In Jammu and Kashmir, while a simultaneous increase in cigarette consumption of around 50% may seem alarming, still only 7.5% of rural and 10.6% of urban households consume cigarettes.[29] In Himachal Pradesh, however, where a bill was enacted in 1997, there has been only a marginal decline in bidi consumption, which remains high. A newspaper commented that in Himachal Pradesh the law was being ignored in public places and government offices, even by top administrators and police personnel on duty.[38] In contrast, bidi consumption increased in Meghalaya between 1993-94 and 1999-2000, where a law was enacted in 1998, too late to create an effect in a year's time, and in rural Tamil Nadu, where a law was enacted in only 2003. Healthy declines in bidi consumption were reported for Maharashtra, where a smoking ban has existed since 1951 for government premises, as well as in Arunachal Pradesh (50%), Bihar and Orissa, where there are no state bans. Smokeless products are known to be currently more popular than smoking in these four states, which may be a factor.[22]

A highly supportive attitude towards tobacco control measures was found among the respondents of the Sentinel Survey, including the tobacco users (not given separately for bidi smokers). The percentage of tobacco-using respondents supporting a ban on smoking in public places and transport was 79.9% in Karnataka and 74.5% in Uttar Pradesh. The percentage supporting increasing prices of tobacco products was 75.8% in Karnataka and 74.5% in Uttar Pradesh. The corresponding percentages in the lowest income groups (up to Rs. 1000 per month) were 77.1%

in Karnataka and 69.0% in Uttar Pradesh. The proportions of tobacco-using respondents in the age group of 10-14 years supporting a ban on the sale of tobacco to minors were 64.7% in Karnataka and 82.3% in Uttar Pradesh. In the age group of 15-19 years, the proportions were 79.9% and 91.5%, respectively.[16]

The GSPS surveys in several states (Bihar, Orissa, Assam, Arunachal Pradesh, Nagaland, Sikkim and Tripura) have shown that the majority of school personnel, including tobacco users, agree on the harmfulness of tobacco, are concerned about youth tobacco use and support tobacco control measures, including school policies prohibiting tobacco use on the premises by school personnel and students alike, and economic policies increasing the prices of tobacco products.[18,19,20]

Clearly there is public support in India for reducing bidi smoking through policy intervention and enforcement. Further support toward such policies can be created by generating greater public awareness on tobacco issues where it is lacking and implementing population-based strategies to prevent and control tobacco use.

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2.3 Prevalence of Bidi Cigarette Use in the United States, 2000 to 2004

Sara A. Mirza and Corinne G. Huston

INTRODUCTION

Tobacco use continues to be the leading cause of preventable death in the United States (in 2000, 435,000 deaths; 18.1% of total US deaths).[1] Smoking prevalence among American youth declined from 1997-2002 following strong anti-smoking campaigns in the 1990's, with rates of falling from 36.4% in 1997 to 21.9% in 2003.[2,3] However data from multiple surveys suggest that this decline has stalled.[3,4,5] In addition, the emergence of bidi cigarettes as an alternative tobacco product among youth serves as an important reminder that continued vigilance and monitoring for emerging tobacco products is necessary.

Bidis are small, hand- rolled unfiltered imported cigarettes that consist of tobacco flakes rolled in a tendu leaf and tied with thread. Originating in Southeast Asia, flavoring agents are added to the bidis for the American market. Flavors such as strawberry, vanilla, grape and root beer appear to appeal to youth.[6] The leaf-wrapped appearance of bidis may also contribute to the perception among youth that bidis are "safer, herbal" cigarettes.[7-8]

It is thought that bidis were first imported to the United States in the 1970s; however, bidis did not emerge as a popular alternative form of tobacco among youth until the late 1990s, when studies and news reports began to point to bidi use as a new phenomenon among youth.[8,9] One of the first surveys that examined youth use of bidis in the United States was conducted in the metropolitan Boston area in 1999.[10] This report indicated that 40% of the youth surveyed had smoked bidis at least once during their lifetime and 16% were current bidi smokers. Among reasons given by these youth for their use of bidis were the better taste (23%), the cheaper cost (18%), and the perception that bidis were safer than regular cigarettes (13%).

Though there may be a perception among youth that bidis are a safer alternative to conventional cigarettes, significant health risks associated with bidi smoking have been documented in the literature. Bidis typically deliver 3-5 times as much nicotine, tar and carbon monoxide as conventional cigarettes.[11] A study of bidi smoking and health in 2000 suggested that bidi use is associated with an increased risk of developing cancers of the tongue, floor of the mouth, buccal and labia mucosa, gingiva, oropharynx, esophagus, stomach, larynx, and lung and the development of chronic conditions such as coronary heart disease, myocardial infarction and chronic bronchitis.[12,13,14]

National surveys conducted in the United States have shown that many youth (ages 11-18) and young adults (18-34) experiment with a wide range of tobacco products, including smokeless tobacco, bidis, kreteks and pipe tobacco. A report of the 2002 National Youth Tobacco Survey (NYTS) indicated a decline in youth reporting current bidi use from 4.1% in 2000 to 2.6% in 2002 among high school students (grades 9-12, ages 15-18); a similar decline was not seen among middle school students (grades 6-8, ages 11-14, 2.4% in 2002).[15] A study of bidi cigarette use among young adults in 15 states indicated nearly 16.5% reported ever bidi use.[16]

This paper will provide estimates of bidi use for youth and young adults using two surveillance systems, specifically the school based National Youth Tobacco Survey (NYTS) for 2000, 2002 and 2004 and the state-based Behavioral Risk Factor Surveillance System (BRFSS) for 2001- 2003.

METHODS

Sources of Data

Surveillance of tobacco products is done via different surveys for youth and adults in the United States. Surveillance of youth use of bidi cigarettes first began in 1999 when baseline data were obtained using the NYTS; adult surveillance began in 2001.[9] National prevalence estimates on bidi use among youth were extracted from the 2000, 2002 and 2004 NYTS, a school-based, self-reported survey of various tobacco products among students in grades 6-12 conducted by the American Legacy Foundation in 2000 and 2002 and by the Centers for Disease Control's Office on Smoking and Health in 2004. Data from the 2001-2003 Behavior Risk Factor Surveillance System (BRFSS), a state-based, random digit dialed telephone survey designed to assess various risk factors (including tobacco use) among a representative sample for each state and the District of Columbia of civilian, non-institutionalized adults 18 years of age and older, were used to provide adult estimates. The BRFSS bidi questions were asked by 15 states in 2001, 13 states in 2002 and 10 states in 2003. BRFSS data do not provide nationally representative estimates.

National Youth Tobacco Survey

The 2000, 2002 and 2004 NYTS employ a three-stage cluster sample design to give a nationally representative sample of public and private school students in grades 6-12. Specifics relevant to each year have been described previously and are repeated here for reference.[2,7] In 2000 the first stage sampling frame contained 1307 primary sampling units (PSUs) consisting of large counties or groups of smaller, adjacent counties. From this group, 148 PSUs were selected from eight strata formed on the basis of the degree of urbanization and the relative percentage of Asian, black and Hispanic students in the PSU and a probability proportional to weighted school enrollment. At the second stage of sampling 360 schools from the 148 PSUs were selected with a probability proportional to weighted school enrollment. Schools with substantial numbers of Asian, black and Hispanic students were sampled at a higher rate than other schools through the use of a weighted measure of size. The third stage of sampling consisted of randomly selecting approximately five intact classes of a required subject (e.g., English or social studies) across grades 6-12 at each participating school. All students selected were eligible to participate in the survey. In the 2000 NYTS 35,828 questionnaires were completed in 324 schools. The school response rate was 90.0% and the student response rate was 93.4%, resulting in an overall response rate of 84.1%.

The three-stage cluster sampling methodology was used in the 2002 NYTS sample and a partial panel design (including a newly drawn sample and a sampling of schools that participated in the 2000 NYTS) was also incorporated. In 2002, there were 94 PSUs in the first stage of sampling; 215 schools were selected from these for the second stage (with 83 selected randomly for the panel sample). Of the 298 eligible schools, 246 (83%) participated in the 2002 NYTS. The third stage consisted of 125 students drawn randomly from a required subject area. In the 2002 NYTS, 26,119 (90%) students completed the survey for an overall response rate of 75%.

The three-stage cluster sampling methodology was repeated for the 2004 NYTS. In 2004, there were 91 PSUs in the first stage of sampling; 273 schools were selected from these for the

second stage (16 small schools were selected randomly from 16 sampled PSUs.) Of the 288 eligible schools, 267 (93%) participated in the 2004 NYTS. The third stage consisted of 125 students drawn randomly from a required subject area. In the 2004 NYTS, 27,933 (88%) students completed the survey for an overall response rate of 82%.

Using the NYTS, bidi use among adolescents aged 11-18 years was examined by gender, race and cigarette smoking status (current and ever) for each year. In 2000, the sample size was 34,599. The youth population was further separated into 2 age groups, those 11-14 years of age (N=17,249) and those 15-18 years of age (N=17,350) in order to better examine patterns of smoking behavior.

The same methodology was used for the 2002 and 2004 NYTS. In 2002, a sample of 25,163 individuals aged 11-18 years was obtained. The 11-14 age group provided 13,032 individuals and the 15-18 age group provided 12,131 individuals. In 2004, a sample of 26,740 individuals was obtained, 14,811 were 11-14 years of age and 11,929 were 15-18 years of age.

Two measures of prevalence for bidi use are presented, ever bidi use and current bidi use. Ever bidi use was assessed by asking if the participant had 'ever tried smoking bidis, even one or two puffs?' Current bidi use was defined as having used a bidi on at least one occasion during the 30 days preceding the survey. Cigarette smoking status was determined as three mutually exclusive categories: ever, current and never users. Ever users were assessed by participants who indicated they had 'ever tried cigarette smoking, even one or two puffs'. If the participant had smoked conventional cigarettes on at least one occasion during the 30 days preceding the survey, they were considered current users. Participants who said they had 'never tried cigarette smoking, even one or two puffs' were considered never smokers.

Behavioral Risk Factor Surveillance System

The majority of the areas (50 states, District of Columbia, and 3 territories) participating in the 2001, 2002 and 2003 BRFSS use a disproportionate stratified sample (DSS) design; Puerto Rico, Guam and the Virgin Islands use a simple random sample. Specifics relevant to each year have been described in detail previously.[17,18]

The BRFSS questionnaire consists of three parts: a core questionnaire, optional modules on specific behaviors, and state-added questions. States are not required to use the optional modules and decide independently which to use each year. Questions pertaining to bidi use were added as part of the optional tobacco use module in 2001-2003 and were used by 15 states in 2001, 13 states and the Virgin Islands in 2002, and 10 states and the Virgin Islands in 2003. Only 5 states administered the optional tobacco use module in all three years: Arkansas, Nebraska, New Jersey, Texas and Wyoming. In order to increase statistical power, data were pooled from the participating states for each year to determine estimates of ever and current bidi use by selected characteristics.

The prevalence of bidi use in these two age groups was examined by gender, race and current cigarette smoking status. Bidi smoking prevalence was designated as two exclusive categories, ever or current bidi use. Ever bidi smoking included those participants who indicated they had 'ever smoked a bidi, even one or two puffs'. Current bidi users were those individuals who smoked bidis 'every day or some days'. Cigarette smoking status was categorized as three exclusive categories: current, former and never smokers. Current cigarette smokers were those who indicated they had smoked 100 cigarettes or more in their lifetime and now smoked cigarettes every day or some days. Former smokers had smoked 100 cigarettes or more in their lifetime and

currently did not smoke at all. Never smokers were those adults that responded they had not smoked 100 cigarettes or more in their lifetime.

In 2001, 63,728 adults age 18 or older completed the BRFSS in 15 states. This analysis focused on 2 age groups from the pooled sample, those 18-24 years of age (N=5,123) and those 25-39 years of age (16,615), and a total sample of 21,738 individuals.[9] The mean response rate for the 15 states in 2001 was 57.5 % with a range of 33.3%-70.8%.[19]

In 2002, 58,425 individuals age 18 or older completed the BRFSS survey among the 13 states that administered the optional tobacco module. Using the same methodology as the 2001 analysis yielded a total sample of 19,238 (N= 4387 for those 18-39 years of age and N= 14,851 for those aged 25-39 years). The mean response rate in 2002 for these 13 states and the U.S. Virgin Islands was 56.9% with a range of 42.2%-73.8%.[20] In 2003, using consistent methodology across 10 states and the U.S. Virgin Islands, 17,470 individuals were sampled; 3729 were aged 18-24 years and 13,741 were aged 25-39. The mean response rate in 2003 was 52.9% with a range of 34.4%-64.6%.[21]

Prevalence estimates and their 95% confidence intervals were obtained for each age group and year within both the NYTS and BRFSS datasets. NYTS data were weighted to be representative of the U.S. population of youth enrolled in grades 6-12, ages 11-18. BRFSS data from each state are weighted to be representative of the population of adults greater than or equal to age 18 for that state. All statistical analyses were conducted using SUDAAN software.[22] Statistical significance was assessed by examining the confidence intervals.

RESULTS

National Youth Tobacco Survey

The results of analysis of the NYTS for years 2000 through 2004 are summarized in Table 1. The number of youth who had ever tried bidis had decreased from 8.8% in 2000 to 6.4% in 2002. In 2004 only 5.6% of youth surveyed indicated they had ever tried a bidi, a non-significant change from 2002. In 2000, 3.2% of youth ages 11-18 surveyed currently smoked bidis. By 2002, this number had decreased to 2.4%, and remained unchanged in 2004 (2.5%). During all three years, older youth ages 15-18 had higher rates of ever bidi use than those 11-14 years of age. For current users, this same pattern was seen, but was only statistically significant in 2000. The older youth experienced a decline in ever bidi use from 2000 -2004 (13.3% in 2000 to 8.9% in 2002 to 7.1% in 2004). Among older youth who currently smoked bidis there was a decline from 4.2% in 2000 to 2.7% in 2002, but no significant change in 2004 (2.7%). This decline was not seen in the younger age group. Their rates of ever trying bidis (4.2%, 4.0%, and 4.2%) and currently using bidis (2.2%, 2.0%, and 2.2%) remained unchanged across the three years.

In all years, males were nearly twice as likely as females to have ever tried bidis and to be current users. Though a decrease was seen from 2000-2004 among males in ever trying bidis (11.0% to 8.3% to 6.5%), the pattern was somewhat different for female ever users (6.6% to 4.6% to 4.7%). Similarly, for male current users, there was a decrease from 2000-2002 (4.3% to 3.2%) and the prevalence remained unchanged in 2004. Females showed no statistically significant change in current bidi use from 2000 (2.1%) to 2004 (1.6%).

There was a decrease in rates of ever using bidis among white youth from 2000 (7.9%) to 2002 (5.6%), and then no change from 2002-2004. A similar pattern was seen for white current

Table 2.3.1: **Prevalence of ever and current bidi use among youth 11-18, by selected characteristics, National Youth Tobacco Survey, 2000-2004.**

	2000[a]				2002[b]				2004[c]			
	Ever bidi use		Current bidi use		Ever bidi use		Current bidi use		Ever bidi use		Current bidi use	
	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Gender												
Male	11.0	(10.2-11.8)	4.3	(3.9-4.7)	8.3	(7.3-9.2)	3.2	(2.8-3.7)	6.5	(5.8-7.2)	3.3	(2.8-3.7)
Female	6.6	(5.9-7.2)	2.1	(1.8-2.4)	4.6	(4.0-5.2)	1.5	(1.2-1.9)	4.7	(4.2-5.2)	1.6	(1.3-1.9)
Age Group												
11-14[d]	4.2	(3.8-4.7)	2.2	(1.9-2.5)	4.0	(3.4-4.5)	2.0	(1.7-2.3)	4.2	(3.7-4.7)	2.2	(1.8-2.5)
15-18[e]	13.3	(12.1-14.5)	4.2	(3.7-4.6)	8.9	(7.8-10.0)	2.7	(2.2-3.2)	7.1	(6.4-7.8)	2.7	(2.3-3.2)
Race												
White	7.9	(7.1-8.7)	2.7	(2.5-3.0)	5.6	(4.9-6.4)	2.0	(1.6-2.3)	5.3	(4.7-5.9)	2.1	(1.7-2.5)
Black	10.5	(9.1-12.0)	3.8	(3.0-4.5)	7.5	(6.3-8.7)	2.8	(2.1-3.6)	5.1	(4.2-6.0)	2.4	(1.8-3.0)
Hispanic	10.8	(9.5-12.0)	4.6	(3.8-5.3)	8.1	(7.1-9.1)	3.0	(2.5-3.6)	8.2	(7.3-9.2)	4.2	(3.7-4.8)
Asian	7.2	(5.8-8.6)	2.5	(1.6-3.4)	5.5	(3.6-7.4)	2.8	(1.6-4.0)	5.2	(3.8-6.7)	1.6	(0.8-2.4)
Other	14.7	(11.2-18.3)	6.9	(4.4-9.5)	13.6	(9.9-17.3)	7.4	(4.3-10.4)	7.1	(4.2-10.0)	3.7	(1.5-5.8)
Cigarette Smoking Status												
Current smoker	27.0	(24.7-29.2)	11.6	(10.4-12.7)	21.8	(19.4-24.2)	9.7	(8.4-11.0)	20.0	(18.2-21.4)	10.5	(9.2-11.9)
Ever smoker	8.9	(7.8-10.0)	1.6	(1.2-1.9)	7.5	(6.7-8.4)	1.2	(0.9-1.5)	7.0	(6.2-7.7)	1.4	(1.0-1.8)
Never smoker	0.8	(0.6-0.9)	0.2	(0.1-0.3)	0.6	(0.5-0.8)	0.1	(0.1-0.2)	1.0	(0.8-1.2)	0.2	(0.1-0.3)
Total	8.8	(8.1-9.5)	3.2	(2.9-3.5)	6.4	(5.8-7.0)	2.4	(2.1-2.7)	5.6	(5.1-6.1)	2.5	(2.2-2.8)

a Sample size: N= 34,599 for 2000 NYTS.
b Sample size: N= 25,163 for 2002 NYTS.
c Sample size: N= 24,609 for 2004 NYTS.
d 11-14 year olds, Sample size: n= 17,249 in 2000; n= 13,032 in 2002 and n= 14,811 in 2004.
e 15-18 year olds, Sample size: n= 17,350 in 2000; n= 12,131 in 2002 and n= 11,929 in 2004.
Source: National Youth Tobacco Survey, 2000-2004.

bidi users: a decrease from 2.7% in 2000, to 2.0% in 2002, and then no change from 2002-2004 (2.1%). Non-whites generally had higher rates of ever and current bidi use compared to white youth across the three years examined. The percentage of black youth who had ever tried bidis was halved (from 10.5% in 2000, to 5.1% in 2004). The decrease in current use (from 3.8% in 2000, to 2.4% in 2004) was borderline statistically significant. Hispanic youth's ever bidi use decreased from 10.8% in 2000 to 8.1% in 2002, and remained unchanged in 2004 (8.2%). A significant decrease from 2000 (4.6%) to 2002 (3.0%) was seen for Hispanic current bidi users. However, a significant increase occurred from 2002 to 2004 (4.2%).

Asian youth did not experience any statistically significant changes among rates of ever bidi use (7.2%, 5.5%, and 5.2%) or current bidi use (2.5%, 2.8%, and 1.6%) over the three years. Youth in the 'other' category, which encompasses American Indians, Alaska Natives and Pacific Islanders and any youth that do not identify as white, black, Hispanic or Asian, experienced a decrease in rates of ever bidi use from 2000 (14.7%) to 2004 (7.1%). No significant change was seen for current bidi use (6.9% to 7.4% to 3.7%).

Looking at bidi use by cigarette smoking status, the youth who were current smokers had markedly higher rates of ever trying bidis and of currently smoking bidis. In 2000, 27% of current

smokers had tried bidis and 11.6% were current bidi users. The percentage of current smokers trying bidis decreased in 2002 to 21.8%, but there was no significant change in the proportion of current bidi users (9.7%). In 2004, 20% of current smokers had ever tried bidis and 10.5% of the current smokers were also current bidi users, a non significant change from 2002. In 2000, among youth who were ever smokers, 8.9% had tried bidis and 1.6% currently smoked bidis. No significant decline was seen among this group in 2002 (7.5% ever smoked bidis and 1.2% currently smoked bidis) or 2004 (7.0% had ever tried bidis and 1.4% currently used bidis). Less than 1% of never smokers had ever tried or currently used bidis in all three years.

Behavioral Risk Factor Survey

The results of analysis of the BRFSS in selected states by age group, gender, race and current smoking status for 2001, 2002 and 2003 are presented in Table 2. Among adults in 15 states ages 18-39 surveyed in 2001, 9.0% reported having ever tried a bidi. This rate did not decrease significantly over the next two years (8.0% in 2002, to 8.5% in 2003). Less than 1% of young adults reported current bidi use in all three years.

Table 2.3.3: **Prevalence of ever and current bidi use among adults 18-39, by selected characteristics.**

	2001[a]				2002[b]				2003[c]			
	Ever bidi use		Current bidi use		Ever bidi use		Current bidi use		Ever bidi use		Current bidi use	
	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Gender												
Male	11.6	(10.6-12.7)	0.8	(0.5-1.0)	11	(9.7-12.3)	1.1	(0.6-1.7)	11.2	(10.0-12.4)	1.1	(0.6-1.6)
Female	6.3	(5.5-7.0)	0.4	(0.2-0.6)	4.9	(4.2-5.6)	0.3	(0.1-0.4)	5.7	(5.0-6.4)	0.3	(0.1-0.4)
Age Group												
18-24[d]	16.5	(14.8-18.2)	1.4	(0.9-1.8)	13.5	(11.7-15.2)	1.5	(0.8-2.2)	13.7	(11.9-15.5)	1.2	(0.5-1.9)
25-39[e]	5.7	(5.1-6.3)	0.2	(0.1-0.3)	5.3	(4.6-6.0)	0.3	(0.1-0.5)	6.1	(5.4-6.7)	0.5	(0.2-0.7)
Race												
White	8.5	(7.7-9.3)	0.5	(0.3-0.7)	7.7	(6.8-8.5)	0.6	(0.3-0.9)	8.3	(7.4-9.2)	0.3	(0.1-0.5)
Black	16.6	(13.8-19.3)	1.1	(0.3-2.0)	11.6	(9.1-14.1)	0.7	(0.3-1.2)	13.5	(1.7-16.2)	1.7	(0.6-2.8)
Hispanic	6.7	(5.1-8.3)	0.6	(0.2-1.1)	6.3	(4.4-8.1)	0.6	(0.1-1.1)	5.5	(4.1-7.0)	1.1	(0.1-2.0)
Asian	6.5	(3.0-10.0)	0	(0-0)	9.7	(5.6-13.8)	0.6	(-0.3-1.5)	11.7	(6.5-16.9)	0.9	(-0.6-2.3)
Other	15.3	(10.5-20.1)	0.6	(-0.3-1.5)	10.4	(4.5-16.2)	3.3	(-1.6-8.1)	17.0	(9.4-24.5)	2.4	(-1.0-5.9)
Cigarette Smoking Status												
Current smoker	18.5	(16.8-20.2)	1.6	(1.1-2.2)	17.4	(15.4-19.4)	2.3	(1.3-3.2)	18.4	(16.2-20.4)	1.7	(0.8-2.6)
Former smoker	11.9	(10-13.8)	0.1	(-0.1-0.3)	11.2	(8.6-13.7)	0	(0-0.1)	13.8	(11.6-16.0)	0.5	(1.0-1.0)
Never smoker	4.1	(3.5-4.7)	0.2	(0.1-0.3)	3.2	(2.6-3.8)	0.2	(0.1-0.3)	3.2	(2.7-3.8)	0.3	(0.1-0.6)
Total	9.0	(8.3-9.6)	0.6	(0.4-0.7)	8.0	(7.2-8.9)	0.7	(0.4-0.9)	8.5	(7.8-9.2)	0.7	(0.4-0.9)

a Unweighted N= 21,738 for 2001 BRFSS 15 states participating.
b Unweighted N=19,238 for 2002 BRFSS 13 states (and US Virgin Islands) participating.
c Unweighted N= 17,471 for 2003 BRFSS 11 states (and US Virgin Islands) participating.
d 18-24 year olds unweighted n= 5123 in 2001; n=4387 in 2002 and n= 3729 in 2003.
e 25-39 year olds unweighted n= 16,615 in 2001; n=14,851 in 2002 and n= 13,741 in 2003.
Source: Behavioral Risk Factor Surveillance System, 2001-2003.

The age groups were further stratified to examine use among young adults ages 18-24 and those 25-39 years of age. The rates of ever bidi use among those 18-24 years of age were nearly three times that of persons aged 25-39 years in 2001 (16.5% vs. 5.7%) and 2002 (13.5% vs. 5.3%) and nearly double in 2003 (13.7% vs. 6.1%). The decline from 2000 to 2002 among those aged 18-24 years was not statistically significant; rates among those 25-39 years of age were unchanged over the 3 years. Current bidi use among both age groups is low compared to youth prevalence. A little over 1% (1.4%) of young adults ages 18-24 reported current bidi use in 2001. This rate was unchanged in 2002 (1.5%) and 2003 (1.2%). Among those aged 25-39 years, less than 1% reported current bidi use all three years.

In looking at ever and current bidi use by gender for young adults overall, the pattern generally reflects what was seen among adolescents. In 2001, males (11.6%) had a higher rate of ever bidi use compared to females (6.3%). Both males and females ever bidi use was unchanged from 2001-2003. Current use among males was about 1% for all 3 years; current use among females was about 0.3% in all years.

The decline that was seen over time among youth was not seen for adults. Ever bidi use among white adults ages 18-39 did not change significantly over the three years: 8.5% (2001), 7.7% (2002) and 8.3% (2003), and about 0.5% of white adults currently used bidis in all years. Black adults and those in the 'other' category (which includes American Indians, Alaska Natives, Pacific Islanders and anyone who does not identify as white, black, Hispanic or Asian) had higher rates of ever bidi use as compared to whites. Among black adults, 16.6% had ever used a bidi in 2001. The changes seen in 2002 (11.6%) and 2003 (13.5%) were not statistically significant. Current bidi use among black adults was not statistically significantly higher than any other race and was unchanged over the three years. Similarly, among the 'other' race category, no significant change was noted over the three years in ever or current use. No significant changes were seen over the three years for Hispanic adult ever bidi use: 6.7% (2001), 6.3% (2002) and 5.5% (2003). Hispanic adult current bidi use was also unchanged over the three years.

Among Asian young adults, a non significant increase in ever bidi use occurred, from 6.5% in 2001 to 9.7% in 2002 and 11.7% in 2003. Similar to white and Hispanic adults, current bidi use was less than 1.0% each year.

When bidi use among young adults is examined by cigarette smoking status, current smokers have higher rates of ever and current bidi use for all years. In 2001, 18.5% of current smokers had ever tried bidis and this was unchanged in 2002 and 2003. About 2% of current smokers were also current bidi users. Among young adults who were former smokers, over 10% had ever tried bidis with no significant change seen over the three years (11.9% in 2001, 11.2% in 2002 and 13.8% in 2003). Less than 1% of former smokers were current bidi users in all three years. Among those young adults who never smoked cigarettes, 3.9% had ever tried bidis (averaged over the three years) and less than 0.5% currently used bidis in all three years.

The BRFSS data reflect variation by state, but the small number of states available each year makes it difficult to look at geographic patterns. The prevalence of ever and current bidi use were also examined for the five states that administered the optional tobacco use module in all three years: Arkansas, Nebraska, New Jersey, Texas and Wyoming. No statistically significant changes in prevalence of ever or current bidi use occurred in these five states over the three years (data not shown). It appears however, that states with large urban areas and metropolitan centers had higher rates of ever bidi use compared to more rural states. For example in 2001, the prevalences

were 14.4%, 12.9%, 10.2%, 11.9% and 8.6% in Arizona, Colorado, Connecticut, Virginia and Texas, respectively, and 5.7%, 4.6%, 6.2% and 5.1% in North Dakota, South Dakota, West Virginia and Kentucky, respectively.

DISCUSSION

During the early 2000s, the prevalence of ever bidi use was similar for youth and young adults, but adolescents aged 11-18 years were more likely to be current bidi users than young adults aged 18-39 years. The prevalence of ever and current bidi use declined more among youth than young adults from 2000 to 2004. Among both youth and young adults, males were more likely than females to have ever tried and to currently use bidis. With the exception of Asians, non-whites generally had higher prevalences of ever and current bidi use than whites. Both adolescent and young adult current smokers were more likely than former or never smokers to have ever tried and to currently use bidi cigarettes.

The findings presented here are similar to those of other researchers. A study by Soldz, Huyser and Dorsey, using data from the Cigar Use Reasons Evaluation (CURE) study conducted among 12 school districts in Massachusetts, also found that middle and high school males were more likely than females to use bidis over their lifetime and to be current bidi users. They also found that current smokers were more likely to have used bidis over their lifetime and to currently use bidis.[23] Hyrwna, Delnevo, Pevzner and Abatemarco analyzed the New Jersey Youth Tobacco Survey and found higher odds of current bidi use among black and Hispanic youth, and users of other tobacco products.[23]

The 1999 NYTS was the first national survey to report the prevalence of current bidi use among middle school (2.4%) and high school students (5.0%).[9] Over the three cycles of the NYTS examined in this paper, the prevalence of ever bidi use declined significantly among adolescents aged 15-18 years, but not among adolescents aged 11-14 years, thus narrowing the difference between the age groups. While a direct comparison is not possible, the age breakdowns presented here are parallel to the middle and high school categories presented in this NYTS analysis. Current bidi use also declined among older youth but not among the younger age group.

It is interesting to note that while black youth generally have lower rates of cigarette use than their white peers, this study's findings and that of other researchers show a higher prevalence of both ever and current bidi use among this group.[24,23,24]

Using data from the BRFSS from selected states for 2001-2003, young adults ages 18-24 years were found to have had a higher prevalence of ever bidi use than adults ages 24-39 years. It is possible that this age group was introduced to bidis during high school or middle school in the late nineties when bidi use among youth began to increase in the United States. However, this use was not sustained; less than 1% indicated they currently used bidis.

Various factors may have contributed to the decline in the prevalence of bidi use among youth from 2000-2004 and young adults from 2001-2003: increased legislative actions concerning sales of bidis to minors in the late 90s and early 2000s, increases in state taxes on bidis, the enforcement of labeling requirements, and the increased attention to the potential adverse health effects of bidis in the popular press, mass media campaigns and school-based smoking prevention programs. [14, 25, 26, 27] The combined effects of these efforts very likely contributed to the decline in prevalence among adolescents.

Limitations

The findings presented here for youth and adults are subject to some limitations. All bidi use and cigarette smoking status data are self-reported and subject to response bias and subsequent under or over reporting, though the NYTS questions have demonstrated good test/re-test reliability and the BRFSS has also been assessed and retested through comparison with similar national surveys. The prevalence estimates for bidi use generated from the NYTS were obtained from youth attending middle school or high school. Nationally among persons aged 16-17 years, nearly 6% are not enrolled in a high school program.[28] Finally, the BRFSS optional tobacco module was only administered by 10 to 15 states for each year of data presented here. The data are only representative for the states that administered the module each year and these states likely differ from other states, so the estimates provided herein are not national estimates of young adult bidi use.

CONCLUSION

The declines seen in bidi use for adolescents over the period examined is encouraging. It is important to continue to monitor emerging tobacco products, such as bidis, water pipes and new forms of smokeless tobacco. It is crucial to continue to include prevention messages on alternative forms of tobacco, which may be seen as "herbal", "natural", or "safer" products.

As evidenced from the data in this chapter, non-white middle school, and young adult populations are continuing to use bidis and are not experiencing declines parallel to those observed among whites. It is important to continue to monitor and identify emerging alternative tobacco products among all youth, with careful attention to males, non-whites, and cigarette smokers, and to tailor prevention and cessation messages to specific high-risk populations in addition to population-based interventions.

U.S. youth, particularly cigarette smokers, are using bidis and no declines in current use have been seen in the past few years. Disparities persist in the patterns of bidi use in specific subgroups. It will be necessary to continue to monitor bidi use in vulnerable populations and foster collaboration in the development and implementation of evidence-based policies to prevent all forms of tobacco use.

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CHAPTER 3

3.1

Chemistry and Toxicology

3.2

Laboratory Studies of Bidi Smoking in Humans

3.1 Chemistry and Toxicology

Patricia Richter and Clifford Watson

INTRODUCTION

This chapter outlines bidis' product characteristics, from curing and processing to wrapping and additives. Cytotoxicity and genotoxicity studies and *in vivo* animal studies of acute, subchronic and chronic exposures are outlined. Epidemiological and occupational studies of human exposure are also presented, as well as clinical and challenge studies that address both specific and non-specific biomarkers of exposure to bidi tobacco or bidi smoke.

PRODUCT CHARACTERISTICS

Physical Characteristics

Dimensions

Because bidis are hand-rolled, their tobacco content varies considerably in individual sticks. Typically, an individual bidi may contain roughly 0.15 to 0.5 gram of pulverized sun-cured locally grown tobacco in a tendu or temburi leaf obtained from native plants, *Diospyros melanoxylon* or *Diospyrus ebemum,* respectively. The leaf is soaked in water overnight then cut into rectangular shaped pieces. The sun-dried tobacco filler is hand-rolled using a leaf cut into a cylindrical shape and secured with a thread.[8] Multiple revolutions of leaf wrappings envelope a bidi instead of the thin single-layered paper construction used in Western-style cigarettes (Figure 3.1.1). Bidis sold in the United States are physically shorter and have a smaller radius than the standard filtered, king-size (85 mm), domestic United States cigarette.

When a bidi is compared to a Kentucky reference 1R5F cigarette, the size difference is obvious. Perhaps less obvious, the bidi contains only about only about one-fifth to two-thirds the tobacco filler used in a typical United States cigarette (1R5F). Unlike the bidi, typical United States

Figure 3.1.1: **Comparative dimensions of bidis and conventional cigarettes.**

Photo: Clifford Watson.

cigarette filler contains a blend of flue-cured, air-cured, oriental, and reconstituted tobaccos. The leaf wrapper used in the bidi's construction accounts for approximately 50% to 60% of its weight. In contrast, the mass of the paper wrapper for a Western-style cigarette manufactured in India accounts for about 5% of its overall weight.[4] Most brands of bidis typically vary in length from 50 to 80 millimeters (mm).[6-10] A few varieties are manufactured with 100-mm lengths. Most bidis sold in India are unfiltered, although filtered varieties are available and are more frequent among brands available in the United States.[7,11]

A study of tar and nicotine levels in bidi brands sold in the United States examined the amount of tobacco filler in individual bidis.[11] The total tobacco filler content in three bidis from each of 20 locally available brands was removed and individually weighed. The filler varied between containing no tobacco (~1% of the bidis examined) to 0.28 gram. On average, the filler contained 0.19 grams ± 0.04 grams (standard deviation) of tobacco filler. The amount of tobacco in an unfiltered bidi and a filtered bidi was, on average, approximately equal. Because the amount of tobacco filler in individual bidis varies considerably and the leaf wrapper contributes a significant portion to the total mass, there can be significant cigarette-to-cigarette fluctuations in the smoke deliveries and the ratio of nicotine to tar. In the measurement of smoke deliveries, collecting mainstream smoke from multiple bidis can help reduce delivery fluctuations and improve reproducibility when measuring mainstream deliveries of selected chemical constituents. Bidis deliver higher levels of tar and nicotine than Western-style filtered cigarettes when smoked using a protocol that more closely approximates how people smoke.[11] Therefore, when using a standardized machine-smoking protocol it is essential to limit the amount of total particulate matter collected to prevent breakthrough of smoke constituents on the standard 44 mm Cambridge filter pad. Typically this is done by smoking three or fewer bidis per pad rather than the standard five per pad for Western-style cigarettes.

Packaging

In India, bidis are usually sold in bundles of 25 and are unflavored.[2] Bidis imported into the United States, however, are often highly flavored variants encased in brightly colored boxes or paper wrappers. The packages sold in the United States generally contain 20 bidis, similar to packages of United States cigarettes. Flavored bidi brands from various manufacturers are commercially available with candy-like flavors, such as grape, wild cherry, strawberry, clove, vanilla, cinnamon, cardamom, dewberry, black licorice, lemon-lime, raspberry, mango, menthol, and chocolate.

Tobacco and Non-tobacco Components

Bidi Tobacco

Agriculture, Curing, Processing

Because India is the third largest producer of leaf tobacco in the world, it is also a very large consumer of tobacco products.[2] Bidi tobacco (*Nicotiana tabacum*) is mainly grown in the states of Gujarat, Mysore, and Maharashtra.[6] The tobacco used to manufacture bidis is manually shredded, pounded, winnowed, and sieved to obtain flakes of desired size distributions.[12] The flaked tobacco is mixed with crushed tobacco ribs to obtain the desired blend and combustibility.[13]

Chemical Composition

Tobacco filler used in bidis, as in all tobacco products, is chemically complex containing hundreds of vastly different chemical species. Many of these compounds are sublimed directly into the smoke, undergo decomposition, or are involved in various pyro-synthetic reactions to form new chemical constituents as the tobacco is smoked. A variety of chemical species provide the characteristic taste, aroma, and flavor to the tobacco smoke. Many chemicals in tobacco smoke are known to have toxic properties, as discussed below, and some (e.g., nicotine) may result in addiction. As with Western-style cigarettes, the tobacco filler and mainstream smoke from bidis contain many potentially harmful chemical constituents, including carcinogenic chemicals such as the tobacco-specific nitrosamines (TSNAs), polyaromatic hydrocarbons (PAHs), aromatic amines, phenols, and metals.[14-16] In addition to harmful chemical constituents that are native to tobacco, the presence of others may originate as a consequence of the various additives used to make flavored varieties. The flavor additives greatly increase the chemical complexity of both the tobacco and smoke for analysis.

Wrapper

The plant species used for the leaf wrapper (*Diospyros malanoxylon, Diospyros ebenaster, Diospyros ebenum*, and *Diospyros isamlii*) contain naphthoquinones and coumarins, but not nicotine.[17] The leaf wrapper, unlike the thin single-layer paper wrapper used in Western-style cigarettes, contributes significantly to the total mass of a bidi and adds substantially to the amount of total particulate matter generated during smoking. In an experiment in which the bidi leaf wrapper was replaced by cigarette paper, the tar delivery was reduced by 66%.[1] The physical properties of the bidi construction also contribute to a higher mainstream delivery of tar than that of Western-style cigarettes. The lower porosity of the leaf wrapper and lack of filter ventilation holes, in contrast to the more porous paper wrapper and filter assembly used in Western-style cigarettes, allow less opportunity for air dilution of the mainstream smoke or for volatile species such as CO to diffuse outward through the wrapper.[6]

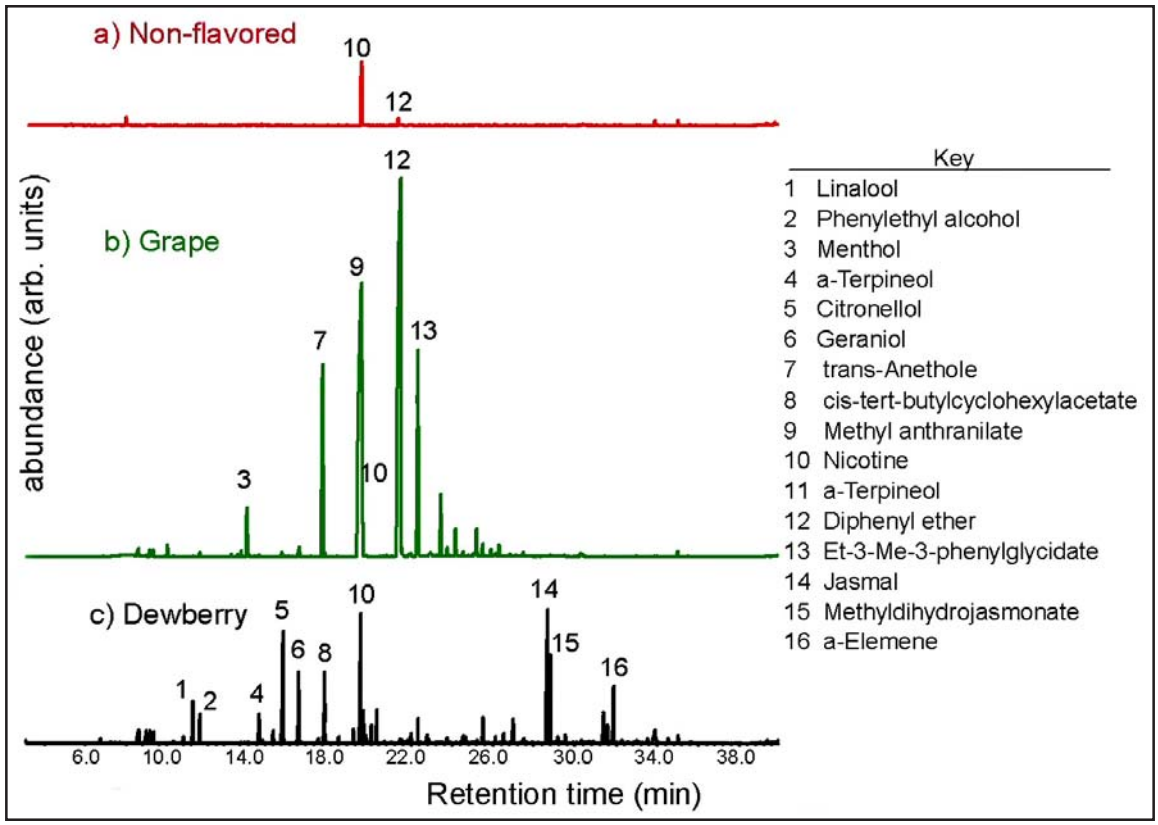
In addition to contributing heavily to the overall tar delivery, the leaf wrapper may generate harmful compounds not normally associated with Western-style cigarette smoke. *Diospyros ebenum* and several other ebony species, which might be substituted as a wrapper material, contain naphthoquinone compounds, including an irritant called plumbagin.[18] Dermal exposure to leaves and bark from several trees in the ebony family has been linked to respiratory tract irritation and contact dermatitis. Exposure to plumbagin or other noxious chemicals associated with the leaf wrapper used in bidis may present additional health concerns not associated with Western-style cigarettes. At present, little is known about these components or other potentially harmful leaf chemical constituents and whether they pose any additional health consequences.

The combination of reduced tobacco filler and the relatively large amount of the leaf wrapper present in bidis is an important consideration in the analysis of the highly flavored varieties sold in the United States. The leaf wrapper provides a large surface area for deposition of natural tobacco constituents and added flavor ingredients. In a study of flavored bidi brands purchased in the United States, Stanfill et al. found that approximately 40% of selected flavor agents were in with the wrapper, with the remainder being in the filler.[19] Therefore, an analysis of the flavor additives in the tobacco filler alone would underestimate their total concentrations. The partitioning of flavor additives between the tobacco filler and the leaf wrapper necessitates analyzing both for an accurate measurement of selected additives used in bidis.

Varieties/Additives

The various flavoring agents added to bidis sold in the United States are presumably intended to increase consumer acceptability. Certain flavoring additives may be included to mask the harshness of the bidi smoke, thus allowing for deeper inhalation.[7,19] Specific flavor additives, especially those containing essential oils, contain many different chemical constituents. Although complex chemical mixtures used as flavor additives provide unique chemical signatures for qualitative identification, their complexity can make the quantitative analysis of individual chemical constituents more difficult. As an example, an analysis of the chemicals present in the air above bidi tobacco filler (the headspace) using solid-phase micro-extraction (SPME) (Stanfill et al., unpublished results) from unflavored, grape, and dewberry bidi brands showed significant chemical differences. The largest peak in the total ion chromatogram from the non-flavored bidi tobacco filler is nicotine (Figure 3.1.2a). In the grape (Figure 3.1.2b) and dewberry varieties (Figure 3.1.2c), nicotine is no longer the largest peak. The additional peaks in the total ion chromatograms (traces b and c) correspond to chemicals from the respective flavor additives, and their presence greatly increases the chemical complexity. It should be noted that in the total ion chromatogram for the grape-flavored bidi, the nicotine peak overlaps with the methyl anthranilate peak (Figure 3.1.2b). However, examination of the reconstructed ion chromatogram shows that each of these compounds has unique mass spectral fragments with differing mass-to-charge ratios. Unfortunately, little is known about the health consequences of inhaling many of the chemical additives used in these products to provide specific aromas or flavors.

Figure 3.1.2: **Headspace GC/MS analysis of select bidi cigarettes.**



Chemicals Identified in Tobacco and Smoke

Bidi Tobacco Filler

Nicotine

Bidis contain about one-fifth to two-thirds the amount of tobacco present in a Western-style cigarette.[1,7,11] Pakhale and Maru analyzed the levels of nicotine and other minor alkaloids in various Indian tobacco products.[20,21] They reported that the sun-cured tobacco used in bidis contained 37.70 milligrams of nicotine per gram of tobacco, whereas Western-style filtered cigarettes contained 16.54 mg/g. A report from Malson et al. on bidis sold in the United States found the average nicotine content in the tobacco filler from eight flavored and four unflavored varieties was 4.7 mg per bidi (range: 3.3 to 12.4 mg per bidi) or 21.1 mg nicotine per gram of bidi tobacco (range: 15.5 to 27.1 mg/g).[7] There is an average of 12.0 mg of nicotine per unfiltered Western-style or Indian-made Western-style cigarette or 13.5 mg of nicotine per gram of tobacco filler. Statistically, on a per gram basis the tobacco filler in bidis has a significantly higher level of nicotine than the tobacco used in Western-style filtered and unfiltered cigarettes. In addition to nicotine, bidi tobacco filler contains other potentially harmful compounds.

Tobacco-specific Nitrosamines

As with Western-style cigarettes, tobacco filler from bidis contains many chemical constituents, including carcinogenic chemicals such as the tobacco-specific nitrosamines (TSNAs). Nair et al. used gas chromatography with thermal energy analyzer (TEA) detection to examine various Indian tobacco products for 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK), N′-nitrosonornicotine (NNN), and N′-nitrosoanatabine (NAT).[14] The highest TSNA levels were measured in snuff and chutta tobacco. Chutta is a handmade cigar composed of loosely packed locally grown *Nicotiana tabacum* tobacco wrapped in a tobacco leaf weighing 1 to 7.5 grams.[22] The TSNA levels in bidi tobacco were similar to those of Western-style cigarettes and smokeless tobacco, ranging from 1 to 10 microgram/gram (µg/g). Limitations of that study were that the chromatographic peaks were not well resolved and that a very limited number of bidi samples (n = 1 to 4) were analyzed for each type of tobacco product.[14]

To help better assess the potential public health risk associated with the increased popularity of flavored bidis in the United States, Wu et al. reported a high-throughput high-resolution gas chromatography mass spectrometry method to accurately quantify TSNA levels in tobacco filler and a liquid chromatography tandem-mass spectrometry technique to quantify TSNAs in mainstream bidi smoke particulate.[23] The levels of TSNAs in the tobacco filler and mainstream smoke from 14 bidi brands were analyzed. In the bidi tobacco filler, the NNK levels ranged from 0.09 to 0.85 µg/g, and NNN levels ranged from 0.15 to 1.44 µg/g. These amounts are similar to those in typical American blended cigarettes.[24] The wide variation in the TSNA levels most likely reflects the hand-rolling of the bidis, a process resulting in less homogenous products and a wider variation in overall quality of the bidi construction.

Metals

Tobacco, like many agricultural products, may contain small amounts of potentially harmful inorganic or elemental species. Lal et al. have examined the uranium content of various Indian

tobacco products.[25] The tobacco filler from five samples of bidis contained radioactive uranium content ranging in concentrations from 0.13 to 0.23 parts per million (ppm). The uranium concentrations in the bidis were, on average, higher than those in Western-style cigarettes (0.037 to 0.12 ppm), but much lower than those in snuff (7.4 to 19.1 ppm). The uranium content of chutta (0.16 to 0.37 ppm) overlapped the range detected in the bidi tobacco. No information is available on the uranium content or other metals in the highly flavored bidi brands sold in the United States.

Volatile Organic Compounds (VOCs)

Quantitative analyses of 42 volatile organic compounds (VOCs) were conducted on samples of tobacco removed from 19 brands of flavored Darshan, Shivsagar, and Shiv bidis and from one unflavored variety of Mangalore Ganesh bidis. Selected alcohols, aldehydes, arenes, esters, and ketones in the headspace above tobacco removed from bidis were sampled using a SPME device and subsequently detected using gas chromatography/mass spectrometry (GC/MS).[26] The following compounds were analyzed: 1,2,3-trimethylbenzene, 2,3-butanedione, 2-butanone, 2-ethyl hexanal, 2-ethyl hexanol, 2-furanaldehyde, 2-methylbutanal, 2-methylpropanal, 3-ethyl toluene, 3-methyl butanal, 3-methyl-2-butanone, 6-methyl-5-hepten-2-one, acetaldehyde, acetone, acetophenone, benzaldehyde, benzene, benzyl alcohol, butanal, butanol, butyl acetate, butyl benzene, ethanol, ethyl acetate, ethyl benzene, hexanal, hexanol, isobutyl alcohol, isopropanol, isopropyl acetate, methyl acetate, methyl propionate, o-xylene, p-xylene, m-xylene, pentanal, propanal, propanol, propyl acetate, propyl benzene, styrene, and toluene. The quantities of these specific VOCs ranged on a per bidi basis from the low nanogram to the microgram range.

Several aldehydes, including 2-ethyl hexanal, 2-methyl propanal, and propanal (each detected in all brands), as well as 2-furanal and benzaldehyde (both detected at high levels in several brands), were present in the bidi tobacco. The presence of nearly uniform levels of certain aldehydes could result from their native presence in tobacco, and this may be true for 2-ethyl hexanal, 2-methyl propanal, and propanal. However, several brands had unusually high levels of 2-furanal and benzaldehyde relative to other brands in which the corresponding levels were much lower or below the quantitation limit. A reasonable explanation is that 2-furanal and benzaldehyde are added during the manufacturing process for selected brands. The three samples with the highest benzaldehyde levels (214.0, 272.7, and 100.9 ng) were manufactured by Darshan. Except for the dewberry-flavored brand (74.7 ng), the average level of benzaldehyde (28.8 ng) in the Shiv and Shivsaga brands was relatively low. Aldehydes are often used as flavor additives in the food industry, with 2-furanal and benzaldehyde imparting pungent, warm, and nutty flavor notes.[27]

The levels of ethanol measured in the tobacco from 19 of the 20 bidi brands were below the quantitation limit. Only one brand, Shivsaga's strawberry flavor, had a measurable amount of ethanol (~600 nanograms (ng) ethanol/bidi). This result was unexpected because a common practice among manufacturers of domestic United States cigarettes is to use alcohols, such as ethanol, as a solvent system for adding a variety of flavor compounds. At least two explanations are possible: 1) the bidis' relatively flimsy packaging material may allow evaporation of the more volatile components, and 2) different solvents from those used in the manufacture of domestic United States cigarettes are used to apply additives during the production of bidis. Low to moderate levels of other alcohols, such as propanol (average = 22 ng), isopropanol (25 ng),

butanol (17 ng), isobutanol (17 ng), and 2-ethanol hexanol (131 ng), were detected in many brands. Benzyl alcohol had the highest levels measured among the alcohols examined. In four of the 20 brands (strawberry, clove, dewberry, and lemon-lime) the benzyl alcohol level exceeded 12.9 µg (the highest calibration point). In an additional six other brands, the benzyl alcohol levels exceeded 700 ng. The remaining 10 brands had levels at or below the limit of quantitation (LOQ) (65 ng). The presence of benzyl alcohol may result from its use as a solvent in selected brands, but it is more likely related to its organoleptic characteristics, which impart a fruity or sweet flavor.[27]

Quantitative analysis of bidi tobacco filler was conducted for 1, 2, 3 trimethyl benzene (avg = 0.8 ng), 3-ethyl toluene (0.2 ng), butyl benzene (1.3 ng), ethyl benzene (2.8 ng), o-xylene (15.3 ng), m/p-xylenes (5.4), styrene (1.8 ng), and toluene (1.6 ng). In these analyses, m-xylene and p-xylene co-eluted during the chromatography so their measured values were reported as the sum of the contribution for these two analytes. The measured levels for all arenes were generally in the low nanogram range with no consistent patterns observed in terms of flavor, brand, or manufacturer.

The measured amounts of ethyl, propyl, and isopropyl acetate were generally lower than those typically measured in domestic United States cigarettes.[26] Ethyl acetate was below the quantitation limit for all of the 20 brands. Unlike ethyl and propyl acetate, isopropyl acetate was detected in all 20 brands at relatively low, but consistently measurable levels (average = 141 ng). Relatively high amounts of methyl propionate were detected in all brands, and seven out of 20 had levels exceeding the highest calibration point (412.5 ng). The flavor industry uses methyl propionate as an additive to impart a fruity or sweet aroma.[27] Methyl acetate levels were consistently detected in all brands with an average value of 31.7 and a standard deviation of 4.9 ng for the 20 brands. The relatively small standard deviation calculated from the averaged value for all 20 brands suggests that methyl acetate is uniformly present in bidis and most likely is a native component of the sun-dried tobacco used in their manufacture.[20]

Of the six ketones measured, four were consistently detected in multiple brands. Both 2-butanone and acetophenone were measured at or below the quantitation limit in all brands. Moderate quantities of acetone and 2, 3-butanedione were detected in all brands, with an average level of 81.5 ng and 36.0 ng, respectively. Lower levels of the remaining two ketones, 3-methyl-2-butanone (detected in 16 of 20 brands, average = 1.4 ng) and 6-methyl-5-hepten-2-one (detected in all brands, average = 2.0 ng) were detected in most brands.

