Bidi and cigarette smoking and risk of acute myocardial infarction among males in urban India

T Rastogi, P Jha, K S Reddy, D Prabhakaran, D Spiegelman, M J Stampfer, W C Willett, A Ascherio

Death from myocardial infarction (MI) in India is exacerbated by smoking of bidis or cigarettes. Smoking among 309 men with incident MI was compared to 618 age matched controls; 56% of the individuals with MI and 26% of controls were current smokers. Current smokers had a relative risk of 4.7 (95% confidence interval [CI] 3.2 to 6.9) compared to never smokers. Relative risks for smoking more than 10 cigarettes or 10 bidis daily were 9.1 (95% CI 4.7 to 17.7) and 8.1 (95% CI 4.3 to 15.3), respectively. It is estimated that smoking may cause 53% (95% CI 47% to 64%) of MIs among urban males in India.

M yocardial infarction (MI) is a leading cause of mortality and disability of adults in urban and rural India, and occurs at a younger age than in western populations.1 For example, about 30% of all estimated MI mortality occurs at ages 45–59 years in India, versus only 14% in high income countries. Male smoking of cigarettes or, more commonly, bidis—small unfiltered cigarettes hand rolled in a temburni leaf—is well established in India and has been recently documented as a major cause of death among Indian men,2 with much of this resulting from vascular and respiratory disease.3 Smoking of cigarettes and bidis has been associated with a twofold risk for fatal MI in India.2

The risks of smoking for non-fatal MI are less well established in India. The large hospital based “Interheart” case-control study, which included some 2171 patients from “South Asia”, found a threefold relative risk of MI for smoking, with a population attributable risk of 37%.4 We know of only one study in India (based at one referral hospital) that examined the risk of smoking bidis or cigarettes and non-fatal MI.5 The risks of smoking for non-fatal MI were among a younger population than that seen in the Interheart or other western studies.6 Indeed, even within largely western populations, the international World Health Organization MONICA (multinational monitoring of trends and determinants in cardiovascular disease) project recently reported a nearly fivefold elevation in risk for non-fatal MI among current smokers compared to never smokers (table 1).

Given the younger age of onset of cardiovascular disease in Indians and the unique patterns of bidi use, it is critical that risk for non-fatal MI be assessed in this population. We report here a case–control study of acute incident MI from eight hospitals in two cities in the north and south of India, and the risks associated with both cigarette and bidi smoking.

METHODS
Details of case and control selection, exclusion criteria, measurements made, and interview procedures have been published previously.8 Ethics approval was received from all participating hospitals and from the Harvard School of Public Health. In brief, eligible cases were men aged 21–74 years hospitalised with incident acute MI among eight urban hospitals in Bangalore and New Delhi between 1999 and 2000 (female smoking is uncommon in India (Jha P, personal communication, 2005) and we do not report here on the results of the 41 women with MI interviewed). Definite diagnosis of MI was based on clinical examination, electrocardiogram, and cardiac enzymes. A total of 363 men met eligibility criteria, and 309 were included in the study; 54 eligible cases were excluded for the following reasons: fatal incident MI patients (n = 21), discharged before interview could take place (n = 18), too sick to be interviewed (n = 9), and not willing to be interviewed (n = 6). For each case, two controls matched by age (within five years) and hospital were obtained from non-cardiac outpatient clinics or inpatient wards. Controls comprised relatively healthy men with minor ailments or conditions. We identified 623 eligible controls, five of whom refused participation. Subjects were interviewed in person, and asked to report the number of bidis and/or cigarettes smoked per day. Anthropometric measures were also obtained. Analyses of cigarette and bidi smoking and risk of MI used standard conditional logistic regression, first controlling for age and hospital, and then, in addition, other potential risk factors demonstrated in previous studies.9 These risk factors include body mass index (<21 kg/m², ≥ 21–23, ≥ 23–26, ≥ 26), waist to hip ratio (<0.91, 0.91–0.95, >0.95–0.98, >0.98), physical activity (none, <155 met-min per day of exercise, ≥ 155), history of hypertension (yes, no), history of diabetes (yes, no), history of high cholesterol (yes, no), family history of coronary heart disease (yes, no), alcohol intake (no intake, any intake), education (none, primary school, middle, secondary, higher secondary, college, graduate/professional), household income (<3000 rupees per month, 3000–6000, 6000–10 000, >10 000), and being Hindu (yes, no).9 Population attributable risk was calculated using the prevalence of smoking in the adult (30+) male urban population (prevalence 31%)9 and the relative risk observed with current smoking in our study (population attributable risk = [prevalence smoking(RRsmoking−1)]/[prevalence smoking(RRsmoking−1)+1]).