Quantitative analysis and comparative examination of specific VOC analyte levels in the various highly flavored bidis help to determine if brand-or manufacturer-dependent differences exist, or if certain chemicals are endogenous to bidi tobacco or if they are added during the manufacturing process. Of course, the highly variable concentrations observed for certain highly volatile analytes in the different brands may be partially attributed to evaporative loss from a particular product or brand. Therefore, the levels of the volatile analytes detected in these 20 brands of bidis should not be viewed as definitive, but rather seen as reflecting an estimate of the concentration ranges present in various brands. Unfortunately, little is known about the potential health consequences of these tobacco filler constituents.

Smoke

Conditions for Machine Smoking of Bidis

Historically, standard smoking machine parameters for Western-style cigarettes have been defined by either the United States Federal Trade Commission (FTC) method or the International Organization for Standardization (ISO).[28-31] In either case, the smoking regimes are similar. Both require a fixed puff size of 35 mL, a puff duration of two seconds, and a puffing rate of once per minute. Western-style cigarettes are smoked to a butt length of 23 mm or the length of the filter overwrap plus 3 mm, whichever is longer. Filter ventilation holes, if present, are not blocked or obscured. These basic protocols were developed for measuring tar and nicotine levels in relatively high delivery cigarettes. Although these protocols may not accurately reflect the current smoking behavior associated with lower delivery filtered Western-style cigarettes popular today, they continue to be used and do provide a relative basis for comparing smoke deliveries from different brands of Western-style cigarettes.

Because of the low porosity of the leaf wrapper, these smoking protocols are not directly applicable for measuring smoke deliveries from bidis. At a puff rate of one per minute, bidis tend to self extinguish. Consequently, researchers have modified smoking machine conditions by increasing the puff frequency to two or more puffs per minute.[1,6,11,20] Observation of bidi and Western-style cigarette smokers indicated that bidi smokers took almost five puffs per minute, whereas cigarette smokers took two puffs per minute. Another difference in smoking behavior was the amount of product consumed. Bidi smokers left 30 mm of unsmoked product while smokers of Indian-made Western-style cigarettes left a 23-to 24-mm butt length. Puff duration was similar for the two products (1.80 ± 0.02 s for bidi smokers and 1.82 ± 0.03 s for cigarette smokers).[1,32] On an automated smoking machine, approximately 14 puffs are required to smoke a regular length bidi (59 – 62 mm), and 21 puffs are required to smoke a long bidi (75 – 80 mm).[32]

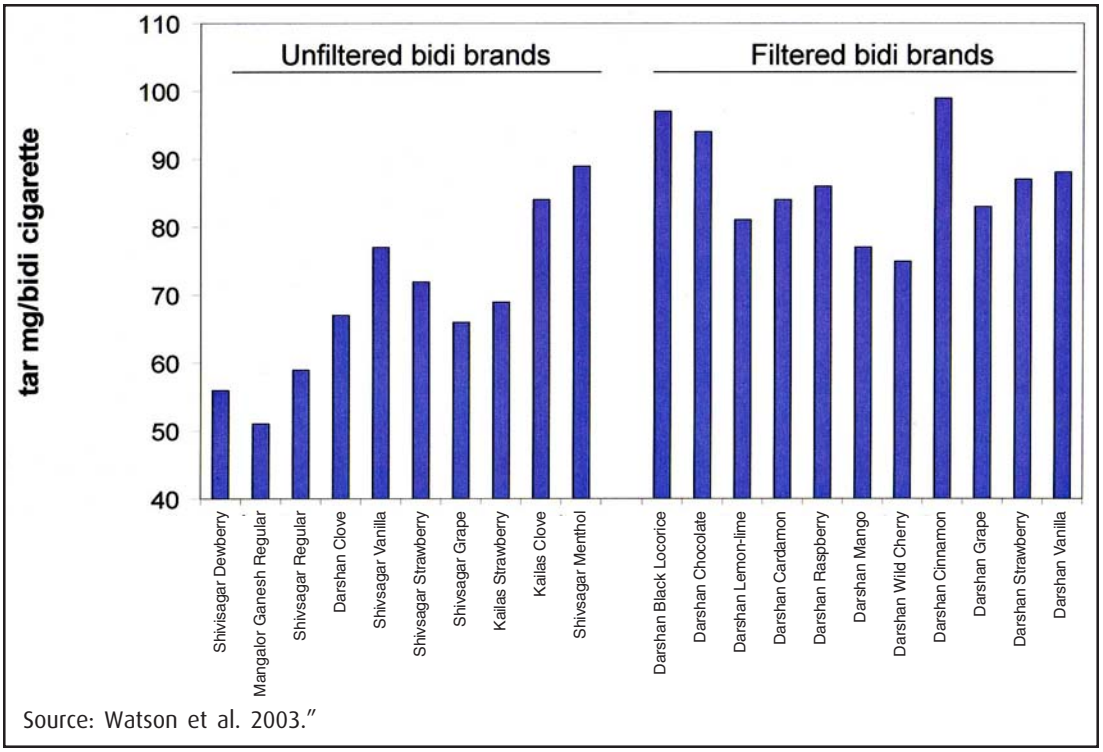
The low porosity of the leaf wrapper results in a higher draw resistance and a higher number of puffs for a bidi than for a Western-style cigarette. For example, the machine-measured draw resistance of a 76 mm unfiltered bidi was found to be 10.4 cm, versus 7.8 cm for an 85 mm unfiltered United States cigarette. Twenty-three puffs were needed to reach a 23 mm butt length, whereas approximately sixteen puffs are needed to produce an equivalent butt length for an unfiltered United States cigarette.[6] Indian researchers have observed that a bidi is smoked more rapidly than a traditional style cigarette and the smoke is thought not to be inhaled deeply into the lungs.[9] Others, however, have noted that low combustibility forces a bidi smoker to inhale more deeply.[7] This is a critical discrepancy because depth of inhalation is an important factor that affects the delivery of harmful chemicals from tobacco smoke. The presence or absence of flavor additives may further influence the depth of inhalation if they mask the harshness of the bidi smoke and allow for deeper inhalation while smoking.[7]

Unflavored Indian Bidi Tar and Nicotine Deliveries

Bidi cigarettes, when machine smoked, had tar deliveries ranging from approximately 23 mg to 45 mg, despite the low quantity of tobacco in them. The tar level for regular length bidis, 60 mm in length, ranged from 23 to 30 mg (dry weight) per bidi. The tar level of long bidis, 80 mm in length, was higher, averaging about 39 mg (dry weight).[1] In an earlier publication, bidis 76 mm in length had an average tar level of 44.9 mg (dry weight).[6] Nicotine delivery of long bidis was

also higher (average 2.61 mg per bidi) than that of regular-length bidis (1.91 mg per bidi). Pakhale and Maru measured the levels of nicotine and selected minor alkaloids in both mainstream (MS) and sidestream (SS) bidi smoke.[20] They found that the MS/SS ratio for bidis was ~8 compared with filtered Western-style cigarettes where the MS/SS ratio was on the order of 1. The dramatic 8:1 variation between the MS/SS ratios of bidis and Western-style cigarettes is most likely a result of their different physical construction. Compared with cigarette paper, the plant material wrapper of a bidi has a low porosity that results in a high draw resistance, a tendency to smolder, and reduced evaporation of volatile components in the sidestream smoke between puffs. The lower porosity of the bidi wrapper also limits air (oxygen) from being drawn through the wrapper, thus contributing to incomplete combustion and resulting in increased yields of tar and carbon monoxide.[6,33]

Figure 3.1.3: **Cytogenetic effects in bidi smokers or bidi workers.**



Source: Watson et al. 2003."

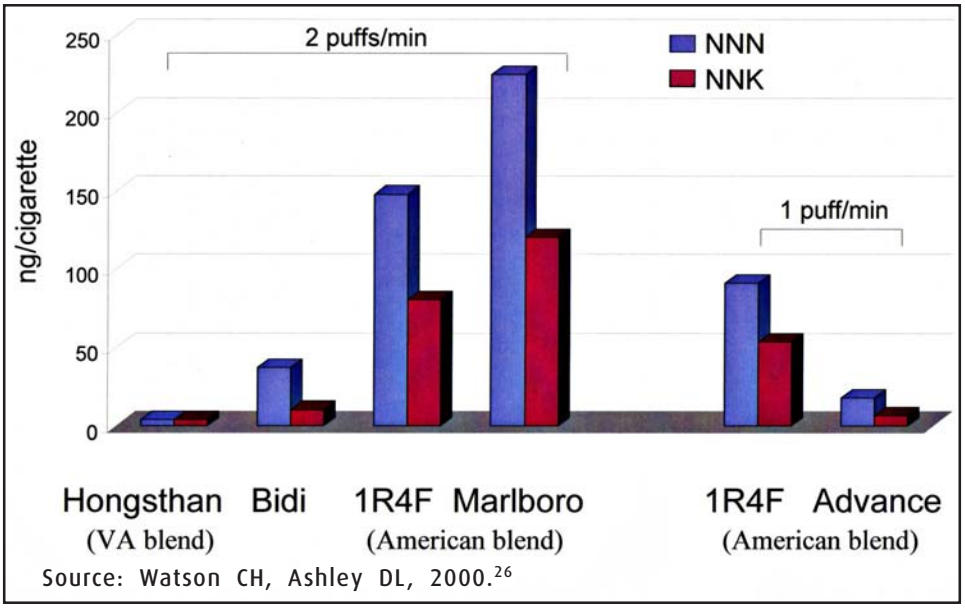
Flavored Bidi Tar and Nicotine Deliveries

Information on the tar, nicotine, and CO smoke yields of 21 brands of flavored bidis was obtained by Watson et al. using a standardized smoking protocol with a puff frequency of four puffs per minute.[11] The tar, nicotine, and CO smoke yields for the 21 brands of bidis ranged from 50.9 mg of tar to 99.3 mg of tar per bidi (Figure 3.1.3), from 1.5 mg nicotine to 4.1 mg nicotine per bidi, and from 24.5 mg CO to 51.6 mg CO per bidi. These values are slightly higher than those obtained previously for the bidi mainstream smoke deliveries discussed above. In the study by Watson et al., 21 flavored brands of bidis were analyzed, including 10 unfiltered and 11 filtered varieties.[11] Unlike Western-style cigarettes, in which incorporation of a cellulose acetate filter reduces tar and nicotine levels, the filtered bidi varieties did not show lower tar and nicotine deliveries than unfiltered bidi brands. In marked contrast to Western-style cigarettes, the filtered

bidi brands generally produced higher tar levels (86.5 ± 4.6 mg/cig) than their unfiltered counterparts (68.9 ± 5.5 mg/cig). This discrepancy presumably reflects the longer average length of a filtered bidi (74.6 mm) compared to the average length of the unfiltered bidis (70.7 mm) smoked in that study. When the two types of bidis are smoked to a fixed butt length (23 mm), the difference in length between the two represents a relative increase of 8% in bidi rod length consumed for the filtered varieties. The flavored bidi mainstream smoke deliveries for nicotine (filtered: 2.8 ± 0.2 mg/cigarette; unfiltered: 2.6 ± 0.2 mg/cigarette) and CO (filtered: 42.0 ± 5.6 mg/cigarette; unfiltered: 36.2 ± 5.6 mg/cig) were not statistically different between the filtered and unfiltered bidi varieties.

Because a 15 second puff interval was used in this study, direct comparisons to previous data are difficult. These results are, however, in relatively good agreement when the smoke deliveries are compared on a per-puff basis. Average coefficients of variation for the tar, nicotine, and CO measurements on the flavored bidi brands were 9.99%, 14.85%, and 15.02%, respectively. Several factors may affect the reproducibility of such measurements, including the amount of tobacco in individual bidis, the tobacco curing and preparation, non-uniform construction of the bidi, and the thickness of the bidi wrapper. Therefore, it is expected that relatively large variations in smoke deliveries may be partially attributed to the non-uniform bidi construction and variations in the amount of tobacco filler in individual bidis. The composition of the mainstream smoke deliveries should be expected to differ somewhat because of the inherent variability associated with the nature of the bidi's hand-rolled construction.

Figure 3.1.4: Levels of NNN and NNK in mainstream cigarette smoke.



Source: Watson CH, Ashley DL, 2000.[26]

Flavored Bidi TSNA Deliveries

To help better assess the potential public health risk associated with flavored bidis sold in the United States, Wu et al. developed a modern high-throughput method to accurately quantify TSNA levels in tobacco and mainstream smoke particulate.[23] They determined the TSNA levels in mainstream smoke from 14 bidi brands. The levels of NNK in mainstream smoke from bidis ranged

from 2.13 to 25.9 ng/bidi, and NNN levels ranged from 8.6 to 112 ng/bidi. No statistically significant difference was observed for mainstream smoke levels of NNK (p=0.23) and NNN (p=0.24) among the different bidi manufacturers. The average concentration of NNK in the mainstream bidi smoke from all 14 brands was 10.5 ng per bidi. The average mainstream smoke NNN level was 37.5 ng per bidi. The highest level of carcinogenic TSNAs (NNK + NNN) was in mainstream smoke from the Shiv Sagar unflavored brand, which contained an average level of 22.0 ng NNK per bidi and 90.7 ng NNN per bidi. A comparison of the NNN and NNK levels in mainstream smoke from bidis and Western-style cigarettes smoked at two puffs per minute indicated that the average TSNA levels in bidis were lower than filtered American-blend cigarettes but higher than flue-cured, Virginia-style (VA style) cigarettes (Figure 3.1.4).

Other Smoke Constituent Deliveries

The smoke from bidis contains numerous toxic chemicals.[6] The gas-phase portion of mainstream smoke from a 76 mm unfiltered bidi smoked by machine at a rate of two puffs per minute contained ammonia (284 µg), hydrogen cyanide (903 µg), isoprene (533 µg), acetaldehyde (751 µg), and acrolein (67 µg). In the particulate phase, considerable quantities of phenol (249 µg), o-cresol (55.3 µg), m-and p-cresol (139 µg), 2,4-dimethylphenol (27.6 µg), p-ethylphenol (41.6 µg), and polyaromatic hydrocarbon compounds (benz[*a*]anthracene 117 ng and benzo[*a*]pyrene 78 ng) were measured.

As with tar and nicotine, the levels of other chemicals in smoke also vary by bidi size (Table 3.1.1).

Table 3.1.1: **Mainstream concentrations of selected constituents from bidis.**

Bidi length (mm)	Hydrogen cyanide (µg)	Phenol (µg)	Benzo[a]pyrene (ng)
60	688	129	108
76	903	249	78
80	904	273	144

Sources: Hoffmann et al. 1974;[6] Jayant and Pakhale, 1989.[1]

Product Modification

Different ways to reduce smoke levels of tar and nicotine in bidi smoke have been investigated.[1] Bidi tobacco wrapped in cigarette paper produced smoke with 66% less tar and 55% less nicotine than that produced by a bidi constructed with a tendu leaf wrapper. The mean number of machine-measured puffs increased from 11.3 to 14.0 when cigarette paper wrapper was used. Replacing the flaked, sun-dried bidi tobacco with processed cigarette tobacco reduced tar and nicotine by 19% and 63%, respectively. Incorporating a 5 mm cotton plug (10 mg or 20 mg weight) reduced tar by 48% to 68% and nicotine by 42% to 65% under machine-smoking conditions. Perforations in the butt end of two brands of bidis reduced tar by an average of 52% and nicotine by an average of 57%. Incorporation of the filter material or perforations near the butt end of the bidi increased the number of puffs required to reach a butt length of 30 mm. Study participants found the taste of the smoke from the cotton plug filtered bidis to be acceptable, to be milder in terms of sensory attributes, and, for some participants, to cause less throat irritation. However, the authors caution that smokers might inhale more deeply or smoke more bidis to obtain their desired level of nicotine.[1,34-35]

Table 3.1.2: **Levels of selected smoke constituents in different tobacco products.**

Product	Phenol (µg/product)	Hydrogen Cyanide (µg/product)	Benzo[a]pyrene (ng/product)
70 mm filtered Indian-made Western-style cigarette*	134	523	85
70 mm unfiltered Indian-made Western-style cigarette*	191	499	114
85 mm king size filter Indian-made Western-style cigarette*	185	467	98
85 mm filtered United States cigarette*	86.4	240	25.1
85 mm unfiltered United States cigarette**	148	445	46.7
60 mm bidi**	129	688	108
80 mm bidi**	273	904	144
76 mm bidi**	249	903	78
80 mm filtered bidi manufactured for export**	170	763	Not determined
70 mm herbal filtered bidi**	179	692	1315
80 mm cheroot**	400	588	2519
125 mm cigarillo**	333	1119	Not determined

* Puff frequency of one puff per minute ** Puff frequency of two puffs per minute
Source: Hoffmann et al., 1974[6]; Pakhale et al., 1990[15].

Comparison with Other Smoked Tobacco Products

Western-style Cigarettes

Tar and Nicotine

Under modified smoking machine conditions (i.e., two puffs per minute), the average bidi dry total particulate matter (TPM) levels of 60-mm long bidis are slightly less than the average TPM levels for unfiltered and filtered 70-mm Indian-made Western-style cigarettes. Average TPM levels of long bidis (80 mm) are similar to those of 85-mm filter king Indian-made Western-style cigarettes. The average smoke nicotine levels of bidis are 1.1 times higher than the average smoke nicotine levels of unfiltered and filtered 70-mm Indian-made Western-style cigarettes. Long bidis yield about 1.2 times more smoke nicotine than do unfiltered and filtered 70-mm Indian-made Western-style cigarettes.[1]

Evidence of higher mainstream smoke deliveries of bidis over Western-style cigarettes was found when a comparison of the distribution of dry TPM and nicotine levels in mainstream (MS) and in sidestream (SS) smoke revealed that unfiltered bidis had a higher MS/SS ratio of dry TPM and nicotine than did United States or Indian-made Western-style flue-cured tobacco cigarettes.[3] All products were smoked at a rate of two puffs per minute. In two brands of unfiltered bidis, the range of total nicotine in mainstream smoke was 1.37 to 1.44 mg per bidi. Total nicotine in sidestream smoke ranged from 0.32 to 0.40 mg per bidi. Nicotine was not detectable in the gas phase of bidi mainstream smoke. In the gas phase of sidestream smoke, nicotine was present at 0.15 to 0.22 mg per bidi. Mainstream bidi smoke TPM ranged from 21.61 to 21.67 mg per bidi. Sidestream bidi smoke TPM ranged from 6.07 to 6.89 mg per bidi. The average MS/SS ratios for TPM and nicotine were 3.36 and 3.94, respectively. In comparison, an unfiltered Indian-made Western-style cigarette had an MS/SS ratio for TPM of 2.09 and for nicotine of 1.70. An imported filtered United States cigarette had an MS/SS ratio for TPM of 1.41 and for nicotine of 0.96. The

average MS/SS TPM ratio for two filtered full flavor brands of Indian-made Western-style cigarettes was 1.78. The average MS/SS nicotine ratio for filtered full flavor Indian-made Western-style cigarettes (1.65) was less than half that of bidis. When calculated on the basis of tobacco weight (excluding wrapper), TPM and nicotine deliveries in bidi mainstream smoke are higher than levels in the mainstream smoke of unfiltered Indian-made Western-style cigarettes.

Other Smoke Constituents

Comparisons of other chemicals in smoke revealed similar patterns in the levels of selected chemical constituents. The levels of hydrogen cyanide, phenol, and benzo[*a*]pyrene in the smoke of long length bidis exceeded the range of values determined for United States cigarettes and Indian-made Western-style cigarettes (Table 3.1.2).[1,6,15] When smoked by machine with two puffs per minute, levels of carbon monoxide, ammonia, hydrogen cyanide, phenol, *o*-cresol, *m*-and *p*-cresol, 2,4-dimethylphenol, and benzo[*a*]pyrene were at least 1.6 times higher in the smoke of an unfiltered bidi (76 mm) when compared to the smoke of an unfiltered United States cigarette (85 mm). Isoprene, acetaldehyde, and acrolein levels were higher (1.5 to 1.9 times) in the smoke of the United States-made cigarette than in the bidi.[6] Carcinogenic tobacco-specific nitrosamines found in bidi smoke were in concentrations similar to those of commercial Western-style cigarettes. Bidis also deliver considerable amounts of carbon monoxide. Compared to the smoke of an unfiltered United States cigarette, bidi smoke contains significantly higher levels of carbon monoxide, ammonia, hydrogen cyanide, phenol, volatile phenols, benz[*a*]anthracene, and benzo[*a*]pyrene.[6]

Cigars, Cheroots, and Cigarillos

Tar and Nicotine

Nicotine and total particulate matter (TPM) levels were compared in the smoke of several Indian smoked tobacco products.[22] The smoke of an unfiltered Indian-made Western-style cigarette (1041 mg mean weight, 70-mm length) contained 1.2 mg nicotine and 21.9 mg dry TPM. Despite their smaller size, bidis (336 mg mean weight, 59-to 60-mm length) delivered 1.9 mg of nicotine in smoke and 26.0 mg of dry TPM (smoking conditions unknown). Small chutta cigars (1291 mg mean weight, 73-mm length) and large chutta cigars (2843 mg mean weight, 98-mm length) produced the highest levels of TPM and nicotine, 4.6 mg of nicotine and 60.6 mg of dry TPM, and 8.1 mg of nicotine and 115.1 mg of dry TPM, respectively. Chuttas were smoked with a puff duration of two seconds, a puff frequency of one minute, a puff volume of 35 mL and a butt length of 23 mm. Of these unfiltered tobacco products, bidis delivered the highest amounts of nicotine and dry TPM on the basis of total product weight. Both bidis and chuttas had an approximately 13:1 tar-to-nicotine ratio, whereas Indian-made Western-style cigarettes had a tar-to-nicotine ratio of 21:1.

Other Smoke Constituents

Levels of phenol, hydrogen cyanide, and benzo[*a*]pyrene were determined in the mainstream smoke of bidis, cheroots, and cigarillos (Table 3.1.2). Cheroots, also known as chutta, are a handmade tobacco product consisting of sun-cured, folded, dried tobacco leaf wrapped in a single tobacco leaf. Cigarillos contain uncut sun-cured tobacco leaf filler that is wrapped in a tobacco leaf and covered by a higher quality thin tobacco leaf. Cigarillos have a tapered plastic mouthpiece.[6,15]

TOXICOLOGY

Tobacco smoke is harmful to smokers and to those exposed to tobacco smoke. The chemicals found in bidi smoke are known for their toxicity:

- Nicotine, the principal pharmacologic agent common to all forms of tobacco, is a powerfully addicting drug.[36] Thus, nicotine in bidi smoke puts smokers at risk for addiction.[7]
- Nicotine also has an adverse effect on cardiovascular health. Nicotine causes vascular injury and increases heart rate and blood pressure.[37]
- Carbon monoxide acts as an added stress in the precipitation of cardiovascular disease.[37] The metabolic product of carbon monoxide, carboxyhemoglobin (COHb), reduces the oxygen-carrying capacity of the blood.
- Hydrogen cyanide and acrolein are highly potent ciliatoxic agents in tobacco smoke, and phenol is a respiratory irritant and paralyzes ciliated cells.[38-40] Ciliated cells in the respiratory tract are responsible for removing cigarette tar and other pollutants from the lungs. Damaging these cells may impede normal lung mecha- nisms for clearing pollutants from the lungs and increase the amount of chemicals the body absorbs from tobacco smoke inhaled into the airways.
- Phenol is also a possible tumor-promoting chemical. It is not known if phenol causes cancer in humans (phenol is classified as AD@C not classifiable as to human carcinogenicity by the U.S. Environmental Protection Agency, based on no human data and inadequate animal data, and unclassifiable as to carcinogenicity to humans by the International Agency for Research on Cancer[41-42]). However, phenols can promote skin tumor formation in specially inbred sensitive mouse strains.[38,43-44]
- Bidi smoke contains high concentrations of tar and carcinogenic polyaromatic hydrocarbons (PAHs). One notable PAH, benzo[*a*]pyrene, is classified as a prob- able human carcinogen by the U.S. Environmental Protection Agency and by the International Agency for Research on Cancer as probably carcinogenic to humans.[41,45] Benzo[*a*]pyrene is a potent lung carcinogen in laboratory animals, and there is strong evidence for PAHs as one of the leading causes of lung cancer in smokers.[46-48] The level of benzo[*a*]pyrene in the smoke of unfiltered bidis exceeded the range of values determined for unfiltered United States cigarettes when smoke was generated under the same smoking machine conditions of two puffs per minute (78 ng versus 46.7 ng). Tar levels are similar between the two tobacco products (51.4 mg versus 54.2 mg).[6]
- The TSNAs, NNN and NNK, present in bidi tobacco and bidi smoke are catego- rized as reasonably anticipated to be human carcinogens by the National Toxicol- ogy Program.[49] The International Agency for Research on Cancer has classified NNN and NNK as possibly carcinogenic to humans (Group 2B).[50] TSNAs are also strongly linked with cancer in tobacco users.[47]

In addition to toxicity to the smoker, bidi smoke can be harmful to an exposed fetus. Carbon monoxide is thought to restrict fetal growth by binding to hemoglobin and reducing the availability of oxygen to the developing organism.[51] As a result, carbon monoxide is a potent fetal toxicant, and the offspring of animals exposed to carbon monoxide while pregnant, leading to COHb levels at or slightly above those seen in the blood of smokers, have central nervous system (CNS) abnormalities.[52] Exposure to carbon monoxide is also associated with low birth weight in infants.[52]

Genotoxicity of Bidi Tobacco and Bidi Smoke

More than 100 short-term genotoxicity screening assays are available. Rather than relying on one assay, several of them are commonly assembled into a battery of tests that attempts a balance between sensitivity and specificity. Commonly used short-term tests are assays for chromosomal aberrations, including tests for aneuploidy, sister chromatid exchanges (SCEs) in mammalian cells, and the micronucleus test in polychromatic erythrocytes and other tissues. Other indicator assays detect DNA adducts, unscheduled DNA synthesis, or DNA damage by alkaline elution. Bacterial point mutation assays (Ames bacterial mutagenicity test) and tests for chromosomal aberrations are considered to be complementary in screening for genotoxic substances.[53-58]

Among the short-term assays, the Ames *Salmonella* bacterial mutagenicity test is regarded as the most predictive for carcinogenicity and is the most widely used short-term bacterial assay of the reversion of histidine-dependent mutants to the histidine-independent wild type (reverse gene mutations).[57] In this assay, strains of histidine-requiring bacteria with increased sensitivity to mutagens are used to screen for frameshift or base-pair mutagens. The bacteria are incubated with various concentrations of the test material in the presence or absence of metabolic activation. Metabolic activation typically consists of a 9000 x *g* supernatant (S9) fraction of a tissue homogenate (e.g., liver) from a rodent species (e.g., rat, mouse) that had been previously administered chemicals to induce elevated levels of metabolic enzymes. Test substances can be directly mutagenic and not require metabolic activation to a mutagenic form. Alternatively, some chemicals are promutagenic and will only produce a mutagenic response in a short-term assay in the presence of metabolic enzymes. A mutagenic response is determined by a dose-related increase in the number of histidine-independent revertant bacterial colonies.[57,59]

Cigarette smoke and smokeless tobacco products, both complex mixtures of chemicals, can be tested for genotoxic activity with these short-term predictive tests. A 2004 monograph by the International Agency for Research on Cancer reviewed mutagenicity and other short-term tests of tobacco smoke.[60] The IARC summary of studies of whole tobacco smoke and tobacco smoke condensate indicates that in the Ames mutagenicity assay whole smoke is more mutagenic than cigarette smoke condensate, and basic and acidic fractions of cigarette smoke condensate are more mutagenic than neutral fractions.[60-70]

Various aqueous and organic extracts of powdered sun-dried bidi tobacco tested negative for mutagenicity in strain TA98, TA100, or TA102 of *S. typhimurium.* After nitrosation with sodium nitrite, the aqueous extract demonstrated mutagenic activity in strains TA98 (-S9) and TA100 (±S9), the aqueous ethanolic extract in strain TA102 (±S9), and the ethanolic extract in TA100 (-S9) and TA102 (-S9).[71] TA100 measures base-pair mutations, i.e., point mutations.[55] In a base-pair mutation one base pair in DNA is replaced by another resulting in a missense or nonsense mutation.[54] TA102 measures frameshift mutations and preferentially detects cross-linking and oxidizing mutagens.[55,72] Puri observed that extracts of bidi tobacco incubated with human saliva cause microsomal degranulation of mouse liver microsomes.[73] Ribosome degranulation is thought to signal carcinogenic activity.

Bidi smoke is mutagenic in bacterial and mammalian test systems and possibly impairs enzymes involved in DNA repair. Bidi smoke condensate produced frameshift reverse mutations in the presence of metabolic activation (+S9) in the TA98 strain of *Salmonella typhimurium*.[9,55] Bidi smoke condensate was also mutagenic in *S. typhimurium* TA1538, which measures frameshift mutations with a specific sensitivity towards aromatic amines.[9,62,74] Frameshift mutations commonly involve

the gain or loss of one or two base pairs in a gene resulting in a change in the reading frame and an altered or incomplete gene product.[54] Bidi smoke condensate produced a significant increase in the frequency of forward mutations in cultured V79 Chinese hamster cells in the presence of S9.[9,75] Concentrations of an organic extract of bidi smoke condensate that inhibited cell survival by 50% and by about 70% also reduced activity of the DNA repair enzyme O^6-methylguanine-DNA methyltransferase (MGMT) to 73% ± 6% and 58% ± 2% of control values, respectively.[76]

Shirname and colleagues administered bidi smoke condensate generated by a smoking machine (smoking machine conditions: 35 ± 0.5 mL puff volume; 2 ± 0.2 second puff duration; 2 puff/minute; 23-mm butt length) to male Swiss mice.[9,75] The treatment regime consisted of two intraperitoneal injections of 40 µg/gram smoke condensate per animal for a total of 2 mg per animal. The bidi smoke condensate treatment group had a significantly higher frequency of micronucleated polychromatic erythrocytes than the solvent control group (0.93% ± 0.05% versus 0.21% ± 0.02%). The mouse micronucleus assay measures chromosome damage (clastogenicity) in bone marrow stem cells.

In a recent study, Thapliyal et al. reported on DNA damage in mice treated with mainstream or sidestream bidi smoke.[77] Bidis, 60 mm in length, were smoked on an automated smoking machine (smoking machine conditions: 35 mL puff volume; two-second puff duration; two puffs/minute; 23 mm butt length) and mainstream smoke and sidestream smoke were collected separately on a filter pad. The first treatment regimen consisted of an application of acetone followed by four successive single daily applications of the total particulate matter (TPM) of a single bidi (mainstream or sidestream smoke) to the dorsal skin of male Swiss bare (hairless) mice. The level of bulky aromatic DNA adducts in the skin of mice treated with TPM from the mainstream smoke of a single bidi (2.91 ± 0.44 relative adduct labeling (RAL)) was significantly higher than the level of adducts in mice treated with TPM from sidestream bidi smoke (2.06 ± 0.21 RAL) when expressed per milligram of TPM. The second treatment regime consisted of four daily topical applications of 2.5 mg of either mainstream or sidestream TPM in acetone for a total of 10 mg of TPM to the dorsal skin of male Swiss bare mice. When treated with equal amounts of either mainstream or sidestream TPM, mice had a significantly higher level of bulky aromatic DNA adducts from treatment with the sidestream smoke TPM than from the mainstream bidi smoke TPM, when expressed per milligram of TPM. Despite a significantly higher level of total polyaromatic hydrocarbons in sidestream TPM, mainstream smoke TPM from either treatment regimen (mainstream or sidestream TPM from a single bidi or equal amounts of mainstream or sidestream TPM) produced a higher relative adduct labeling level on the basis of polyaromatic hydrocarbon content (RAL per 100 ng of polyaromatic hydrocarbons) than did sidestream TPM (not compared statistically). The authors attribute this to the higher TPM level in mainstream bidi smoke.[77] Relative levels of individual polyaromatic hydrocarbon compounds were not determined for mainstream or sidestream bidi smoke.

Cytotoxicity

Chemical-induced cellular toxicity (cytotoxicity) interferes with normal cell growth and proliferation, which can be quantified by biological endpoints such as the number of viable cells.[78] Bidi smoke extract inhibited the survival of cultured normal, non-tumorous human buccal mucosa fibroblasts taken from non-users of tobacco. As measured by reduction of 1-[4,5-dimethylthiazol-2-yl]-2,5-diphenyl tetrazolium bromide, a concentration of 100 µg/mL bidi smoke extract reduced cell survival by 50%, and a concentration of 600 µg/mL reduced cell survival by 70%.[76] Cells must

possess metabolically active mitochondria to reduce the tetrazolium dye.[78] The concentration of the dye metabolite is related to the number of viable cells.

A cultured Syrian golden hamster tracheal cell line was incubated with increasing concentrations of an aqueous bidi tobacco extract. Cells treated with 2.5 mg/mL and higher concentrations of aqueous bidi extract had evidence of morphological changes, including cellular hypertrophy and widening of intercellular spaces. Several parameters related to regulation of cellular growth and transformation were affected by treatment with the bidi tobacco extract. Cell doubling time, stimulation of ornithine decarboxylase activity, and thymidine incorporation into DNA were significantly increased over that of untreated epithelial cells at the nontoxic dose of 2.5 mg/mL. Flow cytometric analysis demonstrated a significant decrease in the percentage of cells in G_1 phase and an increase in the percentage of cells in S phase at 2.5 mg/mL, which persisted at 36 and 48 hours of exposure. Cytotoxicity, as determined by colony formation efficiency, was demonstrated at the highest concentration tested, 5.0 mg/mL, with a significantly reduced number of colonies.[79]

In Vivo Animal Studies

Animal studies allow a researcher to vary the route of exposure and also the duration and frequency of chemical administration. Questions regarding immediate versus delayed, reversible versus irreversible, and local versus systemic toxicity require an intact host system with a full complement of endocrine, hormone, and immune effects, and hepatic and extra-hepatic metabolism. Animal studies can be acute (less than 24 hours), subchronic (1 to 3 months, typically 90 days), or chronic (longer than 3 months) in duration. Animals may be administered the chemical continuously or intermittently during the exposure period. The chemical can be administered in food or drinking water, by implantation, by gavage directly to the stomach, topically, by inhalation, or by injection (intravenous, intraperitoneal, subcutaneous). The dose levels are typically selected so that the highest dose produces toxicity. Animal studies are often used to confirm positive findings or resolve conflicting results in *in vitro* assays and to study organ-specific effects.[80]

Acute Exposure

Bidi smoke condensate (30 mg of bidi condensate/bidi smoked) dissolved in dimethyl sulfoxide (DMSO) was administered by intraperitoneal injection to male Swiss mice at 0 and 24 hours. The dose administered was 40 µg/g body weight for final doses of 2 mg per mouse in the low-dose group (two treatments of 1 mg bidi smoke condensate per animal) or 4 mg per mouse in the high-dose group (two treatments of 2 mg bidi smoke condensate per animal). Animals were fasted overnight before sacrifice 48 hours after the 0 hour injection. The concentration of cytochrome P450 oxidative metabolic enzymes in the liver of treated animals was 0.74 ± 0.03 nanomole per milligram (nmole/mg) protein for the low-dose group and 0.68 ± 0.06 nmole/mg protein for mice in the high-dose group. The concentration of cytochrome P450 in the liver of control groups of untreated mice or mice administered only DMSO (solvent control group) was 0.58 ± 0.06 nmole/mg protein or 0.54 ± 0.03 nmole/mg protein, respectively. Arylhydrocarbon hydroxylase (a form of cytochrome P450 with a high affinity for benzo[*a*]pyrene) activity was 1.51 ± 0.06 nmole of 3-OH benzo[*a*]pyrene/minute/mg protein in the low-dose group and 1.35 ± 0.07 nmole of 3-OH benzo[*a*]pyrene/minute/mg protein in the high-dose group. The arylhydrocarbon hydroxylase activity was 0.66 ± 0.06 nmole of 3-OH benzo[*a*]pyrene/minute/mg protein in untreated mice and 0.70 ± 0.02 nmole of 3-OH benzo[*a*]pyrene/minute/mg protein for mice administered only DMSO. All values for bidi smoke condensate groups were significantly different ($p<0.05$) from the values in

the DMSO group (solvent control).[75] These results suggest that exposure to bidi smoke may enhance the metabolic activation of benzo[*a*]pyrene and possibly other pre-carcinogens metabolized in the liver.

Subchronic Exposure

Rabbits were exposed for two hours a day, daily, for 80 days to bidi smoke. A closed exposure chamber was used and smoke from burning bidis was introduced into the chamber for one minute every 30 minutes. The brief description of methodology does not include how many bidis were burnt or what concentration of bidi smoke was achieved in the exposure chamber.[81] Animals received a 0.5 mL subcutaneous injection of typhoid-paratyphoid vaccine on day 0 and 1.0 mL on day 50. Compared with rabbits in the control group, animals exposed to bidi smoke had a higher level of antibodies (immune titre) beginning on exposure day 20 and continuing to the end of the exposure. The antibody level was measured with the Widal test, which is based on bacterial agglutination. No statistical evaluation of the data was presented in this early study of humoral immune response.

Chronic Exposure

An aqueous bidi tobacco extract (ATE) was tested for its ability to act as a complete carcinogen, a tumor promoter, and a tumor initiator, and to affect the progression of skin papillomas to carcinomas in an inbred hairless mouse strain sensitive to formation of carcinogen-induced skin tumors. In this series of experiments, bidi tobacco demonstrated weak to moderate tumor-promoting abilities.[82]

In the complete carcinogenesis study, uninitiated mice were treated twice a week with acetone or ATE (50 mg) for 40 weeks.[82] In another treatment group in this study, mice received a single initiating topical application of ATE (5 mg) followed one week later by twice weekly treatment with the tumor-promoting agent 12-*O*-tetradecanoyl-phorbol 13-acetate (TPA) for 20 weeks. These treatment regimens failed to induce skin papillomas in the hairless mice.

In the tumor promotion study, one week after initiation with 20 nmol of the carcinogenic polyaromatic hydrocarbon compound 7,12-dimethylbenz[*a*]anthracene (DMBA), mice received twice weekly applications of acetone (solvent control group) or 0.25, 2.5, 5, or 50 mg doses of ATE for 40 weeks.[82] The tumor yield in the high-dose ATE treatment group was about 70% of that in the positive control group receiving DMBA initiation and TPA treatment. The time to appearance of the first tumor was reduced in groups treated with ATE and TPA compared to that in solvent controls. After the 30th week of treatment, a dose-dependent increase in tumor yield occurred in the ATE groups compared to the solvent control group. The papillomas in the treated animals were well-differentiated, showed excessive keratinization, and were accompanied by hyperplasia of the adjoining epidermis.

In the tumor progression study, mice were treated with an initiating dose of DMBA followed by treatment with the tumor promoter TPA for 20 weeks. After a treatment-free period of six weeks, acetone or ATE (50 mg) was applied to the treated backs of the mice for 14 weeks. The number of papillomas and putative carcinomas was recorded every week. Upon gross examination of excised back skin, downward-invading lesions were diagnosed as carcinomas. There was no difference in the progression of papillomas to carcinomas between the animals treated with acetone or ATE.

In a separate experiment, mice were initiated with a single application of 20 nmol DMBA. One week later, animals received a single or twice weekly treatment with acetone or 2.5-, 5-, or 50-mg doses of ATE. Mice were sacrificed after a single application of different doses of ATE or after treatment for 40 weeks. The number of nucleated cells was determined in skin tissues, and the thickness of the epidermis and dermis was measured.

Increased epidermal mitotic activity and dermal thickness were observed in animals treated with 2.5, 5, or 50 mg ATE. Mild epidermal hyperplasia of three or four nucleated cell layers occurred at the two highest doses (5 and 50 mg ATE). At the end of treatment, sustained epidermal hyperplasia and a significant increase in the mitotic activity and thickness of the epidermis and dermis were also observed. The increased epidermal and dermal thickness, number of basal cells, and basal epidermal mitotic activity were significantly higher in the two treatment groups than in animals in the solvent control group. All doses of ATE produced an increase in the number of nucleated cells and a mild inflammatory cell exudate in the edematous dermis. The authors concluded that the ability of ATE to induce mild but sustained epidermal hyperplasia increased mitotic activity and dermal edema correlated with its tumor-promoting potential.[82]

Eight-week-old male Swiss mice were given 1 mg of bidi smoke condensate in DMSO by gavage once a day on 5 days per week for 35 weeks and then were observed until death. Controls received either 0.1 mL DMSO or no treatment. Lung, liver, kidney, and other grossly abnormal tissues were examined microscopically in treated and control mice. Among treated animals, seven of 15 developed tumors: four with liver hemangiomas, one with an esophageal carcinoma, one with a gastric carcinoma, and one with a gastric papilloma. No tumors were seen in controls.[83]

Human Studies

Human studies can be clinical, challenge, occupational, or epidemiological in design. A clinical exposure study is useful for verifying findings from animal toxicology studies. Human challenge studies help to identify biomarkers of exposure. Occupational studies address workplace hazards with the objective of preventing adverse health effects in workers. Epidemiology studies explore the relationship between exposure, risk factors, and disease. In experimental or intervention studies, exposed and unexposed individuals can be matched on certain characteristics that may influence the health endpoint under study, e.g., age, sex, tobacco use, and general dietary features.[84-85] A review of the pub-lished literature located exposure studies of bidi workers and bidi smokers, genotoxicity studies of bidi workers and bidi smokers, and scientific evidence of the role of bidi smoking in the onset of cardiovascular and respiratory tract toxicity.

One measure of the addictive potential of a tobacco product is the amount of nicotine available to the consumer. Even though bidis contain less tobacco than Western-style cigarettes, the amount of nicotine in bidi tobacco puts smokers at risk for addiction to nicotine.[7] The addictive nature of nicotine can lead to repeated, long-term exposure to the components of bidi smoke. Bidi use is associated with other health hazards for smokers.

Compared with nonsmokers, bidi smokers have an increased risk of adverse cardiovascular and respiratory effects.[86-87] Carbon monoxide in bidi smoke results in elevated levels of COHb, which may adversely affect cardiovascular function, and irritant chemicals such as ammonia, which may provoke damage to the respiratory tract.[6,37,52]

Bidi smokers have an elevated risk of cancer at various sites including the tongue, buccal and labia mucosa, esophagus, stomach, larynx, and lung.[60] Bidi smoke contains carcinogens and irritants such as polyaromatic hydrocarbons, tobacco-specific nitrosamines, ammonia, and phenol.[6-7,88]

Studies suggest that bidi workers have higher exposure to mutagens (urine mutagenicity and urine thioether levels) and higher levels of chromosomal damage (for example, micronucleated buccal epithelial cells) than do matched controls.[5,12,89-90] While the effect is not specific to bidi tobacco cultivation, agricultural workers in India may suffer from symptoms of "green tobacco sickness" that result from dermal absorption of nicotine during tobacco harvesting.[91-92] Nonsmoking male and female agricultural workers have detectable nicotine and cotinine in their urine. Predominant symptoms are weakness, giddiness, and abdominal pain.[91]

Biomarkers of Exposure

Exposure to Bidi Smoke or Tobacco

Tobacco-specific Markers of Exposure to Bidi Smoke or Bidi Tobacco

Cotinine is a major metabolic product of nicotine and a specific marker of exposure to tobacco or tobacco smoke from both active and passive smoking. Cotinine is formed from nicotine in two steps involving the enzymes cytochrome P450 2A6 and aldehyde oxidase. Cotinine can be measured in blood (plasma), saliva, and urine.[93-95] Cotinine is a useful biomarker of exposure via bidi smoking or bidi manufacturing because the pattern of nicotine metabolism is similar when nicotine is inhaled or absorbed through the skin.[93]

A study of male bidi smokers reported a mean urine cotinine level of 4.30 ±1.18 mmol/mol creatinine. Female family members passively exposed to bidi tobacco smoke also had measurable levels of urine cotinine (wives, 1.76 ± 0.50; daughters, 0.50 ± 0.26).[96]

Workers involved in various aspects of bidi manufacturing are exposed to bidi tobacco and respirable and nonrespirable bidi tobacco particles. Workers may roll bidis four to six hours per day, seven days a week, resulting in the manufacture of 500 to 1000 bidis per day. Bidi workers making up to 1000 bidis per day handle 225 to 450 grams of tobacco. In addition to dermal (skin) exposure, workers in tobacco-processing facilities receive an inhalation exposure to tobacco dust and volatile components in tobacco.[5,89,97] Among the workplace studies that have been reported, participants were female nonsmokers with exposure to unburnt bidi tobacco. The duration of exposure ranged from one year to more than four decades of employment. The primary route of exposure was dermal contact with bidi tobacco (i.e., the participants were bidi rollers) or, in the case of workers in a tobacco-processing facility, dermal exposure and inhalation of tobacco dust.[5,89,97]

Cotinine is present in the urine and saliva of bidi rollers and workers in bidi tobacco processing plants. In one study, female bidi rollers without an oral tobacco habit had a mean urine cotinine level of 0.07 ± 0.02 µg/mL.[5] Another study reported that nine of 18 female bidi rollers had a mean urine cotinine level of 0.09 ± 0.03 mmol/mol creatinine.[89] Six of 32 female bidi rollers without a smokeless tobacco habit had a mean saliva cotinine level of 0.84 ± 0.26 µg/mL.[89,98] The conclusion that bidi tobacco processing results in a greater exposure to nicotine is based on urine cotinine levels of workers in tobacco-processing facilities. Bhisey and colleagues have reported mean urine cotinine levels of 3.46 to 3.80 mmol/mol creatinine for female bidi tobacco-processing workers without a smokeless tobacco habit.[12,90] In two studies, female bidi tobacco-processing workers

without a smokeless tobacco habit had a mean saliva cotinine level of 2.86 µg/mL.[90,98] In addition to cotinine (1.47 ± 0.18 mg/ml), nicotine (1.45 ± 0.21 mg/mL) was measured in the urine of bidi rollers handling tobacco for approximately 9 to 10 hours per day.[8]

Across studies, cotinine levels were higher in bidi workers without a smokeless tobacco habit than in controls matched on the basis of age, socioeconomic status, and absence of a smokeless tobacco habit. Study findings suggest that both occupational settings (bidi rolling and bidi tobacco processing) resulted in measurable exposure to nicotine from the unburnt bidi tobacco. In addition, levels of cotinine measured in female tobacco-processing plant workers suggest that inhalation exposure to tobacco dust and fine particles represents a considerable exposure pathway to nicotine beyond dermal exposure alone.

Non-specific Markers of Exposure to Bidi Smoke or Bidi Tobacco

Carboxyhemoglobin

The bidi smoker is repeatedly exposed to toxic chemicals in the bidi smoke, inclu-ding carbon monoxide. Smoking of bidis differs from that of Western-style cigarettes. For example, bidis self-extinguish if they are not puffed at least two times a minute. As a result, both the time required to smoke a bidi and the number of puffs are significantly greater than what is required to smoke a Western-style cigarette under similar conditions.[11] Also, there is less air dilution through the tendu leaf than through the paper wrapper of Western-style cigarettes. Finally, low combustibility may force a smoker to inhale bidi smoke more deeply. These factors combine to influence the delivery of smoke constituents such as carbon monoxide to the consumer. Blood COHb concentrations were higher in bidi smokers than nonsmokers, and the COHb concentration correlated with self-assessed degree of smoke inhalation.[99-100] An early study demonstrated that blood COHb levels in bidi smokers correlated with the amount (weight) of bidi tobacco consumed per day.[101] In contrast to cotinine, discussed previously, carbon monoxide is a common pollutant gas from a variety of sources and thus COHb, the metabolic product of carbon monoxide, is a nonspecific marker of exposure to tobacco smoke.

In a clinical study, male bidi smokers instructed to inhale as deeply as possible achieved a mean COHb level of 5.05% ± 2.42% (range: 2.69% to 10.47%) at 15 minutes and 4.19% ± 1.47% (range: 2.14% to 6.1%) at 30 minutes after starting to smoke.[33] The baseline COHb level was 2.24% ±0.94% (range: 1% to 3.6%).

Behera and colleagues found a strong positive correlation between self-assessed degree of inhalation of bidi smoke and levels of COHb in blood.[99-100] In contrast to the findings of Bhown et al., the amount smoked did not show any relationship with blood COHb levels.[101] Specifically, no correlation was found between COHb and the number of bidis smoked per day, number of puffs per bidi, or the length of the bidi. In samples drawn 10 minutes after the last bidi was smoked, blood COHb levels in asymptomatic male bidi smokers were 13.54% ± 3.79%. In nonsmoking controls, blood COHb levels were 3.72% ± 1.15%.[99-100]

In another study, COHb levels were compared among male cigarette smokers, bidi smokers with a similar smoking history and nonsmokers.[102] Cigarette smokers used unfiltered cigarettes and bidi smokers consumed 60-mm unfiltered bidis. The smoking index for both groups of smokers was at least 50 as determined by multiplying the number of bidis or cigarettes consumed per day by the number of years of smoking. Carboxyhemoglobin levels in cigarette smokers and bidi smokers

(11.91% ± 0.8% versus 11.32% ± 0.77%) were significantly higher than those determined in nonsmoking controls (4.84% ± 0.38%).[102] Previously, a comparison of bidi (n = 58; 20.0 ± 14.0 bidis smoked per day) and cigarette smokers (n = 40; 15.0 ± 8.0 cigarettes smoked per day) showed similar mean COHb levels (8.4% ± 4.6% versus 9.0 ± 4.6%) despite the lower tobacco weight in bidis.[103] When equal amounts (1 gram) of bidi tobacco or cigarette tobacco were smoked with a cigarette paper wrapper, peak COHb levels were significantly higher among those smoking the bidi tobacco (mean levels 15 minutes after smoking: 4.48% ± 1.23% versus 3.31% ± 1.27%).[104]

Thioether

Many mutagens and carcinogens are metabolically activated *in vivo* to electrophilic forms capable of interaction with cellular macromolecules. One of the mechanisms that an organism employs to combat the electrophilic attack is conjugation of the reactive chemical moiety with reduced glutathione, a nucleophile. The resulting more polar thioether conjugates are excreted from the body in urine and bile. Urinary thioether levels are used as a nonspecific indicator of exposure to alkylating agents.[105] Cigarette smoking causes a dose-related increase in the urinary excretion of thioethers. Chemicals present in tobacco smoke and excreted in urine as thioethers include benzene, styrene, and vinyl chloride.[105-106]

Thioether excretion among active and passive bidi smokers was reported by Ghosh and colleagues.[96] Male bidi smokers had a mean urine thiother level of 6.45 ± 2.73 mmol/mol creatinine. Female family members passively exposed to bidi tobacco smoke had measurable levels of thiothers in their urine (wives, 4.79 ± 1.48; daughters, 4.85 ± 1.37).

Among individuals with occupational exposure to bidi tobacco, the key cellular components involved in detoxification of reactive electrophiles (mean levels of reduced glutathione and glutathione *S*-transferase activity) are reduced in peripheral blood lymphocytes.[90] Consistent with this finding, female bidi rollers who were nonsmokers and without a smokeless tobacco habit had levels of urine thioethers significantly higher than levels measured in matched controls (4.59 ± 0.52 mmol/mol creatinine versus 1.86 ± 0.34 mmol/mol creatinine).[5,89] In contrast to findings among bidi rollers, one study found no difference in levels of thioethers in exposed tobacco-processing plant workers when compared with controls matched for age, socioeconomic status, and tobacco habits.[90] In the study locale, the background level of urinary thioether excretion among males and females who did not use tobacco or alcohol and who did not have occupational exposure to bidi tobacco was 1.89 ± 0.34 mmol/mol creatinine.[5] The thioether levels in bidi rollers and tobacco-processing plant workers were similar to those seen in male smokers of low or medium tar American-style filtered cigarettes (mean value of 4.3 ± 0.4 mmol/mol creatinine).[107]

Urine Mutagenicity

Urine samples of persons with suspected exposure to mutagens are tested via a modification of the bacterial mutation assay. In the urine mutagenicity assay, dilutions of a concentrate of an organic extract of urine are evaluated in the standard *Salmonella* plate mutagenicity assay.[108] The mutagenic activity (number of bacterial revertants) produced by the urine of exposed individuals is compared with that produced by the urine of nonexposed individuals. Urine mutagenicity is a measure of lifestyle or occupational exposure to mutagens and potential carcinogens. It reflects exposure to mutagens from a variety of sources and is not specific to bidi smoking or occupational exposure to bidi tobacco. The urine of cigarette smokers has a higher level of mutagenic activity than that of nonsmokers.

In one study, the urine of bidi smokers (12 to 15 bidis per day) showed higher mutagenic activity (highest number of revertants) in *Salmonella* strain TA1538 than did the urine of betel quid with tobacco users (5 to 10 betel quids per day) or smokers of Western-style cigarettes (10 to 15 cigarettes per day).[109] Betel quid with tobacco consists of betel leaves, areca nut, slaked lime and tobacco. The mixture is chewed and the resulting excess saliva is often swallowed.[110] Others have observed the urine mutagenicity of bidi smokers to be within the range of Western-style cigarette smokers' urine mutagenicity.[111] Another study showed a relationship between bidi smoking (mean of 2.5 ± 4.3 bidis smoked per day) and increased mutagenic activity in urine in *Salmonella* strain YG 1024.[111] *Salmonella* strains TA1538 and YG1024 detect frameshift mutations and have elevated sensitivity to aromatic amine compounds.[74,111] Among Western-style cigarette smokers, urine mutagenicity correlated with levels of urinary metabolites of mutagens and with DNA adducts in cells from the urinary tract.[111]

Several studies of urine mutagenicity have been conducted among bidi workers. It is noteworthy that most of the study participants were vegetarians or only infrequently consumed non-vegetarian food. A vegetarian diet presumably eliminates or minimizes exposure to the mutagenic and carcinogenic heterocyclic amines that are formed during the high-temperature cooking of protein sources (e.g., meat and fish). Occupational exposure to bidi tobacco ranged from one year to more than four decades. Compared to matched controls, among nonsmoking tobacco-processing plant workers without a smokeless tobacco habit, there was a significant increase in the number of mutagenic samples and in the mean number of induced histidine-positive revertants in *Salmonella* strain TA98 (without metabolic activation), TA100 (with metabolic activation), and TA102 (without metabolic activation).[12,90] Similarly, among nonsmoking bidi rollers without a smokeless tobacco habit, mutagenic activity was demonstrated in TA98 (with and without metabolic activation) and in TA100 (with metabolic activation). Treatment of the urine samples with nitrite or beta-glucuronidase led to increased mutagenic activity.[89]

Pooled and concentrated urine samples of bidi smokers (12 to 15 bidis per day) that were mutagenic in the Ames bacterial assay were tested for 8-azaguanine resistance in V79 Chinese hamster cells.[109] Mutation to 8-azaguanine resistance in V79 cells detects base substitution and frameshift mutations.[112] Induction of resistance was only marginal in this mammalian cell gene forward mutation test system.

Toxicity

Genetic Damage in Exposed Individuals

Short-term genotoxicity tests, including those for point mutation and clastogenicity, two major classes of genetic damage, are used to monitor human exposure to genotoxic chemicals because of the strong association between somatic cell toxicity and primary DNA damage.[57,59]

In addition to mutagenic activity in urine, which suggests increased exposure to bidi-derived mutagenic compounds, chromosomal damage has been demonstrated in bidi smokers and bidi industry workers (Table 3.1.3). Studies of genotoxicity in bidi industry workers have demonstrated a significant increase in micronucleated buccal epithelial cells of bidi rollers and tobacco-processing plant workers. In all of the studies, participants were nonsmoking women. The genotoxic response caused by exposure to bidi tobacco was sufficiently strong to be detectable even in individuals with a masheri habit but not in those using masheri and betel quid with tobacco. Masheri is half-

Table 3.1.3: *In vivo* genotoxicity.

Description of Study Participants	Test System	Endpoint	Result	Reference
Male bidi smokers without a smokeless tobacco habit (age: 14 to 52 years; smoking history: 5 – 30 years; smoking frequency: 8 – 30 bidis per day, average of 17 bidis per day) (n = 45)	Peripheral blood lymphocytes	Satellite associations	Significant increase in the frequency of satellite associations (11.28 ± 5.49 versus 5.26 ± 2.06) versus non-smoking controls (n = 45).	Yadav and Thakur 2000[116]
Female bidi rollers without a tobacco habit (age: 25.6 ± 2.1 years) (n = 32)	Buccal epithelial cells	Micronuclei increase	Significantly higher frequency of micronucleated buccal epithelial cells than matched controls (0.68 ± 0.06% versus 0.48 ± 0.07%)	Bhisey et al. 1992[89]
Female bidi rollers (age: 26 ± 2 years; occupational exposure: 13 ± 2 years) without a tobacco habit (n = 29)	Buccal epithelial cells	Micronuclei increase	Significantly higher frequency of micronucleated buccal epithelial cells than matched controls (0.68 ± 0.06% versus 0.45 ± 0.05%)	Bagwe and Bhisey 1993[98]
Female bidi rollers (age: 35 ± 2 years; occupational exposure: 23 ±2 years) with a smokeless tobacco (masheri) habit (n = 42)	Buccal epithelial cells	Micronuclei increase	Significantly higher frequency of micronucleated buccal epithelial cells than matched controls (0.91 ± 0.05% versus 0.71 ± 0.03%)	Bagwe and Bhisey 1993[98]
Female bidi rollers (age: 53 ± 2 years; occupational exposure: 39 ± 3 years) with a smokeless tobacco habit (masheri and betel quid with tobacco) (n = 31)	Buccal epithelial cells	Micronuclei increase	No difference in the frequency of micronucleated buccal epithelial cells compared to matched controls	Bagwe and Bhisey 1993[98]
Female bidi tobacco processing plant workers (age: 41 ± 3 years; occupational exposure: 18 ±3 years) without a tobacco habit (n = 18)	Buccal epithelial cells	Micronuclei increase	Significantly higher frequency of micronucleated buccal epithelial cells than matched controls (0.66 ± 0.07% versus 0.45 ± 0.05%)	Bagwe and Bhisey 1993[98]
Female bidi tobacco processing plant workers (age: 38 ± 2 years; occupational exposure: 12 ± 2 years) with a smokeless tobacco habit (masheri) (n = 28)	Buccal epithelial cells	Micronuclei increase	Significantly higher frequency of micronucleated buccal epithelial cells than matched controls (0.85 ± 0.04% versus 0.71 ± 0.03%)	Bagwe and Bhisey 1993[98]
Female bidi tobacco processing plant workers (age: 41 ±2 years; occupational exposure: 18 ± 3 years) with a smokeless tobacco habit (masheri and betel quid with tobacco) (n = 21)	Buccal epithelial cells	Micronuclei increase	No difference in the frequency of micronucleated buccal epithelial cells compared to matched controls	Bagwe and Bhisey 1993[98]

Table 3.1.3: *In vivo* genotoxicity.

Description of Study Participants	Test System	Endpoint	Result	Reference
Female bidi tobacco processing plant workers without a tobacco habit (age: 40 ± 3 years; occupational exposure: 15 ± 3 years) (n = 17)	Buccal epithelial cells	Micronuclei increase	Significantly higher frequency of micronucleated buccal epithelial cells than matched controls (0.65 ± 0.07% versus 0.41 ± 0.06%)	Bhisey et al. 1999[90]
Female bidi tobacco processing plant workers without a tobacco habit (age: 40 ± 3 years; occupational exposure: 15 ± 3 years) (n = 17)	Peripheral blood lymphocytes	Micronuclei increase	Significantly higher frequency of micronucleated lymphocytes than matched controls (1.77 ± 0.29% versus 0.58 ± 0.09%)	Bhisey et al. 1999[90]
Female bidi tobacco processing plant workers with a smokeless tobacco habit (masheri) (age: 40 ± 3 years; occupational exposure: 15 ± 3 years) (n = 29)	Buccal epithelial cells	Micronuclei increase	Significantly higher frequency of micronucleated buccal epithelial cells than matched controls (0.85 ± 0.04% versus 0.63 ± 0.03%)	Bhisey et al. 1999[90]
Female bidi tobacco processing plant workers with a smokeless tobacco habit (masheri) (age: 40 ± 3 years; occupational exposure: 15 ± 3 years) (n = 29)	Peripheral blood lymphocytes	Micronuclei increase	Significantly higher frequency of micronucleated lymphocytes than matched controls (1.98 ± 0.20% versus 1.30 ± 0.16%)	Bhisey et al. 1999[90]
Pooled and concentrated urine samples positive in the Ames bacterial mutagenicity test from bidi smokers who smoked 12 to 15 bidis per day (n = 8)	Mouse bone marrow cells	Micronuclei increase	Negative	Menon and Bhide 1984[109]
Male bidi smokers without a smokeless tobacco habit (age: 14 to 52 years; smoking history: 5 – 30 years; smoking frequency: 8 – 30 bidis per day, average of 17 bidis per day) (n = 45)	Cultured peripheral lymphocytes	Chromosomal aberrations	Significant increase in mitotic index (6.24 ± 0.73 versus 3.71 ± 0.39) with bidi smoking duration and frequency versus non-smoking controls (n = 45). Significant increase in total chromosomal aberrations (3.23 ± 1.75% versus 0.84 ± 0.70%) with bidi smoking duration and frequency versus non-smoking controls (n = 45).	Yadav and Thakur 2000[116]

Table 3.1.3: *In vivo* genotoxicity.

Description of Study Participants	Test System	Endpoint	Result	Reference
Female bidi tobacco processing workers without a tobacco habit (age: 37 ±3 years; occupational exposure 15 ± 3 years) (n = 16)	Peripheral blood lymphocytes	Chromosomal aberrations	Significantly higher frequency of chromatid deletion fragments than matched controls (0.82 ± 0.02% versus 0.0 %). Significantly higher frequency of total aberrant metaphases excluding gaps than matched controls (1.21 ± 0.20% versus 0.0 %). Significantly higher frequency of total aberrant metaphases including gaps than matched controls (1.51 ± 0.23% versus 0.04 ± 0.04 %).	Mahimkar and Bhisey 1995[13]
Female bidi tobacco processing workers with a smokeless tobacco habit (masheri) (age: 38 ± 1 years; occupational exposure 18 ± 2 years; masheri exposure: 23 ± 2.4 years; masheri use frequency: 2 ± 0.2 per day) (n = 21)	Peripheral blood lymphocytes	Chromosomal aberrations	Significantly higher frequency of total aberrant metaphases including gaps than matched controls (1.97 ± 0.54% versus 0.82 ± 0.28%).	Mahimkar and Bhisey 1995[13]
Female bidi tobacco processing plant workers without a tobacco habit (age: 40 ± 3 years; occupational exposure: 15 ± 3 years) (n = 14)	Peripheral blood lymphocytes	Chromosomal aberrations	Significantly higher numbers of chromosome aberrations than in matched controls (1.47 ± 0.25% versus 0.04 ± 0.04%)	Bhisey et al. 1999[90]
Female bidi tobacco processing plant workers with a smokeless tobacco (masheri) (age: 40 ± 3 years; occupational exposure: 15 ± 3 years) (n = 21)	Peripheral blood lymphocytes	Chromosomal aberrations	Significantly higher numbers of chromosome aberrations than in matched controls (1.97 ± 0.54% versus 0.82 ± 0.28%)	Bhisey et al. 1999[90]
Male bidi smokers without a smokeless tobacco habit (age: 14 to 52 years; smoking history: 5 – 30 years; smoking frequency: 8 – 30 bidis per day, average of 17 bidis per day) (n = 45)	Peripheral blood lymphocytes	Sister chromatid exchange (SCE)	Significantly higher frequency of SCEs (7.65 ± 1.42 versus 3.68 ± 0.56) with bidi smoking duration and frequency versus non-smoking controls (n = 45).	Yadav and Thakur 2000[116]

Table 3.1.3: *In vivo* genotoxicity.

Description of Study Participants	Test System	Endpoint	Result	Reference
Female bidi tobacco processing plant workers with a smokeless tobacco habit (masheri) (age: 40 ± 3 years; occupational exposure: 15 ± 3 years) (n = 29)	Peripheral blood lymphocytes	Micronuclei increase	Significantly higher frequency of micronucleated lymphocytes than matched controls (1.98 ± 0.20% versus 1.30 ± 0.16%)	Bhisey et al. 1999[90]
Pooled and concentrated urine samples positive in the Ames bacterial mutagenicity test from bidi smokers who smoked 12 to 15 bidis per day (n = 8)	Mouse bone marrow cells	Micronuclei increase	Negative	Menon and Bhide 1984[109]
Male bidi smokers without a smokeless tobacco habit (age: 14 to 52 years; smoking history: 5 – 30 years; smoking frequency: 8 – 30 bidis per day, average of 17 bidis per day) (n = 45)	Cultured peripheral lymphocytes	Chromosomal aberrations	Significant increase in mitotic index (6.24 ± 0.73 versus 3.71 ± 0.39) with bidi smoking duration and frequency versus non-smoking controls (n = 45). Significant increase in total chromosomal aberrations (3.23 ± 1.75% versus 0.84 ± 0.70%) with bidi smoking duration and frequency versus non-smoking controls (n = 45).	Yadav and Thakur 2000[116]
Female bidi tobacco processing workers without a tobacco habit (age: 37 ±3 years; occupational exposure 15 ± 3 years) (n = 16)	Peripheral blood lymphocytes	Chromosomal aberrations	Significantly higher frequency of chromatid deletion fragments than matched controls (0.82 ± 0.02% versus 0.0 %). Significantly higher frequency of total aberrant metaphases excluding gaps than matched controls (1.21 ± 0.20% versus 0.0 %). Significantly higher frequency of total aberrant metaphases including gaps than matched controls (1.51 ± 0.23% versus 0.04 ± 0.04 %).	Mahimkar and Bhisey 1995[13]

Table 3.1.3: *In vivo* genotoxicity.

Description of Study Participants	Test System	Endpoint	Result	Reference
Female bidi tobacco processing workers with a smokeless tobacco habit (masheri) (age: 38 ± 1 years; occupational exposure 18 ± 2 years; masheri exposure: 23 ± 2.4 years; masheri use frequency: 2 ± 0.2 per day) (n = 21)	Peripheral blood lymphocytes	Chromosomal aberrations	Significantly higher frequency of total aberrant metaphases including gaps than matched controls (1.97 ± 0.54% versus 0.82 ± 0.28%).	Mahimkar and Bhisey 1995[13]
Female bidi tobacco processing plant workers without a tobacco habit (age: 40 ± 3 years; occupational exposure: 15 ± 3 years) (n = 14)	Peripheral blood lymphocytes	Chromosomal aberrations	Significantly higher numbers of chromosome aberrations than in matched controls (1.47 ± 0.25% versus 0.04 ± 0.04%)	Bhisey et al. 1999[90]
Female bidi tobacco processing plant workers with a smokeless tobacco (masheri) (age: 40 ± 3 years; occupational exposure: 15 ± 3 years) (n = 21)	Peripheral blood lymphocytes	Chromosomal aberrations	Significantly higher numbers of chromosome aberrations than in matched controls (1.97 ± 0.54% versus 0.82 ± 0.28%)	Bhisey et al. 1999[90]
Male bidi smokers without a smokeless tobacco habit (age: 14 to 52 years; smoking history: 5 – 30 years; smoking frequency: 8 – 30 bidis per day, average of 17 bidis per day) (n = 45)	Peripheral blood lymphocytes	Sister chromatid exchange (SCE)	Significantly higher frequency of SCEs (7.65 ± 1.42 versus 3.68 ± 0.56) with bidi smoking duration and frequency versus non-smoking controls (n = 45).	Yadav and Thakur 2000[116]

burnt tobacco that is used in powder form to clean teeth or may be held in the mouth by the gum.[113] A significantly higher frequency of sister chromatid exchanges in peripheral blood lymphocytes has also been observed in bidi smokers and in bidi industry workers without a smokeless tobacco habit.[90,111-116] For bidi smokers, the increased chromosomal damage correlated with the number of bidis consumed per day and the duration of bidi smoking.[114-116] The mean number of micronucleated cells exfoliated from the buccal mucosa and palate, but not tongue, was significantly increased in habituated male bidi smokers compared to non-smoking controls. Neither bidi smokers nor controls consumed oral tobacco products or alcohol. Cases had a median duration of smoking of 15 years (range: 2 to 45 years). Smokers consumed a median of 13 bidis per day (range: 5 to 60 per day). Micronucleated cell count did not correlate with the duration of smoking or the number of bidis smoked per day.[117]

Cardiovascular Toxicity in Bidi Smokers

Chemicals in bidi smoke, including nicotine and carbon monoxide, may play a role in the increased risk of adverse cardiovascular effects seen in bidi smokers.[37,87,118-119] Several studies have documented physiological changes consistent with indicators of increased demand on the cardiovascular systems of bidi smokers. Hematological parameters differed between male bidi smokers (n = 126; mean age: 34.7 ± 8.4 years) and age-matched male controls (n = 149). The greatest increase was for COHb, which exceeded the level measured in nonsmokers by 239%. Lesser increases of 8.3%, 5.8%, and 4.9% were seen for mean hemoglobin, hematocrit, and erythrocyte values. Hemoglobin, hematocrit, and erythrocyte count values increased in a dose-response manner with bidi smoking. Symptoms indicative of stimulated erythropoiesis in bidi smokers were attributed by the study's authors to tissue hypoxia and myocardial oxygen demand, particularly due to high levels of COHb.[120] Studies have shown that cigarette smokers with COHb levels chronically elevated over 5% have a 20-fold increased risk of developing atherosclerosis compared to smokers with lower levels.[119]

Smoking Western-style cigarettes caused increased platelet aggregation and elevated levels of free fatty acids and COHb.[118] Similar effects have been reported for bidi smokers. In an early study, male subjects (n = 20) smoked equal amounts of bidi tobacco wrapped in the traditional leaf material or in Western-style cigarette paper.[33] The smokers were instructed to inhale the smoke as deeply as possible. There was no significant difference between the two groups in platelet aggregation or in levels of serum free fatty acids or COHb. The smokers of bidi tobacco wrapped in the leaf material had a mean platelet aggregation time of 18.50 ± 4.51 seconds 15 minutes after starting to smoke. By 30 minutes after the start of smoking, the smokers' platelet aggregation time had nearly returned to the baseline levels measured before smoking (25.35 ± 5.13 seconds). Serum free fatty acid levels rose to a mean 704.50 ± 186.31 mEq/L after 15 minutes and to 716.75 ± 188.79 mEq/L 30 minutes after starting to smoke. Carboxyhemoglobin levels reached a mean of 5.05% ± 2.42% by 15 minutes after smoking and decreased slightly to 4.19% ± 1.47% 30 minutes after the start of smoking. Before the participants started to smoke, their baseline level of serum free fatty acids was 561.25 ± 162.55 mEq/L and COHb level was 2.24 ± 0.94% A nonsmoking control group was not included in this study designed to evaluate the contribution of the leaf wrapper to coronary heart disease risk factors for bidi smokers.[33] The Whitehead and Worthington precipitation technique to measure carboxyhemoglobin in the Gupta et al. study has since been found to be of low precision compared to methods using carbon monoxide-dedicated oximeters and spectrophometry.[33,121]

A study of nonsmokers, cigarette smokers, and bidi smokers compared COHb levels, hematological values, and neutrophil myeloperoxidase activity. Myeloperoxidase, an oxidative lysosomal enzyme, is an inflammatory biomarker indicative of cardiovascular risk.[122-123] Carboxyhemoglobin levels in bidi and cigarette smokers were significantly higher (11.32% ± 0.77% versus 11.91% ± 0.86%) than in nonsmoking controls (4.84% ± 0.38%). While significantly higher than nonsmoking controls (n = 20), there was no significant difference in total leukocyte count (8590.0 ± 436.1 per µL versus 8310.0 ± 323.9 per µL), total neutrophil count (5901.70 ± 313.69 per µL versus 5781.6 ± 202.9 per µL), myeloperoxidase levels (0.735 ± 0.079 units/mL versus 0.709 ± 0.095 units per mL), and myeloperoxidase scoring (234.75 ± 18.03 versus 247.70 ± 18.25) between bidi smokers (n = 20) and cigarette smokers (n = 20). When results for cigarette and bidi smokers were combined, myeloperoxidase levels increased according to the severity of the smoking index, derived by multiplying the number of bidis or cigarettes smoked per day by the number of years of smoking (i.e., mild = 50 to 100; moderate = 101 to 300; high = greater than 300). In contrast, the other measures did not correlate with the severity of smoking except for a significant correlation in bidi smokers between COHb and myeloperoxidase scoring and smoking severity and myeloperoxidase levels. The report did not state if the cigarettes were Western-style Indian-made cigarettes or imported Western-style cigarettes.[102]

Respiratory Tract Toxicity in Bidi Smokers

Bidi smoking has been associated with damage to the respiratory tract and notably with the development of chronic bronchitis.[124] Bidi smoke contains chemical irritants, including ammonia.[6] Inhalation exposure to ammonia is associated with adverse respiratory effects.[125] Results from an early study suggest that smokers retain greater amounts of ammonia from bidi smoke than do smokers of filtered and unfiltered Western-style cigarettes.[88] The prevalence of bronchitis increases with the amount and duration of bidi smoking. Among 78 male bidi smokers (average age: 34.02 ± 10.75; average of 15.65 ± 8.85 bidis smoked per day; average smoking history of 16.67 ± 9.71 years), 14% had an abnormal 1-second forced expiratory volume (FEV_1), and 32% had an abnormal maximal mid-expiratory flow rate (MMEFR).[126] Fourteen percent of bidi smokers had a ratio of FEV_1/FVC below 70%, indicating airway obstruction. There was not a clear relationship between ventilatory obstruction and amount and duration of bidi smoking. In contrast, among nonsmokers (average age: 33.86 ± 11.33), 3% had an abnormal FEV_1 and 6% had an abnormal MMEFR.[124] In a later study of 185 male bidi smokers (average age: 26.27 ± 10.40), 10.8% had chronic bronchitis without airway obstruction, 2.7% had chronic bronchitis with airway obstruction, and 2.7% had chronic airway obstruction without symptoms.[126] Duration of smoking history correlated with the percentage of smokers with chronic bronchitis and airway obstruction. Among nonsmokers (age range: 15 to 65 years), 3.13% had chronic bronchitis without airway obstruction, and 0.50% had chronic bronchitis with airway obstruction. In a second group of 121 bidi smokers (average age: 33.0 ± 10.50; average of 16.30 ± 8.30 bidis smoked per day; average smoking history of 17.0 ± 10.6 years), 17% of bidi smokers had a ratio of FEV_1/FVC below 70%.[126] Among nonsmoking controls (average age: 33.0 ± 11.30 years), 3.4% had a FEV_1/FVC below 70%. MMEFR was the only spirometry-derived value significantly lower in symptomatic (cough and sputum) bidi smokers than in nonsmokers.[126]

In the Behera study, the FEV_1 of cigarette smokers showed a significant negative correlation with myeloperoxidase levels ($r = -0.65$) and a significant positive correlation with COHb levels (r

= +0.69).[102] Among bidi smokers, the negative correlation (r = −0.40) between FEV_1 and myeloperoxidase levels did not reach a level of statistical significance.

White blood cell count and superoxide anion production were assessed in male and female smokers of several tobacco products.[127] Superoxide anion is a reactive oxygen species that is produced by lung alveolar macrophages and postulated to cause injury to lung tissue. Subjects were smokers of either bidis (n = 30), hookah (n = 20), locally available Indian-made Western-style cigarettes (n = 30), or a mixture of products (n = 30). Control group members (n = 30) were healthy nonsmokers. The smokers were asymptomatic or diagnosed with chronic obstructive pulmonary disease. Levels of neutrophil superoxide were significantly higher in all groups of smokers than in controls. There was no correlation between neutrophil superoxide anion production and smoking index (i.e., light = less than 100; moderate = 100 to 300; heavy = greater than 300) for the bidi, hookah, or multiple product users groups. Only between heavy and light Western-style cigarette smokers did the difference in neutrophil superoxide anion production reach the level of statistical significance. The extent of neutrophil superoxide anion production following stimulation with phorbol-12-myristate-13-acetate (PMA) was similar for the light, moderate, and heavy bidi smokers. Heavy bidi smokers had higher total neutrophil counts, total leukocyte counts, and neutrophil superoxide production than did light smokers. Among asymptomatic smoker groups, the highest total leukocyte count and total neutrophil count were observed in the bidi group. For bidi smokers, there was no significant difference in values of PMA-stimulated superoxide production, total leukocyte count, or total neutrophil count for symptomatic smokers versus asymptomatic smokers. In the Sharma study, there was no correlation between superoxide anion production and development of symptomatic disease (chronic obstructive pulmonary disease, symptoms not further described) among smokers. Nor was there a dose-response relationship between superoxide anion production and the smoking index (light, moderate, or heavy smokers).

Cigarette smokers have significantly increased neutrophil myeloperoxidase levels.[128] There was a nonsignificant increase in myeloperoxidase levels in smokers with abnormal pulmonary function (9.79 ± 0.66) over levels in smokers with normal pulmonary function (8.90 ± 0.44). Elevated myeloperoxidase is thought to increase the elastase burden in the lung leading to a protease-antiprotease imbalance and contributing to the development of emphysema.[128] Similarly, among bidi smokers, factors such as increased myeloperoxidase activity and superoxide anion production may create an imbalance between the endogenous oxidant load and antioxidant defenses, leading to chronic inflammation and oxidative stress in the lungs. An increased oxidant load led to lung injury, and the increased oxidative enzyme activity and decreased cellular antioxidant levels may play a role in the increased rates of respiratory tract toxicity among bidi smokers.[129]

CONCLUSION

Bidis have been found to contain many of the same harmful chemicals associated with smoking Western-style cigarettes. It is more difficult to obtain accurate quantitative information and report levels in bidi smoke than it is with Western-style cigarette smoke because no standardized smoking machine method has been developed and established as the definitive experimental set-up to produce the bidi smoke needed to make such measurements. Various investigators have reported values of selected smoke constituents obtained using machine-smoking protocols with one, two, or even four puffs per minute resulting in different deliveries. The inconsistent machine smoking protocols lead to difficulty in determining potential health exposure risks. For a given static burn rate, the frequency and volume of the puff will determine the potential for exposure

to the harmful chemical constituents. A higher puff rate or a larger puff interval (or both) will result in a larger volume of smoke consumed. Consequently, how a bidi is smoked by a machine or a person, including the puff frequency, puff duration, and puff volume, will have a dramatic impact on the concentration of chemicals in the smoke. Therefore, to obtain more meaningful data for current and future public health researchers, a standardized testing protocol is needed to provide benchmarks for making quantitative chemical analyses.

Because of the low-porosity of the leaf wrapper and the absence of significant filtration, bidi smoke deliveries of toxic chemicals are generally higher than those from Western-style cigarettes. In addition to the known toxic chemicals in bidi smoke (e.g., ammonia, hydrogen cyanide, polyaromatic hydrocarbons, and tobacco-specific nitrosamines), the highly flavored varieties of bidi brands sold in the United States present additional analytical challenges and may provide unique exposure risks to potentially hazardous chemicals.

Bidis expose smokers to nicotine and numerous other hazardous chemicals by inhalation. Workers in the bidi industry have both dermal and inhalation exposure to unburnt bidi tobacco flakes and bidi tobacco dust, respectively. Exposure and absorption of nicotine have been documented in nonsmoking bidi rollers and bidi manufacturing plant workers by elevated levels of urine and saliva cotinine. Agricultural workers who handle tobacco leaves during harvesting have nicotine and cotinine in their urine and symptoms of nicotine toxicity. Bidi workers have elevated urine thioether levels, a finding that suggests they have been exposed to alkylating agents. Urine mutagenicity, a nonspecific measure of exposure to mutagens, is increased among tobacco-processing plant workers, bidi rollers, and bidi smokers.

Exposure to nicotine facilitates addiction, and exposure to other toxic chemicals in bidi smoke undoubtedly contributes to increased morbidity and mortality among bidi smokers. As with the smoke of Western-style cigarettes, bidi smoke is mutagenic in bacterial and mammalian test systems. Bidi tobacco also tests positive for mutagenicity but only after *in vitro* nitrosation. Systemic exposure to chemicals in bidi smoke or bidi tobacco results in chromosomal damage and an increased frequency of sister chromatid exchanges in bidi smokers and bidi industry workers. Studies of genotoxicity in bidi industry workers have demonstrated a significant increase in micronucleated buccal epithelial cells of bidi rollers and tobacco-processing plant workers.

In laboratory animals, bidi smoke condensate increases the activity of liver enzymes involved in the metabolism of a variety of foreign chemicals, including carcinogens such as benzo[*a*]pyrene. Aqueous bidi tobacco extracts demonstrated weak to moderate tumor-promoting abilities in mice. Aqueous bidi tobacco extracts also increase activity of ornithine decarboxylase, an enzyme activated during cell transformation by carcinogens and a proto-oncogene centrally involved in regulation of cell growth and transformation.[130] Bidi smoke condensate produced tumors at several sites in mice when administered orally. The finding of tumor-promoting and carcinogenic abilities by bidi tobacco and bidi smoke, respectively, lends experimental support to the epidemiological observation of malignant tumors of the respiratory tract and of the upper digestive tract that have been judged to be causally related to bidi smoking.[60]

Similar to what is known about Western-style cigarettes, nicotine and carbon monoxide in bidi smoke likely play a role in the increased risk of adverse cardiovascular effects seen in bidi smokers. Bidis contain about one-fifth to two-thirds the amount of tobacco present in a Western-style cigarettes, yet bidi smokers and smokers of Western-style cigarettes achieve similar, high

levels of COHb.[1,7,11,99-100] Increased myeloperoxidase levels, an inflammatory biomarker indicative of cardiovascular risk, have been reported for bidi smokers. Bidi smoking is associated with damage to the respiratory tract and notably with the development of chronic bronchitis. Increased myeloperoxidase activity and superoxide anion production and decreased glutathione in bidi smokers may create conditions of chronic inflammation and oxidative stress that promote the development of respiratory tract toxicity.

The available quantitative chemical and toxicological information related to bidis is limited and fragmented. Absent from the bidi toxicology literature are mechanistic studies employing modern, molecular techniques. Most previous studies have examined the effects of working with the raw materials during bidi manufacture or the mainstream smoke. No studies were located that describe the chemical composition of bidi-derived secondhand smoke (SHS) or its surrogate, sidestream smoke. Sidestream smoke is the smoke that comes off the lit end of a smoldering cigarette, rather than the smoke pulled through the mouth end of the cigarette during an active puff. Bidis are smoked in social settings, and therefore knowledge of the chemical constituents of bidi SHS is critical for characterizing health hazards from passive exposure to bidi smoke. The high prevalence of bidi smoking in Southeast Asia, the absence of uniform smoke-free indoor air restrictions, and the popularity and easy availability of flavored bidi brands in other countries merit continued research activities to help address public health concerns.[131]

The highly flavored bidi brands, such as those available United States, are relatively new and may pose additional health risks. Relatively little is known about the toxicity of many tobacco product flavor additives and their combustion products. In general, the rationale behind using many of these flavors is that they are considered to pose little or no harm when incorporated and ingested in foodstuffs. However, pyrolysis and inhalation of flavor additives is a vastly different exposure scenario than oral administration of these compounds. Digestion provides an opportunity for hepatic detoxification that is not available with inhalation exposure. Unfortunately, little information is available on the toxic effects of inhalation exposure for these combusted flavor compounds, and much work is required to provide an accurate assessment.

Future research efforts are needed to achieve a better understanding of the rela-tionship between smoking bidis and increased risks of morbidity and mortality. For instance, limited information is available on bidi smoking behavior (i.e., smoking topography). A large number of bidi smokers will have to be studied in order to determine average or typical smoking parameters, such as the number of puffs, the puff interval, inhalation volume, and length of inhalation. Such information would be invaluable to researchers designing studies of bidis and bidi smokers and would also assist in comparisons and compilations of data from different studies. Once these data are available, a comprehensive quantitative assessment of chemical constituents in bidi smoke can be conducted under conditions that more closely resemble actual human smoking behavior. In addition to chemical constituents associated with the leaf wrapper and sun-dried tobacco filler, much effort is needed to examine the chemical additives in the flavored bidi brands. Specific questions about flavored bidis brands include whether the chemical flavorants or their combustion products are harmful when inhaled and whether their presence increases the inherent toxicity of the bidi tobacco for bidi workers and bidi tobacco smoke for bidi smokers. Along with such chemical measurements, biological and toxicological testing is also needed to address gaps in the existing scientific literature and to advance our understanding of the mechanisms whereby bidis contribute to disease and death.

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3.2 Laboratory Studies of Bidi Smoking in Humans

Wallace B. Pickworth and Jennifer L. Malson

INTRODUCTION

This chapter explores the effects of bidi smoking in laboratory studies that employed volunteers who smoked bidi cigarettes in a highly controlled experimental environment. It begins with a brief discussion of the advantages and disadvantages of laboratory studies frequently used to characterize the effects of abused drugs and to probe human cigarette smoking behavior. It then focuses on small-sample within-subject clinical laboratory studies in which volunteers smoked bidi cigarettes.

Laboratory Studies of Nicotine Delivery

For nearly 50 years the effects of acute nicotine administration have been documented in controlled clinical laboratory studies.[1,2,3] These studies have repeatedly demonstrated the effects of acute nicotine delivery, largely through tobacco smoking, and have been a preferred way to evaluate tobacco and other nicotine delivery products. In a small-sample within-subject design each participant is exposed to all of the experimental conditions. This experimental paradigm provides multiple sessions with the same individual, which helps to reduce measurement error in the results, providing a cleaner, more reliable and valid view of the effects of bidi cigarette smoking. Furthermore, in small-sample studies there is exquisite control over independent experimental variables, such as subject population, state of nicotine withdrawal or satiety, and level of tobacco dependence. Additionally, this experimental model provides for a high level of statistical power so that hypotheses may be tested with relatively few research participants.

The utility of the laboratory model has been proven in experiments designed to estimate the abuse liability of several classes of drugs[4,5,6,7] including the opiates[8] and sedative/hypnotics,[9] benzodiazepines,[10] and alcohol.[11] Small clinical laboratory studies have proven useful in evaluating the effects of cigarette smoking[12] and nicotine administration and in outlining the effects of acute and extended tobacco abstinence.[13,14] This methodology has been applied to commercial smoking cessation aids,[15] nicotine replacement products,[16] and newer potentially reduced exposure products.[17] These studies have demonstrated that the quantity of nicotine delivery can be accurately estimated in studies that employ relatively few experimental participants.[18] Typically, in one or more experimental conditions the participants smoke a cigarette that is their usual brand or one that is closely matched for tar and nicotine delivery from machine-smoking estimates derived from Federal Trade Commission (FTC) methods[19,20,21] to control for the novelty of a different cigarette. In other experimental conditions the participants smoke the experimental product. Dependent variables might include measures of smoke exposure (exhaled CO, plasma nicotine) or those that index physiologic, cognitive, or subjective effects of smoking.

This methodology was employed to examine nicotine and CO delivery subjective and physiologic effects from several types of "alternative" flavored and experimental tobacco products. For example, the ability of de-nicotinized cigarettes to acutely diminish subjective but not physiologic effects of tobacco withdrawal has been repeatedly demonstrated.[22,23,24] The study verified substantial delivery of nicotine and CO after experimental subjects smoked clove cigarettes[25] and menthol

cigarettes.[26] The delivery of nicotine and other constituents of the smoke/vapor from a nicotine delivery device (Eclipse) that heats rather than burns tobacco was examined.[17] The small-sample within-subject experimental design was also employed in an evaluation of nicotine delivery from smokeless tobacco products.[27] In these studies the ability of the smoker to extract nicotine from the experimental cigarette in quantities similar to their usual brand was apparent. For example, when participants smoked a clove cigarette (that contained only 50% of the nicotine and tobacco of a conventional cigarette), equivalent plasma levels of nicotine were obtained.[25] In conditions where more nicotine was present in the cigarette rod, as was the case with the additive-free, non-filtered American Spirit cigarettes[28] and the experimentally produced high nicotine yield cigarettes,[26] slightly higher or equivalent plasma nicotine levels were seen after smoking. These data confirm that in the laboratory environment smokers regulate their smoking behavior to achieve familiar levels of nicotine,[29] and although the regulation may be somewhat imprecise, nicotine delivery appears to be an important regulator of smoking behavior.

Experience with using the small-sample within-subject design to evaluate nicotine delivery from "alternative" tobacco products led to interest in bidi smoking. Reports in newspapers, on television, and on the Internet, as well as in scientific literature[30,31,32] indicated the growing popularity of flavored bidis among American youth. The Massachusetts Department of Health tested bidi smoke using a modification of the machine-smoking analysis formerly used by the FTC to compare domestic (U.S.) cigarette brands. The smoke of bidi cigarettes contained high concentrations of nicotine (2.7 mg/bidi) and three times the amount of tar found in a filtered, conventional cigarette.[30,33] However, previous research has amply demonstrated that machine yields of nicotine from conventional cigarettes consistently underestimate the actual amount of nicotine exposure when cigarettes are smoked by people.[34,35] In the first study the concentration of nicotine in the tobacco of 12 popular brands of bidi cigarettes was compared with that of conventional American and Indian cigarettes. The tobacco from bidi cigarettes contained about 20% more nicotine than the tobacco from conventional cigarettes.[36] Although the bidis were smaller and contained only 1/3 the tobacco of the conventional cigarettes, the nicotine concentration in the tobacco of 11 out of 12 brands of bidi cigarettes was greater than concentrations in the tobacco from an unfiltered conventional cigarette. Analyses of the tobacco composition and reports of the growing popularity of bidi smoking among American youth provided the rationale for clinically examining nicotine absorption and subsequent physiologic effects resulting from bidi cigarette smoking.

Experimental Results of Bidi Smoking

In Study 1 college-aged volunteers smoked a bidi and a conventional cigarette.[37] In Study 2 an older population of research volunteers was recruited.[28] Blood samples were collected to document changes in plasma levels of nicotine in Study 2. Otherwise, the methods for both studies were similar and are described below. The interested reader is referred to the original publications for experimental details.

METHODS

Research Volunteers

Research volunteers were recruited from the college community through word-of-mouth advertisement (Study 1) and from the general community through newspaper advertisements and

word of mouth (Study 2). Prior to their participation, individuals signed an informed consent that had been approved by the Institutional Review Boards at the participating institutions. In both studies volunteers were paid for the time and inconvenience of study participation.

The 12 subjects (9 women) enrolled in Study 1 averaged 22 yrs of age (range 19-26). The participants had smoked for an average of five years (range 1-9) at a rate of 10 cigarettes per day (range 2-20). Their usual brand of cigarettes was a light cigarette with an FTC yield[19,20] of 0.8 mg nicotine and 11.3 mg tar. Three of the 12 subjects smoked menthol cigarettes. The average score on the Fagerström Test for Nicotine Dependence (FTND) was 1.5 (range 0-5) out of a maximum score of 10.[38]

Ten subjects (9 men) volunteered for Study 2. They averaged 24.5 years of age (range 20-37) and smoked an average of 25 cigarettes per day (range 20-40) and had smoked for an average 8.7 years (range 3-20) prior to enrollment. The FTC yields of their cigarettes averaged 0.9 mg nicotine (range 0.7-1.1) and 12.8 mg of tar (range 10-18).

Experimental Design

Both studies used a within-subject design; subjects were aware of the type of cigarette they were smoking. The order of cigarette exposure was randomized across subjects. In Study 1 subjects were tested in two experimental sessions on separate days: once smoking a Sher bidi (unflavored, non-filtered) and once smoking a conventional cigarette. The conventional cigarette was not the usual brand the subject smoked but rather a cigarette with similar FTC nicotine and tar yield and flavor (i.e., menthol or non-menthol) as their usual brand. This manipulation was intended to control for the novelty effect of the bidi experience. In Study 2 subjects were tested on four occasions on separate days. They smoked a Sher bidi (unfiltered), an Irie bidi (strawberry flavored, unfiltered), an American Spirit (unfiltered, 'additive-free'), and their usual brand of cigarette. All cigarettes were obtained from a local tobacco outlet.

Procedure

An indwelling cannula was placed into a forearm vein (Study 2 only) for blood sampling. Baseline values of heart rate, blood pressure, exhaled CO, and blood (Study 2) were collected. The subject smoked the cigarette ad libitum. The time to smoke and number of puffs were recorded by the research associate.

Dependent Measures

Systolic and diastolic blood pressures and heart rate were recorded using an automated monitoring instrument (Datascope, Paramus NJ). Cardiovascular measures were made before and 10 minutes after smoking (Study 1) and 2, 5, 10, 30, and 60 minutes after smoking (Study 2). Exhaled CO was measured with a Vitalograph (Lenexa, KS) monitor before and 15 minutes after smoking (Study 1) and 15, 30, and 60 minutes after smoking (Study 2). Blood (100 cc) was collected before and 2, 5, 10, 15, 30, and 60 minutes after smoking (Study 2). The blood was centrifuged and the plasma was removed and frozen (-20 C). Samples were analyzed for nicotine by the high performance liquid chromatography method.[39]

In both studies, 20 minutes after smoking participants completed the Duke Sensory Questionnaire[40] and the Cigarette Evaluation Scale.[41] Both questionnaires employ a seven-point

Likert Scale, with responses ranging from 1 = not at all to 7 = extremely. The Duke Sensory Questionnaire consists of nine items relating to puff liking, puff satisfaction, similarity to own brand, and puff strength on mouth, nose, tongue, throat, windpipe, and chest. The Cigarette Evaluation Scale has 11 items that evaluate the smoking experience in terms of satisfaction, good taste, and effects on craving and enjoyment of sensations. Composite scales of several items were created to measure satisfaction, psychological reward, and aversion.[42]

Table 3.2.1: **Substance delivery factors.**

	Study 1		Study 2		
	Sher	Conventional	Sher	Irie	Conventional (own brand)
Puffs per cigarette (#)	14.2 ± 5.5*	9.8 ± 2.7	14.1 ± 4.3*	13.6 ±3.9	10.4 ± 3.9
Time to Smoke (sec.)	417 ± 182*	290 ± 73	354 ± 110*	322 ± 107	297 ± 72

Note: Mean ± standard deviation
n= 12 (Study 1); n= 10 (Study 2).
*Represents significant differences from conventional cigarette, p<.05.

RESULTS

Substance Delivery Factors

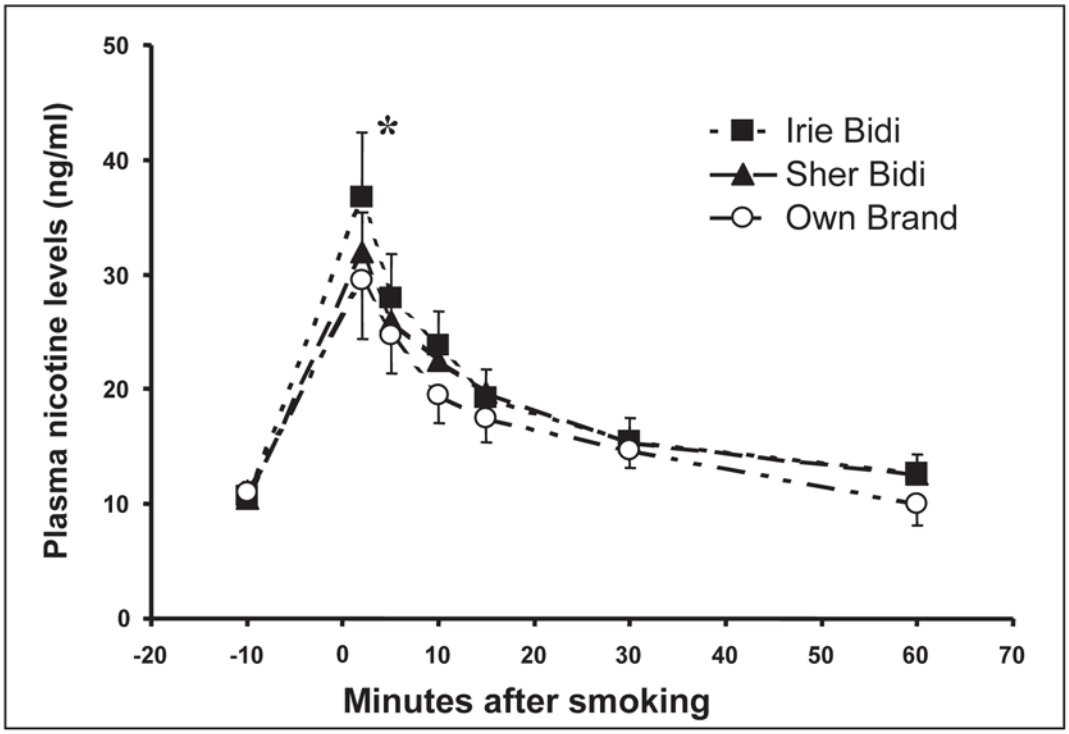
As shown in Table 3.2.1, subjects in both studies took longer to smoke the bidi cigarettes than their own brand (Study 2) or a similar conventional brand (Study 1). Furthermore, more puffs were needed to consume the bidi cigarettes than the conventional cigarettes.

Biochemical Measures of Smoke Exposure

Plasma nicotine levels are a well accepted measure of exposure to nicotine and other toxins of tobacco smoke. As illustrated in Figure 3.2.1, plasma levels of nicotine (Study 2) rose rapidly after smoking either of the bidi cigarettes or a conventional cigarette (own brand). Plasma levels of nicotine increased from baseline (10 ng/ml) to 36 ng/ml after the Irie bidi and to 31 ng/ml after the Sher bidi; the conventional cigarette increased plasma nicotine levels by 19 ng/ml from 10 to 29 ng/ml. The highest levels of plasma nicotine were observed at the first blood collection time after the end of smoking (2 minutes). At that time the increase in plasma nicotine with the Irie bidi was significantly greater than with the conventional cigarette. Subsequent plasma levels decreased to baseline levels at 60 minutes after the cigarette.

Exhaled CO is another commonly used marker of smoke exposure.[43] In a non-smoker the exhaled CO is typically < 2 ppm, whereas in a pack-a-day smoker afternoon values of >20 ppm are common. In Study 1, baseline CO levels were 11 ppm before either the bidi or the conventional cigarette. After smoking, CO levels increased to 17 ppm in both conditions. As shown in Table 3.2.2, the CO increase did not differ significantly between the two conditions. In Study 2 the bidis and the conventional cigarette increased exhaled CO to levels significantly larger than baseline. CO increases seen after the Irie bidi were significantly larger than after the conventional cigarette.

Figure 3.2.1: **Plasma nicotine levels *vs.* minutes after smoking.**



* Represents significant differences from Irie bidi and own brand, p<.05.

Table 3.2.2: **Exhaled carbon monoxide (CO) in ppm.**

	Study 1		Study 2		
	Sher	Conventional	Sher	Irie	Conventional (own brand)
Exhaled CO (ppm)	6.2 ± 1.3	5.7 ± 1.2	3.4 ± 1.3	5.0 ± 3.1	4.6 ± 1.8

Note: Mean ± standard deviation of change from baseline 15 minutes after smoking

Physiologic Markers

Heart rate typically increases after cigarette smoking, particularly after the first cigarette of the day or after an extended period of tobacco abstinence.[44] In both Study 1 and 2 smoking either a bidi cigarette or a conventional cigarette caused a rapid, transient increase in heart rate. For example, in Study 1 bidi smoking increased the mean heart rate from 81 (± 4.2) to 95 (± 2.7) beats per minute (bpm), whereas smoking the conventional cigarette increased heart rate from 72 (± 2.2) to 91 (± 2.5) bpm. Although the increase in heart rate was significantly different from baseline, there was no significant cigarette-by-time interaction, indicating that there were equivalent increases in heart rate after both the bidi and the conventional cigarettes. The subjects in Study 2 were heavier smokers and more nicotine dependent than the subjects in Study 1; therefore, the smoking-induced increases in heart rate were smaller after the bidi cigarettes (Irie bidi 6.7 ± 7.7 bpm; Sher bidi 7.1 ± 7.5 bpm) and the conventional cigarette (2.5 ± 6.4 bpm). The smaller increases in heart rate in the more dependent smokers may have been influenced by the higher baseline heart rate in this subject group.

Blood pressure is irregularly affected by smoking; in some instances there is a slight increase and in other instances no significant changes occur. In Study 1 bidi smoking did not significantly increase systolic or diastolic blood pressure; however the conventional cigarette significantly increased diastolic blood pressure. In Study 2 both the conventional cigarettes and the bidis significantly increased systolic and diastolic blood pressure, but there were no significant differences between the bidi and the conventional cigarette.

Subjective Measures

The subjective response to smoking bidi cigarettes was assessed in both studies by means of the Cigarette Evaluation Scale (CES)[45] and the Duke Sensory Questionnaire (DSQ).[40] As mentioned above, subscales were constructed from the items of these questionnaires and the results are summarized in Table 3.2.3. In both studies participants found that the bidis were less satisfying, less pleasurable, and less able to reduce cigarette cravings than the conventional cigarette. The Irie bidi was rated significantly less strong than the conventional cigarette (Study 2), despite the fact that plasma nicotine levels were higher after smoking the bidi cigarette.

Table 3.2.3: **Subjective evaluation of cigarettes.**

	Study 1		Study 2		
	Sher	Conventional	Sher	Irie	Conventional (own brand)
DSQ					
Liking	4.3 ± 1.4	5.0 ± 1.0	3.9 ± 1.6	4.8 ± .09*	6.3 ± .07
Satisfaction	4.3 ± 1.6*	5.7 ± 0.9	3.7 ± 1.7*	4.8 ± 1.3*	6.3 ± .07
High in Nicotine	5.3 ± 1.2	5.4 ± 1.4	4.2 ± 1.9	4.7 ± 1.8	5.2 ± 1.1
Similar to Own Brand Strength	2.9 ± 1.7	4.2 ± 1.8	1.6 ± 1.0*	1.9 ± 1.1*	7.0 ± 0.0
(ms = 35)	22.0 ± 8.2	21.0 ± 6.8	18.6 ± 5.9*	21.4 ± 5.4	24.6 ± 7.4
CES					
Satisfaction (ms = 14)	8.3 ± 3.4	9.8 ± 2.7	8.4 ± 3.4*	9.2 ± 2.4*	12.6 ± 1.2
Enjoyment of Sensations	3.3 ± 1.6	3.9 ± 1.6	3.7 ± 1.8*	4.7 ± 1.1	5.7 ± 0.1
Psychological Reward (ms = 35)	15.1 ± 6.4	17.0 ± 6.3	14.3 ± 7.3	17.5 ± 5.4	19.3 ± 6.5
Aversion (ms = 14)	5.4 ± 3.1	5.5 ± 2.9	4.3 ± 2.1	6.1 ± 3.5	3.5 ± 1.8
Craving Reduction	4.0 ± 2.2	4.4 ± 1.8	4.1 ± 2.0*	4.7 ± 1.8*	6.0 ± 0.9

Note: ms = maximum score; if not stated maximum score = 7. DSQ = Duke Sensory Questionnaire; a nine item questionnaire assessing subjective characteristics of the cigarette. CES = Cigarette Evaluation Scale; an eleven item questionnaire assessing the overall smoking experience. Composite scales of several items in the CES were created to measure satisfaction, psychological reward, and aversion.[42]
*Represents significant differences from own brand, $p<.05$.

DISCUSSION

The two clinical studies were designed to determine the acute effects of ad libitum bidi smoking on two physiologic parameters, a wide range of subjective measures, and important biochemical measures. They found that, similar to conventional cigarette smoking, bidi smoking increased plasma levels of nicotine. A major and surprising finding of Study 2 was that, although the bidi cigarettes contained much less tobacco (Sher 166 mg; Irie 210 mg; conventional cigarette 738 mg),[36] they delivered as much or significantly more nicotine than the participants' own brand

of conventional cigarettes as evidenced by plasma nicotine levels that equaled or exceeded those of the conventional cigarette smoking.

Exhaled CO, another direct measure of smoke exposure, was similarly increased after both bidi and conventional cigarettes. This suggests that smokers would be exposed to high levels of other toxins that are found in bidi smoke. Toxin exposure is determined by the constituents of the smoke, the number of cigarettes consumed per day and the exposure per cigarette, which is a function of depth of inhalation, puffs per cigarette, and other smoking topography measures. There is no evidence that smoking bidis would lead to lower exposure to nicotine, CO, or other toxins. Furthermore, indirect indices of exposure, such as increases in heart rate and systolic and diastolic blood pressure, were quantitatively and qualitatively similar after bidi and conventional cigarettes. These results strongly indicate that despite their small size and diminished nicotine content, subjects are able to extract comparable quantities of nicotine and presumably other toxic components of tobacco smoke.

Other similarly designed laboratory studies have found that regardless of the type of the cigarette and its apparent nicotine delivery capabilities, smokers are extremely capable of extracting "usual" quantities of nicotine. For example, in a study of clove cigarettes whose nicotine content was about one-half of that of conventional cigarettes, plasma nicotine levels were equivalent after ad libitum smoking either cigarette.[25] Another study compared plasma nicotine levels after smoking an experimental nicotine delivery device (NDD; Eclipse) that heats rather than burns tobacco or the subject's usual brand of commercial cigarette.[17] Furthermore, both the NDD and the cigarette were smoked conventionally (hand held) or through the mouthpiece of a smoking topography instrument. Regardless of the type of cigarette or the way it was smoked, nicotine plasma levels were equivalent in all conditions. These and other published studies indicate that smokers of bidis and other unfamiliar tobacco products are able to regulate smoke exposure so that a sufficient amount of nicotine is absorbed. The subjects in both studies took more puffs and more time to smoke the bidis than the conventional cigarette. It is also probable that the small diameter of the bidis and their nonporous wrapping change the puff pressure and the air dilution of the smoke, smoke chemistry, and the concentration of various smoke constituents.[46] Thus the finding of similar CO and nicotine intake from products with less than half of the tobacco material as conventional cigarettes suggests that the smoke may be more concentrated. In addition, or alternatively, differences in puffing behavior may account for the ability to extract equivalent amounts of nicotine.

Within-subject clinical laboratory studies using fewer than 10 subjects are valid and useful approaches to examine the effects of tobacco-delivered nicotine. The experimental design was adopted from studies on the effects of a wide range of psychoactive compounds.[47] However, there are some limitations associated with this study design. The responses of relatively few subjects are used to generalize to the very broad demographic of bidi smokers in the U.S. and abroad. Youths who smoke bidi cigarettes indicate that they choose bidis because they like the flavor and taste.[30] However, the subjects of both studies did not endorse high levels of liking for the bidi cigarettes compared to their own brand (Study 2) or a comparable conventional cigarette (Study 1). Although these subjects had smoked bidi cigarettes on at least one occasion prior to their participation, they did not indicate high levels of satisfaction, taste, and overall appeal. Anecdotal reports from research subjects indicated that they smoked bidis occasionally, but none were exclusive bidi smokers. Many subjects reported that they would smoke them as a matter of convenience or when offered to them as a novelty tobacco product. It is possible that the levels

of satisfaction and liking would have been higher in a subject population consisting of more frequent bidi smokers.

CONCLUSION

The results of these laboratory studies have important theoretical and practical implications. Although bidis are smaller and contain far less tobacco than conventional cigarettes, after bidi smoking the participants exhibited similar or slightly higher plasma levels of nicotine than after conventional cigarette smoking. Thus, although many consumers smoke bidi cigarettes because of their belief that they are less harmful than conventional cigarettes,[30] the study results do not support that notion.

These data add to the observations of many others that nicotine importantly regulates the process of smoking.[29,48] As with other novel alternative nicotine delivery systems and commercial tobacco products, experienced smokers are extremely capable of extracting usual quantities of nicotine and other components of tobacco smoke that regulate smoking. These data again emphasize that smokers regulate plasma nicotine by changing their smoking behavior, consciously or unconsciously.[49,29] Future research is needed to determine whether the regulation persists when novel cigarettes are smoked chronically or to determine if the levels of liking and satisfaction for the bidi products increase over time.

The study results suggest that the health consequences of bidis are likely to be similar to those of conventional cigarettes. Young people in the U.S. who smoke bidis because they perceive them to be a less harmful alternative to conventional cigarettes are misled. A review of epidemiologic literature and the medical consequences of chronic bidi smoking verifies the toxicity of bidi cigarettes in India and elsewhere.

A central issue pertaining to alternative tobacco products – whether bidis, cloves, or products introduced and promoted by the tobacco industry as less harmful – is their ability to initiate and support tobacco dependence. There are no clear guidelines on the amount, rate, or frequency of nicotine delivery that initiates nicotine dependence.[50,51,52] It is very likely a highly individual threshold. Nevertheless, Benowitz and Henningfield conservatively estimated that as little as 5 mg/day could sustain dependence (prevent withdrawal) and estimated that cigarettes that deliver about 0.17 mg of nicotine (about 1/6 the amount of a typical American cigarette) would not initiate repeated use.[53] Although these estimates may be imprecise, it is clear from the data that bidis deliver nicotine in quantities and at speeds equivalent to conventional cigarettes and have the potential to initiate and sustain dependence. The epidemiologic evidence and the characteristically compulsive use of bidis throughout the Indian subcontinent support the notion that they are addictive.[54,55]

Recent media attention about bidi smoking in the U.S. and documentation in the medical literature about increasing prevalence of bidi use among U.S. teens has led to calls for regulation on their importation and sale. Some states have prohibited the sale of bidi cigarettes. Ironically, within the past several years U.S. tobacco manufacturers have begun to market and advertise highly flavored tobacco products. For many years menthol flavoring of cigarettes was the sole taste alternative. Recently, Camel Cigarettes (U.S. Tobacco) has released a product line consisting of cigarettes flavored with clove, cinnamon, mint, berry, and citrus. The presence of these products in the market illustrates the importance of taste and new product appeal to stimulate initiation and contribute to the maintenance of tobacco consumption. In part some of the appeal of new

products is due to assumptions by consumers (bolstered by product marketing) that the newer products are less harmful than conventional cigarettes. As the U.S. tobacco industry continues to develop and promote highly flavored cigarette products, as they have for smokeless tobacco products, regulation of bidis and other imported cigarettes may not ultimately reduce the availability of highly flavored "exotic" blend cigarettes that pique the interest of U.S. consumers. It is therefore critical to include consideration of bidis, the highly flavored conventional cigarettes and other new tobacco products in regulatory efforts by the U.S. Food and Drug Administration and the World Health Organization.[52]

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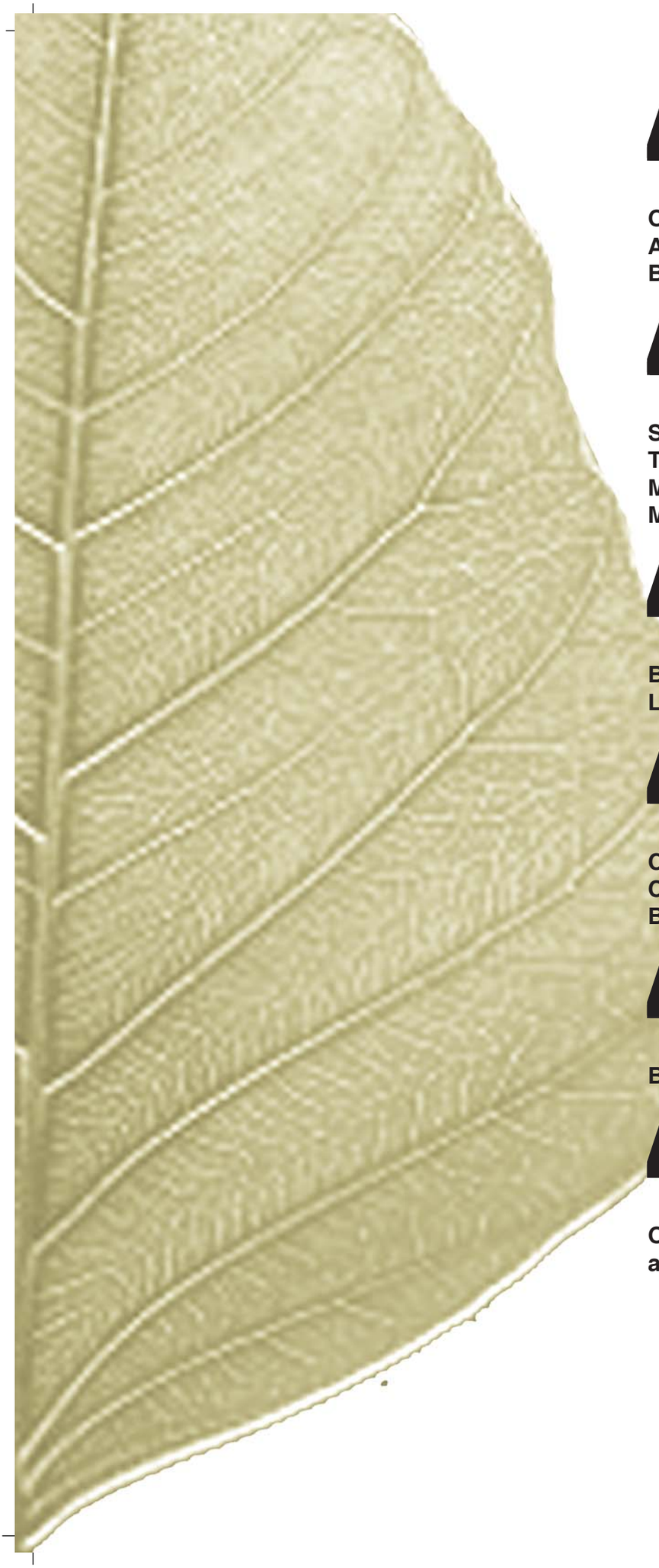

CHAPTER 4

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4.1 Overall Mortality Associated with Bidi Smoking

Mangesh S. Pednekar and Prakash C. Gupta

INTRODUCTION

This chapter reviews the excess mortality among bidi smokers as reported in studies from different parts of India. The health consequences of smoking habits have been studied extensively in many parts of the world. The most widely studied smoking habit is cigarette smoking, the most common form of tobacco use in industrialized countries. In industrialized countries the use of tobacco in forms other than cigarettes is not very common, although some studies show the situation may be changing.[1]

In India, tobacco is smoked, chewed and applied in a wide variety of ways,[2] which have all been shown to be causal risk factors for many types of cancers, such as cancer of the mouth, pharynx, larynx, esophagus and lungs.[3-5] The most common type of smoking is bidi smoking. The bidi is often called the poor man's cigarette and is perhaps the cheapest tobacco smoking product in the world, costing about a one-third of one U.S. cent in India. A bidi contains about one-fourth the quantity of tobacco as a cigarette yet it delivers a higher amount of tar and nicotine. Just like cigarette smoking, bidi smoking has been shown to increase the risk of chronic bronchitis, tuberculosis, and respiratory diseases.[6-9]

Globally tobacco is responsible for the death of one in ten adults worldwide, about five million deaths each year.[10] In India, the first estimate of tobacco-attributable mortality during 1980s was 630,000 deaths per year.[11] It well established that overall mortality rates for cigarette smokers are 60% to 80% higher than for non-smokers. In India, mor-tality rates among bidi smokers were reported to be significantly higher compared to smokeless tobacco users[12] or non-tobacco users.[7-9, 13]

DESCRIPTION OF STUDIES AND RESULTS

Information on excess mortality among bidi smokers is available from four cohort studies and one case-control study.

The Mumbai cohort study is ongoing since 1992. A population-based baseline survey of 99,598 individuals was conducted during 1992-94. Voter lists were used as the selection frame and the sample was confined to the island city of Mumbai (formerly Bombay); personal interviews were conducted on a house-to-house basis. The survey population largely consisted of individuals belonging to the lower and lower-middle classes. Apartment complexes that housed upper-middle and rich classes were not included, due to the difficulty of approach caused by the residents' security precautions and because they perceived no material gain from cooperating.[14] An active house-to-house follow-up was conducted after about 5-6 years. The method of person-year was used to calculate death rates and the relative risks. Since very few women were smokers, the analysis was restricted to men. Interim results from follow-up of 52,568 individuals were published in 2000.[8] Complete follow-up results of 99,598 individuals are reviewed here.[9]

In active follow-up after an average of 5.5 years, 97,244 (98%) individuals were traced. Among these, 7,531 deaths were recorded. A total of 210,129 person-years accrued among men, of which 27% was contributed by smokers, 46% by smokeless-tobacco users and the remaining 27% by non users of tobacco. Among all smokers, 55% were bidi smokers.[14] Age-specific mortality rates among bidi smokers were higher than among non-users of tobacco across all age groups, the excess risk being higher (RR-3.2) for the younger age group (< age 50 yrs) compared to older people (RR-1.5). The overall relative risk adjusted for age and education was 1.37 for cigarette smokers and 1.64 for bidi smokers, with a significant dose-response relationship for frequency of smoking. The relative risk for smoking one to five bidis per day was 1.42 (95% CI 1.20-1.68). For smoking 6-10 bidis/day the relative risk of death was 1.59 (95% CI 1.35 – 1.87); for 11-15 per day it was 1.62 (95% CI 1.37 – 1.91) and for >= 16 per day it was 1.78 (95% CI 1.57-2.02), showing a clear dose response relationship.[9]

Another cohort study was conducted in Ernakulam district, Kerala, South India during 1967-76. In the baseline survey, a number of villages were selected by random sampling and a total of 10,287 individuals aged 15 years and over were interviewed about their tobacco habits in a house-to-house survey. These individuals were re-interviewed after three years and then followed up yearly. A total of eight follow-up surveys were conducted, providing ten years of follow-up results. The follow-up responses ranged from 70% to 74% and the percentage of individuals re-interviewed at least once was 87%. For calculation of death rates the method of person-years was used. Very few (<1%) women smoked, therefore smoking analysis was restricted to men.

Over 85% of the person-years for males were in the tobacco habits group, the majority in the smoking habit group. The overall crude (RR – 2.5) as well as age-adjusted (RR – 1.4) relative risks for tobacco users versus non-tobacco users were highly significant. The excess mortality among smokers was significant (age adjusted RR – 1.5) and was of the same order of magnitude as reported for cigarette smokers in other parts of the world. It should be pointed out that most smokers (~ 90%) in the baseline survey were bidi smokers.[14]

A ten-year follow-up study was performed of tobacco usage and oral disease in a random sample of 10,169 persons aged 15 years and over in Srikakulam district between 1967 and 1976. These individuals were interviewed again three years later and then every year after until ten years of follow-up results were obtained. The proportion followed up, which represents the individuals available for oral examination, was 87%. The loss to follow-up was mainly due to migration outside the district. Information about mortality was collected from the available family members or close relatives.

The dominant habit in Srikakulam district was reverse smoking, i.e., smoking with the glowing end inside the mouth. Conventional smoking was practiced by about 30% of men and included bidi and *chutta* (a country-made cheroot). Around 19% of men did not use tobacco in any form. After ten years of follow-up, 16,989 person-years of observation accrued among conventional smokers and 7,995 among non tobacco users. Age-adjusted relative risk for conventional smokers was 1.77 as compared to non tobacco users.[15]

A follow-up study of two selected cohorts was carried out (1968-71) in Ambegoan and Junnar talukas of Pune district, in Maharashtra. The cohorts were selected from a sample of 101,761 individuals above the age of 15 years who were interviewed and examined in a house-to-house survey for the presence of oral cancer and precancerous lesions.[16] Detailed information regarding

the usage of tobacco was obtained from each individual. One cohort consisted of all leukoplakia cases. The other cohort consisted of two controls for each oral lesion detected, matched for tobacco habits, sex, age (within two years) and neighborhood. The exact number of individuals in the cohort was not specified but in the baseline the number of leukoplakia cases was 521 and total number of oral lesions 1250 (therefore 2500 men in the control cohort). In follow-up surveys, all cohort members were interviewed four times over an eight-year period. The analysis was restricted to men. A few men were non users of tobacco (as almost everyone with an oral lesion used tobacco and controls were matched for tobacco habit) and therefore were excluded from analysis. The analysis was done using the method of person-years. The smoking habits consisted almost solely of bidi smoking. The relative risk of all cause mortality for bidi smokers compared to tobacco chewers was 1.6. The excess mortality among bidi smokers reported here was not in comparison to the general population of non-smokers but to a comparable group of smokeless tobacco users.[12]

A case-control study of 43,000 adult male deaths and 35,000 living controls was reported from urban and rural areas of Tamil Nadu, in southern India. The urban study area was the whole of the city of Chennai, formerly Madras (population 4 million), the capital of the state of Tamil Nadu. Death records for 1995-97 in the Chennai Vital Statistics Department were used to identify all deaths during those years at age 25 years or above. All the eligible households were visited in 1998-99 to collect data, including the smoking habits of the deceased and medical circumstances of death. A total of 27,000 deaths among men were available as cases. The control pool consisted of 20,000 living family members, preferably the surviving spouse.

The rural study area in this case-control study was 2000 villages in the district of Vilippuram, population 2.5 million. The cases were all the deaths occurring among men age 25 years or older during 1997-98. In all 16,000 households were visited during 1999-2000. Cause of death was assigned by using verbal autopsy procedure. Detailed signs and symptoms prior to death were recorded by specially trained investigators who interviewed the next of kin. The information was reviewed by a physician to arrive at the cause of death. The control pool consisted of 15,000 respondents from the same families.

In urban study areas, at ages 25-69 years, 59.6% of the men who had died from medical causes (cases) had been smokers (52.2% in rural areas), as against only 39.0% of the corresponding age-matched controls (42.8% in rural areas). The adjusted (for age, education and use of smokeless tobacco) risk ratio was 2.1 (95% CI, 2.0-2.2) for urban and 1.6 (95% CI, 1.5-1.7) for rural, indicating that middle aged (25-69 years) smokers had significantly higher death rates than non-smokers from all medical causes combined. In urban areas, cigarette smoking predominated among urban controls aged 25-69 years, 4,344 smoked only cigarettes and 798 smoked only bidis. Among the few urban men who did smoke only bidis, however, the cause-specific standardized risk ratios were significantly high (tuberculosis: 6.3 [95% CI, 5.3-7.5]; other respiratory: 3.7 [95% CI, 2.9-4.6]; vascular: 1.7 [95% CI, 1.5-1.9]; neoplastic: 2.0 [95% CI, 1.7-2.5]). In rural areas, bidi smoking predominated among rural controls aged 25-69 years; 679 smoked only cigarettes and 5024 only bidis. As in urban areas, the cause-specific risk ratios (adjusted for age, education and use of smokeless tobacco) were significantly high (tuberculosis: 4.2 [3.7-4.8]; other respiratory: 3.6 [3.0-4.3]; vascular: 1.7 [1.6-1.9]; neoplastic: 2.5 [2.0-3.1]) in rural areas.[7]

CONCLUSION

There are differences in the nature of effects of bidi smoking seen in India and cigarette smoking in the West. For instance, in the U.S. cigarette smoking leads primarily to lung cancer, accounting for over 70% of tobacco-related cancer deaths and a third of all cancer deaths. In India, where bidi smoking and use of smokeless tobacco are common, the major effects of tobacco are seen in the oral cavity, pharynx and esophagus, which together account for almost 75% of tobacco-related cancers.[4]

Tuberculosis is an extremely important cause of death in India, contributing about 400,000 deaths among men annually.[7, 9] Mortality from tuberculosis is reported to be four times as great among smokers compared to non-smokers. About a quarter of all persistent smokers of cigarette or of bidis are killed by tobacco and will lose about 20 years of life expectancy. A third of the deaths caused by smoking are from vascular disease and half are from tuberculosis or other respiratory disease.

Besides the epidemiological observations, there is also experimental evidence showing that bidi smoke has an effect that is equally as harmful as cigarette smoke on parameters such as pulse rate, blood pressure, platelet aggression time and serum-free fatty acid levels known to be related to the pathogenesis of CHD.[4]

These results demonstrate that bidi smoking is at least as important as cigarette smoking. In India where eight to ten times more bidis are smoked than cigarettes, a gross underestimation of the tobacco problem would occur by ignoring bidis. Bidi smoking is practiced in neighboring countries and there are recent reports of its availability and popularity in the USA as well, especially among youth.[1, 17] This is also true for youth in India; the Global Youth Tobacco Survey shows a high prevalence of bidi smoking among school children aged 13-15 years across India.[18] Interestingly, high prevalence was reported among school personnel as well.[19] The results on bidi smoking therefore are more relevant to India, but interesting for many other countries. As the younger generation takes up bidi smoking not only in India but also globally (even though not very high), preventive measures must be taken to avoid long-term health effects. Almost all the studies carried out in different parts of India reported a significantly high risk (>1.5) of dying among bidi smokers. These findings have important implications for public health efforts to reduce tobacco use. A comprehensive approach to tobacco prevention and cessation campaigns must address other tobacco products as well as bidis. Also, appropriate warning labels on bidi packets and advertisements, and higher taxation on bidis, similar to cigarettes, seem highly desirable from a public health point of view. Further research is needed to clearly delineate the pattern of causes of mortality among different types of smoking, mainly bidi smoking, as well as smokeless tobacco use in India.

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4.2 Smoking and Pulmonary Tuberculosis: Mortality and Morbidity in India

Vendhan Gajalakshmi and Richard Peto

INTRODUCTION

Pulmonary tuberculosis (TB) is a major cause of death in India. This chapter reviews the epidemiological relationship between smoking and cases of TB or deaths from TB. Reports of case-control and cohort studies carried out in the states of Tamil Nadu, Kerala, Chandigarh and Maharashtra provide the relative risks of having TB or dying from it for smokers in general and bidi smokers in particular. The chapter also provides an estimate of the number of deaths from pulmonary TB in India that can be attributed to tobacco smoking and the approximate age distribution.

In the main case-control and prospective studies on smoking and TB in India, cases were one of the following: (1) patients recently diagnosed at TB clinics as definitely having active TB, (2) individuals self-reporting a history of TB, or (3) persons whose death was due to TB according to "verbal autopsy". Women in India who use tobacco tend to chew rather than smoke, hence the analyses were generally restricted to men.

DESCRIPTION OF STUDIES AND RESULTS

Tamil Nadu Studies

A case-control study on tobacco use with urban and rural surveys in the state of Tamil Nadu, south India, was conducted to study causes of death.[1] Analysis of smoking was restricted to men. The cases were men aged 25 and above at the time of death due to medical causes in the city of Chennai (urban population of 4.0 million) during 1995-1997 and in the district of Villupuram (rural population of 2.5 million distributed among 2000 villages) during 1997-1998. The interviews with households where death had occurred (male or female) took place from 1998 to 2002. The controls were men aged 25 or older, either married to a woman who died during the study period (1995-1997) or a male family member living in the same home as the deceased woman. The study in the urban area included 27,000 cases (2200 of whom had died of TB), and 20,000 controls, whereas the rural area study included 16,000 cases (1800 of whom had died of TB), and 15,000 controls. The probable underlying cause of death was assigned by verbal autopsy.

The verbal autopsy tool used for adult deaths in Tamil Nadu was an open narrative format with a checklist of symptoms and signs to obtain details on the chain of events or circumstances preceding the death. Random re-interviewing of five percent of the verbal autopsy reports was carried out. All verbal autopsy reports were centrally but independently reviewed by two physicians to arrive at "probable underlying cause of death". The validity of the verbal autopsy tool was assessed only for cancer deaths because a population-based registry with morbidity and mortality databases for com-parison is available only for cancer in Tamil Nadu. The sensitivity of the verbal autopsy tool to identify cancer was 94% in the age group 25-69.[2-4]

In the urban area, 60% of those who had died of a medical cause smoked (ages 25-69), but only 39% of the controls were smokers. This corresponds to a standardized (for age, education and use of smokeless tobacco) risk ratio (RR) of 2.1, with narrow confidence limits (2.0-2.2), indicating that middle-aged (25-69 years) smokers have about twice the death rate from medical causes as non-smokers. If the smokers had had the same age-specific death rate as the non-smokers, 5021 deaths (31% of all deaths from medical causes at these ages) in the urban area during the study period would have been avoided (Table 4.2.1). In the rural area (age range 25-69 years), 52% of the cases and 43% of the controls were smokers (chiefly of bidis), corresponding to a standardized (for age, education and use of smokeless tobacco) RR of 1.6, with narrow confidence limits (1.5-1.7), indicating that middle-aged rural smokers have a 60% higher death rate from medical causes than non-smokers. If the smokers had had the same age-specific death rate as the non-smokers, 2057 deaths (20% of all deaths from medical causes at these ages) in the rural area during the study period would have been avoided (Table 4.2.1). The risk among smokers of dying from TB was

Table 4.2.1: **Death from pulmonary tuberculosis, by smoking and age; men in urban and in rural areas of Tamil Nadu.**

A: Urban (Chennai): 2231 tuberculosis deaths (cases) and 20,162 controls

Age range	TB deaths (cases)		Unmatched controls		Risk ratio, ever/ never smoked* (& 95% CI)	Smoking-associated	
	No.	% smoked	No.	% smoked		%	No.
25-34	205	73.7	1787	31.7	5.1 (3.6-7.1)	59	121
35-44	415	80.2	3847	40.7	4.6 (3.6-6.0)	63	261
45-54	517	82.4	5079	41.5	5.2 (4.1-6.6)	67	344
55-64	494	78.9	4171	39.8	4.4 (3.5-5.5)	61	301
65-69	209	72.2	1604	36.3	3.4 (2.4-4.8)	51	107
70-74	177	74.0	1570	37.8	4.1 (2.9-5.9)	56	99
75+	214	64.0	2104	30.8	3.4 (2.5-4.6)	45	96
Subtotal:							
25-69	**1840**	**78.9**	**16,488**	**39.2**	**4.5 (4.0-5.0)**	**61**	**1127**
All medical causes	16,076	60.0	16,488	39.2	2.1 (2.0-2.2)	31	5021

B: Rural (Villupuram): 1841 tuberculosis deaths (cases) and 15,128 controls

Age range	TB deaths (cases)		Unmatched controls		Risk ratio, ever/ never smoked* (& 95% CI)	Smoking-associated	
	No.	% smoked	No.	% smoked		%	No.
25-34	119	64.7	2738	43.1	2.4 (1.6-3.5)	37	44
35-44	291	79.7	4068	51.8	4.1 (3.1-5.6)	61	176
45-54	471	75.8	3510	47.8	4.0 (3.2-5.1)	57	268
55-64	461	74.4	2183	39.4	5.5 (4.3-6.9)	61	280
65-69	167	59.9	864	34.3	3.2 (2.3-4.6)	41	77
70-74	139	51.1	794	36.1	2.2 (1.5-3.3)	28	39
75+	173	49.1	971	29.4	2.5 (1.8-3.5)	29	51
Subtotal:							
25-69	**1529**	**73.3**	**13,363**	**44.0**	**4.2 (3.7-4.8)**	**56**	**853**
All medical causes	10,121	52.0	13,363	44.0	1.6 (1.5-1.7)	20	2057

*Standardized for age, educational level and use of smokeless tobacco.
Source: Gajalakshmi et al. 2003.[1]

four times that among non-smokers in both urban (RR: 4.5; 95% CI: 4.0-5.0) and rural (RR: 4.2; 95% CI: 3.7-4.8) areas. Seventy-nine percent of the 1840 deaths from TB in the urban area involved smokers, and 61% (1127/1840) of all male TB deaths in this age range would have been avoided if the smokers had had non-smoker TB death rates. Of the 1529 deaths from TB in the rural area, 73% of those who had died of TB had smoked, and 56% (853/1529) of the deaths from TB would have been avoided.[1]

Age-specific comparisons throughout adult life between the men whose deaths were attributed to pulmonary TB and the controls are given in Table 4.2.1. In urban Chennai, the smoker versus non-smoker RRs decreased slightly with age, from 5.1 in early adult life (25-34 years) to 3.4 in old age (75+), but in each age group the excess TB mortality among smokers was substantial and highly significant (Table 4.2.1A, upper half). Likewise, in rural Villupuram the excess mortality from TB is substantial and highly significant in all age ranges (Table 4.2.1B, lower half).

Table 4.2.2 shows the risk associated with type of smoking. In both rural and urban areas the risk associated with bidis is double that of cigarettes. Smoking bidis predominates in rural areas. About 47% of deaths from tuberculosis are attributed to smoking bidis in rural areas and to smoking cigarettes or a combination of cigarettes/bidi/chutta in urban areas.[1]

Table 4.2.2: **Death from pulmonary tuberculosis (TB), by type smoked (cigarette, bidi, chutta or any combination): men aged 25-69 in urban and rural areas in Tamil Nadu.**

Type of smoke	Urban (Chennai) : TB cases - 1840			Rural (Villupuram): TB cases - 1529		
	Cases/ Controls	Risk ratio (95%CI)*	Smoking-Associated (%)	Cases/ Controls	Risk ratio (95%CI)*	Smoking-Associated (%)
Cigarette only	586/4344	3.1 (2.7-3.6)	22	52/679	2.1 (1.6-2.9)	2
Bidi only	321/798	6.3 (5.3-7.5)	15	950/5024	4.2 (3.7-4.8)	47
Chutta only	5/29	2.6 (1.0-6.8)	0.2	35/56	7.5 (4.8-11.8)	2
Any combination	539/1312	7.3 (6.3-8.4)	25	84/362	5.2 (3.9-6.8)	4

*Standardized for age, educational level and use of smokeless tobacco. Reference: never smoked.
Source: Gajalakshmi et al. 2003.[1]

A population survey was undertaken in urban Chennai during 1998-2001, which sought to visit all the houses in randomly selected areas of the city.[1,5] All men and women aged 35 or above were interviewed and self-reports on history of smoking and use of smokeless tobacco, history of TB, and educational status were elicited. Various health-related indices were also measured. Survey data for 251,000 men were analyzed with respect to smoking.

Table 4.2.3 shows that 67% of the men with a history of TB and 37% of other men (age 35-69 years) in the general population were smokers. Both among non-smokers and particularly among smokers, the self-reported prevalence of pulmonary TB (past or current) increased with age, and by about 60 years of age (55-69 years), 0.3% of never-smokers and 1.5% of ever-smokers reported a history of TB. In the age range of 35–69 years, the standardized TB prevalence ratio was 2.9 (95% CI: 2.6-3.3). This self-reported prevalence of TB was, both in middle and in old age, about three times as great among the ever-smokers as among the never-smokers. The excess prevalence of self-reported TB among smokers was highly significant, and had relatively narrow confidence intervals. This provides strong evidence that smoking substantially increases the incidence of clinical TB.

Table 4.2.3: **Prevalence of pulmonary tuberculosis (past or current), by smoking and age: Survey of 250,000 men in an urban area of Tamil Nadu.**

Age range	Ever smoker Ever TB/total	(%)	Never smoker Ever TB/total	(%)	TB prevalence ratio, ever/never smoked * (95% CI)	
35-44	233/42,813	(0.5)	134/71,273	(0.2)	2.4	(1.9-3.0)
45-54	254/27,293	(0.9)	123/42,196	(0.3)	2.7	(2.1-3.3)
55-64	214/15,159	(1.4)	73/24,162	(0.3)	3.9	(3.0-5.1)
65-69	68/4171	(1.6)	25/8034	(0.3)	4.6	(2.8-7.3)
Sub total:						
35-69	**769/89,436**	**(0.86)**	**355/145,665**	**(0.2)**	**2.9**	**(2.6-3.3)**
70+	63/4448	(1.4)	53/11,468	(0.5)	2.8	(1.9-4.0)

*Standardized for age, educational level and use of smokeless tobacco. The lower age limit in this survey was 35 years.
Source: Gajalakshmi et al. 2003.[1]

Among ever-smokers aged 35-69, the TB prevalence ratio was also positively related to the daily consumption of cigarettes, particularly of bidis, showing a dose-response relationship and further substantiating the association between smoking and TB (Table 4.2.4).

A population survey to identify TB cases was carried out among 60,000 subjects 10 years of age and above in 30 villages in the Tiruvallur district of the state of Tamil Nadu, south India, during 1993-96. Those with chest symptoms and/or positive chest X-rays were investigated by sputum smear and/or culture to diagnose active TB. The results of this earlier survey were used to identify cases and controls for a subsequent study conducted in 1998 to assess the association between smoking and TB. Men aged 20-50 with TB, confirmed by sputum smear and/or culture, were defined as cases (n=85). For each case, five age-matched population controls (n=459) were selected from those aged 20-50 who had been screened and declared not to have TB during 1993-1996. Data on previous smoking were collected from cases and controls in 1998. The results of the study are provided in Table 4.2.5. Seventy five percent of cases and 55% of controls were smokers. The age-adjusted relative risk of developing TB among ever-smokers compared to never-smokers was 2.2 (95% CI: 1.3-3.9).[6]

Table 4.2.4: **Prevalence of pulmonary tuberculosis (TB) at ages 35-69, by amount of cigarettes or bidis smoked: survey of 250,000 men in an urban area in Tamil Nadu.**

Smoking habit (most recent)	Prevalence of TB Ever TB/total		TB prevalence ratio, smoker/never smoked* (& 95% CI)
Never smoked	355/145,665	(0.24%)	1.0 (reference)
Cigarette smoker@			
<10 cigarettes/day	103/22,039	(0.47%)	1.7 (1.4-2.2)
10+ cigarettes/day	267/38,317	(0.70%)	2.6 (2.2-3.1)
Bidi smoker@			
<15 bidis/day	125/12,563	(0.99%)	2.9 (2.4-3.6)
15+ bidis/day	170/10,553	(1.61%)	4.5 (3.7-5.5)

Source: Gajalakshmi et al. 2003.[1]

Kerala Studies

Preliminary results are available for two ongoing population-based case-control studies in Kerala, one urban and one rural.[7] The urban survey of 106,637 males aged 25 and above in Thiruvananthapuram, Kerala, used self-reports of ever having smoked and ever having TB. Results show that the percentage of ever-smokers among those with a self-reported history of TB was 74%, as against 49% in other adults. A history of TB was reported by 1.5% of ever-smokers and 0.5% of never-smokers, yielding a risk ratio of 3.0 (95% CI: 2.6-3.5) (Table 4.2.6).

Table 4.2.5: **Prevalence of confirmed pulmonary tuberculosis by smoking in men (cases vs. controls) aged 20-50 in rural Tamil Nadu.**

	Cases (n=85)	Controls (n=459)	Age-adjusted TB prevalence ratio, ever/never smoked (95% CI)
Never smokers	21	206	1.0 (reference)
Ever smokers	64	253	2.2 (1.3-3.9)

Source: Kolappan and Gopi 2002.[6]

Table 4.2.6: **Prevalence of self-reported pulmonary tuberculosis in men aged 25 and above in Kerala.**

Smoking status	Tuberculosis		Risk of tuberculosis (95% CI)
	Yes	No	
Never smokers	267	51495	1.0 (reference)
Ever smokers	748	55142	3.0 (2.6-3.5)

Source: Shenoy et al. 2002.[7]

The rural study is being conducted in four districts of Kerala using the government public health system. Over a period of four months, 805 confirmed TB cases under treatment by the local TB control program and 878 population controls were recruited. About 86% of cases and 68% of controls were smokers, yielding a risk ratio for developing TB among smokers of 2.9 (95% CI: 2.3-3.7) (Table 4.2.7).[7]

Table 4.2.7: **Confirmed incident male pulmonary tuberculosis cases versus population controls, by smoking status in Kerala, south India.**

Smoking status	Cases	Controls	Risk Ratio (95% CI)
Never smokers	115	280	1.0 (reference)
Ever smokers	693	598	2.9 (2.3-3.7)

Source: Shenoy et al. 2002.[7]

Mumbai, Maharashtra Study

An ongoing prospective cohort study of 100,000 adults (age 35+) in urban Mumbai has provided data on mortality from TB and smoking status.[8] A baseline survey of 99,598 individuals aged 35 and above in Mumbai (population 3.4 million) was conducted between 1991 and 1994. Active follow-up began five to six years after the initial survey. Comparing ever-smokers versus

never-smokers, the age-adjusted relative risk of death due to TB was 2.6, but this decreased to 2.1 on standardizing for education. Higher corresponding relative risks were seen for bidi than for cigarette smokers (Table 4.2.8). (The relative risk for all-cause mortality for ever-smokers compared to never-smokers was 1.6 in men and 1.3 in women).[9]

Table 4.2.8: **Death from pulmonary tuberculosis by smoking: Prospective study of men aged 35+ in Mumbai, Maharashtra.**

Smoking status	TB deaths (cases)	Adjusted relative risk	
		By age	By education
No tobacco users	30	1.0 (reference)	1.0 (reference)
Ever smokers	86	2.6	2.1
Bidi smokers	62	3.3	2.9
Cigarette smokers	24	1.7	1.3

Source: Gupta et al. 2002.[8]

Chandigarh Study

A hospital-based case-control study conducted in urban Chandigarh used 200 incident cases (males and females) of active pulmonary TB (either smear-positive or strong clinical and radiographic evidence with documented response to anti-tubercular drugs).[10] Cases were matched by age and sex to controls of two types: 200 healthy individuals (healthy controls) and 200 patients who attended the chest clinic, excluding those with chronic obstructive pulmonary disease and lung cancer.

For the purpose of analysis, a non-smoker was defined as a person having a lifetime exposure of <400 cigarettes or the equivalent. Thirty-five percent of cases, 11% of controls with other respiratory disorders and 12.5% of healthy controls, were smokers. Comparing the active TB cases versus the healthy controls, the ever-smoker versus never-smoker odds ratio standardized for age, sex, socioeconomic status and history of exposure to TB was 4.4 (95% CI: 2.5-7.6).

DISCUSSION

There are several sources of uncertainty in the studies described. The main case-control studies of TB deaths involved interviews with family members or other informants some time later (perhaps six months or more after the death) to determine whether TB was the underlying cause (verbal autopsy) and the smoking habits of the deceased prior to the onset of any relevant disease. The time lag between the death and the verbal autopsy could lead to some uncertainty due to memory lapse. Prospective studies of smoking and death in India are subject to uncertainty about the underlying cause of any death. Case-control studies to determine the smoking habits of patients who definitively had active TB (cases) before the onset of any relevant disease have thus far involved only limited numbers. Finally, large population surveys could have misclassified many previous TB patients as never having had the disease. Most of these sources of uncertainty could dilute any real association between smoking and the prevalence/incidence of, or mortality from, clinical TB, but despite these possibilities a strong, consistent association does emerge.

Some previous studies on smoking have been done in developed countries,[11] where pulmonary TB had already become uncommon as a cause of death, and in developing countries,[12,13] where the main increase in smoking was too recent for the full hazards yet to have materialized. Hence,

the potential importance of the association between persistent smoking and TB has been greatly under-estimated. For example, the disease was not even indexed in two major reports on smoking and health by the U.S. Surgeon General.[14, 15] Two major reports on smoking and health from the International Agency for Research on Cancer, a part of the World Health Organization, mentioned the association between smoking and TB, chiefly in order to dismiss it.[16] Even today WHO does not mention smoking as a risk factor on its Web site fact sheet on tuberculosis.[17] Yet in India, as in many other countries, TB remains a major cause of premature death, both in early adult life and in middle age, particularly among men who smoke. The percentage of smokers among those who died of TB in the Tamil Nadu and Mumbai studies was much higher than the percentage of smokers in the general population. After standardization for age, educational level and use of smokeless tobacco, the results in both the urban and rural areas in Tamil Nadu indicate a mortality ratio (ever-smoker versus never-smoker) of about 4. The results of the Mumbai study indicate an age-standardized mortality ratio of nearly 3. The magnitude of these risk ratios is too high to be plausibly explained unless smoking itself makes death from TB more probable.

In the general population surveys and case-control studies, the proportion of adults who reported a current or previous history of TB (self-reported TB) and the proportion with confirmed TB (by laboratory tests) are substantially higher among ever-smokers than among never-smokers. This indicates that smoking acts more to increase the incidence of clinical disease than to increase the probability that clinical disease will lead to death from TB. An increased case-fatality rate among smokers would selectively remove smokers from the population of patients with TB, and would therefore tend to reduce rather than increase the proportion of smokers with a history of clinical disease in the population. Further evidence of causality is that the heavier the exposure (either to cigarettes or to bidis), the greater the prevalence of TB among smokers. Thus, smoking is a cause, and an important cause, of morbidity and death due to TB.

The National Family Health Survey (NFHS-2) was one of over 150 large-scale sample surveys conducted in 70 less-developed countries as part of the United Nations Demographic and Health Surveys program. The NFHS-2 covered a representative sample of 486,011 persons in 91,196 households during 1998-99 in India.[18] Information gathered included tobacco smoking and use of smokeless tobacco among family members, whether any family member had suffered from TB and, if so, whether they received medical treatment for TB. The survey results indicated that the overall prevalence of TB in India was 0.6% in rural areas and 0.4% in urban areas. The prevalence was 0.62% among males and 0.46% among females and increased with age. It has been estimated that about two million people in India develop TB each year and that there were 5.6 million TB cases in India in 2000, as shown in Table 4.2.9.[19]

Table 4.2.9: **Burden of TB in India in 2000.**

Age-range	Interview-reported history of ever having had TB	Population in 2000 (in millions)*	Millions with a history of TB
<15	0.15%	338	0.5
15-59	0.68%	594	4.0
60+	1.37%	77	1.1
Total	–	**1009**	**5.6**

*Population Division, UN Department of Economic and Social Affairs. World Population Prospects: The 2000 Revision. New York, United Nations 2001.[20]

Source: Dye et al. 1999.[19]

The prevalence of all reported cases of TB among males aged 15 and over in 1998-99 was 552 per 1000 and the total population of males in India in 2000 in the corresponding age range was about 345,630,000.[20] The burden of TB in India among those aged 15 and over in 2000 was thus nearly two million. Data on TB from this survey have yet to be analyzed with respect to smoking status.

The studies done in India show a two to four-fold TB prevalence: incidence ratio among males, based on the age range analyzed in the study, and the smoking-associated proportion was 41%-56%. Half of all TB-prevalent cases in 2000, about one million, would have been avoided if the smokers had had non-smoker TB prevelance rates.

Two cohort studies in the rural areas of Ernakulam district, Kerala[21] and one in Srikakulam district in Andhra Pradesh[22] suggested that at least 630,000 deaths in 1986 were due to tobacco use. The Indian Council of Medical Research (ICMR)[23] attributed 800,000 deaths in 1996 to tobacco use. The studies done in Tamil Nadu[1] estimated that at the death rates of the year 2000, there would be about 700,000 deaths a year in India due to tobacco use, of which about 200,000 would involve pulmonary TB. Half of these tobacco-attributed TB deaths were persons still only in their 30s, 40s or early 50s.

CONCLUSION

TB is a major cause of premature death in India, particularly among men who smoke. The studies show that the prevalence of self-reported TB and confirmed disease was about three times as great among the ever-smokers as among the never-smokers. Mortality from TB was also three to four times as great in ever-smokers as in never-smokers. The heavier the exposure, either to cigarettes or to bidis, the greater the prevalence of TB and deaths due to TB among smokers. In rural and urban Tamil Nadu and urban Maharashtra, where the risk of death due to bidi smoking was calculated separately from that due to cigarette smoking, bidi smoking was found to be even more dangerous than cigarette smoking. Smoking contributes to half the male deaths from TB in India and a quarter of all middle-aged male deaths (25-69 years). Preventing initiation of smoking and promoting quitting are important and effective strategies for preventing onset of TB and death from TB.

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4.3 Bidi Smoking and Lung Diseases

S.K. Jindal

INTRODUCTION

This chapter examines available information on the association of bidi smoking with lung diseases, such as chronic obstructive pulmonary disease (COPD), bronchial asthma and cancer. Lung diseases constitute a major burden on health services the world over. In the Global Burden of Disease Study (GBDS), lower respiratory tract infection (LRTI) was the leading specific cause of disability adjusted life years (DALYs), while chronic obstructive pulmonary disease (COPD) ranked 12th and asthma 30th in the list of specific causes.[1] Similarly, respiratory problems such as LRTI, COPD, tuberculosis and lung cancer, together accounting for 9.4 million deaths, were included in the top ten leading causes of death in 1990.[2] As per GBDS findings, the trend was nearly the same in both the developed and the developing countries. Intriguingly, non-communicable diseases such as COPD were the major public health challenges in all regions, even in sub-Saharan Africa and other developing regions, where the probability of a man or a woman dying from these illnesses was higher than in the developed countries.[2] An increase in the burden of these problems can be directly attributed to an increase in the prevalence of tobacco smoking. The trend of increased mortality from non-communicable illness in the developing countries may also reflect the globalization of tobacco industry influence.

Tobacco smoking is an established cause of respiratory diseases such as COPD and lung cancer. It is also an important factor in causing increased morbidity and mortality from asthma, respiratory infections and tuberculosis. The relationship between smoking and chronic bronchitis was well established through many epidemiological surveys by the early 1960s.[3]

Bidi smoking has been popular among smokers in the Indian sub-continent for the past few hundred years. However, its association with lung diseases remained uninvestigated. The smoking habits of over 73,605 subjects from different centers in India were recently examined in a study on the epidemiology of asthma.[4] Among men who were smokers, over 80% in rural areas and over 50% in urban areas smoked bidis (Table 4.3.1). Among women smokers, more than two-thirds smoked bidis in both rural and urban areas.

There were several reports on prevalence of different lung diseases in India and Nepal in the 1960s and 1970s, which included smoking as an important association.[5-12] Most of these investigations did not report their findings separately for cigarette and bidi smoking. Since several studies on the prevalence of smoking habits reported that almost two-thirds of smokers in India smoked bidis, it was presumed that bidi smoking prevalence was similar or higher than cigarette smoking in these patient populations. Later studies clearly established this belief when both cigarette and bidi smoking were identified as causal factors for different lung diseases, in particular COPD.[13-15]

CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Chronic obstructive pulmonary disease (COPD), which includes chronic bronchitis and emphysema as two distinct entities, is characterized by the presence of chronic respiratory symptoms, such as

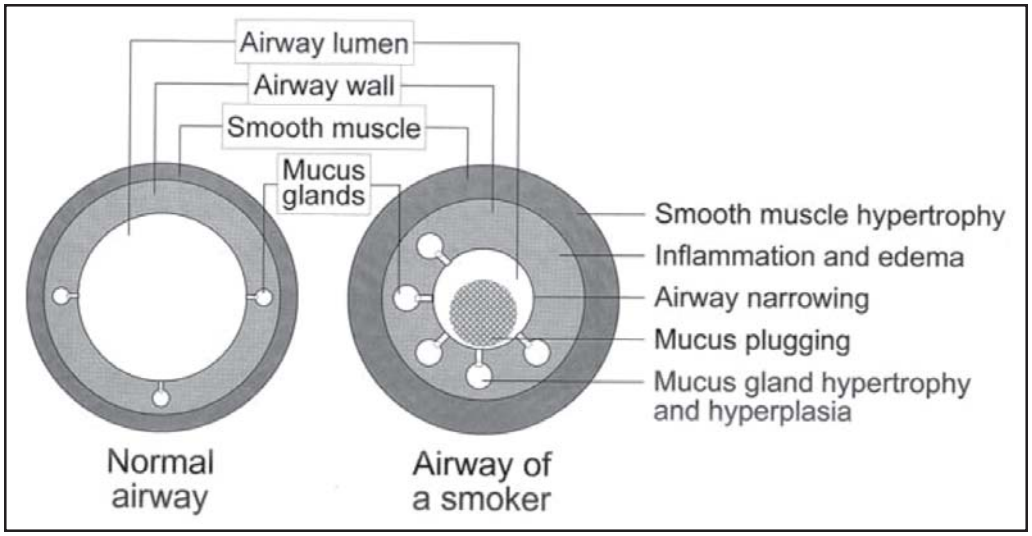
Table 4.3.1: **Smoking habits in the general population.**

			No. of subjects	Proportion of smokers	Smoking product		
					Cigarette	Bidi	Hookah
Rural	Men	Chandigarh	5333	40.48%	13.34%	81.47%	5.19%
		Delhi	3933	41.42%	12.65%	78.21%	9.09%
		Kanpur	3921	26.32%	6.30%	92.54%	0.78%
		Bangalore	4111	34.71%	18.57%	81.43%	0.00%
		Total	17298	36.11%	13.19%	82.44%	4.29%
	Women	Chandigarh	4976	5.53%	8.00%	76.00%	16.00%
		Delhi	3749	7.47%	3.21%	56.79%	40.00%
		Kanpur	3278	1.59%	3.85%	96.15%	0.00%
		Bangalore	4003	0.00%	–	–	–
		Total	16006	3.79%	5.44%	68.86%	25.70%
Urban	Men	Chandigarh	5717	20.01%	53.41%	45.45%	1.05%
		Delhi	4033	17.85%	37.92%	60.97%	0.97%
		Kanpur	6107	19.16%	40.17%	59.74%	0.09%
		Bangalore	4527	32.58%	56.07%	43.93%	0.00%
		Total	20384	22.12%	48.37%	51.14%	0.44%
	Women	Chandigarh	5638	0.96%	20.37%	68.52%	11.11%
		Delhi	3927	1.07%	11.90%	71.43%	16.67%
		Kanpur	5552	0.65%	16.67%	80.56%	2.78%
		Bangalore	4800	0.02%	100.00%	0.00%	0.00%
		Total	19917	0.67%	17.29%	72.18%	10.53%

Source: Jindal SK et al. 2005.[4]

cough, expectoration and breathlessness, and evidence of airflow obstruction. Airflow obstruction occurs from the inflammatory narrowing of airways caused by multiple factors, such as swelling, mucus hyper-secretion and smooth muscle hypertrophy (Figure 4.3.1). It is a progressive disorder leading to marked respiratory disability and death. It also causes a substantial economic burden

Figure 4.3.1: **Air flow obstruction.**



on individuals and society. The total economic cost of COPD morbidity and mortality was 23.9 billion dollars in 1993 in the United States.[16] From India, the direct mean expenditure for a patient was assessed as Rs. 2,258 per year and Rs. 1,970 for the caregiver in the family.[17] This is a huge burden when seen in the light of the per capita income.

Chronic bronchitis was recognized as early as 1808 in the United Kingdom as a serious disorder,[18] but it was the London smog disaster of December 1952 that brought the disease into sharp focus, when 4,000 excess deaths were reported within one week, mostly people already suffering from chronic respiratory or cardiovascular disease.[18-19] The association between smoking and COPD was first recognized about 40 years ago in large epidemiological surveys.[3,4] This is now established through a large body of not only epidemiological but also clinical and experimental data.[20,21] Exposure to risk factors such as tobacco smoking is in fact an important criterion for diagnosis of COPD.[22]

Specific data on bidi smoking and COPD are relatively limited and mostly from India where bidi smoking has remained popular. Some of the early papers on COPD from India included descriptive data on clinical findings and other characteristics when the disease was first described as a distinct clinical entity. Tobacco smoking, including bidis, was clearly recognized as an important etiological factor.[15,23-25] Exposure to smoke from combustion of different kinds of fuels, such as dried wood and animal dung, was another important factor, especially in rural populations, which was considered a major cause for the higher prevalence of chronic cor pulmonale in women.[26,27] The role of smoking was not studied and therefore the contribution of smoking in the etiopatho-genesis of COPD and respiratory failure was not clear. But almost all the subsequent reports on COPD prevalence demonstrated a significantly higher male predominance, thereby suggesting only a secondary role of exposure to solid-fuel combustion, compared to tobacco smoking.[28] Even in the urban areas such as Delhi, where the sur-rounding air was generally polluted, smokers had more respiratory symptoms than nonsmokers.[28]

There is a large number of studies on prevalence of COPD from India (Tables 4.3.2 and 4.3.3).[5-15,27-39] Several allude to the role of bidi smoking, either directly or implied

in reference to tobacco smoking. In the earlier studies, the magnitude of the problem was largely recognized from analyses of hospital statistics.[27] COPD (with or without complications) accounted for about 30% of chest clinic attendance and 2.5% of total hospital admissions in North India.[30]

A large number of surveys was undertaken in different population groups for COPD prevalence, assessed mostly by interviewing with the help of a questionnaire (Table 4.3.2). Some of the investigators included other methods of diagnosis, such as physical examination, chest radiography and spirometry. Although the history of tobacco smoking was obtained in most of these reports, only a few included a reference to bidi smoking. Nonetheless, bidi smoking remained the predominant smoking habit in these populations in the 1950s, 60s and 70s when these studies were carried out. Several later studies specifically included bidi smoking as a major risk factor for COPD (Table 4.3.3).

Evidence of the association of COPD with bidi smoking is available in studies from Chandigarh and Delhi in North India.[13,14,32-34,37] The association was specifically examined by Malik, who studied "apparently healthy" hospital employees and attendants of patients without the presence of any known chest disease.[33] The apparently healthy population was selected because an individual

Table 4.3.2: **Studies on COPD prevalence in India.**

	Author	N	Age, Yrs.	Sex	Smk %	Population		No of subjects		COPD (%)	
						Area	Urban or Rural	Non-smokers	Smokers	Non-smokers	Smokers
1	Wig et al., 1964[9]	578	> 25	M	47.8	Delhi: Chest patients	U	302	276	0.7	5.8
		296	> 25	M	63.5	Delhi	R	115	181	2.6	12.1
2	Viswanathan, 1964[30]	219	> 14	M	20.5	Delhi: Patient attendants	U	174	45	3.5	13.3
3	Viswanathan et al., 1966[10]	15,805	> 0	M+F	10.7	Patna	U	14,119	1,686	1.1	7.5
4	Sikand et al., 1966[6]	1,501	>15	M	NR	Delhi (slum)	U	1,052	449	2.8	16.9
5	Joshi et al., 1975[5]	473	17-64	M	50.2	Ludhiana industrial workers	U	229	244	3.9	20.5
6	Bhattacharya et al., 1975[13]	1,140	>30	M+F	52.3	Lucknow	R	544	596 incl. former smokers	4.2	7.0
7	Thiruvengadam et al.,1977 [23]	817 M: 397 F : 420	> 5; mostly 15-60	M +F	6.7	Chennai (Madras)	U	762	55 (all men)	1.2 2.5	7.4 25.5
8	Viswanathan & Singh,1977[7]	993	> 5	M+F	20.6	Delhi	U	788	205	3.9	15.6
		1,001	> 5	M+F	23.1	Delhi	R	770	231	1.4	13.4
9	Radha et al., 1977[14]	744	>15	M	43.7	Delhi	U	435	338 incl. former smokers	4.4	8.0
10	Charan, 1977[12]	7,132	16-73	M+F	NR	Punjab	R	7,132	0.7		
11	Malik & Singh, 1978 [31]	278	> 15	M	71.0	Haryana	R	81	197	1.2	21.8
12	Malik et al., 1977[8]	1,144	>15	M+F	58.4	Chandigarh hospital visitors	U&R	810	334	4.0	18.0
13	Malik & Wahi, 1978[32]	2,360	>15	M	33.1	North India, hospital visitors to PGI, Chandigarh	U&R	1,580	780	5.2	20.0
14	Shrestha & Pandey, 1980[11]	1,427	> 20	M+F	NR	Kathmandu, Nepal	R	1,427		4.3	13.5
15	Malik et al, 1986[15]	1,450	> 15	M	44.1	Chandigarh, N. India	U	1,006	444	1.0	9.9
16	Nigam et al., 1982[34]	775	> 20	M	73.3	Jhansi, N. India	R	115	660 (incl. former smkrs	6.1	8.5
		649	> 20	F	12.0						
17	Pandey., 1984[27]	2,826	> 20	M+F	68.0	Nepal, hills	R	2,826	18.3		
18	Malik and Kashyap.,1986 [35]	304	18-80	M	60.5	Himachal:	R	120	184	5.8	32.0
		142	18-80	F	28.2	Shimla hills		102	40	5.9	52.5
19	Behera and Malik., 1987 [36]	397	NR	M	18.1	Chandigarh	U	336	61	0.6	8.2
		346 *	NR	F	0.0	Teachers		346	0	1.2	–
20	Jindal (follow-up), 1993 [37]	356	> 15	M	30.6	Chandigarh	U	296	60	0.3	21.7
		223 †	> 15	M	42.6	& Mullanpur†	R	139	84	2.2	13.1
21	Ray et al., 1995 [38]	9,946	>30	M+F	NR	Tamil Nadu	R	9,946	3.3		

NR Not reported

*Subjects studied in 1976 prior to follow-up (Behera & Malik, 1987).[36]

†The figures represent the subjects restudied after 10 years out of the original group studied in 1980: 1,450 urban (Chandigarh) and 671 rural (Mullanpur) male subjects (Jindal, 1993).[37]

smoker with early COPD may be clinically asymptomatic. More than half of such smokers are likely to develop severe COPD and respiratory disability if smoking is continued. For this reason, COPD staging includes an early 'at-risk' or '0' stage and smoking cessation is advised as the treatment as per all COPD guidelines, including those from India.[22,40] The British Medical Research Council (1965) questionnaire was used for the diagnosis of chronic bronchitis. Smoking habits were determined and spirometry performed on each individual. Of 198 subjects there were 133 (67.2%) smokers, of whom 78 (58.6%) smoked bidis and 55 (41.3%) smoked cigarettes. The remaining 65 individuals (32.8%) were non-smokers. Chronic bronchitis was observed in 34.6% of bidi smokers, 45.4% of cigarette smokers and only 3% of non-smokers. The difference between cigarette and bidi smokers was not found to be significant. In a later analysis of a larger number of 780 smokers and 1580 non-smokers in the same population, chronic bronchitis was observed in 19.75% of bidi smokers (17.23% had chronic bronchitis, simple, and 2.52% had chronic bronchitis with the presence of airway obstruction).[32] The prevalence in bidi smokers was even higher than the 16.3% prevalence in cigarette smokers, although not statistically significant.

Table 4.3.3: **Summary of studies on COPD prevalence in bidi smokers.**

Authors	Total No	Age	COPD		Prevalence (%)	
			Non-smoker	Cig. Smoker	Bidi	Mixed
Bhattacharya et al., 1975[13]	1,140	> 30	4.2	–	4.4*	–
Radha et al., 1977[14]	774	> 15	4.35	6.02	8.33	15.7
Malik & Wahi, 1978[32]	2,360	15-64	5.2	16.3	19.7	37.5
Nigam et al., 1982[34]	775	> 20	6.1	4.3*	4.6*	–
Jindal, 1993 [37]	1,473	> 15	2.2	21.7† (urban)	13.1† (rural)	–

* Excludes the high prevalence of 25% seen in ex-smokers (mostly bidis) in both studies.
† For this study rural smokers were taken as bidi smokers and urban subjects cigarette smokers.

Prevalence of COPD was also studied in farmers of a village in North India, where smoking was almost exclusively confined to bidis and/or "hookah" (water pipe).[31] Of 197 smokers, some respiratory symptom was present in most individuals, while COPD was documented in 21.6% (5.6% had documented airway obstruction on peak expiratory flow measurements).

Jindal SK studied 4381 individuals for their smoking habits, respiratory symptoms and peak expiratory flow in 1977-1980, of whom 1475 (33.7%) were re-examined in 1990.[37] There were 739 (20.3%) smokers in the initial study, of whom a rural cohort of 286 exclusively smoked bidis. Of these, 84 (29.4%) were again available for the follow-up study. The overall COPD prevalence was about 13.1% of rural male smokers (bidis) and 21.7% of urban (cigarettes) male smokers.[37]

In a recent ICMR-sponsored multicentric study on 35,295 subjects aged 35 years or more, bidi smoking was identified as a significant risk factor for chronic bronchitis with uniformly higher odds ratios for the disease as compared to cigarette smoking at all four study centers. Table 4.3.4 shows as yet unpublished results.[4]

LUNG FUNCTION AND BIDI SMOKING

Information on the effects of bidi smoking on lung function is mostly available from the studies on prevalence of chronic bronchitis (or COPD). It is generally restricted to measurements of peak expiratory flow (PEF) used as a tool for screening of airway obstruction.

Table 4.3.4: Odds ratio of developing chronic bronchitis * or bronchial asthma for different smoking products in four cities.

	Chandigarh	Delhi	Kanpur	Bangalore
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Chronic bronchitis				
– Cigarette smokers	2.4 (1.6-3.7)	3.5 (2.3-5.4)	1.1 (0.6-1.9)	1.8 (1.3-2.4)
– Bidi smokers	3.0 (2.3-4.0)	3.9 (3.0-5.0)	2.4 (1.9-3.1)	2.8 (2.3-3.2)
– Hookah smokers	9.4 (5.9-15.2)	3.2 (1.9-5.3)	9.6 (1.9-47.9)	–
Bronchial asthma				
– Cigarette smokers	2.5 (1.8-3.5)	3.0 (1.9-4.8)	1.6 (0.99-2.7)	1.5 (1.1-2.0)
– Bidi smokers	1.7 (1.4-2.2)	2.1 (1.6-2.9)	2.2 (1.7-2.9)	2.0 (1.6-2.5)
– Hookah smokers	7.8 (5.0-12.3)	2.1 (1.0-4.4)	6.0 (0.8-47.5)	–

*Data on chronic bronchitis limited to a subset of subjects aged 35 years or more.
Source: Jindal SK et al., 2005.[4]

A selected number of authors used PEF measurements to categorize chronic bronchitis with airways obstruction (CB, AO) separately from simple chronic bronchitis (CB, S), based only on symptoms of cough and sputum production. Of 442 cigarette smokers and 238 bidi smokers, symptomatic airway obstruction was diagnosed in 2.94% and 2.52%, respectively.[32] The significantly lower mean PEF in the bidi smoking categories clearly points to its role in causing airways obstruction. Detailed spirometric indices are also available in some studies.[33] A higher frequency of ventilatory abnormalities was reported in bidi smokers than nonsmokers, i.e., low forced expiratory volume in 1st second to forced vital capacity (FEV_1/FVC) ratio in 14% and reduced mid flow rates in 32%. The relatively higher prevalence of spirometric abnormalities in cigarette (vs. bidi) smokers was attributed to the higher total consumption of tobacco among cigarette smokers. In a more recent study on 775 smokers, of whom 432 (55.7%) smoked bidis, spirometric abnormalities such as the reduced FVC and FEV_1/FVC ratio were more common in both the urban and the rural smokers.[41]

Pulmonary function tests were performed in three groups of 30 subjects each among non-smokers, cigarette smokers, and bidi smokers. The spirometric parameters were decreased in smokers versus non-smokers, although the decrease was greater in cigarette smokers than bidi smokers.[42] In another study on a larger number of subjects, bidi smoking was shown to be more likely to cause both clinical and functional impairment of lungs than cigarette smoking.[43]

Information is also available on the long-term effects of bidi smoking. Spirometry was performed on 150 smokers over the age of 55 and an equal number of age-matched controls.[44] The smokers of cigarette, bidi, hookah and mixed forms included 52, 12, 32 and 54 individuals, respectively. The majority of smokers showed an accelerated decline in lung function with age.[44] The worsening of lung function was similar in smokers of hookah, bidis and cigarettes, the heaviest smokers having evidence of more severe airflow obstruction.

The results of the follow-up study also suggested a significantly greater fall in PEF over a ten-year period in smokers than in non-smokers, and more in the symptomatic subjects.[37] The mean PEF fall of about 50 L/min among smokers of over age 40 was almost the same in the urban and rural individuals, classified as smokers of cigarettes and bidis, respectively. It was also concluded that those with an initial airway obstruction had deteriorated significantly more than those with normal initial PEF.

The Chandigarh Institute is currently engaged in a longitudinal study to investigate the natural history of COPD with reference to smoking history and other risk factors.[45] A total of 8069 individuals were screened to include about 250 subjects in each of four cohorts: asymptomatic and symptomatic individuals, with and without a smoking history. The initial analysis shows some differences among cohorts in the spirometric indices: bidi smokers had significantly lower PEF in the asymptomatic individuals and lower FVC and FEV_1 in the symptomatic cohort than the cigarette smokers (Table 4.3.5).

Table 4.3.5: **Differences in spirometry in cigarette and bidi smokers.**

	Asymptomatic		Symptomatic	
Smoking product	Cigarette	Bidi	Cigarette	Bidi
Number of subjects	50	136	30	129
FVC (% of predicted)	70.92 ± 11.93	70.93 ± 15.01	72.42 ± 11.66	66.50 ± 16.40*
FEV_1 (% of predicted)	86.73 ± 15.90	83.92 ± 19.65	87.41 ± 14.95	79.77 ± 20.33*
PEF (% of predicted)	83.02 ± 16.62	74.09 ± 19.88*	79.69 ± 15.23	73.14 ± 19.64

*$p < 0.05$
Source: ICMR, ongoing.

BRONCHIAL HYPER-RESPONSIVENESS AND ASTHMA

Bronchial responsiveness (BR) is a hallmark of asthma and airway obstruction. There is plenty of evidence on cigarette smoking causing bronchial hyper-responsiveness.[46-47] Similar findings were reported in smokers of bidis.[48-50] Bronchial response to broncho-constricting aerosol (methacholine) was increased in 54.5% of asymptomatic and 83.3% of symptomatic smokers; no differences were shown in baseline spirometry or in methacholine reactivity between cigarette and bidi smokers.[50] There was also a significant correlation of log PD_{20} methacholine (provacative dose causing a 20% fall in FEV_1) with both the baseline FEV_1 and the smoking index (SI). It was concluded that the greater the SI and lower the baseline FEV_1, the lower the PD,[20] i.e., the greater the bronchial responsiveness.

Cigarette smoking is known to trigger a worsening of asthma.[51,52] This is also true for non-smoking individuals who get exposed to secondhand smoke in the home or in public places.[53,54] There is no published account of similar observations on bidi smoking. In view of the biological plausibility, these effects are however likely to be similar for bidi smokers. The effects of secondhand smoke exposure from bidi smoking for non-smoking subjects need to be studied since the release of secondhand smoke from bidis is generally small in magnitude.

In a large multi-centric population study in India, the symptomatic prevalence of asthma among 73,605 individuals was found to be more than twice as common in smokers as in nonsmokers.[55] The odds ratios for bidis were largely similar to those for cigarettes at all four centers (Table 4.3.4), with aggregate odds ratios of 2.12 and 1.97 for cigarettes and bidis,

respectively. Although the true interpretation of these findings is not clear as yet, it is possible that smoking being responsible for precipitating and/or worsening asthma results in exaggerated symptomatology and therefore allows an earlier and easier diagnosis, especially in the population studies. But the results of this study clearly implicate bidis, even more than cigarette smoking.

LUNG CANCER

Lung cancer is perhaps the only lung disease other than COPD for which there is both clinical and epidemiological evidence of association with bidi smoking. The analogy is somewhat similar to that for COPD, in that reports on tobacco association from India can be assumed to indicate an association with bidi smoking, as much as the association with cigarettes (Table 4.3.6).[56-69] Most of the earlier reports pointed to two to five times higher prevalence of lung cancer in smokers. More elaborate analyses are available from recent reports on risk factors.[70,71] In one case-control study, the odds ratio adjusted for age for smoking was 2.2 (95% CI 1.4 – 3.3) versus hospital controls and 5.8 (95% CI 3.5 – 9.7) versus population controls.[70] The effect was found to be dose-related in another study, with the odds ratio for developing lung cancer increasing from 1.72 (95% CI 0.77 – 3.85) for 1-5 pack years to 113.0 (95% CI 35.2 – 303.3) for more than 61 pack years.[71]

Table 4.3.6: **A summary of reports from India on the association of tobacco with lung cancer.**

Authors	Age Group	Total No. Patients	Smokers *vs.* Non smokers	Smoking Association Smoker: Non smoker Ratio
Viswanathan et al. 1962[56*]	NR	95	64:31	2.1
Shankar, 1967[57]	40-69	20	17:3	5.7
Nagrath et al. 1970[58]	13-70	35	23:12	1.9
Guleria et al. 1971[59]	19-70+	120	70:35 *	2.0
Basu and Gosh, 1971[60]	30-69	24	20:4	5.0
Jha et al. 1972[61]	21-80	25	12:13	0.9
Nafae et al. 1973[62]	40-80	25	22:3	7.3
Malik and Aikat, 1976[63]	11-80	67	35:10 *	3.5
Narang et al. 1977[64]	18-70	58	48:10	4.8
Jindal et al. 1979[65]	21-70+	150	106:44	2.4
Notani et al. 1977[66]	30-70+	683	549:134	4.1
Malhotra, 1986[67]	21-80	53	33:20	1.7
Jindal et al. 1987[68]	21-70+	480	360:120	3.0
Jindal and Behera, 1990[69]	21-70+	1,009	735:274	2.7

*Information on smoking status was not available for all patients.

There are a few reports where the association between bidi smoking and lung cancer has been specifically analyzed. The relative risks for bidi and cigarette smoking were assessed from analysis of 683 male lung cancer cases and 1279 male non-cancer patients from Mumbai.[66] The relative risk of 3.38 for bidis was higher than the 2.36 relative risk for cigarette smoking, compared to non-smokers.

Similar observations were made in clinical studies on hospital lung cancer patients.[67,72] Of 338 patients seen between 1973-79 at the Chandigarh Institute, 232 were smokers, of whom 66 (28.4%) smoked only bidis and 46 (19.8%) smoked both cigarettes and bidis.[72] In the recent case-control study of 265 lung cancer cases and 525 hospital controls, the odds ratio for 137 bidi

smokers (vs. nonsmokers) was 5.76 (95% CI 3.42 – 9.7).[73] This was almost the same as for 78 cigarette smokers (OR 5.64; 95% CI 3.15 – 10.1). It was concluded that smoking cigarettes or bidis was the principal risk factor for lung cancer in men. In women, the association with smoking was not as strong.[74]

There were some data from India on an increased risk of lung cancer from secondhand smoke exposure.[74] But the absence of information on different forms of smoking precludes any interpretations regarding secondhand smoke specifically from bidis.

MISCELLANEOUS LUNG DISEASES

Tobacco smoking in general is associated with several other lung disorders, such as respiratory infections, including pneumonias, interstitial lung diseases and pulmonary tuberculosis. But separate data on bidi smoking are not available. There is some evidence of an association between bidi smoking and tuberculosis in recent studies. A study was done of 200 patients of active pulmonary tuberculosis and 400 age, sex and residence-matched controls for their smoking habits.[75] There were 35% smokers among the patients, of whom 20% and 15% smoked cigarettes and bidis, respectively. Only 11.8% of controls reported a smoking history. The adjusted odds ratio for smokers of both cigarettes and bidis was around 5.0.

In a large population study on cause-specific mortality from India, tobacco smoking where bidi smoking predominated was reported as a cause of half the male tuberculosis deaths.[76] The relative risk for bidis for tuberculosis deaths was 3.62 in a cohort study of 99,598 individuals over 35 years of age in Mumbai.[77]

CONCLUSION

Most clinical and epidemiological studies from India clearly demonstrate that bidi smoking is at least as hazardous as cigarette smoking in causing different lung diseases. The risk ratios for development of COPD and lung cancer in particular are generally similar for cigarettes and bidis. Bidis are equally responsible for causing bronchial hyper-responsiveness, impairment of lung function and precipitation of asthma. But the role of adverse health effects of secondhand smoke exposure from bidis has not been definitively documented.

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4.4 Cardiovascular Disease: Consequences of Bidi Smoking

K. S. Reddy and G. S. Ramakrishna

INTRODUCTION

This chapter focuses on bidi smoking and cardiovascular diseases (CVD). It uses research on the association between tobacco use and CVD, and points to the need to look more specifically into the deleterious health effects of bidi smoking.

Cardiovascular diseases (CVD), as a group, are major contributors to global health burdens of death and disability. CVD accounted for 16.7 million, or 29.2% of total global deaths, according to World Health Report 2003.[1] Cardiovascular diseases are also a leading cause of death in India, which accounted for 17% of CVD mortality in the world in 1990.[2] In India 27% of the total annual deaths in 2002 were related to cardiovascular diseases, and this is projected to rise to 42% by the year 2020.[3] CVD-related deaths are expected to rise from about 3 million in 2000 to 4.8 million in 2020.[4] Many of the CVD-related deaths in India occur at a younger age compared to western countries and China. During the period 2000-2030, about 35% of all CVD deaths in India are projected to occur in the 35-64 age group.[3] Tobacco, as a major cause of premature mortality attributable to CVD, becomes especially relevant in this context.

Tobacco use is a major known risk factor for cardiovascular diseases and leads to high burdens of early death and disability. In India, tobacco is smoked in many forms, including cigarettes, bidis, cheroots, and chuttas. Only about 20% of the total tobacco (by weight) is consumed in the form of cigarettes. The most prevalent form is the bidi, which accounts for 40% of tobacco consumption.[5] It consists of finely ground sun-dried tobacco rolled in brown tendu leaf, which is native to India, but is exported worldwide. The popularity of the bidi is probably due to the fact that it is less expensive and easily accessible.

TOBACCO AND CVD

Knowledge about the relationship between tobacco and CVD is primarily based on studies conducted on cigarette smoking. Current cigarette smoking was seen to be strongly associated with the risk of coronary events for both acute myocardial infarction and coronary artery disease.[6] A study done in the United Kingdom found that at ages 30-49 the rates of myocardial infarction (MI) in smokers were about five times those in non-smokers; at ages 50-59 they were three times those in non-smokers; at ages 60-79 they were twice as great as in non-smokers.[7] About 48% of all myocardial infarctions in young and middle-aged Italian women were attributable to cigarette smoking.[8] Of all the coronary risk factors, cigarette smoking is the strongest predictor of sudden cardiac death (SCD). Middle-aged men who smoke have a 10-fold greater risk of SCD and 3.6-fold increased risk of MI.[9] Secondhand smoke is associated with ischemic heart disease, with 30% excess risk of ischemic heart disease in nonsmokers whose spouses smoke, compared with nonsmokers whose spouses do not smoke.[10]

Chemical Constituents of Tobacco Smoke as Related to CVD

The major constituents of tobacco smoke responsible for cardiovascular effects are nicotine and carbon monoxide, which have profound effects on blood pressure, heart rate, endothelial function, blood lipids, thrombotic factors, insulin resistance and tissue oxygenation. Other chemicals in tobacco smoke that cause vascular injury include nitrogen oxides, hydrogen cyanide and tar with cadmium; zinc and carbon disulfide are minor contributors.[12]

Bidi Composition: Pathophysiologic Basis for CVD

Bidi smoke contains higher concentrations of hydrogen cyanide, carbon monoxide, and ammonia as well as nicotine, compared to cigarette smoke.[13,14] Bidi smoke delivers three times the amount of carbon monoxide and nicotine and five times the amount of tar compared to cigarette smoke.[15] Bidi smoke also contains carcinogenic chemicals such as tobacco-specific nitrosamines (TSNAs) and their levels are comparable with those of conventional cigarettes.[16] Bidi smokers tend to take more puffs per minute because the bidi has low combustibility and has to be lit frequently as it self-extinguishes. In addition, due to their lower porosity, the tendu leaves used as wrapping dilute tobacco smoke less than cigarette paper.[17] Bidi smoke contains the same constituents as cigarette smoke, but some of the constituents are present in higher amounts, so it is more likely to lead to CVD.

The effects of bidi smoking on the cardiovascular system are mediated through nicotine and carbon monoxide. Nicotine operates through increased levels of catecholamines that elevate heart rate and systolic pressure and enhance platelet aggregation (increased tendency of blood to clot). Left ventricular performance decreases after smoking, especially in coronary patients.[12] Bidi smoking increases myocardial oxygen demand and hypoxia induced by it impairs myocardial performance when athero-sclerosis restricts the coronary flow.[18]

There are various mechanisms by which bidi smoking leads to lipid alteration and endothelial dysfunction:

- Nicotine stimulates the sympathetic adrenal system leading to increased secretion of catecholamines, resulting in increased lipolysis and increased concentration of plasma free fatty acids, which further result in increased secretion of hepatic free fatty acids and hepatic triglycerides along with VLDL-cholesterol in the blood.[19]
- A fall in estrogen level occurs due to smoking, which further leads to a decrease in HDL-cholesterol.[19]
- Presence of hyperinsulinemia in smokers leads to increased total cholesterol, LDL cholesterol and triglycerides due to decreased activity of lipoprotein lipase.[19]
- Carbon monoxide (CO) inhalation results in the formation of carboxyhemoglobin, resulting in reduced ability of blood to carry oxygen to the tissues, endothelial dysfunction and cardiac arrhythmias.

STUDIES ON CARDIOVASCULAR HEALTH EFFECTS

There are very few studies that have looked specifically at the cardiovascular effects of bidi smoking. The few studies that are available show that bidi smokers have an elevated risk of cardiovascular disease.

A case-control study conducted in Bangalore showed that bidi smoking is an important risk factor for ischemic heart disease (IHD).[20] Smoking ten or more cigarettes/bidis per day carried an independent four-fold increased risk of acute myocardial infarction (AMI). The odds ratio of AMI among those smoking >10 bidis per day was higher (4.36) than that of the same number of cigarettes (3.58), compared to nonsmokers.[21]

In another (unpublished) case-control study conducted in New Delhi and Bangalore, it was seen that, compared to never-smokers, those consuming 25 bidis per day had a ten-fold increased risk of CHD.[22]

In a case control study in Bombay, it was observed that the odds ratio of CHD among bidi smokers was 3.1 and that of cigarette smokers was 2.5, compared to nonsmokers. The odds ratio of MI among bidi smokers was 3.8, compared to 3.3 among cigarette smokers.[23]

In a case control study in Chennai, men smoking bidis were 1.7 times more likely (CI of 1.5-1.9) to die of vascular disease compared to nonsmokers.[24]

Thromboangiitis obliterans (TAO) is an occlusive disease of the arteries that mainly affects the legs. It causes claudication and can even lead to gangrene. It is typically found in younger men (20-40 years old) of low socioeconomic status who have been heavy bidi smokers from childhood.[25] It has been observed that the risk of TAO is greater with bidi smoking, compared to cigarette smoking. Using people who smoked <10 cigarettes per day as reference for comparison, those smoking 11-20 bidis per day had an odds ratio (OR) of 7 and those smoking >20 bidis per day had an OR of 34. Those smoking 11-20 cigarettes had an OR of 4 and those smoking >20 cigarettes per day had an OR of 7.[26]

CONCLUSION

Population segments with low socio-economic status (low income and education levels) are at greater risk of consuming tobacco.[27] The bidi, a cheaper alternative to cigarettes, predominantly attracts these poorer segments, who usually cannot afford to pay for health care. Although bidis contain smaller amounts of tobacco, they produce higher amounts of noxious chemicals and, combined with their low price, have serious public health implications.

Taxes on bidis are low compared to cigarettes and smokers may to shift to bidis as taxes are raised on cigarettes. It is important to include all tobacco products, including bidis, under the tax net, so as to avoid product substitution and promote cessation. Bidi packages should also display effective health warnings.

The deleterious effects of bidi smoking on cardiovascular health have not been studied extensively. The evidence comes mostly from a few cross-sectional surveys and case-control studies. Data from cohort studies are still awaited. However, given the constituents of bidi smoke, the bidi can be expected to be as harmful as other tobacco products, if not more so. There is a need for more research to look into the health effects of bidi smoking. Research is required to evaluate various cessation methods for people who are addicted to bidis. Thus far, such cessation research has been restricted mainly to cigarette smokers. More information is needed on the nature and timeframe of cessation benefits associated with quitting bidi smoking and the most cost-effective cessation techniques for poorer sections of society, who constitute the main consumer groups for bidi smoking.

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4.5 Bidi Smoking and Cancer

Surendra S. Shastri

INTRODUCTION

This chapter looks at several case-control studies that provide evidence of an association between bidi smoking and cancers of the upper aero-digestive tract and of the lung, esophagus and stomach, as well as dose-response relationships with respect to frequency, cumulative dose and total duration of bidi smoking. Biological evidence is presented that complements these findings. Mention is made of studies that show that bidi workers also run an increased risk of developing cancer.

The carcinogenicity of tobacco smoking was established in the 1950s.[1] Available evidence suggests that active tobacco smoking causes cancers of the lung, the lower urinary tract, including the renal pelvis and bladder, the upper aero-digestive tract, including oral cavity, pharynx, larynx and esophagus, and the pancreas.[2] Recent evidence confirms the above findings and provides further evidence that tobacco smoking causes cancers of the nasal cavity, paranasal sinuses, nasopharynx, stomach, liver, kidney, cervix-uteri, adenocarcinoma of the esophagus and myeloid leukemia. New evidence also confirms that exposure to secondhand smoke is also carcinogenic to the human lung. Current evidence of an association between tobacco smoking and cancer of the bowel, breast and prostate is equivocal.[3]

BIDI SMOKING AND CARCINOGENESIS

Case-Control Studies

To assess the carcinogenic effect of bidi smoking, one must consider potential confounders in the form of associated smokeless tobacco and betel quid use of smokers, as well as alcohol consumption. Several case-control studies provide evidence of an association between bidi smoking and cancers of the upper aero-digestive tract (including mouth, oropharynx and larynx) and of the lung, esophagus and stomach.[4-18] Several of these studies also demonstrate a duration and dose-response relationship. Fifteen case-control studies where the odds ratios or relative risks were available are reviewed in this article. All odds ratios/relative risks mentioned in this article have 95% confidence intervals (shown in brackets). These studies are summarized in the Table 4.5.1.

Sankaranarayanan et al. conducted five hospital-based case-control studies during 1983-84, at the Regional Cancer Centre, Thirvananthapuram. Age (within five years), sex and religion-matched controls were selected from the outpatient department of Thirvananthapuram Medical College during the same period. Trained social workers interviewed the participants to collect socio-demographic and clinical details. History of betel quid and smokeless tobacco use, bidi smoking, cigarette smoking, alcohol use and nasal snuff inhalation was collected. Only male participants were analyzed for smoking and alcohol habits due to the small number of women with these habits. The first study compared 187 biopsy-proven cases of carcinoma of the gingiva (ICD.0 sites 143.0 and 143.1), with 895 controls. In this study daily bidi smoking for less than 20 years

Table 4.5.1: **Case-control studies – bidi smoking and cancer.**

Reference	Location	Period	Site of Cancer	Subjects		OR/RR (95% CI)
				Cases	Controls	
Sankaranarayanan et al., 1989[4]	Thirvananthapuram	1983-84	Gingiva	187	895	< 20 yrs.: 2.64 (0.70–9.89) > 20 yrs.: 2.12 (1.19–27.88)
Sankaranarayanan et al., 1990[6]	Thirvananthapuram	1983-84	Buccal & Labial Mucosa	414	895	< 20 yrs.: 2.90 (1.26–6.64) > 20 yrs.: 1.66 (1.06–2.60)
Rao et al., 1994[9]	Mumbai	1980-84	Oral (subsites not given)	713	635	1.59 (1.25–2.03)
Balaram et al., 2002[18]	Bangalore, Chennai, Thirvananthapuram	1996-99	Oral (subsites not given)	591	582	< 20 bidis/day: 2.04 (1.10–3.79) > 20 bidis/day: 2.50 (1.41–4.42)
Sankaranarayanan et al., 1989[5]	Thirvananthapuram	1983-84	Tongue & Floor-of-Mouth	228	453	> 20 bidis/day: 7.46 (2.56–21.74)
Rao et al., 1998[10]	Mumbai	1980-84	Base of Tongue	495	635	5.90 (4.2–8.2)
Sankaranarayanan et al., 1990[7]	Thirvananthapuram	1983-84	Larynx	191	546	> 20 yrs.: 7.12 (4.04–12.51)
Rao et al., 1999[11]	Mumbai	1980-84	Pharynx & Larynx	1698	635	Oropharynx: 5.6 (4.1–7.6) Hypopharynx: 2.6 (2.0–3.5) Larynx: 2.3 (1.7–3.2)
Sankaranarayanan et al., 1991[8]	Thirvananthapuram	1983-84	Esophagus	267	895	> 20 yrs.: 3.75 (2.61-5.36)
Nandakumar et al., 1996[14]	Bangalore	1982-85	Esophagus	343	686	4.00 (2.3–6.8)
Nayar et al., 2000[15]	Delhi	1994-97	Esophagus	150	150	2.41 (1.43–4.06)
Gajalakshmi et al., 1996[16]	Chennai	1988-90	Stomach	388	388	Moderate Lifetime exposure 5.3 (1.56–18.28) Heavy Lifetime exposure 4.5 (1.81–11.28)
Gupta et al., 2001[13]	Chandigarh	1995-97	Lung	265	525	5.76 (3.42–9.70)
Gajalakshmi et al., 2003[17]	Chennai, Thirvananthapuram	1993-99	Lung	778	3430	> 30 yrs.: 6.45 (4.38–9.50)
Prasad et al., 1998[18]	Lucknow	1996	Lung	52	156	5.05 (2.21–11.7)

and more than 20 years showed age-adjusted relative risks of 2.49 (0.86-7.21) and 2.48 (1.57-3.92), respectively. The authors used a forward stepwise logistic regression on four main habits: pan-tobacco use, bidi smoking, alcohol drinking and snuff inhalation, and demonstrated that the relative risks for smoking bidi for less than 20 years and more than 20 years were 2.64 (0.70-9.89) and 2.12 (1.19-27.88), respectively.[4]

The second study compared 228 cases of cancer of the tongue (ICD.0 sites 141.1, 141.2, 141.3 and 141.4: n=188) and floor-of-mouth (ICD.0 site 144: n=40) with 453 controls. This study also used a forward stepwise logistic regression to estimate relative risk for four habits: pan-tobacco use, bidi smoking, bidi and cigarette smoking and cigarette smoking. After adjusting for the effect of pan-tobacco use and bidi and cigarette smoking, a relative risk of 7.46 (2.56-21.74) was observed for those smoking 20 or more bidis per day,. A corresponding relative risk of 8.91 (3.57-22.17) was found for smoking bidis and cigarettes and 6.14 (2.85-13.20) for pan-tobacco use.[5]

In the third study the investigators compared 413 cases of cancer of the buccal mucosa (ICD.0 sites 145.0, 145.1 and 145.6) and labial mucosa (ICD.0 sites 140.3 and 4) with 895 controls. All estimates were adjusted for age. A forward stepwise logistic regression was used to create a

multivariate model of risk for buccal and labial mucosa. When adjusted for other habits (pan-tobacco use, bidi and cigarette smoking and cigarette smoking), bidi smoking had a relative risk of 2.90 (1.26-6.64) for duration of the habit for less than 20 years and 1.66 (1.06-2.60) for 21 years or more.[6]

The fourth study compared 190 men with biopsy-proven squamous cell carcinoma of the larynx with 546 controls. Unconditional logistic regression with a forward stepwise approach was used to produce estimates of relative risk adjusted for age and religion. Occasional users were excluded from the analysis of frequency, duration and age at starting. All levels of bidi smoking had significant relative risk estimates, ranging from 1.79 (1.09-2.92) to 5.09 (2.69-9.63), with a highly significant trend for frequency. Bidi smoking for over 21 years posed a risk of 2.74 (1.91-3.94), with a highly significant trend. Those who reported bidi as well as cigarette smoking experienced a significant risk when smoking 11-20 pieces per day with a relative risk of 2.94 (2.50-7.34). When bidi smoking was tested in a forward stepwise logistic regression model adjusted for the other habits, including cigarette smoking, alcohol and the combination of bidi with cigarette smoking, the relative risk for bidi smoking for over 21 years was 7.12 (4.04-12.51), with a highly significant trend. Bidi and cigarette daily frequency in this model also exhibited a highly significant trend. The estimated relative risk of smoking 11-20 pieces per day was 6.78 (3.00-15.26).[7]

The fifth study compared 267 cases of esophageal cancers that were confirmed by histology or by radiology with 895 controls. Relative risks were adjusted for age and religion through unconditional logistic regression. Smoking 21 or more bidis per day carried a relative risk of 5.22 (2.72-10.00). The estimated relative risk for over 20 years of bidi smoking was 3.75 (2.61-5.36). The trend for frequency as well as duration of smoking of bidi was significant. In a forward step-wise logistic regression model, trend by duration and frequency of bidi smoking emerged as significant.[8]

Rao et al. conducted three hospital-based case-control studies during 1980-1984 at the Tata Memorial Hospital, Mumbai. In the first study they compared 713 men with histologically proven oral cancer with 635 cancer-free controls matched only for gender. Trained social workers interviewed all participants for demographic variables, family history of cancer, tobacco and alcohol consumption, frequency, duration and cessation of these habits, and dietary practices. Bidi smokers in this study had an unadjusted relative risk of 1.59 (1.25–2.03) and an adjusted relative risk of 1.37 (1.06 – 1.77), with all the other risk factors in a stepwise model.[9]

In the second study, investigators compared 647 men with histologically proven cancer of the tongue with 635 cancer-free controls matched only for gender. The cancer cases were grouped into 142 cases of anterior-tongue cancer (ICD9 141.1-141.4) and 495 cases of base-of-tongue cancer (ICD9 141.0). Trained social workers interviewed all participants for socio-demographic variables, tobacco and alcohol consumption habits, and dietary practices. In this study, bidi smoking emerged as a significant risk factor for base-of-tongue cancer, with a relative risk of 5.90 (4.2-8.2). While relative risks for all levels of frequency were significant for base-of-tongue, bidi smoking did not pose a significant relative risk of cancer in anterior-tongue for any level of frequency, The duration of bidi smoking was significant for base-of-tongue with a significant trend that peaked at 21-30 years with a relative risk of 7.7 (4.8-13.0). The estimated relative risk for 1-10 years of bidi smoking for base-of-tongue was 2.2 (1.3–4.1) and that for 31 or more years was 5.1 (3.3–8.3). An unconditional logistic regression model that included bidi smoking, alcohol drinking, illiteracy, non vegetarian diet and use of smokeless tobacco, showed that the greatest risk for base-of-

tongue cancer came from bidi smoking, with a relative risk of 4.69 (3.51-6.27). This was however not true for anterior-tongue cancer.[10]

The third study compared 1698 men with pharyngeal and laryngeal cancers with 635 controls. The estimated relative risk for bidi smoking was found to be 5.6 (4.1-7.6) for cancer of the oropharynx, 2.0 (2.0-3.5) for cancer of the hypopharynx and 2.3 for cancer of the larynx (1.7-3.2). A dose-response relationship was observed for the number of bidis smoked per day for all three sites and a significant trend for the duration of bidi smoking for oropharynx and hypopharynx. When unconditional logistic regression was performed using five variables (including bidi smoking, alcohol drinking, illiteracy, non-vegetarian diet and tobacco chewing), bidi smoking was still clearly the most important variable for all three sites.[11]

Balaram et al. conducted a three-center (Bangalore, Chennai and Thirvananthapur-am) case-control study during 1996-99, comparing 591 cases of oral cancer with 582 age and sex-matched controls, selected from the same centers, from among out-patient attendees (accompanying relatives and friends). Information was collected regarding socio-demographic variables, tobacco and alcohol habits, oral hygiene, dental status and occupation. Combined data analysis was carried out for all three centers, using unconditional multiple logistic regression models containing terms for center, age (5-year intervals), education, and smokeless tobacco use in addition to the variables being tested. Alcohol consumption was included in models evaluating relative risks due to smoking habits. Attributable risk fractions were computed separately for men and women. Oral cancer cases reported significantly fewer years of education, especially women. Industrial manual workers and farmers were at approximately a two-fold risk compared to clerical workers in their respective gender. The odds ratio for men who smoked fewer than 20 bidis per day was 2.04 (1.10 – 3.79) and for those who smoked over 20 bidis per day it was 2.50 (1.41 – 4.42).[12]

Gupta et al. from Chandigarh conducted a case-control study comparing 265 cases of lung cancer, confirmed by cytology or histology, with 525 controls matched by age, sex, religion and residence, from January 1995 to June 1997. Trained personnel gathered information on demographic variables, lifetime exposure to smoking, detailed occupational history, residence, and exposure to indoor air pollution due to burning of organic fuels. The odds ratio for bidi smoking was 5.76 (3.42-9.70), while that for cigarette smoking was 3.86 (2.11-7.06). There was no clear trend for duration of habit for bidi smoking in this study.[13]

A hospital-based case-control study by Nandakumar et al. investigated the risk of esophageal cancer by subsite and histology at the Kidwai Memorial Institute of Oncology, Bangalore during 1982-85. Data were collected on 343 cases using a structured questionnaire administered by trained social workers to elicit information on demographic variables, literacy, habits and diet. For each case, two controls were randomly selected from a database of 1875 patients who did not have cancer or benign tumors. They were matched on age (within 5 years), sex, area of residence, and calendar time of their hospital visit. Statistical analysis to obtain odds ratios was done by conditional logistic regression to account for the pair matched design. Bidi smoking and cigarette smoking had unadjusted odds ratios of 3.5 (2.1 – 5.6) and 1.5 (0.9 – 2.8), respectively. Adjusting for all the other factors (use of smokeless tobacco and pan without tobacco, alcohol drinking, and cigarette-bidi smoking) with logistic regression, bidi smoking had an odds ratio of 4.0 (2.3 – 6.8) for cancer of the esophagus. Bidi smoking had a significantly elevated risk for all three segments of the esophagus, but the highest risk was for the upper third with an odds ratio of 7.1 (1.1 – 46.8), followed by the middle third with an odds ratio of 6.0 (2.5 – 14.5), and then the lower third with an odds ratio of 3.9 (1.4 – 10.7).[14]

A case-control study by Nayar et al. conducted from February 1994 to March 1997 at the All India Institute of Medical Sciences, New Delhi compared 150 histologically proven cases of esophageal cancer with an equal number of controls matched for age (within 5 years), sex and socioeconomic status. This study examined nutritional risk factors in addition to habits. In a univariate analysis, daily bidi smoking was found to increase risk for esophageal cancer, with an odds ratio of 2.41 (1.43-4.06). Later, after using unconditional stepwise logistic regression to eliminate habits that had no effect, bidi smoking showed an odds ratio of 1.95 (1.17-3.26). This was adjusted for other risk factors, such as using betel quid with tobacco and consumption of vegetables other than leafy vegetables fewer than three times per week (versus daily consumption).[15]

Gajalakshmi et al. conducted two case-control studies. The first was a prospective hospital-based case-control study of stomach cancer at Chennai. The disease was con-firmed by histology, endoscopy, barium meal or surgery. Controls were selected from among other patients of the Cancer Institute (excluding those with cancer of the oral cavity, pharynx, larynx, lung, urinary bladder, pancreas and gastrointestinal tract), after matching for age, sex, religion and mother tongue. Participants were interviewed for demographic variables, tobacco and alcohol habits, occupation and income, personal and family medical history and diet (one year prior to diagnosis). Details collected on smoking habits included type of tobacco smoked, age at starting, daily frequency, and age at cessation (more than six months prior to diagnosis of cancer). The odds ratio for current smoking of any type of tobacco was 2.7 (1.79 – 4.07). The odds ratio for current bidi smoking was 3.2 (1.80 – 5.67) and that for current cigarette smoking was 2.0 (1.07 – 3.58). The odds ratio for starting to smoke bidis under 21 years of age was 3.7 (1.66 – 8.34). It remained elevated and significant even for those who started smoking bidis between 21 and 30 years of age. A highly significant dose-response trend was seen for lifetime exposure to bidis. 'Moderate' lifetime exposure to bidi smoking had an odds ratio of 5.3 (1.56 – 18.28), while 'heavy' bidi smoking had an odds ratio of 4.5 (1.81 – 11.28).[16]

In their second study, Gajalakshmi et al. analyzed the effect of alcohol and tobacco consumption on lung cancer risk among men. This case-control study, conducted in Chennai and Thirvananthapuram, compared 778 lung cancer cases with 3430 controls. The effects of cigarette smoking, bidi smoking, use of smokeless tobacco and alcohol drinking on the risk of lung cancer were estimated from unconditional multivariate logistic regression. The odds ratios were 4.54 (2.96 – 6.95) and 6.45 (4.38 – 9.50) for more than 30 years of exclusive cigarette smoking and exclusive bidi smoking, respectively. The study also concluded that the lung cancer risk of former cigarette smokers drops more quickly after they quit smoking than it does for former bidi smokers.[17]

Prasad et al. from KG Medical College, Lucknow, conducted a hospital-based case-control study comparing 52 cases of lung cancer with 156 healthy controls. They were able to demonstrate that bidi smokers had an odds ratio of 5.05 (2.21 – 11.7). They were also able to show a significant duration and dose-response relationship between bidi smoking and lung cancer.[18]

Biological Evidence

Biological evidence for the association between tobacco smoking and cancers is provided by the presence of known carcinogenic compounds in tobacco smoke. Polycyclic Aromatic Hydrocarbons (PAH) are implicated in the causation of lung cancer.[19] N-nitroso compounds are another major group of chemicals found in tobacco smoke, several of which are potent animal carcinogens. N-nitroso compounds are also found in the urine of smokers.[20] Cotinine, which is secreted in the

urine and saliva, is probably the best marker of exposure to tobacco smoke, but it is not directly relevant to carcinogenesis. A potent carcinogen for bladder cancer is 4-aminobiphenyl, which is present in tobacco smoke.[21, 22] Hemoglobin adducts formed by 4-aminobiphenyl are markedly increased in smokers, particularly smokers of black tobacco. Smokers of black tobacco have more than twice the risk of bladder cancers as smokers of blond tobacco.[23] Benzo[a]pyrene metabolites have been found in the cervical mucus and as DNA adducts in cervical tissues of smokers, thereby providing support to the association between tobacco smoking and cancer of uterine cervix.[24] Cytogenetic cell damage in patients with myeloid leukemia has been consistent with the effect of benzene in cigarette smoke.[25]

People exposed to secondhand smoke inhale the same carcinogens as active smokers, although in much lower doses.[3] Because smoking is an established cause of lung cancer, it follows that there must be some risk of lung cancer to lifelong secondhand smokers too.[2] The association between the risk of lung cancer and exposure to secondhand smoke is supported by the fact that the urine of secondhand smokers contains concentrations of N-nitroso compounds that are 1% to 5% of the concentrations found in the urine of active smokers, i.e., approximately proportional to the increased risk found in epidemiologic studies of secondhand smoking.[20]

Bidi smoke contains several of the same carcinogens as does cigarette smoke, sometimes in much higher concentrations. Bidi smoke contains higher amounts of tar, nicotine, carbon monoxide, ammonia, hydrogen cyanide, other volatile phenols and carcinogenic hydrocarbons, benz[a]anthracine, benz[a]pyrene, and radioactive uranium, as compared to cigarette smoke.[26-29] The material used for wrapping the bidi tobacco is less porous and less combustible than cigarette wrapping paper. This may be a reason for the higher intake of carbon monoxide, nicotine and tar during bidi smoking. The wrapping material is also responsible for the fact that a bidi has to be puffed two to three times more frequently than a cigarette.[27] Frequent puffs cause greater inhalation of nicotine and tar. The tar intake of bidi smokers has been reported to be three times that of cigarette smokers.[30]

It has been reported that bidis contain 1.5 times more carcinogenic hydrocarbons than American cigarettes.[28] Bidi smoke condensate induced angioma in the liver, papilloma and cancer of the forestomach, and cancer of the esophagus in seven out of 15 Swiss albino mice in one study, while at the same dose level cigarette smoke condensate failed to produce tumors in any of the 15 mice.[31] Urine of bidi smokers had higher concentrations of mutagenic chemicals than that of cigarette smokers.[32] The biological evidence is consonant with the findings of the case-control studies that bidi smoking has greater odds ratios/relative risks than cigarette smoking for developing cancer of the tongue, floor of the mouth, buccal and labia mucosa, gingiva and oropharynx; and of the esophagus, stomach, larynx and lung.[4-18]

BIDI ROLLING AND CANCER RISK

Bidis are hand rolled and bidi rolling is a household industry in India, with all female members (including young girls) of some communities occupied for 10-12 hours a day on the job (personal observation of the author). These women and young children (who are generally in close proximity) are continuously exposed to tobacco dust. Tobacco enters their bodies by inhalation and rubbing against the skin. High urinary cotinine levels have been detected in bidi workers who did not consume tobacco.[33] Studies have shown increased chromosomal aberrations, elevated mutagenic and genotoxic burden. An increase in the frequency of microuncleated buccal epithelial

cell development is also seen.[34-37] Aqueous extract of bidi tobacco exhibited skin tumor promoting activity in S/RV Cri-ba mice.[38] These findings support the possibility of an increased cancer risk among bidi workers.

CONCLUSION

Fifteen case-control studies conducted in India were reviewed. Risks were appropriately adjusted for potential confounders, such as use of smokeless tobacco and alcohol drinking (except for two lung cancer studies). Six studies on oral cancer showed that bidi smokers had at least a two-fold higher risk than persons who did not smoke bidis. Bidi smokers had a nearly five-fold higher risk for cancer of the base tongue and oropharyngeal cancer in two different studies. Bidi smoking posed a nearly three-fold higher risk for cancer of the hypopharynx and a two-fold greater risk for laryngeal cancer in one of the studies. In two studies on esophageal cancer, four and two-fold higher risks were found. The risk of stomach cancer in one study was around five times higher for moderate lifetime bidi smoking than for non smokers. Three studies on lung cancer showed that bidi smokers have a five to six-fold greater risk than non-smokers. It can be concluded that bidi smoking poses a very high risk of cancer.

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4.6 Oral Mucosal Lesions and Diseases

Mihur N. Shah, P. R. Murti and K.B. Rajpura

INTRODUCTION

This chapter reviews several epidemiological studies that confirm that bidi smoking is deleterious to oral health. The most life-threatening oral lesion associated with bidi smoking is oral cancer. Bidi smoking causes leukoplakia, which is precancerous, a few other oral mucosal lesions and presumably, like other smoking habits, compromises periodontal health. Most of these mucosal lesions remain asymptomatic for a long time, resulting in the progression of lesions to oral cancer, and then more clinically advanced stages, with the consequent poor prognosis.

MALIGNANCY

Oral Cancer

The term oral cancer encompasses any malignancy arising from the oral tissues. However, over 95% of oral cancers are squamous cell carcinoma or its variants. Oral cancer represents ICD-9 (*International Classification of Diseases*) groups 140 (lip), 141 (tongue), 143 (gum), 144 (floor of the mouth), 145 (palate and other parts of the mouth). The corresponding codes in the revised ICD-10 version are: C00 (lip), C01 and C02 (tongue), C03 (gum), C04 (floor of mouth), C05 (palate), and C06 (other parts of the mouth).

Globally, oral cancer is one of the 10 most common cancers; on the basis of annual age-adjusted incidence rates, oral cancer ranks from 1st to 6th among all cancers that occur in different regions in India. Ten percent of the estimated 800,000 new cancers that occur in all parts of the body each year are oral cancers.[1]

Tobacco use including bidi smoking, is the most important causal factor for oral cancer.[2-9] Bidi smoking predisposes to cancer in the commissures of the lip, floor of the mouth and oral tongue. Cancers in this location may be ulcerative or appear like a nodular leukoplakia. If a nodular leukoplakia is thick or shows even a small growth, it might prove to be a cancer microscopically.

PRECANCER

A precancerous lesion is defined as "a morphologically altered state in which cancer is more likely to occur than in its apparently normal counterpart".[10] The importance is that such lesions are amenable for primary and secondary preventive measures.

Leukoplakia

Leukoplakia (white patch) is defined as a "raised white patch of the oral mucosa measuring 5 mm or more, which cannot be scraped off and which cannot be attributed to any other diagnosable diseases; this definition does not carry any histological connotation.[11] Leukoplakia is the most common precancerous lesion.

The prevalence of leukoplakia in over 158,000 villagers in different regions of India varied from 0.2% to 4.9%.[11,12,13] Tobacco is the principal etiologic factor for leukoplakia. Among different tobacco habits, bidi smoking, wherever prevalent, accounts for a significant proportion of leukoplakias. For example, in a study among 4700 Bombay policemen, the prevalence of leukoplakia among bidi smokers was 3.7% compared to 4.2% in smokeless tobacco users and 7% in mixed users.[14] In several population-based studies in rural areas of India, the prevalence of leukoplakia in bidi smokers varied from 0.4% to 5.2%, compared to zero in non-users of tobacco. The prevalence ranged from 0.4% to 1.8% in smokeless tobacco users and 0.3% to 6.3% in mixed users.[11,12,13] Furthermore, the dose-response relationship was stronger for bidi smoking compared to smokeless use, the ratio of age-adjusted prevalence of leukoplakia for frequency <10 vs. 1-10 being 5.0 for bidi smoking and 1.8 for use of smokeless tobacco.[15]

A multivariate analysis of 15 variables, which included sex, age, religion and diff-erent forms of tobacco use, showed bidi smoking to be the most important factor for leukoplakia.[16] Consistent with these observations, a 10-year prospective study in India demonstrated age-adjusted incidence rates of 0.7 and 2.9 per 1000 among bidi smokers, compared to 0.7 to 2.5 among tobacco chewers, while in mixed users, the incidence was 2.5 and 6.0, respectively; the incidence of leukoplakia was zero in non-users of tobacco.[17]

Leukoplakias are primarily classified into homogeneous and non-homogeneous types. This categorization is important because of their long-term behavioral implications and management protocol.

Homogeneous leukoplakias constituted about 84% of the 881 leukoplakias associated with different forms of tobacco usage observed in an extensive epidemiologic study among 51,000 villagers in India.[11] Homogeneous leukoplakias are characterized by raised plaque formation consisting of a plaque or groups of plaques varying in size with irregular edges.

Non-homogeneous leukoplakias, which include ulcerative and nodular types, form up to 16% of leukoplakias. Of these, 13% were ulcerated leukoplakias marked by a red area, which at times exhibit yellowish areas of fibrin; occasionally pigmentation may be present as a heat effect of smoking. Ulcerated leukoplakias are generally observed among bidi smokers.[18] Nodular leukoplakias are marked by the presence of white nodules on an erythematous base.

Labial commissures are the most favored (7% to 35%) location for leukoplakia in bidi smokers; while homogenous and nodular leukoplakias occur in the commissures and other intraoral sites, ulcerated leukoplakia occurs almost always in the commissures and the anterior part of the buccal mucosa. Interestingly, 12% to 33% of bidi-associated leukoplakias show bilateral commissural involvement. Leukoplakias on the ventral surface of the tongue and floor of the mouth, which are high-risk locations, though rare in India, are observed in bidi smokers. Ulcerated leukoplakias also occur in association with palatal erythema and central papillary atrophy of the tongue.

Generally, ulcerated leukoplakias show a parakeratinized surface and epithelial hyperplasia. Epithelial dysplasia, which indicates malignant potential, was observed in 13.7% of ulcerated leukoplakias, compared to 8.7% in homogenous and 59.1% in nodular leukoplakias; [11] 16% of the ulcerated leukoplakias showed superimposed *Candida* hyphae compared to 5% and 32% in homogeneous and nodular leukoplakias, respectively.[19]

Leukoplakias associated with bidi smoking are different than those associated with other forms of tobacco use.[17] The former are more stable with longer duration (29 yrs) compared to

those associated with smokeless tobacco use (5-8 yrs) and mixed tobacco use behaviors (8-18 yrs). Their annual spontaneous regression rate was 2.2%-3.3% compared to 3.3%-12.2% in other habits. The annual recurrence rates were lower (0%-3%) compared to 1.1%-15.3% in other habit groups. In an extensive long-term epidemiologic study in India, with a mean observation period of 4.4 years, ulcerated leukoplakias demonstrated a malignant transformation rate of 218.8 per 100,000 per year and a relative risk of 43.6 for malignant transformation.[20] The corresponding figures for homogeneous and nodular leukoplakias were 128.8 and 16,216 per 100,000, respectively, and the relative risks were 25.6 and 3243.2 in comparison to individuals who were tobacco users but were without any precancerous lesions.

OTHER ORAL MUCOSAL LESIONS

Preleukoplakia

Preleukoplakia was conceived as a precursor to leukoplakia because of its clinical appearance and other characteristics. It is defined as a "low-grade" or a mild reaction of the oral mucosa, appearing as a grey or greyish-white, but never completely white lesion. It has a slight lobular pattern and indistinct borders blending into the adjacent mucosa. Most preleukoplakias lack clear-cut margins, whiteness and elevation to qualify the diagnosis of leukoplakia. They cannot be ignored as they represent a well-defined clinical abnormality that is a possible precursor to leukoplakia and could possess some independent malignant potential as well.

The prevalence of this lesion varied from 0.5% to 4.1%.[99] Preleukoplakia is predominantly associated with bidi smoking.[17] The age-adjusted incidence rates in smokers varied from 3.3 to 10.1 per 1000 compared to 5.2 to 10.4 per 1000 in those who smoked and chewed but in whom the principal habit was smoking.

Preleukoplakia can remain stationary (12%-34%) or regress (43%-57%) and of those regressed lesions, 7%-24% recurred; [17] about 7%-15% of preleukoplakias progressed to leukoplakia and less than 1% showed malignant transformation. Malignant transformation can occur after a preleukoplakia develops into a leukoplakia, or even directly.

Leukoedema

Leukoedema is regarded as a variant of the normal mucosa. It is a chronic mucosal condition in which the oral mucosa has a grey, opaque appearance as though a greyish film were hanging over it like a veil. When the mucosa is stretched, leukoedema disappears, only to reappear when it is relaxed. Unlike leukoplakia, leukoedema does not present a keratinized surface. It develops due to the piling up of spongy cells and intercellular edema.

The prevalence of leukoedema varied from 0.02% to 0.3%.[21] Leukoedema is more often observed in bidi smokers. The age-adjusted incidence rate among bidi smokers was 3.8 per 1000 compared to 1.8 per 1000 in chewers.[17] Over a 10-year observation period, out of 87 lesions observed, 66% remained stationary and 34% regressed; malignant transformation was not observed in leukoedema.[17]

Smoker's Palate

Smoker's palate, also known as *leukokeratosis nicotina palati* or *nicotinic stomatitis,* is perhaps the most common reaction of the palate to all forms of smoking. It consists of a diffuse white

palate with numerous excrescences having central red dots, corresponding to the orifices of the minor salivary glands. In an early stage, smoker's palate may consist of a greyish palatal mucosa, with fewer excrescences.

The prevalence of this lesion varied from 0.3% to 9.5%. Smoker's palate, as the term implies, is a lesion produced by smoking. However, in addition to smoking, some individuals with this lesion may also practice other smokeless tobacco habits. The annual age-adjusted incidence rates of smoker's palate in bidi smokers varied from 0.9 to 1.7 per 1000. It was, however, observed much more (3.8 per 1000) in clay pipe smokers in Bhavnagar District, Gujarat, India.[17]

Smoker's palate remained persistent in 25%-66% of cases and the remaining regressed; [17] no malignant transformation was observed in smoker's palate. Smoker's palate as such is not considered precancerous. Palatal changes associated with reverse *chutta* smoking (inappropriately referred to as *leukokeratosis nicotina palati* by some investigators), however, must be distinguished from smoker's palate as the former, i.e., palatal changes, show diverse clinical appearance and are high-risk precancerous lesions.

Palatal Erythema

This lesion consists of diffuse erythema on the hard palate that occasionally extends to the soft palate. About 10% of the lesions were associated with palatal papillary hyperplasia, which is more often observed in denture wearers and occasionally in dentate persons. Most palatal erythemas show *Candida* hyphae, microscopically. The clinical and microscopical features of palatal erythema are similar to erythematous candidosis. Often the redness in palatal erythema in bidi smokers is quite intense, so as to mimic an erythroplakia.

In one study palatal erythema was observed in about 1% of 7,216 tobacco users.[18] All lesions were observed in bidi smokers, but some chewed tobacco as well as smoking. Palatal erythema was observed in only three women, who smoked bidis. Palatal erythema occurred either independently or sometimes with other bidi smoking-related lesions.

Over a 10-year period, 35% of the 69 lesions persisted, 56% regressed and 9% were transient, i.e., they regressed, recurred and regressed again.[17] The highest percentage (60%) of lesions was persistent in those who had not given up their smoking and the highest percentage (75%) of palatal erythemas regressed in those who gave up their smoking habits or reduced them substantially. Interestingly, most of the transient lesions were observed in those whose smoking behavior was inconsistent, i.e., they discontinued, restarted, and stopped again. Thus the strong association of palatal erythema with bidi smoking is clear. In view of the association between *Candida* hyphae and leukoplakia,[19] a link of this form of smoking, predisposition to *Candida* infection and palatal erythema appears to be strong.

Central Papillary Atrophy of the Tongue

Central papillary atrophy of the tongue, also described in the literature as median rhomboid glossitis and erythematous candidosis, consists of a well-defined oval, pink area in the center of the dorsum of the tongue, which is devoid of lingual papillae.

The prevalence of this lesion in India varied from 0.04% to 0.1%.[22] This lesion was mostly seen in bidi smokers. In a cross-sectional study it was observed in 2.2% of bidi smokers, 1.6% of cigarette smokers, and 0.3% of non-users of tobacco. In a study of 182 lesions with an observation

period of 10 years, 82% occurred among bidi smokers and the rest in those who smoked and chewed; nine of the 182 individuals were women who smoked bidis, which is otherwise an uncommon habit among Indian women.[23]

The length of central papillary atrophy lesions may vary from 0.8 to 5 cm and the breadth from 0.4 to 2.4 cm. The lesions may be oval, elongated, rhomboid, or irregular with smooth, fissured, or lobular surface. About 14% of the lesions occurred with palatal erythema, 8% with leukoplakia, and 3% with palatal erythema and commissural leukoplakia (triad). Some 6% of the lesions occurred along with other tobacco-related lesions, and about 95% occurred in men. Microscopically, over 67% of the lesions show *Candida* hyphae.[23] A lesion similar to central papillary atrophy of the tongue was reported among people with HIV infection under the term erythematous candidosis. It is, therefore, important to consider bidi smoking as a possible cause, in addition to suspecting HIV in the presence of this lesion.

Like all tobacco-related lesions, central papillary atrophy may remain stationary, regress (re-papillate), recur or may show inconsistent behavior. Discontinuation or appreciable reduction in smoking results in their higher re-papillation rates. For instance, in a 10-year study of 182 lesions, 50% persisted, 43% re-papillated, 5% re-papillated and recurred, and 2% showed inconsistent behavior.[23] The highest percentage (65%) of persistent lesions were found among people who did not stop or reduce their habits, while the highest percentage (87%) of regressed lesions were among those who discontinued or reduced their bidi smoking considerably.

Erythroplakia

Erythroplakia is a clinical term for lesions of oral mucosa, which describes a bright red, velvety plaque that cannot be characterized clinically or pathologically as being due to any other condition.[24] Though rather uncommon, erythroplakia represents the most severe of all precancerous lesions.

The prevalence of this lesion in rural India was 0.02%.[25] Perhaps due to the rarity of this lesion, there are no sufficient accrued data in regard to its age, sex and habit distribution. It can be rightly assumed that bidi smoking would be an etiologic factor for this lesion as well.

Erythroplakia shows clearly demarcated margins. Shear described three clinical types: homogeneous erythroplakia, erythroplakia interspersed with patches of leukoplakia and granular or speckled erythroplakia.[26] Erythroplakia must be distinguished from transient inflammatory conditions, stomatitis associated with nutritional deficiencies, and palatal erythema caused by bidi smoking.

Long-term studies that might indicate the malignant transformation rates of erythropakia are not available. Often erythroplakias demonstrate squamous cell carcinoma, carcinoma-in-situ, i.e., most severe epithelial dysplasia, microscopically.[27] Erythroplakias thus require immediate attention.

PERIDONTAL DISEASES

Tobacco smoking is an independent risk factor for gingival and periodontal diseases.[28-31] Several cross-sectional and longitudinal studies have shown higher prevalence rates and severity of periodontal diseases and tooth loss,[32] bone loss, deep periodontal pockets, and attachment loss compared to non-smokers.[33] Smokers are estimated to be at a 2.5 to six-fold higher risk for periodontal disease. In the U.S., smoking is estimated to be responsible for 50% of the more than

eight million patients with periodontal diseases.[34,35] Presumably bidi smoking is also expected to be harmful to periodontal health.

CONCLUSION

The addictive agent in tobacco is nicotine and the extent to which it is absorbed by the mucosa is said to depend on whether it is present in ionized or non-ionized form. Acidic pH, as in cigarette smoke, gives rise to ionized nicotine, and alkaline pH, as in pipe and cigar smoke and in smokeless tobacco, gives non-ionized nicotine;[36] only nicotine in non-ionized form is readily absorbed in the mouth. Bidi smoke is slightly acidic (pH 5.7-5.9);[37] nevertheless, it produces a variety of oral lesions.[42] It is likely that this pH-free nicotine is in the vapor phase of the smoke, which is easily absorbed through the oral mucous membrane, thereby inducing lesions. Perhaps the high levels of nicotine in bidi smoke[38] also contribute in the causation of oral lesions.

An interventional approach showed that quitting bidi smoking was feasible through health education, which led to a decreased risk for oral mucosal lesions.[39-41] For example, in a 10-year prospective intervention study, over 36,000 tobacco users were examined in a baseline survey for oral cancer and precancer and subsequently annually, for 10 years.[40,41] At each examination they were exposed to health education for their tobacco habits. The outcome was that even at the end of one year, a significantly higher percentage of leukoplakias regressed in those who quit or reduced their habit substantially.[40] At the end of 10 years of intervention, 11% of the men and 37% of the women in the intervention cohort quit their bidi smoking, compared to 2% and 10% in the control cohort.[41] In addition a substantial proportion of tobacco users reduced their smoking significantly. This led to a drop in the incidence of leukoplakia in bidi smokers to 146 per 100,000 in the intervention cohort compared to 302 per 100,000 in the control cohort. Among those who stopped bidi smoking, no new cases of preleukoplakia, leukoedema, and smoker's palate were observed, as against 10.7, 9.6 and 6 lesions expected, respectively. Only one leukoplakia and one central papillary atrophy were observed, as against 5.8 and 6 expected. In addition to confirming the association as a causal one, these findings implied a reduction in the risk for oral cancer as a result of health education interventions.

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CHAPTER 5

5.0

Economics of Bidis in India

5.0 Economics of Bidis in India

P.R. Panchamukhi, Trevor A. Woollery and S.N. Nayanatara

INTRODUCTION

This chapter describes the economics of agricultural production of bidi tobacco, bidi manufacturing and the Indian govern-ment's policy and approach towards the bidi sector. It provides an overview of issues related to employment, taxation and trade in bidis.

India is the world's second largest producer of leaf tobacco, accounting for about 10% of the world's leaf crop. Per capita consumption of manufactured cigarettes is low in India, due to the wide variety of cheaper alternative tobacco products, particularly bidis and smokeless tobacco, which are widely consumed.[1] As a result, cigarettes account for only about 14% of the country's total tobacco market.

The bidi is believed to be of Indian origin, but is widely used in other Asian countries, such as Pakistan, Bangladesh, Nepal, Sri Lanka, Singapore and Malaysia.[2] A bidi consists of 0.2-0.3g of sun-cured smoking tobacco loosely packed and rolled inside a rectangular piece of dried tendu leaf and tied with a cotton thread.[4] They rarely carry filters and are normally sold in bundles of 20 to 25 through informal retailers.

Tendu leaf (*Diospyros melanoxylon)* is the main non-tobacco component of bidis and it is used for rolling.[2] The leaf is flexible, durable and widely available in Madhya Pradesh, Maharashtra, Orissa, Andhra Pradesh, Bihar and Uttar Pradesh; 50% of the tendu leaf supply comes from Madhya Pradesh. Around 150,000 tons of tobacco and 30,000 tons of wrapper tendu leaves are used annually to manufacture bidis.[3] To reduce costs, some small manufacturers in Karnataka are using tumari leaves, which are similar to tendu, but cost less due to local availability. Apta or ashitri leaves can also be used.

In the mid-1990s, a niche overseas market was cultivated for flavored bidis (strawberry, cherry, chocolate, etc.), and they are becoming viable exports for profit and foreign exchange earnings. Bidis exported to the USA have attractive wrappers and are cheaper than cigarettes, where they are reported to be favored by children and college students. Flavored bidis are not popular in India.

AGRICULTURE

India accounts for more than 85% of the world's bidi production.[2] Bidi tobacco occupied around 30% of the total area under tobacco cultivation and 33% of total tobacco production in the country in 2002.

Bidi tobacco was probably first grown in Kaira district of Gujarat.[5] According to the "Report on Marketing of Tobacco in India and Burma" (1939), about one-fourth of the total bidi production was concentrated in Central Province (Gujarat, MP), while about 40% of the total production was contributed by the Provinces of Bombay (Maharashtra and Karnataka) and Madras (Andhra Pradesh and Tamil Nadu) and the remainder was scattered over the rest of the country.[6]

Today Gujarat and Karnataka are the main bidi tobacco-producing states. In Gujarat, it is grown mainly in Kaira and Baroda districts. In Karnataka it is grown in Nippani area of Belgaum districts. It is found to a limited extent in Kolhapur and Sangli districts of Maharashtra and in Kurnool district of Andhra Pradesh. The average yield of bidi tobacco is 1000 kg/ha in Karnataka, 1800 kg/ha in Gujarat and 1300 kg/ha in Maharashtra.[2] Despite lower yield, Karnataka (Nippani) bidi tobacco is considered to be of superior quality.

Bidi tobacco is a 'Nicotiana tobacum' variety. Unlike the Virginia variety, it is thick and heavy with strong aroma. It is grown under rain-fed conditions in Karnataka[7] (Box 5.1) in black silt loamy soil having moisture retention capacity, and is grown under irrigation in sandy to sandy-loam soil in Gujarat. Bidi tobacco is generally affected by blank shank, root knot, frog eye and leaf spot diseases in the nursery and during the transplant stage. The tobacco plant is infested by aphids, caterpillar, and white fly.

Box 5.1: **Bidi Farming in Karnataka**

1. Profitability, increasing fertility of soil, non-suitability of other crops and grown by forefathers are the main reasons quoted by farmers for cultivating bidi tobacco.
2. People belonging to upper castes [78%] dominate tobacco farming.
3. About 78% of the heads of households are literate.
4. More than 87% of the households are cultivators in all categories of land holdings.
5. Economic status, as measured by annual income according to size holdings, indicates that 13% of the bidi tobacco growing households are below the poverty line (<Rs.20,000), 49% are middle income (Rs.20,000-Rs.200,000) and 38% are high income (>Rs.200,000).
6. The Area Replacement Index (the ratio of area under tobacco to area under other crops) for tobacco vs. non tobacco crops in the sample region is 69.19. Maximum replacement applies to jowar, the staple food grain in the region.
7. Bidi tobacco is labor-intensive vis-à-vis other crops, except in the case of small farmers (where cotton requires more days of labor).
8. Use of bullocks is highest for bidi tobacco in all the size holdings, with the exception of cotton among small farmers.
9. Cost of cultivation per acre is highest for sugarcane, with bidi tobacco in second place.
10. Net return per acre is highest for sugarcane [Rs.8,649] followed by bidi tobacco [Rs.3,499] and soybeans [Rs.1,290]. Net return per rupee of investment is 0.87 for sugarcane, 0.57 for bidi tobacco and 0.43 for soy beans.
11. Bidi tobacco residue stains laborers' hands and makes their food taste bitter. Members of households where bidi tobacco is stored report that food spoils within a few hours of preparation and they experience nausea and headaches due to the tobacco smell.
12. Price variability is lower for bidi tobacco than for other crops, as there are buy-back arrangements with processing units and factories.
13. Small farmers who have shifted from tobacco have more than 70% of their agricultural land under irrigation. Even marginal farmers who have shifted have 42% of their land under irrigation.
14. Considering the adverse health effects of tobacco production and use, the majority of farmers are willing to shift from bidi tobacco cultivation if they are assured of better quality seeds for alternative crops, irrigation and marketing facilities.

Sample: 1652 tobacco-growing households, representing 10% of tobacco-growing households in the three selected blocks. Area: Three main taluks (blocks) of the bidi tobacco cultivating region. Villages: 50.
Source: Panchamukhi et al., 2000.[7]

Bidi tobacco is grown as a rabi crop in the month of August and harvested generally in the month of January. It is harvested by stalk-cut method and left in the field for sun curing for three days or until dry (Figure 5.1). After sun-curing, the dried leaves are taken to farmers' houses for crushing, then cleaned to remove mud, mid ribs and stones and finally packed into bags weighing around 60 kg. The leftover stalks, mid ribs and roots are used as fuel for domestic purposes.

Figure 5.1 **Some stages of bidi tobacco production.** Source: Panchamukhi et al., 2000.[7]

Harvesting and curing of bidi tobacco.

Packing of bidi tobacco for storage and transport.

Women in bidi tobacco cultivation taking home sun-cured bidi tobacco.

During the period from 1990–91 to 1997–98, the area under bidi tobacco increased by 7%, while production declined by 3%[8] (Table 5.1). However, area and production of flue-cured Virginia (FCV) tobacco increased by 52% and 35%, respectively, during the same period.[9] The difference could be due to the increase in research on FCV tobacco for promoting cultivation of flavorful and light tobacco, which is in demand internationally, and other support that FCV tobacco farmers receive through the Tobacco Board of India, ICAR research institutes and the government, for increasing production and exports.

Around 76% of bidi tobacco production is from Gujarat in an area of around 90,000 hectares[8] (Table 5.2). In Karnataka bidi tobacco area is confined to around 24,000 ha. Karnataka and Maharashtra grow 12% and 6% of the total bidi tobacco produced, respectively. The remainder comes from Orissa and Andhra Pradesh. The yield of bidi tobacco is higher in Gujarat due to planting of high-yield variety seedlings, irrigation, and optimum use of pesticides and manure.

Bidi tobacco production fell from 39% in 1985-86 to 33% in 2002 (Table 5.3). The FCV tobacco share for the first time increased to 29% in 2002. In 2002, India produced approximately 602,100 metric tons of tobacco, an increase of 14% over the previous year, but still lower than 1997-98(650,000 metric tons). [8-12]

Table 5.1: **Area and production of bidi and FCV tobacco.**

	Bidi Tobacco		FCV Tobacco	
Year	Area (000′ ha)	Production (million kg)	Area (000′ ha)	Production (million kg)
1990–91	128.3	197.1	118.9	112.9
1991–92	113.3	167.1	158.6	164.7
1992–93	123.8	188.3	155.2	165.8
1993–94	118.6	188.2	133.2	123.8
1994–95	130.8	218.8	120.8	113.4
1995–96	138.5	205.2	125.6	117.7
1996–97	139.1	211.4	149.2	138.2
1997–98	137.2	190.7	181.0	152.4
2002	NA	200.0	NA	175.0

Source: DTD, 2000[8]; Tobacco Board, 2002.[9]

Table 5. 2: **State-wise area, production and productivity of bidi tobacco.**

State	1995–96		
	Area (000′ ha)	Production (million kg)	Productivity Kg/Ha
Gujarat	92.0	156.3	1699
Karnataka	24.0	24.5	1020
Maharashtra	8.0	11.5	1438
Total	**124.0**	**192.3**	**1551**
Bidi Tobacco: All India	**138.5**	**205.2**	**1482**

Source: DTD,2000.[8]

Table 5.3: **Share of bidi and FCV tobacco in total production of tobacco.**

Year	Bidi (%)	FCV (%)	All types of tobacco (million kg)
1970–71	27.6	26.6	361.9
1975–76	31.4	27.7	349.8
1980–81	36.5	26.1	520.1
1985–86	39.3	18.0	441.2
1990–91	35.3	20.2	558.4
1995–96	38.0	21.7	540.0
1996–97	34.0	22.1	620.0
1997–98	29.3	26.2	650.0
1999*	NA	NA	587.6
2000*	NA	NA	599.4
2001*	NA	NA	530.0
2002*	33.0	29.1	602.1

Source: NCAER, 1994[10]; Tobacco Board, 2002[9];
DTD, 2000[8];*USDA[11] & USDA Gain Report, 2003.[12]

EMPLOYMENT

The bidi industry is not particularly organized because production is predominantly carried out at the household level. It is difficult to estimate precisely the number of people engaged in bidi making as women are paid on a piecework basis and are often assisted by their children and other family members.[14] Roughly four million people earn their livelihood from bidi rolling (See Annex 5.1 for number of workers by state). The National Sample Survey (NSS) 50th Round (1993–94) estimates the number of people presently employed in the bidi sector to be 2,634,000 (estimates based on a large sample of more than 100,000, covering the whole of India and using households as the sampling unit). The lower estimate is mainly because only 10% of bidi rollers work in factories;[15] the other 90% work at home, where only the main person who collects raw materials and delivers finished bidis to the contractor is reported as a bidi worker. According to NSS estimates (1993-94), around 74% of the tobacco-dependent employment is in bidi manufacture and 76% of bidi makers are women (Figure 5.2). The Labor Bureau's "Report on the working conditions of bidi workers in India" (1995), found that 66% of the workers in bidi-making were women.[15]

Figure 5.2: **Women in the bidi industry.** Source: Panchamukhi et al., 2004

Women (from Muslim families) rolling bidis in their houses.

Women waiting to collect bidi tobacco powder, tendu leaf and thread from a bidi-making unit.

Women take up bidi making as a supplementary source of income, especially Muslim women. They integrate bidi rolling with their household chores and get assistance from their children, sisters, in-laws, and other family members.

According to NSS 50th Round (1993-94) estimates, nearly 2.25 lakh (225,000) children are engaged in bidi making,[16] accounting for about 8.4% of the total labor force employed in bidi manufacture. Studies also indicate that children in bonded labor, particularly girls, are employed in the bidi industry[17,18] from as early as age four in some cases.[19] Such children may work 10 hours a day on bidi manufacture and still attend to domestic chores, sometimes experiencing physical abuse from their employers.[17]

Though there are variations in estimations of the number of person days spent in the cultivation of different crops [20,21] (as shown in Table 5.4), it is revealing that bidi tobacco is a major source of employment in agriculture[22] (Table 5.5). Women's labor constitutes around 44% of total labor employed in bidi tobacco cultivation.[7] In addition, the bidi industry directly supports nearly 2.2 million[23] tribal people who are engaged in plucking and sale of tendu leaves.

Table 5.4: **Farm employment in bidi tobacco growing regions.**

Crops	Person days/ha	Person days/ha	Person days/ha
Bidi tobacco	241	132	144
Ground nut	125	29	80
Jowar	55	29	50
Paddy	256	–	168
Green gram	49	3	40
Soy bean	–	10	66
	Source: Sathyapriya and Govinda Raju, 1990.[20]	Source: Panchamukhi et.al., 2000.[7]	Source: Karnataka State Department of Agriculture, 1994-95.[21]

Table 5.5: **Employment in bidi and cigarette sector (1994–95).**

Persons	Cultivation	Processing	Manufacturing	Wholesale trade	Retail trade	Total
Bidis	290,000	44,000	4,461,000	83,000	757,000	5,635,000
Cigarettes	267,000	3,278	10,620	81,616	543,000	906,090

Source: Sen, 1999[22] [Reproduced from the IMRB Report (1996), Cigarette and Bidi Industry – A Comparative Status].

TOBACCO INDUSTRY ORGANIZATION AND PRODUCTION

The Tobacco Board of India, a quasi-governmental agency, regulates the production and marketing of flue-cured variety (FCV) tobacco.[9] The production of other tobacco types, mainly burley and other cigarette tobaccos, is governed by contracts with traders and exporters of raw tobacco, as well as with local industry for domestic consumption. However, non-cigarette tobacco, particularly bidi tobacco, is not regulated by any agency. Production and marketing is entirely in the private sector. There are some direct and indirect subsidies and benefits for the cultivation of FCV tobacco, which are facilitated by the tobacco industry and the Tobacco Board.

Bidi Industry

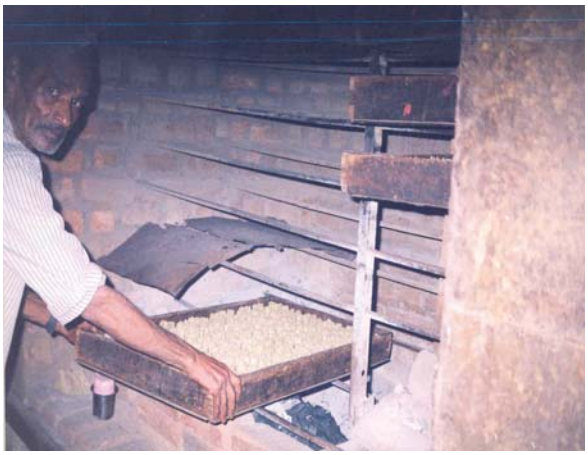
Bidi making originated in the tribal habit of rolling *sal* leaves for smoking.[24] The bidi industry is supposed to have come into existence at the dawn of industrialization. It consists of rolling, sorting, filling, threading, drying (roasting), labeling and packing.

Men are often involved in the roasting and packaging of bidis. To facilitate cutting, tendu leaves are soaked overnight and cut into the required size for filling tobacco powder. Bidi size varies from 5.0 cm to 7.5 cm.

The bidi-making industry is concentrated mainly in Maharashtra (Nasik and Pune), Madhya Pradesh (Jabalpur, Sagar and Raipur), Gujarat, Andhra Pradesh (Nizambad, Karimnagar and Warangal), Tamil Nadu (Tirunelveli and Chennai), Kerala (Canna-nore) Orissa, Karnataka (Mangalore, Mysore and Nippani) and West Bengal. Bidi manufacturing is considered to be a small-scale industry, one of the foremost cottage industries in India. As per the Indian Market Research Bureau (IMRB) report of 1996, around 37% of tobacco production in India goes to bidi making.[8]

Most of the bidi industries operate at the local level. The most prominent are M/s. Mangalore Ganesh Bidi Works, Mangalore in Karnataka, Kajah Beedi Group, Tiru-nelveli and George Beedi,

Figure 5.3. **Men in the bidi industry: roasting and packaging.** Source: Panchamukhi et al., 2004.



Roasting of bidis (unbranded).

Making of paper-rolled bidis.

Kaviyur in Tamil Nadu, Payal Bidi Company in Jhansi, Natwar Bidi Works in Porbandar, Madrasi Chakkar Beedi Factory Private Ltd. and Shama Gold Beedi in Warangal, Trishul Beedi Company in Jodhpur, Dinesh Beedi Works and Sadhoo Beedi Company in Kerala. Their brands are sold in locally and exported to other countries. No one brand has a national presence.

The bidi industry is faced with competition. On the one hand, cigarette companies (including multinationals) have increased production of mini cigarettes, which cost less than regular cigarettes. The government has also provided tax concessions for bidi production units manufacturing fewer than 20 lakh (two million) bidis per annum. However, this may not be applicable to bidi production units with high domestic and export markets. The bidi industry is largely unorganized, as firms engage contractors for the supply of bidis. These contractors then subcontract household laborers, particularly women, for bidi making and pay them on a piecework basis, i.e., per batch of 750 or 1000 bidis.

There are some state-level associations of bidi workers and bidi industries that were organized many years ago to protect the interests of the sector, workers and their families. The All-India Beedi, Cigar & Tobacco Workers Federation, New Delhi; the Karnataka State Beedi Workers' Federation, the S.K.Beedi Workers Federation [affiliated with the All India Trade Union Congress] and the Karnataka Beedi Industry Association, in Mangalore, Karnataka; Mumbai Beedi Workers Union in Maharashtra; the Kerala Dinesh Beedi Workers Co-operative Society [KDBWCS], Kerala; All Bengali Beedi Workers' and Employees Federation, Calcutta are a few examples.

Although information available on the bidi industry is scanty and outdated, some relevant features are shown in Table 5.6.

As shown in Table 5.7, bidi-making is labor intensive.[25] Payment of wages constitutes 44% of the total cost, followed by purchase of tendu leaves (32%), which are available from the natural forest but must be transported from Madhya Pradesh and Orissa. The current costs of bidi making may be higher due to the increased cost of raw material (tendu leaves), tax rate and cess (a dedicated tax earmarked for the welfare of bidi workers). A report on Kerala Dinesh Bidi[26] shows bidi manufacturing costs to be up to Rs. 210 for 1000 bidis.

Table 5.6: **Bidi industry in India.**

Particulars	1980–81	1993–94
No. of Factories	7384	6847
Invested Capital (Rs. Lakh)	4939	46234
Value of Output (Rs. Lakh)	28252	185292
Net Income (Rs. Lakh)	6550	47765
Profit (Rs. Lakh)	1703	15743
Net Value Added (Rs. Lakh)	6822	50066

Source: GOI, Annual Survey of Industries [Reproduced from COSMODE, Tobacco Industry in Andhra Pradesh, COSMODE, Hyderabad, 2001.[25]

Table 5.7: **Cost component in bidi manufacturing (Per 1000 bidis).**

Cost Items	Cost (Rs.)	
I. Cost of Manufacturing		
Tobacco leaf	6.50	
Tendu leaf	21.00	
Thread, freight and fuel	0.82	
Packaging	1.20	
Commission Agent	1.95	
Excise	5.30	
Subtotal	**36.77**	(56%)
II. Labor cost	**28.84**	(44%)
Total Cost [I+II]	**65.61**	(100%)

Source: IMRB, 1996
[Reproduced from COSMODE, 2001].[25]

Table 5.7: **Cost component in bidi manufacturing (Per 1000 bidis).**

	FY 1997	FY 1998	FY 1999
ITC	66.1	65.0	65.9
GPI	12.6	12.5	12.5
VS Industries	13.0	13.3	12.5
GTC Industries	7.3	8.2	8.1
Other	1.0	1.0	1.0

Source: World Tobacco, 2001.[3]

Since bidi-making is a cottage industry providing employment to nearly 40 lakh (4 million) people, it benefits from India's protectionist policies towards Small Scale Industries (SSIs). Bidi workers were a major part of the trade unions organized back in 1930s, but after more than 70 years, their lot has not greatly improved. Though the minimum wage fixed by state governments for rolling 1000 bidis varies from Rs. 29.0 in Tripura to Rs. 64.8 in Gujarat,[27] actual wages vary from Rs. 20 to Rs. 40 per thousand in different states.

The national government has tried to ensure certain benefits to bidi workers through the Bidi and Cigar Workers Act (1966); the Minimum Wages Act, 1948 (bidi workers covered in 1952); the Employees Provident Fund (1952); and the Maternity Benefit Act (1961). The Bidi Workers Welfare Fund Act, 1976 and the Workers Welfare Cess Act, 1976 provide for collection of cess from the

management to provide medical care, edu-cation and recreational facilities to bidi workers and their dependents, and grants to bidi firms to cover half the cost of establishing dispensaries for workers.

Cigarette Industry

The Indian cigarette market comprises four large manufacturers and many small-scale producers, totaling about 36 companies. The four leading producers, ITC, VST Industries, Godfrey Phillips India (GPI) and GTC industries, account for 99% of the market (Table 5.8). These enterprises produced over 92 billion cigarettes in 2000–2001 and over 98 billion pieces for sale in 1998.[3]

Table 5.8: **Leading companies and market share by volume (%).**

	FY 1997	FY 1998	FY 1999
ITC	66.1	65.0	65.9
GPI	12.6	12.5	12.5
VS Industries	13.0	13.3	12.5
GTC Industries	7.3	8.2	8.1
Other	1.0	1.0	1.0

Source: World Tobacco, 2001.[3]

Manufactured cigarettes are classified as either filtered or non-filtered, and are of varying lengths. Non-filtered cigarettes are either less than 60mm or 61-70mm. Non-filtered cigarettes less than 60mm, also called micros, were designed to attract a portion of the bidi market. Filtered cigarettes fall into four categories: <70mm, 71-75mm, 76-85mm, and 86-100mm, and are more expensive than non-filtered cigarettes. A six-tier excise tax system dictates how cigarettes are taxed, priced, produced and consumed.[1] As a result of tax breaks, non-filtered cigarettes have assumed a greater share of the Indian cigarette market, accounting for 43% of market volume. The non-filtered <60mm market segment has experienced the greatest growth in sales since 1994. Filtered cigarettes form the remaining 57% of the market.[3]

MARKETING, SALES AND TAXATION

Marketing of bidi tobacco leaf is an unorganized, private sector initiative in which anyone can participate. Farmers sell largely to middlemen and traders at the village level. Commission agents sell processed tobacco as per manufacturers' requirements. Some tobacco companies purchase through their representatives, who directly approach farmers in the village.

Bidi tobacco is valued in terms of its physical characteristics, such as leaf color, luster, spangling, thickness and smoking/burning qualities. Smoke is the main factor in fixing the price of bidi tobacco. There is no proper authentic grading of bidi tobacco brought for sale.

In 1983, the Government of India established the National Cooperative Tobacco Growers Federation Ltd., Anand, to protect the interests of non-Virginia tobacco growing farmers, but it has been defunct since April 1988.[2] The Agricultural Produce Market Committees took over the marketing of bidi tobacco, but they also could not continue their operation for long. In 1985, the Supreme Court ruled out the market fee on bidi tobacco levied by Committees[2] on the grounds that the Tobacco Board Act, 1975, covers all types of tobacco. Since then, the marketing of bidi tobacco has remained under the control of middlemen and traders.

In contrast, cigarette tobacco (FCV) marketing is regulated by the Tobacco Board, which is involved right from sowing through to distribution and export. Only registered growers can grow FCV tobacco, restricting cultivation to permitted areas. The Tobacco Board facilitates crop loans from banks, arranges auctions for sale of tobacco, organizes exhibitions, promotes meetings of exporters with importers, and buys tobacco products at a minimum price during times of crisis.

Tobacco Sales and Consumption

By weight, bidis account for some 53%-55% of total tobacco consumption (see Box 5.2). Sales have fallen in recent years[28] as a result of changes to the tax structure and the simultaneous rise in demand for micro/mini cigarettes (see Table 5.11). In 1999, bidi sales totaled 810 billion pieces, down from an estimated 990 billion pieces in 1993 (Table 5.9). However, bidis still outsell cigarettes by eight to one.

Box 5.2: **Tobacco Consumption**

A study by John shows that there was a reduction in the consumption of bidis and cigarettes in India from 1987-88 to 1999-00.[28] But there was an increase in the consumption of *paan* in rural India. Consumption of tobacco is higher among the poor. Per capita monthly bidi consumption is higher in the states of Haryana, Rajastan and Tripura (around 80 bidis) and cigarette consumption is higher in Jammu and Kashmir, Mizoram and Kerala (around 5-7 per capita monthly). Lack of awareness about ill effects of tobacco and myths about its medicinal use could be the main reasons for use of tobacco among the poor.

Source: John R, 2005.[28]

In 2001, domestic cigarette sales were approximately 92.1 billion pieces, valued at an estimated Rs. 86.574 million, an increase over the sales value of Rs. 52.248 million in 1994 (Table 5.10). Between 1990 and 2001, cigarette sales by value are estimated to have increased by approximately 93%.[3] The non-filtered micro cigarette, which is less than 60 mm in length, is in direct competition with bidis.

Table 5.9: **India: bidi sales, 1980-1999.**

Year	Volume (billion pieces)
1970	740
1975	800
1980	810
1985	790
1990	700
1991	790
1992	805
1993	990
1994	820
1995	810
1996	800
1997	799
1998	800
1999	810

Source: World Tobacco, 2001.[3]

Table 5.10: **Domestic cigarette sales in India, 1990-2000.**

Year	Volume (billion pieces)	Value (Rs. million)
1990/91	77.9	44870
1991/92	80.1	46858
1992/93	80.8	47373
1993/94	78.8	49773
1994/95	84.3	52248
1995/96	95.2	57143.8
1996/97	103.0	65975.4
1997/98	104.8	78452.8
1998/99	102.6	85529.6
1999/00	98.4	86592
2000/01	92.1	86574

Source: World Tobacco, 2001.[3]

Tobacco Taxes

The Central Board of Customs and Excise collects taxes from the tobacco sector. Until 1998, a flat 40% tax was levied on all tobacco products. The cigarette excise tax rate depends on the class [plain (non-filtered) or filtered] of the cigarette (Table 5.12). There are two tax classes for plain cigarettes (not exceeding 60 mm and 61-70 mm) and four tax classes for filtered cigarettes (not exceeding 70 mm, 71-75 mm, 76-85 mm, and 86-100 mm). These classes dictate market segmentation due to tax differentials applied to each category, and most manufacturers have entries in each category.

As Table 5.12 shows, plain cigarettes are taxed lower than filtered cigarettes. Within the plain category, micro cigarettes have experienced the greatest growth since the 1990s. In 1994 the tax on micro cigarettes was halved, although taxes overall were increased by around 12% on average.[1] The stated objective was to boost the micro segment of cigarette consumption by inducing bidi consumers to switch to manufactured cigarettes. Prior to the reduction in taxation,

Table 5.11: Cigarette consumption (million pieces and % breakdown) by type and size, 1994-1998.

	1994	1995	1996	1997	1998
<60mm Plain	856 [1%]	6557 [7%]	18171 [18%]	19533 [19%]	20204 [19.4%]
61-70mm Plain	30824 [36%]	33722 [36%]	28266 [28%]	23645 [23%]	23953 [23%]
<70mm Filter	39386 [46%]	40279 [43%]	41389 [41%]	45749 [44.5%]	45822 [44%]
71-75mm Filter	10275 [12%]	8431 [9%]	9086 [8%]	8739 [8.5%]	8540 [8.2%]
76-85mm Filter	4281 [5%]	4684 [5%]	5048 [5%]	5140 [5%]	5624 [5.4%]
Total Consumption	85622	93673	101960	102806	104143

[Figures in brackets are % total]
Source: ERC, 2001.[1]

Table 5.12: Excise duty on cigarettes [1987/88-2001/02] (Rs. per '000).

Year	Plain 60 mm	Plain 61-70 mm	Filters 70 mm	Filters 71-75 mm	Filters 76-85 mm	Filters >85 mm
1987/88	–	150.00	200.00	300.00	400.00	600.00
1988/89	–	155.00	206.67	310.00	413.33	620.00
1989/90	103.25	165.20	216.83	387.19	490.44	696.94
1990/91	103.25	180.69	232.31	413.00	567.88	774.38
1991/92	117.15	213.00	276.90	532.50	718.88	850.00
1992/93	120.73	252.43	329.25	631.06	850.56	990.00
1993/94	120.00	250.00	330.00	630.00	850.00	990.00
1994/95	60.00	280.00	370.00	710.00	950.00	1350.00
1995/96	60.00	300.00	400.00	750.00	1000.00	1350.00
1996/97	75.00	315.00	430.00	800.00	1070.00	1350.00
1997/98	90.00	350.00	500.00	820.00	1100.00	1350.00
1998/99	100.00	370.00	550.00	900.00	1200.00	1470.00
1999/00	110.00	370.00	550.00	900.00	1200.00	1470.00
2000/01	115.00	390.00	580.00	945.00	1260.00	1545.00
2001/02	135.00	450.00	670.00	1090.00	1450.00	1780.00

Source: World Tobacco, 2001.[3]

micro cigarettes accounted for less than 1% of the market.[3] The lower tax caused the price of micro/mini cigarettes to fall, which stimulated demand and increased consumption as bidi users switched to the relatively cheaper cigarettes (Table 5.11). However, the tax reduction did not last. Beginning in 1996, the excise duty on all cigarettes was gradually increased each year and by 2001 the excise on micros exceeded the pre-1994 excise tax rate. The regular increase in the excise duty of micro cigarettes made them less competitive with bidis. The now cheaper bidis regained popularity and consumers switched back in greater numbers.

Box 5.3: **Some Salient Features of Bidi Taxation in India.**

- In the first budget year of independent India (1947-48), the excise duty on bidi tobacco was 9 annas per lb. This was increased to 12 annas in 1948–49.
- In 1951–52, there was some rationality in the levy of excise duty on tobacco. In addition to the leaf duty of 8 annas per lb on bidi tobacco, a manufacture duty on tobacco content in bidis was levied, averaging about 8 annas per lb. But there was no direct duty on bidis in their final form. At these rates, an average bidi smoker was expected to pay Rs. 8 a year.
- A central excise duty was imposed at the rate of Rs. 1 per 1000 on branded bidis in 1975 and increased to Rs. 2 in 1977–78.
- As a result of the abolition of excise duties on unmanufactured tobacco in the 1979–80 budget, bidi, smokeless tobacco and snuff manufacturing units in the unorganized sector using tobacco leaf were to a large extent excluded from tax coverage. Farmers, curers, small dealers and warehouse centers were the main beneficiaries.
- Shift from an ad valorem duty to a specific duty structure based on size and type of product was introduced in the 1987-88 budget.
- The Workers Welfare Cess increased from 50 paise to Rs. 1 in 1998 and increased to Rs. 2 in 2000.
- A National Calamity Contingent Duty [NC duty] of Rs. 1 per 1000 was levied in February, 2001.
- In 2001, cigarettes contributed 79.5% of excise revenue, while contributions from bidis and smokeless tobacco products were 10.4% and 10.1%, respectively.
- Current excise duties on bidis [2004] [per 1000]

	Basic	Additional
Other-than-paper rolled bidis, manufactured without the aid of machines	Rs. 6	Rs. 1.40
Other	Rs.15	Rs. 3.50
Unbranded bidis other than paper rolled and manufactured without the aid of machines and clearance of bidis from factories up to but not exceeding 20 lakhs (2 million)	Nil	Nil

Sources: Tobacco Institute of India, 2002;[23] Jain RK, 2004;[33] Sury MM, 2004.[34]

The duty increase on mini cigarettes could have been partly due to protests made by the bidi industry and bidi workers' associations that if mini cigarettes were to replace bidis, it would leave many families jobless.[29,30] In fact, the Ministry of Labor commissioned a study on the "Decline in the level of employment in the bidi sector – potential impact of mini-cigarettes" by the All India Society for Social Upliftment, which is available from the Ministry.[31] The 'humble bidi', as it is commonly called, even in budget speeches of the Indian government, has always been taxed at a lower rate than cigarettes, on the premise that mostly poor and rural people smoke them and thousands of poor households are involved in making them.

Bidis attract very little excise tax[32] (Table 5.13) as they tend to be produced in small operatives dispersed across the country. Only branded bidis are covered under excise duties.[33] The lack of organization among bidi producers makes the efficient collection of taxes in the sector difficult[34](See Box 5.3). The government levies a welfare cess at Rs. 2 per thousand on bidis under the the Bidi Workers Welfare Fund Act, 1976 and the Workers Welfare Cess Act, 1976. The amount collected from the bidi manufacturers goes to the Bidi Workers Welfare Fund to provide medical care, education and recreational facilities to workers and their dependents.

Table 5.13: **Excise duty on bidis (Rs. per thousand)**

Details		1998–99	1999–00	2000–01	2001–02	2002–03
Manufactured	Basic	11.50	11.50	11.50	11.50	11.50
with machines	Additional	3.50	3.50	3.50	3.50	3.50
with or without	Special (NC Duty)	–	–	–	2.00	2.00
power	Workers Welfare Cess	1.00	1.00	2.00	2.00	2.00
	Total	**16.00**	**16.00**	**17.00**	**19.00**	**19.00**
Other than	Basic+Addl	6.00	6.00	6.00	6.00	6.00
paper rolled	Special (NC Duty)	–	–	–	1.00	1.00
(packaged).	Workers Welfare Cess	1.00	1.00	2.00	2.00	2.00
	Total	**7.00**	**7.00**	**8.00**	**9.00**	**9.00**

– : Not Relevant

Source: Tobacco Board India [homepage on the Internet]. Excise Duty from Bidis; (1998-99 to 2002-2003); 2003 [cited 2003 Aug 7]. Guntur (Andhra Pradesh, India): Tobacco Board: Ministry of Commerce, Government of India. Available from: http://indiantobacco.com/tobacco report/taxation of tobacco.[32]

Government Revenue from Tobacco

Taxes on tobacco leaf were abolished in India in 1979 and excise duty is now generated only from the manufacture and sale of value-added products.[3] Excise tax revenues from the value-added tobacco industry generate more than 10% of total national government revenue.[3] Among all tobacco products, the cigarette industry contributes the most to the revenue base, followed by bidis, smokeless tobacco, and other tobacco products.

Table 5.14 shows that in 2000/2001 revenues from cigarettes totaled Rs. 65,070 million, bidis totaled Rs. 4,328.9 million, smokeless tobacco totaled Rs. 6,720 million, and other tobacco products totaled Rs. 5,702 million. In total, the industry contributed in excess of Rs. 81,823 million in 2000/2001. Cigarette excise taxes have not, until recently, been collected at the sub-national level. Fifteen states now impose a luxury tax/entry tax on tobacco products at rates that range from 1.5% in Rajasthan to 10% in Assam.[35] Since January 2005 this state tax was stopped by the Supreme Court.

There is no major change in the share of Additional Excise Duty (AED) in total excise duties, which actually has decreased slightly from 22.6% in 1993–94 to 21.4% in 2000–01 (Table 5.15). As a result there is no change in the revenue base accruing to state governments (the entire collection of AED is distributed among states). But with the shift in tax base for bidis from ad valorem to specific duty structure in 1997, there was a 37% increase in the total revenue in 1997-98. Bidi tobacco is supposed to be the least targeted tobacco product in terms of taxation. Duty realized per kg. of tobacco amounted to Rs. 33 for bidis, Rs. 40 for smokeless and other tobacco, and Rs. 680 for cigarettes, for the year 1998–99.[36]

Table 5.14: Excise revenue from tobacco and tobacco products (Rs. million).

	Cigarettes	Bidis	Cess on Bidis	Chewing Tobacco	Others	Total
1991/92	23858.0	2060.3	NA	NA	1038.3	26956.6
1992/93	27766.8	2206.8	NA	NA	1078.2	31051.8
1993/94	27513.3	2186.3	130.1	1137.5	351.6	31318.8
1994/95	26884.8	2199.1	119.2	1507.6	3747.5	34458.2
1995/96	34246.1	2257.2	158.0	2165.3	1480.5	40307.1
1996/97	39826.6	2207.0	207.5	2601.2	1651.2	46493.5
1997/98	44924.4	3026.2	211.5	2660.6	1320.5	52143.2
1998/99	51181.8	3221.7	320.0	6058.9	4587.7*	65370.1
1999/00	60181.8	3221.7	520.0	5845.9	4387.7*	74157.1
2000/01	65071.2	3578.9	750.0	6721.4	5702.0*	81823.5

*Includes revenue collections on products for which specific data are not available
Sources: World Tobacco, 2001;[3] DTD, 2000;[8] Thimmaiah, 1995.[35]

There is a discriminatory tax structure in India as shown in Table 5.16. Taxes on cigarettes range from Rs. 135 to Rs. 1780 per 1000, depending upon length and quality, while the excise duty on bidis varies from Rs. 9 to Rs. 19 per 1000 (2001–02).[36]

Excise duty collections from bidis are higher in West Bengal, Andhra Pradesh, Madhya Pradesh and Karnataka, due to the location of a large number of bidi industries in these states. Revenue from cigarettes is highest in Karnataka, followed by Andhra Pradesh and Bihar. For other tobacco products, collection is higher in Uttar Pradesh, Maharashtra, Karnataka, Gujarat, Himachal Pradesh, Assam and Delhi.

Table 5.15: **Excise duty from bidis [1993-94 to 2000-01] Rs. million).**

Structure	Year	Actual		
		BED	AED	Total
Ad Valorem based on assessable price	1993–94	1598.0	467.0	2065.0
	1994–95	1614.0	467.0	2081.0
Ad Valorem based on MRP	1995–96	1589.0	486.0	2075.0
	1996–97	1713.0	494.0	2207.0
Specific based on length and type	1997–98	2351.0	675.0	3026.2
	1998–99*	2309.0	616.0	2924.5
	1999–00**	2533.0	689.0	3221.7
	2000–01*	2814.0	765.0	3578.9

Note: (i) Ad Valorem: The tax levied on the value of the commodity and is proportional to the price of the product. (ii) Specific Duty: Introduced in 1987-88 budget is product specific and is levied on the size (length) and type of the product. (iii) *RE; **BE
Source: Union Budget figures collected by CMDR from the Office of the Additional Director, Government of India Central Revenues Division, GOI, New Delhi.[36]

Table 5.16: Duty realized [Rs per Kg] from tobacco, 1998-99.

Cigarettes	Bidis	Smokeless/Other
680	33	40

Source: Office of the Additional Director, Central Revenues Division. New Delhi. GOI.[36]

Table 5.17 shows that 54% of the total tobacco production goes into bidi making, but it yields only 9% of excise revenue.[37] Though cigarette consumers account for only 12.5% of total tobacco users, they yield 81% of excise revenue. This is because of higher tax rates levied on cigarettes.

Table 5.17 **Tobacco consumption and revenue yield in India [1999–2000].**

	Cigarettes	Bidis	Others	Total
No. of users	25	100	75	200
(millions)	(12.5)	(50.0)	(37.5)	
Annual tobacco consumption	77	219	110	406
(in million kg)	(18.96)	(53.94)	(27.09)	
Annual consumer spending	8,850	6,876	7,944	23,670
(Rs. Crore)	(37.39)	(29.05)	(33.56)	
Excise revenue	6,018	673	725	7,416
(Rs. Crore p.a.)	(81.15)	(9.07)	(9.77)	
Revenue yield (Rs. per kg.)	782	31	66	183

(Figures in parentheses indicate % of total.)
Source: Thimmaiah and Nageswara Rao, 2000.[37]

Bidi/Cigarette Prices and Demand

There is a large difference between the prices of bidis and manufactured cigarettes. Cigarettes cost approximately three times more than bidis per packet, but eight times more per piece [1] (Table 5.18).

Table 5.18: **Comparisons of prices (Rs.) of cigarettes and other tobacco products, 1995, 1998, and 2000.**

Types of tobacco products	1995	1998	2000
Bidi (per bundle – 25)	2.01	2.54	2.85
Cigarette (per packet – 10)	6.64	8.25	9.09
Cheroot (each)	0.35	0.43	0.49
Snuff (per 100g packet)	15.17	17.33	18.31
Tobacco – hookka (per kg)	13.85	17.71	19.76
Pan leaf medium (per 100)	9.79	12.94	15.77
Pan finished ordinary (each)	0.95	1.33	1.56
Raw leaf (per kg)	35.49	40.5	46.98

Source: ERC, 2001.[1]

Since the mid-1990s, there have been consistent increases in the excise tax on cigarettes, which have been passed on to consumers in the form of increased prices. The price of cigarettes increased from an average of Rs. 6.64 per pack in 1995 to Rs. 9.09 per pack in 2000, an increase of 37%. Manufacturers tend to raise prices in line with tax hikes and rising production costs.[3] As a direct result of tax hikes and the imposition of a luxury tax by some states, cigarette prices have doubled in recent years. Typical nominal cigarette prices (including inflation) vary and can be priced from around Rs. 50-70 for premium brands, Rs. 30-40 for medium-priced brands, and below Rs. 20 for low-value brands. Despite increasing prices, prevalence and consumption remain high.

There are no rigorous assessments of the nature and characteristics of the demand for cigarettes and its relationship to other tobacco products, such as smokeless tobacco and bidis. An estimate of elasticity was worked out by the National Council of Applied Economic Research (NCAER) for cigarettes only, using per capita consumption, index of real price (on an average basis, not on individual price segments) and per capita private consumption expenditure. Elasticity of per capita consumption with respect to real price of cigarettes was –0.67, indicating that a 10% increase in the real price of cigarettes will lead to reduction in the per capita consumption to the tune of 6.7%.[10]

The natural experiment from 1994 to 1995, when the excise tax on cigarettes increased and the tax on micro cigarettes was halved to increase sales of the latter, suggests that bidis and low-cost micro cigarettes could be considered as economic substitutes.

Export and Import of Bidi Tobacco

Cigarette and smokeless tobacco are the main components of India's manufactured tobacco exports. In 2003-04, cigarette exports constituted 37% of the total, while smokeless tobacco exports constituted 35%. Bidis account for about 10% of these exports. During the eight years from 1995-96 to 2003-04, bidi exports have doubled,[39] but there was also a tremendous increase in the export of cigarettes (584%) and smokeless tobacco (594%) during this period. (Table 5.19)

Table 5.19: Export of bidis and cigarettes.

Year	Bidis		Cigarettes		Hookah tobacco paste		Chewing tobacco		Others (cut tobacco/ snuff/others)	
	Quantity (tons)	Value (Rs. in lakhs)	Quantity (tons)	Value (Rs. in lakhs)	Quantity (tons)	Value (Rs. in lakhs)	Quantity (tons)	Value (Rs. in lakhs)	Quantity (tons)	Value (Rs. in lakhs)
1995-96	676	1152.28	884	1392.79	9376	2612.26	424	607.00	523	540.70
1996-97	662	1596.43	714	1414.43	10759	3408.98	643	2606.33	337	259.94
1997-98	761	2004.00	1206	2072.00	4540	1324.00	773	3064.00	515	434.00
1998-99	998	3070.00	1432	3167.00	12811	3659.00	1191	4993.00	2525	2283.00
1999-00	1174	3717.89	1851	4629.30	8439	3166.00	1724	6635.00	443	397.00
2000-01	962	3295.88	2016	5651.53	9543	3423.08	1953	9433.46	919	830.54
2001-02	961	3337.48	2883	8488.30	8910	3482.85	2640	12494.05	702	760.05
2002-03	1112	3819.00	4704	12192.00	10182	3629.00	2413	11688.00	1431	1205.00
2003-04	1029	3440.00	6050	13075.00	10534	4293.00	2944	12337.00	2219	1870.00

1 lakh = 100,000.
Sources: DTD, 2000[8]; Tobacco Board, 2002 (b)[38]; Tobacco Board(a), 2002[9] ; Tobacco Board, 2004.[39]

Indian tobacco is exported to around 80 countries. Unmanufactured tobacco accounts for 80% of the tobacco exports and, of that amount, 75% is FCV tobacco. Non-cigarette tobaccos exported are Lalchopadia, Judi and Rustica, used mainly for chewing purposes. Bidi tobacco is exported in small quantities. Bidis are exported to around 30 countries. In 2001–02, the major importers were the United Arab Emirates (565 tons), Yemen (184 tons), Afghanistan (66 tons) and Singapore (42 tons).[38] Bidis are also exported to Sri Lanka, the USA, Malaysia, Iran, Kuwait, Saudi Arabia, Bahrain, Switzerland, Oman and Jordan. They are mostly exported from Tamil Nadu, Karnataka, Maharashtra, Madhya Pradesh and Uttar Pradesh.

Smokeless tobacco consumption has increased in some of the tobacco-consuming countries as shown in Table 5.19. Export of smokeless and hookah tobacco have increased to UAE, Saudi Arabia, Libya, Djibouti and South Korea.[9]

Export of bidis to the USA is also on the rise,[40] due to a demand for flavored Indian bidis among American youth, as shown in Table 5.20.

Table 5.20: **Export of bidis to the USA.**

Year	Quantity (in tons)	Value (Rs. in millions)
1996–97	76.65	17.94
1997–98	109.52	22.92
1998–99	137.17	91.13

Source: TII,1999. [40]

The U.S. Customs Department has issued a ban on the import of Ganesh bidis from Mangalore on the basis that forced child labor is being used in manufacturing them. In India it is common for children to be involved in family labor, ranging from agriculture to domestic chores.

In 2000 India exported 365 million cigarettes to the UAE, 310 million to Malaysia, 185 million to Saudi Arabia, 125 million to Singapore and 32 million to Russia.[41] In 2001-02 the volume of Indian cigarette exports increased by 43%, the major markets being the USA (1752 tons), Azerbaijan (506 tons), the UAE (491 tons) and Turkey (86 tons).[38] Cigarettes are also exported to Iran, Afghanistan, Malaysia, Saudi Arabia, Singapore and Russia. In 2001, 172 and 189 Indian companies were registered as exporters of tobacco and tobacco products, respectively.[38]

Imported cigarettes are not a significant factor in the Indian market due to the high demand for cheap, low quality cigarettes and the large domestic supply (Table 5.21), and such imports are charged custom and other duties [42] (Box 5.4).

Box 5.4: **Customs duty on tobacco product imports.**

In 2001, tobacco products attracted a basic customs duty of 35%. In addition, a duty of 'goods of special importance' @ Rs. 37 per thousand to Rs. 495 per thousand was levied on different types of cigarettes. A National Calamity Duty, ranging from Rs. 20 to Rs. 495 per thousand, was also levied on imported cigarettes. In total the duties amounted to around 150%. – Source: Golden Leaf in Parliament' TII. Feb 19, – Dec. 19, 2001 p 1.

Foreign brands account for less than 1% of the Indian market,[1] coming mainly from the UK, the USA, Japan, and Singapore. In 1999, the United Kingdom and the United States together supplied approximately 78% of all cigarettes imported into India. Consumption of foreign cigarette brands could be as high as 10% to 15% if smuggled products are taken into account, which may account for an estimated 5%-8% of total consumption and deprives the treasury of an estimated Rs. 3 million per year.[3]

Cigarette imports registered a sharp 77% increase in 2000 (Table 5.21), accounting for 0.4% of domestic consumption. Export volume was 1.9 billion pieces in 2000, up from 1.3 billion pieces in 1999.[3] In 2000, exports accounted for 2% of total production.

Table 5.21: Cigarette production, imports, exports and apparent consumption (million pieces).

	1994	1995	1996	1997	1998	1999	2000
Production	89000	95000	102000	99000	98000	97000	96000
Imports	45	157	252	265	245	225	399
Exports	1200	1206	1466	1585	1425	1250	1910
Apparent Domestic Consumption	87845	93951	100786	97680	96820	95975	95000

Sources: World Tobacco 2001[3] Tobacco Board (a) 2002[9]

ECONOMIC AND HEALTH COSTS

Bidi smoking is widespread across India, but especially common in rural areas and among the urban poor. Domestic demand for bidis drives the cultivation of bidi tobacco. More than 80% of the bidi tobacco produced in India goes for domestic consumption and manufacture of bidis. In 2001, bidis constituted 48% of total tobacco consumption in the country, while cigarettes and smokeless tobacco constituted 14% and 38%, respectively.[43]

There are arguments that bidis are equally or even more harmful than cigarettes because the nicotine content in bidi tobacco is higher than in FCV tobacco. Moreover, bidis must be puffed frequently to keep them burning. In addition to the health care costs of tobacco consumption, there are health costs associated with tobacco cultivation and production. Studies at the Center for Multi-Disciplinary Development Research, Dhar-wad, Karnataka[7] and the National Institute of Occupational Health, Ahmedabad have revealed that laborers who work in the field, particularly during harvesting, are affected by contact with the leaves and nicotine absorption. Storage of tobacco in houses is believed to cause dizziness and headaches. There are also reports of nicotine absorption among workers engaged in processing of tobacco leaf and bidi making.[44] Common health problems among workers were weakness, joint pain, asthma, bronchitis and allergies.

Resource costs of morbidity due to tobacco use are not readily available in India. Though tobacco is one of the risk factors for cardiovascular diseases, cancer and diseases of the lungs, it is not proven to be the single cause for the occurrence of a particular disease. The first attempt to estimate the tobacco-related resource costs for specific diseases was initiated by the Indian Council for Medical Research ICMR in 1990. The ICMR study included tobacco-related cancers, coronary artery disease (CAD), and chronic obstructive lung diseases (COLD). It assessed the direct (both medical and non-medical) as well as indirect costs due to these tobacco-related diseases. A cohort approach was used to collect data for the tobacco-related cancer segment of the study, while a cross-sectional approach was used to collect data over one year for the CAD and COLD portion.

To assess the economic costs of tobacco, a cohort of 195 patients with tobacco-related cancers was enrolled at the All India Institute of Medical Sciences, New Delhi. ICMR carried out a study on cost management of major tobacco-related diseases. Patients were followed for three years to determine their treatment expenditures (medical as well as non-medical), disease management expenditure by the health care institution, and loss of income due to absenteeism or premature death. The loss due to premature death was estimated based on the last income level and expected remaining age of the patient estimated from standard life tables. Institutional cost was assessed from the records of the institution and the information on services used by the patient. All expenditures were discounted at a rate of 10%.

In the case of premature death, the societal cost was Rs. 134,449 per death (discounted at the 1990 level, the year the study began).[45] In 1999 the annual costs of coronary artery diseases (CAD) and chronic obstructive lung diseases (COLD) were Rs. 29,000 and Rs. 23,300 per case, respectively. The average cost of tobacco-related cancer was estimated to be Rs. 350,000 per case.[45] Using these numbers as representative, costs were estimated for the country as a whole by using the incidence of tobacco-related cancers and prevalent cases of CAD and COLD. The estimates for the country were Rs. 57.225 billion, Rs. 129.05 billion, and Rs. 91.336 billion for tobacco-related cancers, CAD and COLD, respectively.[45] Therefore, the overall cost to the country due to the three major tobacco-related diseases in 1999 was Rs. 277,611 billion.[45]

On average, patients in the cohort study spent Rs. 17,965 (including loss of income due to absenteeism), and the institution contributed various treatment services valued at Rs. 4,009 per patient for a total direct cost of Rs. 21,974.[45] Direct costs included consultations, investigations, treatment, travel and lodging for treatment, and money spent on food away from home. Average loss due to premature death from tobacco-related cancers was estimated at Rs. 112,475.[45] There are no separate estimates of social and economic costs of bidi tobacco consumption.

The Expert Committee on the Economics of Tobacco Use appointed by the Ministry of Health and Family Welfare examined the ICMR study and concluded that the short-run secondary benefits of tobacco use are easily outweighed by the conservatively estimated costs associated with the use of tobacco.

INDUSTRY OUTLOOK

The Indian Government and the Tobacco Sector

Comparison of the cigarette and bidi sectors in terms of intervention, regulation and promotion indicates that cigarette tobacco enjoys state support and facilities. While cigarette tobacco cultivation is promoted, cigarettes are more heavily taxed than bidis.

Bidi tobacco cultivation does not receive any incentives from the Tobacco Board, but bidi manufacturers have benefited from tax concessions and bidi exporters are eligible to obtain Market Development Assistance (MDA) and other government incentives on a par with other exporters of tobacco and tobacco products. Agriculture Research Stations assisted by the Indian Council of Agricultural Research (ICAR) located at Nippani (Karnataka) and the Bidi Tobacco Research Station (BTRS) at Anand (Gujarat) have been promoting the cultivation of bidi tobacco since the 1940s, by supplying seeds to farmers on payment and providing them with training on pest/ disease management and information on new varieties. Now these activities have been minimized and are no longer priorities of the research centers.

Bidi tobacco cultivation is based mainly on domestic demand for bidis. For FCV tobacco farmers, the Tobacco Board continues to play a major role in ensuring a fair market by arranging auctions, providing a platform for sale, and facilitating fixation of minimum prices. It also arranges crop credit from banks, provides fertilizers and materials for curing on a credit basis with some subsidy component, organizes exhibitions and meetings of exporters and importers, and provides information on international prices and demand.

Though the government has withdrawn many of its activities, including research on bidi tobacco, it is sympathetic towards bidi workers. Since millions of poor families are dependent on bidi making, the government has extended some benefits and is implementing various schemes

in the fields of health, housing, education, recreation and social security under the Bidi Workers Welfare Fund Act, 1976, for workers and their dependents [46] (Box 5.5).

Box 5.5: **Selected facilities available to bidi workers as per the Bidi Workers Walfare Fund Act, 1976.**

- Health care services at ESI hospitals and at the 50-bed Bidi Workers' Central hospital at Mysore.
- Assistance of Rs. 20,000 is given to a bidi worker who has worked for a minimum of six months and is suffering from tuberculosis (TB). A monthly maintenance charge of Rs. 500 and Rs. 400 is given to patients with and without dependents, respectively, for a period of nine months.
- Assistance and treatment for bidi workers suffering from mental disorders.
- Heart and kidney patients who have worked for a minimum of three years receive 50% of the cost or Rs. 100,000, whichever is less, for undergoing surgery.
- Maternity benefit of Rs. 500 each for the first two deliveries to women who have worked for at least six months.
- Rs. 20,000 in assistance is given to bidi workers to construct a house.
- Fellowships ranging from Rs. 400 to Rs. 5000 p.a. is payable to children of bidi workers studying in 5th class to graduation, respectively.
- Incentives ranging from Rs. 500 to Rs. 2000 to children of bidi workers with high scores in the 10th Standard and professional courses.
- A pension scheme from the Provident Fund (PF) account is available to those who have paid into the PF account for at least 10 years.

Source: Nagarika Seva Trust, 2002.[46]

A review of the bidi economy over the past 50 years reveals that although bidis have always held a greater share of tobacco consumption, there was a decline in 1961-62. Later, with increased taxation on cigarettes, that share increased, but there was another decline after 1994, perhaps due to the reduction in duties on mini cigarettes. During the past ten years bidis have been losing out to smokeless tobacco, which has entered the Indian market with attractive forms, flavor and advertising. Though not established by research, general market trends indicate that the younger generation is consuming more *gutkha* and *pan masala*, at least in urban areas. The level of their exports has also increased significantly.

A government decision to invite 100% Foreign Direct Investment (FDI) in the tobacco industry is likely to affect the Indian bidi industry. The Bidi Workers Federation has already expressed opposition to this move. In addition, complete tax exemption to production units manufacturing fewer than 20 lakh (2 million) bidis per year is likely have an adverse impact on the producers manufacturing branded bidis. Different minimum wages among states and sale of tendu leaves by calling tenders are likely to affect the bidi industry in the future.

Bidi producers, like cigarette manufacturers, are venturing into other businesses, for example, incense sticks in Tamil Nadu, pickles and curry powder in Kerala, and trading and hotel businesses in Karnataka. Due to low wages, bidi workers naturally shift to alternate employment if available. Mussel (shellfish) farming in the backwaters of Kasargode, one of the districts in North Kerala, has provided alternate employment to agricultural laborers and bidi rollers.[47] Options to cultivate mussels in sea water may assure employment throughout the year. Irrigation facilities in some of

the villages in the bidi tobacco region of Karnataka have enabled farmers to shift to other crops and take up dairying.

Bidi tobacco research stations, which used to concentrate on tobacco, are now experimenting with alternative crops. In addition, advances in technology and growing awareness of the adverse consequences of tobacco consumption have facilitated research on alternate productive uses of tobacco. The Bidi Tobacco Research Station (BTRS) at Anand, Gujarat and the Central Tobacco Research Institute (CTRI), Rajahmundry, Andhra Pradesh, have investigated the use of bidi tobacco leaves in the production of food-grade protein and the extraction of edible oil from tobacco seeds has been found to be useful. In Gujarat, tobacco extractives are used as plant growth stimulants.[48]

Research on bidi tobacco is done at agricultural research centers under the All India Coordinated Research Project (AICRP) initiated by the Indian Council of Agricultural Research (ICAR). These centers are under the control of the respective state agricultural universities located at Nippani in Karnataka and at Anand in Gujarat. An experimental study taken up[49] at the Agriculture Research Station, Nippani (Table 5.22) shows that mixed cropping gives a greater return than mono cropping of bidi tobacco. Mixed cropping and multiple cropping may be encouraged to gradually reduce the area under bidi tobacco cultivation.

Table 5.22: **Alternate cropping systems to bidi tobacco (1992-1994).**

Cropping System	Amount Realized (gross) [Rs/ha]
1. Bidi Tobacco	13,680
2. Cotton	16,677
3. Chilli	20,521
4. Cotton + Chilli	25,815
5. Groundnut + Tobacco	31,696
6. Soybean + Tobacco	25,448
7. Groundnut followed by Rabi Jowar	39,384
8. Soybean followed by Rabi Jowar	37,726
9. Tobacco followed by Rabi Jowar	15,557

ARS: Agricultural Research Station
Source: Bhat B.N., A.R. Hundekar, R.S. Khot and B.A. Yandaoudar, 1998.[49]

Table 5.23: **Economics of bidi tobacco cultivation *vs.* other crops.**

Crops	Cost of Cultivation (per acre in Rs.)	Net Return (per acre in Rs.)	Net Return (per rupee of investment)
Jawar	2604	490	0.19
Paddy	2791	–154	–0.06
Wheat	3506	–464	–0.13
Pulses	2100	141	0.07
Sugarcane	9930	8649	0.87
Cotton	5707	649	0.11
Soybean	3015	1290	0.43
Groundnut	2565	125	0.05
Tobacco	6163	3499	0.57

Source: Panchamukhi, et al., 2000[7]

Figure 5.4. **Alternate crops to bidi tobacco.**

Source: Panchamukhi, et al., 2000[7] Annex 5.1.

The Directorate of Tobacco Development (DTD) had two non-plan schemes on bidi tobacco: (i) the Seed and Seedlings scheme and (ii) the Farmers' Training Program at Anand, Gujarat, both terminated since March, 2000.[8] However, DTD staff has been minimized and it is not undertaking any activities as the government has not provided funds.

Though tobacco cultivation appears to be profitable as shown by the returns, for which only sugarcane is higher (Table 5.23), net returns per rupee of investment indicate that soybeans in dry agriculture and sugarcane in irrigated conditions can be alternatives for bidi tobacco (Figure 5.4).

Future Research Needs

- A nationally representative analysis of the costs (direct costs, indirect costs, productivity losses, etc.) of tobacco-related diseases.
- Analysis of the structure of demand for bidis, cigarettes, and other tobacco products.
- Analysis of the impact of changes in tobacco excise taxes and other policies on the consumption of the different varieties of tobacco products.
- Identifying alternatives for livelihoods currently dependent on the bidi sector.
- Estimating the resource costs of shifting, and the costs and appropriate package for rehabilitating bidi-dependent livelihoods.
- Determinants of tobacco consumption among schoolchildren.
- Production-related health hazards of tobacco cultivation, storage, processing and bidi making.
- Alternative crops to bidi tobacco, with experiments carried out in farmers' irrigated and non irrigated fields in states where bidi tobacco is grown.
- Research focusing on the increase in the consumption of smokeless tobacco (i.e., *gutkha*) by both youth and the elderly.
- The approach and specific role of stakeholders, including the government, in implementing the provisions of the Framework Convention on Tobacco Control (FCTC).

- Documenting the responses of the actors in bidi tobacco with response to the FCTC.
- Alternative uses of bidi tobacco and its feasibility, i.e., infrastructure requirements, investment, marketing, domestic and international demand, etc.
- International experiences with reference to tobacco control. Evaluation of measures for control of tobacco production/cultivation, especially in major tobacco-producing countries, may help in formulating suitable policies for tobacco control.
- Analysis of the effectiveness of measures to control demand and supply on tobacco consumption.

CONCLUSION

It is difficult to present the entire gamut of bidi economics because of the paucity of data regarding the use and production of bidis, and employment related to bidis. Levy of excise duties on bidis is negligible compared to cigarettes even though bidi smoking is equally or more harmful than cigarette smoking. Bidis do not have filters and the nicotine content of bidi tobacco leaf is higher than cigarette tobacco leaf. Bidis are cheaper than cigarettes and it is likely that users, particularly the poor, consume them in greater numbers.

The tobacco industry has been an important source of revenue for the Indian government. Excise taxes on tobacco products contribute at least 10% of gross revenue earnings annually. Per capita consumption of manufactured cigarettes is low in India due to a wide variety of alternative tobacco products, particularly bidis and smokeless tobacco, however among all producers of finished tobacco products, the cigarette industry contributes the most to the tax revenue base.

Though more than four million people are dependent on bidi making, it cannot be said that the work is healthy and lucrative. Workers are constantly in contact with tobacco powder. Moreover, the wages are very low.[18,29,19] It is difficult to monitor whether wages comply with the Minimum Wage Act, as bidi rolling is largely a household activity. In states where bidi laborers get around Rs. 20, they could definitely benefit from better paid work. So diversification of activities from bidi making to other labor-intensive industries and other agro-based industries in the tobacco producing regions should be promoted.

The few studies that are available indicate that the rate ratio of development of heart disease due to bidi smoking is higher than that for cigarette smoking.[50] Though there is no evidence that tobacco use is the single cause leading to any specific disease, there is no doubt about its linkages with respiratory diseases, cancer and heart problems.

The literature on the economic cost of tobacco use in India is limited, but it suggests that the cost due to three major tobacco-related diseases in 1999 was Rs. 277.611 billion or Rs. 27,760 crore.[45]

Efforts to reduce the supply and demand of tobacco should be universally adopted by all tobacco-growing countries, framing suitable policies for compensating for the economic returns accruing to farmers as well as to the country from tobacco. This also applies to the bidi sector in India. Since India is a signatory to the FCTC, it would be feasible and in the national interest to come up with a comprehensive tobacco control policy where all the stakeholders play a positive role. A comprehensive database will be required for making concrete policy decisions.

Annex 5.1 **Number of bidi workers by state – 2001.**

Sl.No.	State	No of Workers [Estimated]	% of Total Work Force
1.	Andhra Pradesh	625,050	14.1
2.	Tamil Nadu	620,950	14.1
3.	Madhya Pradesh	750,000	17.0
4.	Uttar Pradesh	450,000	10.2
5.	West Bengal	497,758	11.1
6.	Bihar	391,500	8.9
7.	Karnataka	360,876	8.9
8.	Rajasthan	100,000	2.3
9.	Maharashtra	256,000	5.8
10.	Gujarat	50,000	1.1
11.	Orissa	160,000	3.6
12.	Kerala	136,416	3.0
13.	Assam	7,725	0.2
14.	Tripura	5,000	0.1
	Total	**44,11,275**	**100.0**

Source:TII (2001), 'Bidi Industry', The Golden Leaf in Parliament [February 19 to December 19], Tobacco Institute of India, New Delhi, p.5.[52] [Available from the Ministry of Labor, Government of India]

Annex 5.2: **Minimum wage rates fixed by state governments.**

Sl.No.	State	Minimum wage rate for rolling bidis (Rs. per thousand)
1.	Andhra Pradesh	45.65
2.	Assam	40.80
3.	Bihar	41.81
4	Gujarat	64.80
5.	Karnataka	53.23
6.	Kerala	60.96
7.	Madhya Pradesh	32.42
8.	Rajasthan	34.50
9.	Maharashtra	39.00
10.	Orissa	42.50
11.	Tripura	29.00
12.	Tamil Nadu	37.68
13.	Uttar Pradesh.	59.62
14.	West Bengal	61.62

Source: TII (1999), 'Workers', The Golden Leaf in Parliament [February 22 to December 23], TII, New Delhi, p.8.[51]

Annex 5.3: **Facts about bidi and FCV tobacco (India).**

	Bidi Tobacco	FCV tobacco
1.	Rabi crop (August-January)	Monsoon crop (May-September)
2.	Rain-fed [Irrigated in Gujarat]	Rain-fed
3.	Black sandy soil [Gujarat – sandy to sandy-loam soils]	Light soils-sandy loams
4.	Thick and large levels	Thin and long leaves
5.	Leaves-Greenish yellow color at maturity, Golden yellow after curing/aging/storage	Cured leaves bright lemon to golden color
6.	Plant height-100-120 cm	150 cm
7.	Topping is done at 15-16 leaves to increase nutrient content of the leaves (Leaves become thick and nicotine content increases)	Topping is not done.
8.	Leaves hard	Leaves can be stretched as sugar content is high.
9.	High nicotine content [5-8%]	Low nicotine content (1.5-3.2%)
10.	Harvesting is done at a time (stalks are cut down and dried).	3-4 leaves per week are harvested, which is continued for 6-7 weeks.
11.	Sun curing in the field for 10-15 days and the leaves are crushed	Leaves are weaved and put on bamboo sticks and are cured in barn in smoke/hot air at 100 F to 160 F.
12.	Curing cost is less as it is done in natural sun light.	>24% of the cost is on curing. Wood/coal is required for heating.
13.	Used for bidi manufacture, Zarda, chewing and as raw leaves	Used for cigarette manufacture and export
14.	Price – fixed on the basis for forces of demand and supply under free market condition. Not under control of Govt. agency (marketing)	Production and marketing has been regulated by Tobacco Board established under the Ministry of Commerce. Board has introduced auction sale of FCV from 1984-85 Marketing season
15.	Average price realized in 2001-02 [Rs. 21-Rs.24]	[Rs. 38 to Rs. 42]

Annex 5.4: **Excise revenue by state (Rs. in lakhs).**

State/UTs	Bidis			Cigarettes			Other tobacco companies		
	1999-2000	2000-2001	2001-2002	1999-2000	2000-2001	2001-2002 (up to Jan. 2002)	1999-2000	2000-2001	2001-2002 (up to Jan. 2002)
Tamil Nadu	42.23	45.03	42.45	109.43	124.47	116.73	24.72	28.04	24.61
Kerala	913.10	912.14	730.00	0.00	0.00	0.00	0.02	0.00	0.00
Karnataka	3532.81	3717.93	3380.09	156251.52	160233.88	133554.81	2457.51	2506.78	7970.84
Andhra Pradesh	5699.66	6019.30	5688.23	55264.03	47360.62	41931.75	3358.01	3345.69	3432.00
Orissa	450.43	498.44	487.36	0.00	0.00	0.00	261.40	270.00	227.70
Maharashtra	1807.94	1954.10	1725.88	44904.00	32010.32	24073.00	9359.51	10561.50	13375.53
Gujarat	23.88	26.81	23.76	5971.00	3958.00	7958.00	4929.36	6163.84	9543.90
Rajasthan	234.71	231.11	220.81	0.00	0.00	0.00	1143.81	1325.81	1261.13
Madhya Pradesh	3235.74	3499.37	3975.68	11837.00	9087.27	3377.98	643.59	746.65	370.21
Chatisgarh	0.00	122.78	256.44	0.00	4108.87	4897.79	0.00	138.02	323.74
Uttar Pradesh	11549.68	1647.58	1449.71	1093.80	1203.88	1210.20	15590.59	16211.33	14462.42
Uttaranchal	1.00	1.50	1.61	0.00	0.00	0.00	0.59	2.56	3.09
Himachal Pradesh	0.00	0.00	0.00	0.00	0.00	0.00	9868.00	7081.00	6342.00
Punjab	0.00	0.00	0.00	0.00	0.00	0.00	334.13	343.55	363.73
Haryana	0.00	0.00	0.00	0.00	0.00	0.00	1343.35	1312.93	1270.34
West Bengal	5592.82	6241.56	5405.80	42496.50	45644.80	37237.60	1369.70	1335.80	1155.10
Bihar	1397.75	1438.97	1212.54	46344.48	45594.51	43479.15	2713.03	3579.86	5366.98
Jharkhand	509.25	504.97	433.59	0.00	0.00	0.00	97.21	101.52	98.76
Sikkim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Assam	14.08	13.60	17.68	3369.00	39341.00	70.00	0.00	5475.00	9321.00
Tripura	4.98	5.80	4.32	0.00	0.00	0.00	0.00	0.00	0.00
Delhi	0.00	0.00	0.00	0.00	0.00	0.00	6060.27	6023.06	6348.73
Dadra Nagar Haveli	0.00	0.00	0.00	0.00	0.00	0.00	50.31	42.61	85.39
All other states/U.T.s	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	35009.06	26879.99	27056.95	367639.80	388666.62	299908.01	59604.11	66794.55	83348.22

Source: Tobacco Institute of India (2002), 'Taxation', The Golden Leaf in Parliament [February 25 to December 20], Tobacco Institute of India, New Delhi, p.19.[53]

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CHAPTER 6

6.1

Indian Bidi Industry and Related Policies

6.2

Policy Implications for Bidis in the United States

6.3

Global Policy for Regulating Bidis

6.1 Indian Bidi Industry and Related Policies

Monika Arora, Bejon Misra and J S Shrihari

INTRODUCTION

This chapter discusses legislation and policies developed by the Indian government aimed at protection of consumers and society, monitoring working conditions and providing social security benefits for the welfare of laborers, and fiscal policies with regard to tobacco control. It argues that the absence of policies on pricing and taxation of bidis has helped increase popularity and consumption, and that government and other stakeholders need to consider avenues for providing alternative employment to bidi workers.

Bidi smoking, having originated in India, is currently practiced all over the country and is the most popular form of tobacco use. Inadequate awareness about the dangers of smoking, combined with the addictive potential of bidi smoking, the low price, and marketing strategies of bidi manufacturers have increased its popularity. Bidi smoking adversely affects the health of consumers, in terms of early mortality, lung diseases, heart and circulatory diseases, cancers and oral diseases. Due to the widespread use of bidis, especially among the lower socioeconomic strata, many people are suffering from or are at risk for these health problems.

Bidi manufacturing is highly labor-intensive and most of the bidi workers belong to lower socioeconomic groups. The industry engages about 4.4 million workers, of whom nearly two-thirds are home-based women and one percent are children. Unofficial sources claim this figure is actually 7-8 million. The figures would be even higher if those engaged in tendu leaf collection were also included.[1] The bidi industry provides seasonal and part-time vocational employment,[2] spread over 13 states and three union territories.[3]

Manufacturing

Bidi manufacturing involves forest-based tribal workers who collect tendu/kendu leaves, tobacco-growing farmers, and home-based workers who roll bidis, most of whom are women. There are about 300 manufacturers of major branded bidis in India, and thousands of small-scale manufacturers and contractors who are involved in the bulk of the bidi production.[4]

The principal manufacturer functions through an intermediary contractor, who gets bidis rolled by home-based workers in the villages.[3] Contractors often exploit vulnerable workers due to illiteracy and lack of awareness of their rights.[5]

Bidi rolling began in organized factories during the early 20th century, but gradually shifted to the unorganized sector, consisting of households, small unincorporated pro-duction units and workshops. At present, only about ten percent of bidi manufacturing takes place in the organized sector.[1]

Bidi making is primarily regarded as women's work, carried out in the home. Women and girls are paid on piecework basis, a mere Rs. 21 (US$0.50) for making 1000 bidis. Most of the boys work in the factories and are involved in packaging and transport.

Since bidi rolling takes place mostly in homes, it has an adverse impact not only on the health of the workers, but also on other family members, especially children. Inhalation of tobacco dust causes measurable exposure to nicotine. The involvement of children, particularly girls, in bidi rolling, labeling and packing, exposes them to various health hazards. Even though existing laws prohibit the employment of children in the bidi industry, the fact that a majority of the bidi workers live below the poverty line forces children to get involved in bidi manufacturing.[1]

Fiscal Revenue to the Government

For the Indian government the bidi industry is an important source of revenue, which last year totaled Rs. 709.50 crore ($165 million) in excise and Rs. 860 crore ($200 million) in foreign exchange.[6] It has always received preferential treatment as a cottage industry, and managed to escape paying higher taxes due to its unorganized and unregulated nature. The absence of pricing and taxation policies has contributed to bidis' popularity, increasing consumption in India and exports to other countries. The bidi industry has also been accused of evading taxes due to differential tax structures imposed by the government. Bidi manufacturing units producing fewer than 20 lakh (two million) bidis per annum do not have to pay taxes, which leads many manufacturers always to report production to be below that amount.

Exploitation

The 1.5 million private-sector bidi workers are among the most exploited workers in India. Since most are poor and illiterate, they are easy prey for the contractors. The lack of organized bidi production adds to the difficulty in regulating working conditions or implementing welfare laws. Bidi workers are subject to low wages and fraud from contractors who can arbitrarily reject finished bidis on the basis of being below quality standards and refuse payment. Often assisted by children, they work in filthy, disease-causing conditions, breathing in tobacco fumes. Women may roll bidis with infants on their laps, so both mother and child are smeared with tobacco and breathing in tobacco fumes. Male contractors also subject many women to sexual harassment and abuse. Home-based workers expose the entire family to tobacco fumes, working all hours of the day and night to fulfill contractors' demands. After continuous exposure to tobacco, the skin on the fingertips begins to thin and they become inefficient in rolling bidis at about the age of 45. Many are forced to resort to begging when they can no longer work.[7]

According to the law, employers are responsible for issuing identity cards to bidi workers to enable them to receive workers' welfare benefits. Since many employers do not fulfill this responsibility, the Labor Welfare Organization, under the Ministry of Labor, also issues ID cards to the bidi workers through the Welfare Commissioners. This is done mainly by Medical Officers of the dispensaries in the field, under the BWWF (Bidi Worker's Welfare Fund). Trade unions claim that the majority of bidi workers do not have identity cards. Standard practice is to issue an identity card to only one member of the family, even though three or four members roll bidis.[4]

Minimum wage revisions are often delayed and significant differences exist in rates across states, which results in a shifting of the industry to the low-wage areas. Shifting bidi production leaves many women jobless, with no source of alternative employment. Lack of education and training programs leaves bidi women workers ignorant of their rights and alternative options.[8] There is also a lack of credit facilities that would enable them to undertake self-employment ventures. Big bidi traders and manufacturers exploit poor workers by loaning them money at very

high interest rates. Unable to repay the loans, the workers become bonded laborers.[8] Despite much legislation enacted for the bidi industry, middlemen and contractors continue to exploit the workers.[5]

LEGISLATION

The government of India has enacted a number of legislative measures to regulate working conditions and provide welfare schemes to bidi workers and their families.[9] However, major efforts need to be undertaken to regulate the functioning of this un-organized sector. The first national-level bills were introduced not to curtail the tobacco industry, but to build a foundation that would enable it to be competitive in the inter-national market, without regard for the health of consumers.

Pro-tobacco legislation dates back to 1975 with the Tobacco Board Act, enacted to develop the tobacco industry. It facilitated the regulation of production and curing of tobacco, fixed minimum prices, and provided subsidies to tobacco growers. The objective was to develop the Indian tobacco market and make exports competitive. Even the Tobacco Cess Act of 1975 aimed to develop the tobacco industry by levying a duty on tobacco. These acts nurtured the tobacco industry through subsidies and loose export policies.[10]

Early attempts to enact tobacco control legislation were ineffective and only recently has there been sufficient impetus to come up with a multifaceted national tobacco control measure. The legislative measures related to bidis are discussed below.

Policies Related to Protection of Consumers

Regulations on Labeling

The first legislation regulating labeling of tobacco products in India was 'The Cigarettes (Regulation of Production, Supply and Distribution) Act', 1975, but it did not include bidis and was restricted to cigarettes.[11] This Act has been proposed to be repealed with the passage of a comprehensive legislation on tobacco control in 2003, and the repeal awaits notification.

The Cigarette and Other Tobacco Products (Prohibition of Advertisement and Regulation of Trade and Commerce, Production, Supply and Distribution) Act, 2003, mandates labeling of all tobacco product packages, including bidis. The provisions include specified health warnings and indication of nicotine and tar contents. According to provision 7 (1 to 3) of the act, no person shall, directly or indirectly, produce, supply or distribute tobacco products, carry on trade or commerce in tobacco products and import tobacco products for distribution unless every package of tobacco product, supplied or distributed, bears thereon or on its label, the specified warning, pictorial depiction of skulls and cross bones and such other warnings. The act also specifies labeling of tobacco product packages with information about nicotine and tar contents of each tobacco product (Provision 7 (5) of the act). This comprehensive act further explains the placement of health warning and language to be used for health messages on tobacco product messages (Provision 7 (4), 8 & 9). While rules under some provisions of this act were formulated and have been notified since May 2004, the rules related to packaging and labeling of tobacco products are still being framed by the Ministry of Health and Family Welfare. Two health warnings in national and regional languages are being considered by the Ministry of Health and Family Welfare for bidi packets in India.

Advertising Restrictions

The Indian Tobacco Control Act of 2003 imposes a total ban on direct and indirect advertising of cigarettes and other tobacco products and also prohibits sponsorship of sports and cultural events (Provision 5 (1 to 3) of the act). The ban on advertising extends to producers, suppliers and distributors, and also includes media and models that promote these products. Point-of-sale advertising is permitted as per guidelines specified in the rules related to this provision of the act.

Consumer Protection Act, 1986

The main objective of this act is better protection of consumers. It is intended to provide simple, speedy and inexpensive redress to consumers' grievances, and relief of a specific nature and award of compensation wherever appropriate to the consumer. The act was amended in 1993, both to extend its coverage and scope and to enhance the powers of the redress machinery. It covers all sectors, whether private, public or cooperative. The provisions of the act are compensatory in nature. It enshrines the rights of consumers against the marketing of goods and services that are hazardous to life and property and several other related rights.[13] To date no action has been initiated under the provisions of the Consumer Protection Act on harm caused by tobacco consumption and addiction.

Prevention of Food Adulteration Act, 1954

Smokeless tobacco is treated as a food item under the Food Adulteration Act, 1954. The provisions of this act were utilized in 1990 to extend statutory health warnings on smokeless tobacco products. It was formulated to protect consumers from any adulteration of food items. Since only orally consumed tobacco is classified as a food product in this act, bidis are not included. Section 7 (4) of the act states that no one can make or sell any article of food, the sale of which is for the time being prohibited by the Food Health Authority in the interest of public health. Although tobacco is the basic ingredient in both oral and smoked forms of tobacco products, using provisions of this law, sale and manufacturing of *gutkha* was banned in some states of India, though later revoked.[12]

The Standards of Weights and Measures Act, 1976 and the Standards of Weights and Measures (Packaged Commodities) Rules, 1977

These acts apply to commodities in packaged form that are or are intended or likely to be sold, distributed or delivered or offered or displayed for sale, distribution or delivery or stored for sale or for distribution or delivery, in the course of inter-state trade and commerce. With the enactment of the Standards of Weights & Measures Act, 1976 and the Standards of Weights & Measures (Packaged Commodities) Rules of 1977, the government started considering it prudent that consumers have access to information through labeling and packaging.[14]

State Legislation om Smoking, Advertising and Sale of Tobacco Products

The Bombay Police Act of 1951 prohibited smoking in all government or public offices. Finding it inoperative, in 1987 the State of Maharashtra issued an order to enforce the act.[15] In Karnataka, the Prohibition of Smoking in Show Houses and Public Halls Act came into effect in October 1963.[16]

In 1995, subsequent to the Ministry of Health of India formulating a draft of a comprehensive tobacco control bill, several states enacted laws prohibiting smoking in 'places of public work or use' (government offices), e.g., Delhi (1996), Goa (1997), Himachal Pradesh (1997), Jammu and Kashmir (1997), Meghalaya (1998), Rajasthan (2000), and Sikkim (1997).[12, 17]

For example, the Delhi Prohibition of Smoking and Non-Smokers Health Protection Act, 1996 prohibits smoking in places of public work or use, and in public service vehicles, and advertisement, sale to minors and storage, sale and distribution of cigarettes, etc., in the vicinity (100 yards) of educational institutions. It also provides authority to government officials to act on violations under this act.[18] It applies to all forms of smoked tobacco products, including bidis.

In 1999, the Kerala High Court imposed a ban on smoking in public places as a result of a public interest litigation, based on Article 21 of the Constitution regarding the fundamental right to the protection of life and Article 268 of the Indian Penal Code regarding public nuisance.[19]

A Supreme Court Order of November 2001, following public interest litigation, banned smoking in public places, including auditoriums, hospitals, health institutions, educational institutions, libraries, court buildings, public offices, and public conveyances, including railways, and required the central government, states and territories to enact laws.[17] Since then, several states have enacted laws conforming to it: Andhra Pradesh (2002), Assam (2001), Gujarat (2004), Haryana (2001), Karnataka (2001), Punjab (2004), Tamil Nadu (2003), Uttar Pradesh (2001), West Bengal (2001).[12, 20-27]

Policies Related to Protection of Labor

Several laws have been enacted to protect bidi workers, since they belong to vulnerable sectors of society and work under adverse and unhealthy conditions.

Bonded Labour System (Abolition) Act, 1976

The "bonded labor system" is the system of forced, or partly forced labor under which a debtor enters, or has, or is presumed to have, entered into an agreement with the creditor. Children often become bonded when parents cannot repay a loan, which jeopardizes their education. This act aims to abolish the bonded labor system with the intent of preventing the economic and physical exploitation of weaker sectors of the population.[28]

The Child Labour (Prohibition and Regulation) Act, 1986

Since bidi rolling engages children as part of a working family, it is important to protect children from any exploitation or forced labor. This act prohibits the engagement of young children in certain jobs that are hazardous to their health and regulates their working conditions in certain other occupations.[29]

Bidi manufacturers do not formally employ children to roll bidis. However the system of sub-contracting bidi rolling to home-based workers and the piecework payment system (the more bidis rolled, the higher the pay) create an environment that forces involvement of children in this family work. Legally India's child labor laws do not cover children who help with family chores and this loophole allows the employment of children in bidi rolling at home. A survey conducted by the Labor Bureau, Ministry of Labor in 1995, estimated the prevalence of child labor to be 1% of the total number of bidi workers.[4]

Salient features of this act are as follows:

- Employment of children under 14 years of age is prohibited.
- Except for family-based work or recognized school-based activities, children are not permitted to work in occupations connected with passenger, goods, or mail transport by railways, cinder picking, cleaning of ash pits, building operations, construction, catering establishments in railway premises or ports, bidi making, carpet weaving, cement manufacturing, cloth printing, dyeing, weaving, manufacture of matches, explosives, and fireworks, mica cutting/splitting, or wool cleaning.
- In occupations and processes other than the above, children are permitted to work only for six hours between 8:00 a.m. and 7:00 p.m. with one day's rest weekly. An establishment employing children is required to give notice to the local Inspector and maintain the prescribed register.

Minimum Wages Act, 1948

The Minimum Wages Act aims to fix minimum rates of wages in industry and trade where labor organizations are non-existent or ineffective. This law protects laborers by fixing the work hours, proper rest, payment for work on the day of rest, etc.[30]

Over the years, many efforts have been made to improve the working and living conditions of workers and their families involved in the bidi industry. Besides the general labor laws applicable (such as the Minimum Wages Act and the Provident Funds Act), the Government of India has also enacted two major laws specifically for the bidi sector workers – Bidi and Cigar Workers (Conditions of Employment) Act 1966, and Bidi Workers Welfare Fund Act, 1976.

The Bidi and Cigar Workers (Conditions of Employment) Act, 1966

The Bidi and Cigar Workers (Conditions of Employment) Act, 1966, was enacted to regulate the employment of workers in the bidi industry.[31] It prohibits the employment of children less than 14 years of age in any industrial premises manufacturing bidis or cigars. The act mainly regulates factory-based workers, although it also mentions home-based bidi workers.[32] It requires the licensing of industrial premises and appointment of inspectors of working conditions. Industrial premises have to meet standards of cleanliness and ventilation, may not be overcrowded, and must have separate latrine and urinal facilities for men and women, washing facilities, first-aid facilities, daycare facilities, and a canteen (in workplaces having 250 employees or more). It regulates working hours, rest and leave, prohibits child labor on the premises, permits contract labor outside the industrial premises, but requires that it be recorded, and empowers the state to make rules for implementation of the act. This act has not brought about any significant improvement in the working conditions of the majority of the bidi workers who roll bidis at home. Moreover, it has led more manufacturers to shift from factory-based to home-based production.

Bidi Workers Welfare Fund Act, 1976

The Bidi Workers Welfare Fund Act, 1976 (BWWF), aims to provide welfare schemes for the bidi workers and their families, relating to health, education, maternity benefits, group insurance, recreation, housing assistance, sanction of scholarships for the children of bidi workers, and drinking water supplies. There are also special schemes to encourage education of children of bidi

workers, especially girls. In addition, the Ministry of Labor provides health care facilities through 12 hospitals and over 276 dispensaries located in different parts of the country under the Welfare Funds for bidi workers.[4]

The Bidi Workers Welfare Cess (Amendment) Act, 1976

The Bidi Workers Welfare Cess Act, 1976 and the Bidi Workers Welfare Funds Act, 1976 were enacted to ameliorate living conditions and provide welfare benefits to bidi workers. These two acts contribute to the Bidi Workers Welfare Fund, through the cess collected by way of excise duty on manufactured bidis. This cess gets revised from time to time by the central government. It was raised from Rs.1 to Rs.2 per 1000 bidis in June 2000 for registered companies manufacturing more than 20 lakh (two million) bidis per annum.

Bidi workers are issued identity cards by the manufacturer, in order to be eligible for benefits under the fund. It is administered through the Labor Welfare Organization, headed by the Director General, Labor Welfare, Ministry of Labor. There is also a tripartite Central Advisory Committee and state-wide tripartite advisory committees, headed by the state labor ministers, under the BWWF. About 3.8 million workers are currently covered under the BWWF. However, this leaves a large number of bidi workers uncovered.[4]

Other Labor Laws Applicable to Bidi Workers

Equal Remuneration Act, 1976. According to this act, employers must provide equal remuneration to men and women workers for same work or work of a similar nature. No discrimination to be made while recruiting male and female workers.[33]

The Factories Act, 1948. This act aims to ensure adequate safety measures and to promote the health and welfare of factory workers. It prevents haphazard growth of factories by requiring the approval of plans before the creation of a factory.[30]

Employees State Insurance Act, 1948. This act provides health coverage, medical care and cash benefits for sickness, maternity, employment injury and pensions to dependents in case of death or employment injury. It applies to employees drawing wages not exceeding Rs. 3000 ($67.17) per month.[30]

The Payment of Bonus Act, 1965. This act provides statutory obligations for payment of bonuses to persons employed in certain establishments on the basis of profits or productivity.[30]

The Payment of Wages Act, 1936. The purpose of this legislation was to ensure regular and prompt payment of wages and to prevent the exploitation of a wage earner by prohibiting arbitrary fines and deductions from wages. It is not applicable to wages that average Rs. 1600 ($35.83) per month or more.[30]

The Trade Union Act, 1926. The act confers legal and corporate status on registered trade unions. It is applicable to unions of workers as well as associations of employers.[30]

The Employees Provident Funds and Miscellaneous Provisions Act, 1952. The objectives of this act include making provisions for the future of the industrial worker after retirement or for dependents in the case of early death, through the Compulsory Provident Fund, Family Pension and deposit-linked insurance. It is applicable to factories and establishments employing 20 or more persons and employees drawing pay not exceeding Rs. 3500 ($78.37) per month.[30]

The Contract Labour (Regulation & Abolition) Act, 1970. According to this act, a worker need not work more than nine hours between 6 A.M. and 7 P.M (with the exception of midwives and nurses).[30]

Maternity Benefit Act, 1961. Maternity benefits are to be provided on completion of 80 working days. Women are not required to work during six weeks immediately following the day of delivery or miscarriage.[30]

Other Applicable Labor-Related Acts

- The Inter-state Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979. Separate toilets and washing facilities are to be provided for men and women.
- The Children (Pledging of Labour) Act, 1933. Any agreement to pledge the labor of children is void.
- The Payment of Gratuity Act, 1972. To provide for payment of gratuity on ceasing to hold office.
- The Shops & Establishment Act, 1953. To provide statutory obligation and rights to employees and employers in the organized employment sector, i.e., shops and establishments.
- The Industrial Disputes Act. This act provides a mechanism for peaceful resolution of disputes and promotion of harmonious relations between employers and workers.
- Apprentices Act, 1961
- Employers Liability Act, 1938
- The Industrial Employment (Standing Orders) Act, 1946
- Employment Exchange (Compulsory Notification of Vacancies) Act, 1959
- The Weekly Holidays Act, 1942

Other Welfare Efforts Undertaken for Bidi Workers

Most of the labor laws just described have been passed for the welfare of employees. Several studies and reports have found that all the welfare measures do not reach the bidi workers.[35] In April 1992, a Group Insurance Scheme for Bidi Workers was introduced under the social security scheme of the Life Insurance Corporation (LIC) of India. It provides insurance coverage of Rs. 5000 in case of natural death and Rs. 25,000 in case of accidental death to those bidi workers who have identity cards.

The bidi industry came under the influence of the trade unions as early as the 1920s and 1930s. The five major Central Trade Unions (BMS, INTUC, CITU, HMS and AITUC) have been organizing bidi workers for many years and there are other independent organizations in a number of states. These efforts have led to the revision of minimum wages and coverage of many bidi workers with social security under the BWWF in several states. There are also instances where bidi workers formed cooperatives to protect their interests, e.g., Kerala Dinesh Bidi Workers' Cooperative Society Ltd, which at one time was providing employment to over 32,000 workers.[4]

Other State-Level Welfare Initiatives

Considering the loss of employment and declining economic status of bidi workers, the International Labor Organization (ILO), in association with the Department of Labor, State of Karnataka,

organized a workshop to explore ways of providing decent alternative work opportunities for women, and to promote dialogue among social partners in the industry.[35]

The Karnataka State Government has also taken the initiative to develop a uniform minimum wage policy for bidi workers in South India. It is planning to develop another policy to ensure that they get work for at least five days a week.[34]

Implementation and Impact of Labor Policies

Despite efforts to protect bidi workers through legislation, the coverage of welfare policies is low and the degree to which workers are organized is poor (only about 15%). The trade unions say that the shift from factory-based production to home-based bidi rolling adversely affected the organizing process. Implementation of minimum wages, dearness allowance and other regulatory provisions of the bidi workers law has been very difficult, especially for home-based workers. The average actual earnings for bidi rolling vary widely from state to state (from Rs. 25 to Rs. 45 for rolling 1000 bidis) and within states. Even the official minimum wages vary significantly from state to state (from Rs. 29 to Rs. 64.80). The low fixed capital required and the high wage sensitivity of the bidi industry has also meant that bidi manufacturers could quickly shift production whenever workers became too well organized and started raising demands that the manufacturers did not want to concede. The cooperatives have not succeeded either (except in Kerala), due to the absence of support to cooperatives and marketing difficulties.[4]

The Labor Ministry has taken several initiatives to promote the welfare of about 40 lakh (four million) bidi, mine and cine workers who are mostly living below the poverty line. The Government raised the subsidy rate for construction of houses by bidi workers to Rs. 20,000 to encourage them to construct their own houses.[36]

According to a study among women in Karnataka, trade union representatives and others in the study community believed that women bidi workers did not significantly benefit from the welfare provisions in the existing legislation. A member would become eligible for benefits only when she had registration and/or a passbook, but in the study area 44% of the respondents were unregistered workers. Only 50% of the sample respondents had identity cards and only 9% had membership in trade unions. Thus, a large number of workers were unorganized and did not have an identity card. As sufficient work was not available from the registered companies, women had to contract work with unregistered companies. The proliferation of unregistered manufacturers of bidis and contractors/middlemen appears to have prevented a large number of women bidi workers from accessing benefits.

In the study area, most of the bidi workers were living in abject conditions as indi-cated by poor housing and a lack of basic amenities, as well as low levels of education and health. Over half of the women bidi workers were affected by several health problems.[1]

Policies Related to Fiscal Measures

Taxation and Excise Duty Structure

The Bidi Workers Welfare Cess Act, 1976, and the Bidi Workers Welfare Fund Act, 1976, have been discussed in detail under the labor-related policies section. The excise duty rate on manufactured bidis doubled to two rupees in June 2000 to generate an additional Rs. 42 crore (420 million) annually for the Bidi Workers Welfare Fund.[36]

Recently, the Finance Minister levied a cess on cigarettes, pan masala and tobacco products to fund the health sector. From this the government is expecting to generate revenues of Rs. 700 crore (7 billion) to fund the National Rural Health Mission. It increased the specific rate on cigarettes by 10% and imposed a surcharge of 10% on ad valorem duties on other tobacco products, including gutka, smokeless tobacco, snuff and pan masala. Bidis, however, have been exempted from this levy.[37]

The price gap between bidis and cigarettes still leaves a considerable margin for the government to raise taxes on bidis in order to narrow the price difference. The existing differential pricing pattern ensures that smoking is accessible to the less affluent consumer. Since less affluent consumers tend to be less aware of the health consequences, a greater proportion of them smoke and consequently suffer from smoking-related diseases.

Challenges Before the Bidi Manufacturers

The prevailing excise duty structure appears to protect employment in the bidi sector and discourage employers from mechanizing their bidi rolling operations. The formal bidi sector also faces competition from informal, unregistered bidi manufacturers. The trade unions and the social welfare NGOs in India advocate for support to ensure the survival of the bidi industry, improving the conditions of work, providing workshops and access to the facilities under the Welfare Fund, and planning for the transition to alternative occupations and income-generation activities for bidi workers in the longer run.

CONCLUSION

Labeling bidis with health warnings as per the Cigarette and Other Tobacco Products Act, 2003 needs to be made a priority to inform consumers of the harm that may come from using bidis.

In view of the recent policies with regard to tobacco control, the Cigarette and Other Tobacco Products Act, 2003 and the Framework Convention on Tobacco Control, which are expected to reduce bidi consumption in India, the central and state governments need to assist bidi workers to shift to alternative avenues of employment now and in the coming years.

The stakeholders in tobacco control should work together to implement and enforce regulations to reduce tobacco production and products like the bidi to protect the health of the bidi workers and the consumers.

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6.2 Policy Implications for Bidis in the United States

Nicole Kuiper and Jack Henningfield

INTRODUCTION

This chapter examines the importation of bidis from India, tariff, taxation and labeling issues, youth access to bidis, advertising and marketing policies, product regulation implications, as well as state legislation and federal regulation regarding the importation, sale, and use of bidis. It details how these policies have been applied, sometimes inadequately, and how public attention led to increased awareness and enforcement of these laws and regulations.

Bidis have been imported into the United States for many years. As early as 1969, the Internal Revenue Service classified bidis as cigarettes for taxation purposes.[68] Classification as cigarettes means that all federal laws or regulations applicable to cigarettes are equally applicable to bidis. Bidis are classified as cigarettes by every U.S. federal agency that oversees tobacco products: Bureau of Alcohol, Tobacco and Firearms (BATF), Internal Revenue Service (IRS), Customs and Border Protection (CBP), Foreign Agricultural Service (FAS), Federal Trade Commission (FTC), International Trade Commission (ITC), and the Food and Drug Administration (FDA). United States Code defines cigarettes as "any roll of tobacco wrapped in paper or in any substance not containing tobacco, and any roll of tobacco wrapped in any substance containing tobacco which, because of its appearance, the type of tobacco used in the filler, or its packaging and labeling, is likely to be offered to, or purchased by, consumers as a cigarette".[67] Though state laws regarding bidis vary, federal laws require that bidis should be regulated as cigarettes.

IMPORTATION

Bidis are primarily imported from India, and as such, are subject to tariffs according to the classification of the Harmonized Tariff Schedule (HTS). It is customary for the U.S. Customs Agency to issue tariff rulings in the form of letters responding to inquiries from importing retailers about particular products. In July 1995, the U.S. Customs Agency issued a tariff classification ruling in response to an inquiry about Mangalore Ganesh Beedies.[68] This ruling determined the applicable HTS subheading for those particular bidis was 2402.20.9000, or Cigarettes, NEC (Not Elsewhere Classified). Prior to this ruling, it was common for bidis to be imported with the tariff codes for cigars. However, this ruling established that since bidis were not wrapped in leaf containing tobacco (as determined by laboratory reports), bidis could not be classified as cigars for tariff or taxation purposes.

According to the Foreign Agricultural Service (FAS), bidis are currently imported under two HTS (10 digit) codes: 2402.20.9000 – Cigarettes, NEC and 2402.20.8000 – Cigarettes, Paper* .[80] Both of these categories exclude any cigarettes containing clove, which belong to the third category under this heading, 2402.20.1000 – Clove cigarettes.

*Despite the fact that bidis are not wrapped in traditional cigarette paper, the U.S. code defines cigarette paper as "paper, or any other material except tobacco, prepared for use as a cigarette wrapper" (26 U.S.C., 2002).

Trends in cigarette imports from India were examined in the two HTS classification codes known to include bidi cigarettes. Though the "Cigarettes, Paper" code may also include traditional manufactured cigarettes from India, the majority of Indian imports are believed to be bidis.[5] In 2003, 87.6% of all "NEC" cigarettes imported into the United States came from India,[72] while only 5.6% of all "Cigarettes, Paper" imports came from India.[73] Since India produces the vast majority of bidis worldwide, virtually all imports from India classified under "Cigarettes, NEC" are likely to be bidis. However, one cannot assume that all "Paper" cigarette imports from India are bidis. Thus, utilizing the "NEC" category alone likely provides an underestimate of all bidi imports from India, while combining "NEC" and "Paper" categories probably provides an overestimate because it includes some non-bidi cigarettes. Therefore, estimates were calculated for each category separately, and for a combined category.

Table 6.2.1 details trends in the Customs value of cigarette imports from India obtained from the U.S. Department of Agriculture, Foreign Agricultural Service (FAS) for the time period of 1993-2004. Customs value data were obtained from FAS Online Database[22] and represent data collected from the U.S. Department of Commerce, U.S. Census Bureau, and Foreign Trade Statistics.

Tariff data were obtained from the FAS, USITC, and the World Trade Organization (WTO), and represent tariff rates for Normal Trade Relation (NTR, formerly Most Favored Nation (MFN) status) countries, which include India. Beginning in 1995, tariff reductions were staged over a six-year period until 2000. The 2000 rates remain the current tariff rates for both cigarette categories. Annual tariff rates from 1994 and 1997-2004 were obtained from the ITC.[74] Rates from 1995-1996 were calculated according to equal yearly reductions as stated in WTO tariff schedules.[23]

Results of Import Data Analyses

Table 6.2.1 shows that the percentage of all cigarettes that were imported from India under the "Cigarettes, NEC" classification ranged from a high of 88.5% in 1993 to a low of 1.1% in 2002. Following the Customs classification ruling in 1995 stating that bidis should be classified as "NEC", the value of imports in this category increased 120.4% in 1996, the second largest one-year increase in this classification. The largest annual decrease in imports of "NEC" cigarettes occurred from 1999 to 2000, when there was a 59.1% decrease in Customs value. This decrease was concurrent with several major policy initiatives, such as the detention order of U.S. Customs on Mangalore Ganesh Bidis (1999) and efforts by the FTC (1999, 2002) to increase enforcement against bidi smuggling and tax evasion.

Since 1995, the vast majority of all cigarettes from India have been imported under the classification "Cigarettes, Paper." Despite the fact that "Paper" cigarettes represented only 11.5% and 26.4% of all cigarette imports in 1993 and 1994, respectively, the value of imports in this category increased an astounding 2,369% from less than $20,000 in 1994 to over $490,000 in 1995.[22] This increase represents more than a mere re-classification effect from the other categories of cigarettes because, although clove cigarettes decreased from about $9,300 to about $1,400 from 1994 to 1995, these values were a tiny fraction of other cigarette imports (clove cigarettes as a percent of total cigarettes not shown). Moreover, in the same time frame, the value of "NEC" cigarette imports increased 135% from about $46,000 in 1994 to just under $109,000 in 1995.[22]

This increase in the value of "Paper" imports is also remarkable because it occurred notwithstanding the HTS bidi classification ruling in 1995,[68] leaving open several possibilities. One is that bidis continued to be imported under the "Paper" classification and represent the majority

Table 6.2.1: **Cigarette imports (for consumption) from India, by Harmonized Tariff Schedule (HTS) subheading, in dollars, 1993-2004.**

	Paper				**NEC***				**NEC & Paper** (Combined)		**Clove**	**Total**
Year	Customs Value t	Annual Change	% Paper (of Total)	NTR Tariff Rate ‡	Customs Value t	Annual Change	% NEC (of Total)	NTR Tariff Rate ‡	Customs Value t	Annual Change	Customs Value t	Customs Value t
1993	$4,045		11.5%	$2.34/kg + 5.0%	$31,053		88.5%	$2.34/kg + 5.0%	$35,098		$0	$35,098
1994	$19,919	392.4%	26.4%		$46,333	49.2%	61.3%		$66,252	88.8%	$9,309	$75,561
1995	$491,876	2369.4%	81.7%	$2.13/kg + 4.6%	$108,980	135.2%	18.1%	$2.20/kg + 4.7%	$600,856	806.9%	$1,440	$602,296
1996	$1,638,032	233.0%	86.4%	$1.91/kg + 4.1%	$240,150	120.4%	12.7%	$2.06/kg + 4.4%	$1,878,182	212.6%	$18,220	$1,896,402
1997	$1,452,968	-11.3%	76.8%	$1.70/kg + 3.6%	$422,021	75.7%	22.3%	$1.92/kg + 4.1%	$1,874,989	-0.2%	$17,939	$1,892,928
1998	$2,663,568	83.3%	79.9%	$1.48/kg + 3.2%	$642,392	52.2%	19.3%	$1.78/kg + 3.8%	$3,305,960	76.3%	$25,755	$3,331,715
1999	$10,022,745	276.3%	91.3%	$1.26/kg + 2.8%	$929,575	44.7%	8.5%	$1.64/kg + 3.5%	$10,952,320	231.3%	$26,129	$10,978,449
2000	$9,352,447	-6.7%	96.0%	$1.05/kg + 2.3%	$380,322	-59.1%	3.9%	$1.50/kg + 3.2%	$9,732,769	-11.1%	$7,649	$9,740,418
2001	$9,965,617	6.6%	96.9%		$307,822	-19.1%	3.0%		$10,273,439	5.6%	$7,960	$10,281,399
2002	$15,230,029	52.8%	98.9%		$168,936	-45.1%	1.1%		$15,398,965	49.9%	$0	$15,398,965
2003	$12,620,278	-17.1%	98.5%		$188,295	11.5%	1.5%		$12,808,573	-16.8%	$4,200	$12,812,773
2004	$11,156,219	-11.6%	98.8%		$133,922	-28.9%	1.2%		$11,290,141	-11.9%	$0	$11,290,141
Annual Average	$6,218,145	306.1%			$299,983	30.6%			$6,518,129	130.1%	$9,883	$6,528,012
Overall Change 1995-2004		2168.1%				22.9%				1779.0%		

* NEC = Not elsewhere classified.

t Customs Value is the value of imports as appraised by the U.S. Customs Service. This value is defined as the price actually paid or payable for merchandise, excluding U.S. import duties, freight, insurance, and other charges. Source: http://dataweb.usitc.gov/scripts/prepro.asp.

‡NTR = Normal Trade Relations (formerly known as Most Favored Nation – MFN). Tariff is calculated by adding together a rate per specified weight unit (e.g., $2.34/Kg) with an *Ad Valorem* (percent of value) component (e.g., 5.0%). Source: USITC, 2004. http://dataweb.usitc.gov/scripts/tariff2004.asp.

of the increase. Another is that Indian non-bidi cigarettes were increasing in popularity even more than were bidis. It could also represent an increase in the value of "Paper" cigarette imports, although because bidis were often sold at cheaper prices than other cigarettes, this does not seem likely.

Preferences for classifying goods are likely to be influenced by tariff rates. It is notable that before 1995 the tariff rates for the "NEC" and "Paper" categories were equivalent. In 1995, the WTO began to reduce tariffs in six annual stages, which resulted in lower but differential tariff rates in these categories.[23] As shown in Table 6.2.1, throughout the course of these staged tariff reductions, the NTR tariff rate for "Paper" cigarettes decreased to a lower rate than that of the "NEC" cigarettes. Thus, the lower tariff rate for "Paper" cigarette imports may have led importers to classify bidis as "Paper" cigarettes rather than the "NEC" cigarettes, the latter of which would have been in agreement with the 1995 Customs ruling. Unfortunately, there is no valid information available on how many bidis and non-bidi cigarette imports are included in the "Paper" category.

Considering that two import categories contain bidis, these were merged into one category. Overall, the value of cigarettes when the two categories were combined increased 1,779% from 1995 to 2004. The largest one-year increase after the 1995 ruling was from 1998 to 1999, when the value of imports rose 231.3%; this increase coincides with the multitude of news reports and surveillance data detailing the relatively high prevalence of bidi use among urban youth. In 2000, imports in the combined category decreased by 11.1%, but remained valued at $9.7 million.[22]

Decreases in the value of the combined category of imports since 2002 were concurrent with increased FTC enforcement, though it is not known how much of an impact the regulatory actions had on importation practices. Though the value of imports has been decreasing since 2002, Indian cigarette imports were still valued at over $11 million annually in 2004.[22]

There are several important limitations to interpreting these data, besides the like-lihood that these tariff categories include non-bidi cigarettes. First, these data only include imports from India; however, the vast majority of bidis worldwide are produced in India. Other countries that have imported products under the "Cigarettes, NEC" category since the 1995 classification ruling include Canada, the United Kingdom, the Dominican Republic, and Japan, among others[22]; imports from these countries may have been bidis or other types of cigarettes.

A second limitation is that these data only represent those imports that were processed through U.S. Customs. Current bidi smuggling estimates are not available, though a 1999 FTC report estimated as many as 40% of bidis were smuggled into the United States.[18] While enforcement with respect to bidis has increased since then, it is possible that bidis may still go undeclared, and subsequently, could be arriving taxand tariff-free. For example, when incoming shipments for ethnic food stores and other businesses arrive with small quantities of bidis, the bidis may go undeclared. As such, these estimates may be lower than the actual value of all bidi imports.

Finally, some caution must be used when comparing data before and after 1995 when the U.S. Customs issued the classification ruling. Though this ruling likely resulted in some re-classification from cigars to cigarettes, the effect is likely to be small relative to the increase in imports overall. From 1994-1996, though the value of all cigar imports from India decreased by 61.6%, this represents a decrease in value of only about $38,000, less than 20% of the increase in value of "NEC" cigarettes from 1994-1996 (cigar import data not shown).[22] Thus, the observed increase in value of cigarette imports in the 1990s likely represents a real increase in demand for bidis, rather than a mere re-classification effect.

TAXATION

In addition to paying import tariffs, bidis are subject to the same federal excise taxes as other cigarettes, the rates of which vary depending on cigarette length and presence or absence of filters.[68] However, in the 1990s, there were reports that bidi cigarettes were being imported without paying the appropriate federal taxes. The San Francisco Tobacco Free Project in California undertook an informal community survey in 1998 which examined shops that sold bidis and youth prevalence of bidi use. They found that 41.4% (24 out of 58) of bidis packs purchased did not have the federal tax stamp.[4] At the conclusion of their work, they filed complaints with the FTC over the lack of federal tax stamps and subsequent lower prices, among other issues. Following this report, several public officials, such as U.S. Senator Richard Durbin of Illinois, filed similar complaints with the FTC.[18]

Because bidis contain tobacco but are wrapped in a tendu leaf (which does not contain tobacco), they cannot be classified as cigars or cigarillos, which are defined as "any roll of tobacco wrapped in leaf tobacco or in any substance containing tobacco".[67] Despite this fact, a 2003 report alleged that Kretek International may have been importing bidis created exclusively for the United States market and labeling them as cigarillos.[17] In addition to reducing federal tax liability by $0.35 per pack, this alleged practice would allow these products to be sold in states that ban or otherwise regulate the sale of bidis.[17] Continued vigilance by regulatory agencies is necessary to ensure appropriate classification and taxation of bidis.

Bidis are also subject to the applicable state taxes wherein they are being sold. Some states tax bidis at the same rate as cigarettes, and others assign different state tax values to bidis. For example, the cigarette tax rate for Tennessee is 20 cents/pack, or 9.4% of the manufacturer's price,[5] while the rate for other tobacco products, including bidis, is 6.6% of the wholesale cost price.[65] In contrast, Delaware's tax code does not specify a tax rate for bidis, but defines cigarettes in a manner consistent with classification of bidis as cigarettes.[15] Thus, the cigarette tax rate of 55 cents per pack[5] should be applied to bidis, rather than the rate specified for cigars and smokeless tobacco, which is 15% of the wholesale price.[15]

LABELING AND ADVERTISING

The U.S. Customs tariff ruling issued in 1995 advised importers that bidi cigarettes packages must by labeled with one of the four rotating Surgeon General's Health Warnings, according to the Comprehensive Smoking Education Act (Public Law 98-974, 1984). Despite this, the San Francisco survey found that 67.2% (39 packs out of 58 packs purchased) were not labeled with one of the Surgeon General's warnings.[4] The FTC investigated reports filed by the San Francisco group and others over the lack of health warning labels on bidis.[62,35] In addition, in a multi-state sting operation on Internet cigarette retailers in 1999, bidi packages sold to minors arrived without the federal warning labels.[77] The lack of the standard health warnings could be a factor in why bidis are often perceived as less harmful than cigarettes.[7] After receiving these reports, as well as requests from several senators,[34] the FTC was successful in obtaining plans from five bidi importers to place and rotate the warning labels, and had obtained one plea agreement with a bidi importer distributing packs without a Surgeon General's warning.[8]

Although bidis are not widely promoted using traditional cigarettes advertising methods (e.g., print, magazines, promotions, sponsorships) in the United States, they are visible on the Internet. However, one study found that just over one-quarter of the Web sites that sell cigarettes

in the U.S. posted the approved warning labels on their sites.[57] Moreover, Web sites selling bidi cigarettes may make claims that bidis are "less harmful," either explicitly[60] or implicitly by product labels that state "natural", "pure" or "herbal" tobacco. These messages reportedly resonate with youth and young adults who believe that the aroma of bidis is more pleasant[34] and that bidis are "safer"[7] than traditional cigarettes.

PRODUCT REGULATION

Tobacco manufacturers are required to abide by labeling and ingredient reporting requirements, as well as several advertising limitations either passed by Congress or in effect via the Master Settlement Agreement.[37,19] Surgeon General warning labeling requirements on bidi imports are currently being enforced by the FTC.[19] Current legislation requires cigarette companies (including importers) to report ingredients that are added to the tobacco, in a manner that maintains trade secrets and confidentiality[66]; it is unclear the extent to which bidi importers submit these lists of ingredients. Finally, the FTC has jurisdiction over false or deceptive advertising and marketing practices of all products, including tobacco, via the Federal Trade Commission Act.

At present, there is no comprehensive tobacco product regulation in the United States. However, the U.S. Congress has considered granting tobacco product regulation to the Food and Drug Administration (FDA) since the 1998 MSA,[28] though nothing to date has been passed into law. Any potential legislation or regulation could be applicable to bidis as well as other cigarettes.

Such tobacco product regulation could have several consequences for bidi cigarettes. Studies have shown that bidis are as harmful or potentially more harmful than manufactured cigarettes.[79,61,78,36] Therefore, laws that make labeling, marketing and enforcement of youth access laws comparable to those for conventional cigarettes would be worthy of consideration. Regulation of the design, ingredients and manufacture of bidis is as important for bidis as for cigarettes. Presently, most bidis do not have filters or they employ ineffective cotton filters, and they appear to deliver more variable, but generally higher, levels of nicotine, carbon monoxide, tar and nitrosamines than manufactured cigarettes. Additionally, although the largest U.S. cigarette manufacturers undergo voluntary testing of tar and nicotine yields using the FTC-approved machine-measured method, cigarette importers are under no obligation either to test their cigarettes for tar, nicotine and carbon monoxide yields or to disclose those yields to their customers.[20]

Another issue that could present a challenge to the regulation of bidis is the flavoring of the bidis and how such flavors tend to lure young people to experiment. The flavoring added to the bidis tends to mask their harshness, and teen bidi smokers report that they get a big "rush" or "high" that they don't get from regular cigarettes or any other legal product.[35,21,34] The most common reason cited for smoking bidis rather than cigarettes in an urban sample was that they "tasted better" (23% of sample).[7] However, laboratory research has not yet determined how the flavors are added to bidi cigarettes, and what implications the addition of the flavoring components could have for health or for the uptake of smoking.[61]

ACCESS AND YOUTH ACCESS

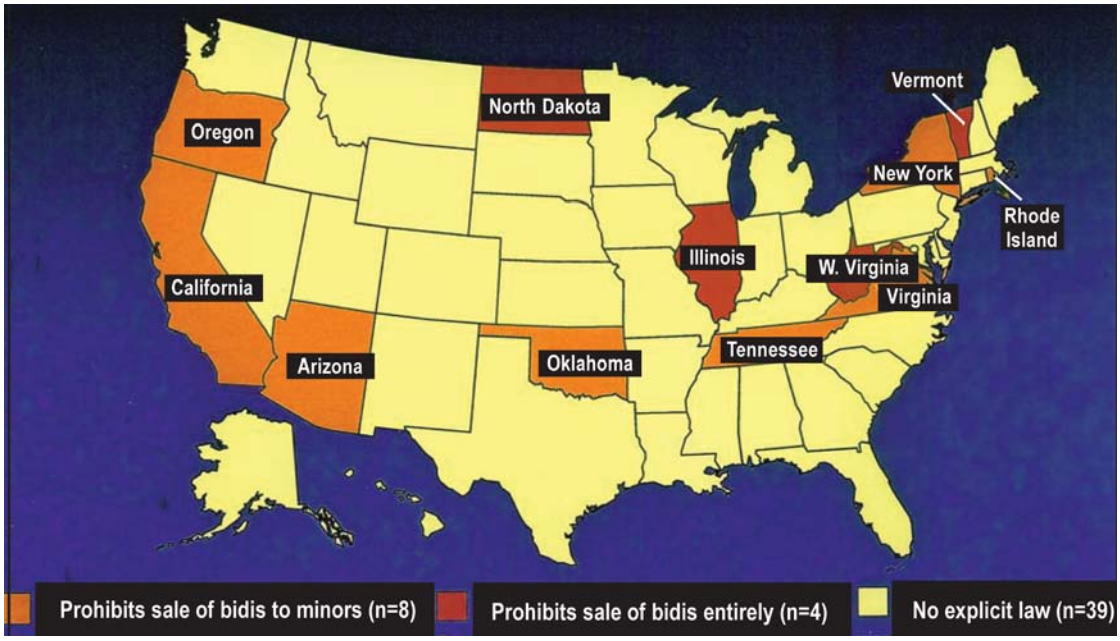
Though bidis have been imported into the U.S. since about 1960, they became noticeably easier to find in the midto late-1990s.[31] During this time, there were anecdotal reports that youth could buy bidis than more easily than manufactured cigarettes because they were sold in some health food stores[35] and ethnic grocery stores.[26] They were also widely reported to be less

expensive than regular cigarettes.[7] In San Francisco, bidis were reportedly available at grocery stores for as little as $1.25 per bundle of 20.[59] In one Midwest metropolitan area, bidis were reportedly about a dollar cheaper than regular cigarettes.[75] Survey data also suggest bidis may be more available in some com-munities than others, particularly within African-American and Hispanic neighborhoods and those with populations of lower socioeconomic status.[4,7,1]

In the 1990s, there were many well-publicized reports that bidis were not only cheaper than conventional cigarettes, but also easier to purchase. The earliest examination of this was the 1998 community survey conducted by youths in San Francisco who had noticed many of their peers smoking bidis. The San Francisco Tobacco Free Project found that 58 of the 109 stores that were sampled sold bidis. Of these, 24% (14 of 58) of minors were successful in purchasing bidis, a rate that was 14% higher than the cigarette purchase success rate.[4] Across the 14 neighborhoods sampled, there were differences in rates of success purchasing bidis, and in the proportion of bidis sold without warning labels or tax stamps. The average price paid per pack (approximately 25 bidis) was $2.20, compared with $2.50-$3.00 per pack of 20 major brand cigarettes, making them more affordable than regular cigarettes. Although all but one shop that sold bidis kept them behind the counter, two shops were selling single bidis. A subsequent report from San Francisco observed that youths bought single bidis for a quarter each.[34]

Since the FTC has received requests urging increased enforcement of youth access laws and enforcement of tax and minimum packaging regulations with bidis,[5,34] prices have reportedly become comparable to those of conventional cigarettes, at least in some areas.[21,14] Additionally, bidis are not legally sold in some areas because of bans (see Figure 6.2.1). However, access to bidis and other cigarettes via the Internet is still a major challenge facing states. In a multi-state sting operation on Internet cigarette retailers in 1999, bidi packages were successfully sold to minors as young as nine years old in various states.[77]

Figure 6.2.1: States with explicit laws addressing the sale of bidis, as of March 2004.



Source: State Cancer Legislative Database Update. National Cancer Institute. Issue 57. Spring 2004.

FEDERAL, STATE, AND LOCAL LEGISLATION

Other than classification and import rulings, bidis represented such a small market share that until the mid-1990s virtually no legislative action was taken. Following the media attention of the San Francisco community project in 1998 and a 1999 Massachusetts survey that showed high rates of bidi use among urban youth,[7] legislation began to emerge. Moreover, in 1999 Attorneys General from all fifty states plus the Virgin Islands wrote letters to the FTC, the Secretary of Health and Human Services, and U.S. Customs urging enforcement of federal tax and warning label regulations on bidis and investigation into the child labor violations of bidi manufacturers.[9]

At the state and local level, reports of bidi use among youths garnered support in legislatures for addressing the emerging popularity of the products. The city of Chicago imposed the nation's first ban on the sale of bidis in February 2000, setting fines of up to $1,000 for retailers violating the ban.[75] As of March 2004, twelve states (Arizona, California, Illinois, New York, North Dakota, Oklahoma, Oregon, Rhode Island, Tennessee, Vermont, Virginia, and West Virginia) had laws specifically addressing the sale of bidis.[52] Figure 6.2.1 summarizes whether these states have amended the existing youth access laws specifically to include bidis, or whether the states have banned the sale of bidis altogether. Table 6.2.2 details the legislative and regulatory policies that have been enacted regarding the importation, sale, and possession of bidis. It also gives information on penalties, which population the legislation and/or penalty impacts, and in which jurisdiction the law is applicable.

Table 6.2.2: **Enacted policies regarding sale of bidis by year, realm, affected population, and penalty, United States, 1969-2003.**

Year	Realm	Legislative or Regulatory Policy	Affected Population	Penalty for Violation (if applicable)	Source**
1969	Federal	IRS defines bidis as cigarettes for tax purposes.	Importers		CBP
1995	Federal	U.S. Customs issues tariff classification ruling on bidi cigarette imports.	Importers		CBP
1999	Federal	U.S. Customs banned importation of bidis produced by Ganesh Beedie Works because of evidence that the company used indentured child labor.	Importers		CBP
1999	State	Arizona prohibits retailers from selling, furnishing, or giving bidis to minors. (H.B. 2701).	Retailers	Class 3 misdemeanor	SCLD #38
2000	Local	The city of Chicago (Illinois) bans sale of bidis.	Retailers	Fines up to $1000	Fracassa, 2000
2000	State	Illinois prohibits selling, bartering, exchanging, delivering or giving away bidis (H.B. 4369).	Retailers	Petty offense, may be subject to graduated civil fines	SCLD #42
2000	Local	The city of Warren (Michigan) bans sale of bidis.	Retailers	Business & tobacco licenses may be lost	Fracassa, 2000
2000	State	Vermont prohibits sale and purchase of bidis (H.B. 662).	Retailers Adults, Minors	$500 fine for selling $250 fine for purchasing	SCLD #42
2000	State	Virginia includes bidis in existing law prohibiting sale or distribution to minors and requires retail establishments to post conspicuous signs indicating sales of bidis to minors are prohibited; prohibits purchase or possession of bidis by minors (H.B. 1461).	Retailers Youth	Graduated civil fines Graduated civil fines and/or community service; possible driver's license suspension	SCLD #42

Table 6.2.2: **Enacted policies regarding sale of bidis by year, realm, affected population, and penalty, United States, 1969-2003.**

Year	Realm	Legislative or Regulatory Policy	Affected Population	Penalty for Violation (if applicable)	Source**
2000	State	New York includes bidis in existing law prohibiting individuals and retailers from selling or giving away bidis to minors; it also prohibits anyone other than tobacco businesses from selling bidis. Effective Oct. 2001, bidis are included as tobacco products in provisions of state law that restrict, to certain locations, free distribution of tobacco products and vending machines (S.B. 7066).	Retailers, Adults	Graduated civil fines and registration suspension or revocation for subsequent violations	SCLD #44; P.H.L. 1399-LL
2001	State	Oregon adds bidis to existing provisions that restrict sale and distribution of tobacco products to minors (H.B. 2571).	Retailers	Endangering welfare of a minor, fine $100-$500	SCLD #46; O.R.S. 431.840 & 163.575
2001	State	West Virginia prohibits any person or business from importing, selling, offering for sale, possessing, or distributing "bidis" or "beedies." (H.B. 3020).	Retailers	Graduated civil fines	SCLD #46
2001	State	California restricts sale, offer for sale, distribution, or import of "bidis" or "beedies" to businesses that prohibit presence of minors on the premises (S.B. 322).	Retailers	Misdemeanor or subject to civil fines up to $2,000 per violation	SCLD #47
2001	State	Rhode Island prohibits selling, giving, or delivering bidis to minors; prohibits minors from purchasing bidis (H.B. 5882 and S.B. 376).	Retailers Minors	Citation with unspecified fine Minors who smoke in public subject to $5 per offense	SCLD #47
2002	State	Tennessee includes bidis in the definition of tobacco products in the existing youth access laws, which prohibits the sale or distribution to minors as well as the possession or purchase by minors. (S.B. 2371) In addition, Tennessee increased the state tax on bidis from 6 to 6.6 percent of the wholesale cost price. (S.B. 3110).	Retailers Minors	Warning letter for 1st violation, then graduated civil fines Civil offense, fines of $10-50; appearance in juvenile court	SCLD #49, #51; T.C.A. 39-17-1505 & 39-17-1509
2002	State	Oklahoma added bidis to list of tobacco products that must not be furnished to minors, according to youth access laws. (S.B. 1504).	Retailers, Adults Minors	Misdemeanor; fine of $25-$200 and imprisonment 10-90 days Penalties (age-dependent) if minor refuses to disclose place where and person from whom obtained.	SCLD #50; O.S. Sec. 21-1241
2003	State	Virginia prohibits minors from attempting to purchase tobacco products including bidis. (H.B. 1403).	Minors	Graduated civil fines and/or community service; possible driver's license suspension	SCLD #53
2003	State	North Dakota prohibits the sale of bidis (H.B. 1301).	Retailers	Infraction	SCLD #54

*Minors are defined as persons under age 18, unless otherwise described.
**Sources: SCLD refers to the State Cancer Legislative Database Update, published by National Cancer Institute. State laws referenced were found via LexisNexis database.

Ten additional states have attempted to pass legislation specific to bidis, usually by including it in the definitions of tobacco products. For example, Indiana, Maryland, Massachusetts, Michigan, Pennsylvania and the District of Columbia introduced legislation on bidis in 2001.[58] In addition, a search of the LexisNexis® database showed that the legislatures of Louisiana (2003), Massachusetts (2003), Nebraska (2003), New Mexico (2004), and Pennsylvania (2003) introduced legislation that addressed bidis in some fashion. Despite the introduction of legislation in these states, none has been enacted to date.

Since bidis are classified as cigarettes at the federal level, states may include bidis *de facto* with current laws regarding cigarettes. For example, Delaware revised the state tax code[16] to add bidis and herbal cigarettes to the definition of "tobacco products", but didn't specifically add references to bidis in their youth access statutes. In addition, Maryland revised its youth access laws to include "candy-like products that contain tobacco"[51]; if bidis are not explicitly referenced, a bill like H.B. 32 would likely apply to any flavored bidis. Additionally, other agencies of state government may have considered state policy on bidis. For example, the Iowa Department of Public Health appointed a committee to address bidi use; in addition to tracking bidi use and state and federal legislation, the recommendations of the committee were to target and strictly enforce bidi cigarette marketing using current Iowa law.[32]

Other state action related to the sale of bidis involved filing suit against bidi companies that did not comply with the terms of the Master Settlement Agreement[37] as "non-participating manufacturers." For example, the Attorneys General of Colorado (2001), Montana (2002), and Oklahoma (2003) all sued to recover funds from Indian manufacturers that sold bidis in their states. These suits varied by state, but they essentially banned sales from certain companies until they were in compliance with requests for payment into the escrow funds created for tobacco companies that were not a part of the MSA. State Attorneys General of seventeen states also conducted the 1999 multi-state sting operation on Internet retailers that found many bidis were sold to youth. These states took various actions, including issuing cease-and-desist orders to several merchants to stop selling to minors in their states.[77]

In addition to the regulatory decisions and classifications, there have been other federal actions and initiatives.

- In November, 1999, the U.S. Customs Agency issued a detention order that banned the importation of bidis from Ganesh Beedie Works in Mangalore India (the same company that prompted the HTS tariff ruling in 1995), because they received evidence that the bidis were produced using indentured child laborers.[69]
- At the urging of the state Attorneys General, the FTC investigated claims that minors were able to purchase bidis over the Internet.[76]
- In February, 2000, a bill was introduced in the House of Representatives that sought to ban the importation of all bidis into the country.[29] However it was referred to the Subcommittee on Trade and was not moved forward by the committee.
- Several federal bills that have been introduced regarding FDA product regulation[28] and tobacco price support buyouts[27] included bidis in their descriptions of tobacco products. In 2004, one version of a bill that would have given the FDA power to regulate tobacco included a provision that would have banned flavoring other than menthol in all tobacco products.[30] While no product regulation bill passed, state legislation seeking to ban all non-

menthol flavoring from tobacco products has proliferated in 2005.[2] Though flavoring of tobacco products seems to be part of a larger industry trend, it is possible that the popularity of flavored bidis was a factor in American tobacco companies creating new flavor mixes, which are purportedly designed to attract young adult smokers, but also serve to attract youth.[12]

CONCLUSION

Bidi use may be fueled by perceptions that bidis are safer than conventional cigarettes, as well as by their ready availability to youth on the Internet and in retail outlets that cater to health conscious people and do not sell conventional cigarettes. Perceptions of the relative safety of bidis and bidi use in general may be supported in the policies regulating and enforcing cigarettes and bidis in terms of their sales, taxation, and warnings labels. These policies need to be addressed to prevent bidi use in the U.S. The core policy recommendations flow from conclusions related to health effects and factors driving addictive drug preference. Laboratory evidence has demonstrated that bidis can deliver as high or higher levels of nicotine, tar, and carbon monoxide as conventional cigarettes. In addition, the lack of consistent policies across tobacco products may influence product preference and use. These factors play a role in consumers, especially young people, purchasing less expensive products and being drawn to products they perceive as less harmful.

Specific Policy Recommendations concerning Bidis

- Consistent and aggressive enforcement of warning labels on bidis that are required by federal regulations and are identical to those on conventional cigarettes.
- At the federal level, bidi taxation should be the same as for conventional cigarette taxation and current tax and tariff policies need to be enforced at the point of import.
- Consistent and aggressive enforcement of current restrictions on age of purchase, access, and use of tobacco products needs to be enforced, especially with regard to Internet sales.
- State regulations and actions should be examined in light of federal regulations concerning taxation and youth access laws, so that consumers are not unintentionally driven to bidi use because they are perceived to be healthier, cheaper, or easier to purchase substitutes for conventional cigarettes.
- Tobacco education programs should include clear messages that bidi use causes nicotine addiction, tobacco-related diseases and death.

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6.3 Global Policy for Regulating Bidis

Vera Luiza da Costa e Silva, Poonam Dhavan, and Khalilur Rahman

INTRODUCTION

This chapter focuses on the bidi as a 'global' tobacco product, with concerns that unless clear control mechanisms are identified and implemented, bidis may become a global public health problem. It recommends that a policy framework for bidis should incorporate the various demand-side and supply-side measures for tobacco control addressed in the Framework Convention on Tobacco Control (FCTC) that are both specific to 'the Indian cigarette' and to the local circumstances in countries where bidis are already widely used.

Prevalence and Patterns of Bidi Consumption: The Global Scenario

Bidis, produced in India, Bangladesh, Nepal, Pakistan and to a lesser extent in other Asian countries, account for the largest proportion of tobacco consumption in India and are exported to several countries.[1] According to the International Labor Organization (ILO), in 1997-98, 1.1 million kg of bidis worth US$ 6.5 million were exported to 36 countries. About half of the total exports went to the United Arab Emirates, followed by the United States, Singapore, Afghanistan, Saudi Arabia and Panama.[2] Bidis are gaining popularity in many countries. There is an increasing trend among youth in the United States to use bidis, which are readily available in convenience stores, gas stations and ethnic food stores.[3] In the last couple of years, reports of increase in prevalence of bidi consumption have emerged from other countries in Asia, as well as other parts of the world, such as the United States, France, Canada and Australia.[3-8] Recent evidence from the WHO-CDC Global Youth Tobacco Survey (GYTS) shows relatively high prevalence in the use of tobacco products other than cigarettes and indicates that the epidemic of tobacco-related health problems may be graver than previously predicted.[9]

Health, Social and Economic Effects of Bidi Use

All forms of tobacco products are recognized as harmful to health.[10] Results from scientific studies in India have confirmed that bidi smoking is no less hazardous than cigarette smoking.[11-13] The international scientific community has also recognized the harm caused by bidis. The International Agency for Research on Cancer (IARC) found bidi smoke to be carcinogenic almost two decades ago.[14,15] In its recent monograph, IARC recognizes a strong association between bidi smoking and cancer at various sites in humans, with significant trends associated with the duration of bidi smoking and number of bidis smoked.[16]

In addition to health effects, tobacco use has socioeconomic costs for individuals and families as well as governments, creating a vicious circle of tobacco use and poverty, as documented by the World Health Organization (WHO).[17] Globally 84% of smokers live in developing and transitional economy countries.[18] In many countries at all levels of development and income, it is the poor who smoke the most and bear most of the economic and disease burden of tobacco use. Like other tobacco products, bidi use is also linked to increases in poverty. The proportion of household

expenditures allocated to tobacco products is often very high in developing countries. Scarce family resources are spent on tobacco products, including bidis, instead of food and other essential needs. For example, street children in Mumbai, India spent more than twice as much on bidis as they did on fruits or eggs (2002); Bangladeshi men spent in 1997 more than twice as much on bidis as on health or education.[19,20] Tobacco also puts an enormous financial burden on countries, including increased healthcare costs, lost productivity due to illness and early death, foreign exchange losses and environmental damage.

The Tobacco Industry and Bidis

In recent years, multinational cigarette companies have shifted their focus to the huge market in developing countries, especially vulnerable groups such as youth and women. Meanwhile, local products, such as bidis from India, kreteks from Indonesia and herbal cigarettes from China, are being promoted in developed countries. Some reasons for the increasing popularity of bidis are their availability in flavors that appeal to youth, lower prices than commercially available cigarettes, easy accessibility, trendy image and false notions that bidis have fewer or no health risks. Thus they are seen as a "cool" and "safe" alternative to regular cigarettes.[3, 21]

Tobacco industry documents have long suggested that flavored tobacco products might appeal specifically to young teenagers. As early as 1972, a Brown and Williamson document on "Youth cigarette – new concepts" suggested developing cola, apple and sweet-flavored cigarettes and stated, "It is a well-known fact that teenagers like sweet products".[22] It is not surprising then to find flavored bidi cigarettes being exported from India. Further, there is an implicit, and in some cases, explicit claim by the manufacturers and distributors that bidis are a 'healthier' option to cigarettes. To illustrate, Shawn Ulizio, director of Kretek International, one of the largest distributors of bidis in the U.S., was quoted as speculating that "many of his customers are looking for a 'healthier' smoke and are puffing bidis under the false impression that they are somehow less harmful than American brands".[23] Bidis are being extensively promoted and are easily available on the Internet (see, for example, www.discount-cigarettes.org or www.azadbidi.com).

The unorganized and largely unregulated nature of the bidi industry in countries like India has hindered enforcement of tobacco control measures on this sector. Specific demand-side and supply-side measures for tobacco control are outlined in detail below. However, most of these measures are either non-existent or poorly applied to the bidi industry. Internet sales of bidis pose several global challenges, including unrestricted sales to minors; lower prices through tax avoidance and smuggling; unfettered advertising, marketing and promotion; and continued normalization of the product.[24, 25] The Internet as a marketing tool is largely unregulated and any existing regulation is difficult to enforce.

The WHO Framework Convention on Tobacco Control (WHO FCTC)

The WHO FCTC was developed in response to the current globalization of the tobacco epidemic.[26] On May 24, 1999, the World Health Assembly adopted a resolution (WHA 52.18) to pave the way for multilateral negotiations on a WHO Framework Convention on Tobacco Control and possible related protocols. [27] After six rounds of intense negotiation, the final text of the treaty was adopted unanimously by the 56th World Health Assembly on 21 May 2003 (WHA 56.1).[28] The opening of the Convention for signature and ratification represented a landmark opportunity for countries to strengthen their national tobacco control capacity and improve the health of the world's population.

The WHO FCTC represents a paradigm shift in developing a regulatory strategy to address addictive substances as it asserts the importance of demand reduction strategies as well as supply issues. Article 1 (f) of the WHO FCTC defines tobacco products as "...products entirely or partly made of the leaf tobacco as raw material, which are manufactured to be used for smoking, sucking, chewing or snuffing".[29] Since bidis fall under this category, the Convention requires parties to adopt and apply its measures to bidis, in addition to cigarettes and other tobacco products.

The largely unregulated nature of the bidi industry, absence of policies on pricing and taxation of bidis, lack of experience in countering misleading health claims made by the bidi industry, increasing use of the Internet to market bidis globally, lack of standardized approaches for testing bidi ingredients and emissions, and illicit trade all have the potential to challenge various aspects of international tobacco control. Thus, the WHO FCTC provides a unique opportunity to promote international cooperation and coordination of efforts to control use of bidis, particularly as the challenges become increasingly trans-boundary in nature.

It is recommended that a policy framework for bidis should incorporate the various demand-side and supply-side measures for tobacco control addressed in the WHO FCTC. Such a policy framework, national, transnational, regional or global, should address the demand and supply characteristics specific to 'the Indian cigarette', as well as the local circumstances in countries where bidis are already widely used.

DEMAND-SIDE MEASURES

Price and Tax Measures

Raising the price of tobacco and tobacco products, primarily through tax increases, is the single most effective measure to reduce short-term consumption.[30] A small but growing body of evidence indicates that smokers in developing countries have been more responsive to price increases than those in developed countries, in particular the youth, poor and less educated.[31] Studies in India highlighted the minimal contribution of the unorganized sector to excise revenue; bidis, in particular, have been shown to have a far lower excise tax than cigarettes.[32] In India, cigarette taxes represent about 75% of the retail price. However most bidis and other non-cigarette tobacco products are not taxed due to the decentralized nature of the industry and political influence of larger bidi manufacturers.[1] It can also be difficult to collect excise tax from the unorganized sector bidi industry, as it largely consists of small producers. In countries where bidis are imported, lower prices of bidis compared to cigarettes result in more teenagers taking up the habit.[3] Even manufacturers and exporters of 'kreteks' or clove cigarettes in Indonesia have resisted international pressure to increase taxes on their products.[33]

It is well recognized that all tobacco products have negative health effects and thus warrant a tax to reduce demand.[31] Therefore, price and tax measures should be enforced on bidis. It is important to remember that while demand for more expensive cigarettes is likely to fall with increased prices, this decrease in cigarette consumption could be offset by a switch to bidis. It is imperative to prevent consumers from switching to bidis, the cheaper alternative, instead of quitting altogether.[34]

Packaging and Labeling

The color and graphic design of the tobacco product package is effectively used by the tobacco industry to create a 'trade image', which ultimately contributes to advertising and promotion

of the product.[35,36] On the other hand, display of conspicuous health warnings on packages can be a valuable vehicle for health promotion messages.[37] The provisions for packaging and labeling of tobacco products in the WHO FCTC reflect the urgent need for an effective package-based labeling system for tobacco products. Countries like Brazil, Canada and Thailand have used regulation on packaging and labeling of cigarettes with success as part of their tobacco control strategy.[38,39,40]

There are at least two purposes of health warnings: one is to inform consumers about the nature and magnitude of health risks, and the other is to remove any deceptions that are part of the package. There is already a popular belief among youth that bidis and other "alternative" cigarettes like kreteks (additive-free, natural tobacco cigarettes) are safe alternatives to commercial cigarettes.[3] Recent studies in the United States disprove this belief.[41,42,43] However, bidis frequently do not carry health warnings. In countries with strong health warnings only on cigarette packages, people, especially youth, are likely to assume that bidis are less dangerous.[24] Bidis are reportedly sold at health food stores, which has a further implied health claim. This makes packaging and labeling measures for bidis necessary and highly desirable.

Advertising and Promotion

In India, the bidi market is largely independent of the type of advertising used by the cigarette industry. However point-of-sale advertising at local tobacco shops and other retails outlets of bidis is extremely common.[44] There are regional 'brands' of bidis with which smokers can identify. Recent reports indicate how brand-building exercises, such as concept marketing, local print and radio advertisements as well as direct mass marketing, e.g., road dances, are being used to introduce new bidi products.[45,46,47] A recent study revealed how viewers are exposed to bidi usage in the Indian cinema, especially movies broadcast on television.[48]

Globally, online advertising and promotion for bidis is common.[24] Web sites of bidi manufacturers and distributors promote their products with implied or explicit health claims, such as "tendu leaves used in bidi cigarettes have herbal properties" and "tobacco content in bidi cigarettes is much less as compared to any other tobacco product" (e.g., http://www.azadbidi.com). A variety of flavored bidis is continually developed and promoted to attract young customers, who can also suggest new flavors through industry Web sites (e.g., www.soex.tv or http://www.sopariwala.com/html/tobacco/tobacco.htm).[49] Further, sales of bidis in health food stores and ethnic groceries contribute to promotion of this product as a 'healthier' option to cigarettes.[50] Promotion of bidis without consumer health warnings is likely to create an erroneous impression about their characteristics, health effects, hazards and/or emissions.

Research has shown that a comprehensive set of tobacco advertising bans can reduce tobacco consumption.[31] Experiences of countries like the Islamic Republic of Iran, Norway and Thailand, which have had considerable success through bans on advertising and promotion on cigarettes, can serve as a starting point to develop such bans on bidis.[51, 52, 53] A strong enforcement infrastructure must also be in place to control circumventions and violations of these measures.

Education, Communication, Training and Public Awareness

Large, sustained public information campaigns are an important way to change social attitudes, beliefs and norms. There is an urgent need to promote public awareness and access to information on the addictiveness of tobacco in bidis, the health risks of bidi use and exposure to smoke, the

benefits of cessation, and actions of the bidi industry. This is required in populations where bidi smoking has existed for a long time and is socio-culturally acceptable (such as in parts of Southeast Asia), as well as countries where the product has been recently introduced and is fast gaining popularity, especially among youth. Studies conducted in the U.S. have revealed that youth believe bidis are safe.[3] To quote one: "I don't think they give you cancer. There's not even tobacco in them, I don't think."[54] Educational and public awareness programs should be implemented to refute this emerging belief that bidi smoking is a safe alternative to commercial cigarettes. The growing body of scientific evidence of the harmful effects of smoking bidis should be widely disseminated using appropriate channels.[41,42,43]

Regulation of Contents of Bidis and Disclosures of the Contents and Emissions

Recent studies show that bidis and other smoking products are no safer than conventional cigarettes. They deliver substantial amounts of nicotine and other toxic components of tobacco smoke. The market is largely unregulated in terms of product testing and disclosures. Despite manufacturers' claims and the perception of some users, bidis (as well as low-smoke smoking devices and non-additive cigarettes) do not reduce mortality and disease associated with tobacco use. On the contrary, some devices might promote heavier smoking and introduce new risks not currently associated with cigarette smoking.[41,42] With better understanding of modern cigarettes and the compensatory smoking behavior of consumers, limitations of ratings based on the ISO/FTC standardized testing methods in the measurement of 'actual' exposure of smokers to the toxins in cigarettes become evident.[55] As with cigarettes, smokers can compensate for the amount of nicotine obtained from bidis by changing their smoking behavior. Further, bidis are even smoked differently than commercial cigarettes; they often have to be re-lit several times and the number of puffs is significantly greater than with commercial cigarettes.[56,57,58] These factors may exaggerate the health risks associated with nicotine, other components and emissions of bidi smoke. In light of this evidence, regulation of ingredients and emissions of bidis is needed to prevent initiation and stimulate cessation of bidi use.

In its recommendation on tobacco products ingredients and emissions, the WHO Study Group on Tobacco Product Regulation states that regulations setting upper ingredients and emissions limits for toxicants need to be developed for all tobacco products, considering the variety of ways in which products are smoked. The manufactured product needs to be differentiated from what is actually consumed, i.e., the smoke.[59]

Another important aspect of regulation is the introduction of new or modified products. The recent launch of a non-tobacco bidi (rolled tendu leaf) by a group in India that also owns a brand of cigarettes is one such example.[45] It is being promoted as the "first real safer and healthier tobacco alternative" and the leaves are supposed to mimic the effect of tobacco without its carcinogenic effects. Strong sales of the product in target areas in India within six months of its launch have encouraged the group to develop a paper-wrapped product for the export market.[60,61] There are reports of other new products, including a non-filter cigarette targeted at bidi smokers looking to upgrade, in small cities and towns in India, new brands of flavored cigarettes and new versions of flavored 'kretek' or clove cigarettes.[49,62,63,64] Most of these new or modified versions of bidis are being promoted by manufacturers and distributors, and are thus perceived by consumers, especially youth, as 'natural', meaning not processed or made by a big tobacco company.[65] The WHO Study Group on Tobacco Product Regulation concluded that existing scientific

evidence is insufficient to assess health risk differences between new and existing tobacco products for composition, exposure, toxicity or harm.[66] Health or 'reduced harm' claims made by manufacturers call for regulatory oversight by competent authorities.

Box 6.3.1. The WHO Study Group on Tobacco Product Regulation (TobReg) is composed of national and international experts on product regulation, smoking cessation and policy making, and was established to guide international policy development in the area of regulating tobacco products and facilitate access to scientific information needed for tobacco regulation. The Study Group advises WHO on scientifically sound recommendations to member states on the most effective ways to achieve a coordinated regulatory framework for tobacco products.

To date, little effort has been made to standardize testing protocols for non-cigarette tobacco products, although some progress has been made recently for testing bidis.[42] A recent recommendation of the WHO Study Group on Tobacco Product Regulation lays down the principles for development of laboratory capacity that can be used by government regulatory authorities to guide and validate tobacco product testing, including any testing that may be carried out by the tobacco industry itself.[67] These principles should guide the initiation of testing of contents and emissions of all available bidi brands. Results from such testing can provide the evidence base to formulate policies for regu-lating bidis.

Measures Concerning Tobacco Dependence, Smoking Cessation and Protection from Secondhand Smoke

Recent analyses of the contents of bidis have concluded that they contain a higher concentration of nicotine than conventional cigarettes. Therefore bidi smokers are just as at risk of becoming nicotine dependant as cigarette smokers.[42] In countries where bidi use is prevalent, tobacco dependence treatment and cessation policies should be extended to address bidi smoking. The WHO policy recommendations on smoking cessation and treatment of tobacco dependence propose a broad framework for cessation policies.[68] Along with individual approaches (behavioral and/or pharmacological interventions), a supportive environment is needed to encourage tobacco consumers in their attempts to quit. Bidi smoking is often socio-culturally acceptable in communities where it is highly prevalent. A cessation policy for bidis should address the creation of a supportive environment by raising public awareness about the health and economic harm related to bidi smoking as well as benefits of cessation.

Harmful health effects of secondhand cigarette smoke on non smokers are well established.[69] Secondhand 'bidi' smoke is equally likely to cause harm to the health of non-smokers. Further scientific studies on contents and emissions of bidis will be needed to gather evidence on possible harm. Regulations on secondhand bidi smoke would especially be important in Southeast Asian countries, where many non-smokers are exposed to bidi smoke, especially in indoor workplaces and on public transport.

SUPPLY-SIDE MEASURES

Illicit Trade

Smuggling of bidis has been reported in Southeast Asia as well as countries like the United States and Australia, among others.[8,23] As with cigarettes, when bidis enter markets illegally trade

barriers are effectively bypassed, prices can be lowered (thereby increasing consumption), and governments are deprived of revenue.[70,71,72] Indeed, availability of cheap bidis further attracts youth and poor people to the product. As international exports and sales of bidis increase, national and regional programs for tobacco control should focus on control of smuggling as the main intervention to reduce supply. Policies that should be adopted include efficient tracking systems for the largely unregulated bidis trade, use of prominent tax stamps and serial numbers, special package warnings and good governance.[31] It should also be noted that legal exports of bidis from India are vulnerable to import restrictions by some countries for various reasons, including use of child labor, lack of health warnings, and ingredient issues. For example, in 1999 the United States Customs Service banned importation of bidis produced by a certain manufacturer in India, after receiving evidence of use of child labor in production.[22] Regulatory oversight and monitoring of trade in bidis should be strengthened. This will require regional, sub-regional and international cooperation.

Sales to and by Minors

In the absence of regulation on sales, bidis are easily available to minors, not only in countries where they are manufactured and account for a large proportion of overall tobacco consumption, but also in countries that import bidis. Easy accessibility and sales to minors without having to show proof of age increase consumption of bidis by teenagers.[3,22] Online sales of bidis add to the problem and should be regulated.[73] Regulation of sales of bidis to and by minors will be imperative as countries regulate similar sales of cigarettes. Along with lower prices and false health claims, unregulated sales encourage young smokers to switch to bidis instead of quitting altogether.

Support for Economically Viable Alternative Activities for Bidi Workers

In India at least 4.5 million workers are employed in the bidi sector (some feel this is an under-estimation) and it also absorbs considerable numbers of workers in Bangla-desh and Nepal.[2] A large part of the work force is home-based, where predominantly women and children workers at best earn minimum wages. Recent studies conducted by the ILO in selected states in India revealed a stagnation and even decline in employment in this sector. This is attributed to competition with other tobacco products such as mini-cigarettes (less than 60 mm) and smokeless tobacco, competition among bidi brands, shift of manufacturing to other states in India or even to Bangladesh or Nepal that provide cheap labor, use of less organized migrant workers, and isolated cases of bans on exports to other countries, as well as manufacture of illegal bidis.[2,12,74] The bidi industry meanwhile has been blaming the global tobacco control movement for the impact on the livelihood of tobacco cultivators and bidi workers. To quote the All India Bidi, Cigar and Tobacco Workers Federation, *"We are deeply concerned with the efforts of any organisation, including the World Health Organisation to ban or restrict the production or sale of bidis, cigars and other tobacco products in the country or abroad. We find that the efforts of the World Health Organisation to evolve the FCTC will directly hit the employment of the bidi and cigar workers in the Country".*[75]

The social and economic implications for displaced bidi workers, in particular the most vulnerable members, such as women and other home-based rural workers, will be a major challenge.[2] The WHO FCTC encourages countries to support crop diversification and other economically viable alternatives as part of sustainable development strategies.[29] However, policymakers should recognize that tobacco control is only one of the many determinants of the profitability of tobacco farming

and bidi manufacture, as noted by the ILO studies.[2,74] Although tobacco farmers and workers are economically vulnerable, their shift toward other livelihoods even in the most optimistic tobacco-control scenario is expected to be a slow process over several generations. Further, money not spent on tobacco will be spent on other goods and services, thereby creating new employment opportunities.[18]

There are pilot projects in some states in India to identify alternative employment and income opportunities for bidi workers.[12] Farmers dependent on tendu leaf production will need support for crop diversification. Lessons can be learned from emerging successful experiences, such as diversification to banana production in a municipality in Brazil.[76] Manufacturing units will need support to explore alternative employment for workers, such as cottage industries based on local natural resources, as well as to provide opportunities for vocational training of workers.[12,77]

OTHER IMPORTANT ISSUES

Protection of Health of Persons in Respect of Bidi Manufacture

Illnesses like tuberculosis, asthma, backache, joint pain and arthritis are reported to be common among bidi workers.[78] Constant exposure to tobacco dust has been reported to increase vulnerability to various chronic diseases.[79] Although bidi workers are pro-tected by special labor legislation in India, lack of organization in the sector leads to gross abuse of labor laws. The working conditions of bidi workers are reported to be well below the ILO standards of worker protection and they are often excluded from welfare benefits.[20, 74] Children are employed in large numbers, even though bidi rolling is classified as hazardous.[22, 80]

As the shift of bidi workers to other livelihoods is expected to be a slow process, implementation and monitoring of appropriate labor laws and welfare benefits is needed in the bidi sector. The issue of child labor should be addressed through public information and advocacy in communities where it exists.[81]

Research, Surveillance and Exchange of Information

To succeed, tobacco control policies need the support of scientific evidence and effective surveillance systems. Systematic research and wide dissemination of the information gathered is essential to convince individuals, communities and governments to take action to reduce bidi consumption. In the last couple of years, new evidence has emerged on bidis, such as nicotine content, physiological and biochemical effects of smoking, psychosocial factors determining use, as well as dissemination of previously existing evidence.[41,42,43,74,82] Further scientific probes are needed to study different brands and determine causes and incidence of occupational diseases related to bidi manufacture. Research is also needed to ascertain whether locally consumed bidis have different ingredients and other properties than those that are exported. Behavioral research is needed to examine beliefs and motivations surrounding bidi use, especially among youth who see bidis as a safer alternate to cigarettes. Local research on the economics of the bidi market and possible employment alternatives is needed to develop appropriate policies. Surveillance, the ongoing tracking of prevalence and patterns of use, health and socio-economic outcomes, policies and programs, is an essential component of any tobacco control policy. Recent analyses based on the Global Youth Tobacco Survey revealed surprisingly high use of other tobacco products compared to cigarettes among youth, with no significant gender difference. Such findings highlight the need for tobacco control policies to focus not just on cigarettes, but also on other tobacco products like

bidis.[9,83] In Southeast Asian countries, where bidis account for a large proportion of tobacco use, such evidence calls for urgent measures. Surveillance systems must be equipped to track information related to bidis in order to effectively monitor use and provide the evidence base to develop policies to regulate bidis.

CONCLUSION

Traditionally, tobacco control programs have focused on reducing cigarette consumption. Effective strategies are now needed to expand the focus of tobacco control programs to all types of tobacco use, including bidis.[9, 83] Countries that adopted comprehensive tobacco control programs with a mix of interventions (including bans on tobacco advertising, strong warnings on packages, controls on the use of tobacco in indoor locations, high taxes on tobacco products, and health education and smoking cessation programs) have had considerable success in decreasing the prevalence of cigarette smoking.[84] A similar policy framework with a mix of interventions will have to be implemented to control bidi use in India and other Southeast Asian countries where bidi use is highly prevalent, as well as in countries like the United States where the bidi market is relatively new and expanding. The recent adoption of comprehensive legislation on tobacco control by India, *The Cigarettes and Other Tobacco Products (Prohibition of advertisement and regulation of trade, commerce, production, supply and distribution) Act, 2003,* is an important step forward in this direction. Strong enforcement of the provisions of this comprehensive act on the bidi industry will be essential to control bidi use.

Finally, with the advent of the WHO FCTC, comprehensive tobacco control has been effectively redefined. Building national capacity to implement and enforce its provisions is an urgent priority.[85] It will enable countries to carry out effective and sustainable national tobacco-control programs to control the epidemic caused by all tobacco products, including bidis.

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