RESULTS
Fifty six per cent of the 309 male cases and 26% of the 618 male controls currently smoked either bidis or cigarettes.Overlap of bidi and cigarette use was low; only 16% of current bidi smokers used cigarettes and 14% of current cigarette smokers used bidis. Compared to never smokers, current smokers were younger, had lower body mass indexes and physical activity levels, and higher levels of alcohol intake (data not shown).

Current and former smokers had significantly increased risk for MI, with current smokers having a higher risk than former smokers (table 1).
In comparison to never smokers, current smokers had an age adjusted relative risk (RR) of 4.6 (95% confidence interval CI 3.4 to 6.4). This risk changed little with multivariate adjustment. In multivariate analysis of bidi smoking (table 2), persons consuming more than 10 bidis per day (median 20 bidis/day) had an RR of 9.1 (95% CI 4.7 to 17.7; p for trend < 0.0001). In multivariate analysis of cigarette smoking, persons consuming more than 10 cigarettes per day (median 15 cigarettes/day) had an RR of 7.3 (95% CI 3.9 to 13.8; p for trend < 0.0001) in comparison to never smokers. After excluding men who consumed both cigarettes and bidis (n = 27), risk estimates for bidi smoking did not change substantially, while risk in the higher category of cigarette smoking slightly increased though with wider confidence intervals. No significant interaction was found between bidi or cigarette smoking and other coronary risk factors, although the statistical power to detect small interactions was limited.

DISCUSSION

Our fourfold increased risk associated with current smoking for non-fatal MI is consistent with findings from the Interheart study, where a threefold elevation in risk was observed. Two western studies have already documented that the RRs for smoking are more extreme (even at lower absolute risks) at younger ages. The observed risk for non-fatal MI is consistent with findings from the INTERHEART study, where a threefold elevation in risk was observed. In comparison to never smokers, current smokers had an age adjusted relative risk (RR) of 4.6 (95% confidence interval CI 3.4 to 6.4). This risk changed little with multivariate adjustment. In multivariate analysis of bidi smoking (table 2), persons consuming more than 10 bidis per day (median 20 bidis/day) had an RR of 9.1 (95% CI 4.7 to 17.7; p for trend < 0.0001). In multivariate analysis of cigarette smoking, persons consuming more than 10 cigarettes per day (median 15 cigarettes/day) had an RR of 7.3 (95% CI 3.9 to 13.8; p for trend < 0.0001) in comparison to never smokers. After excluding men who consumed both cigarettes and bidis (n = 27), risk estimates for bidi smoking did not change substantially, while risk in the higher category of cigarette smoking slightly increased though with wider confidence intervals. No significant interaction was found between bidi or cigarette smoking and other coronary risk factors, although the statistical power to detect small interactions was limited.

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### Table 1

<table>
<thead>
<tr>
<th>Smoking status</th>
<th>Cases</th>
<th>Controls</th>
<th>Age and hospital adjusted RR (95% CI)</th>
<th>Multivariate adjusted RR (95% CI)</th>
<th>Number of smoking associated MI cases (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>82</td>
<td>359</td>
<td>1.0</td>
<td>1.0</td>
<td>–</td>
</tr>
<tr>
<td>Ever</td>
<td>220</td>
<td>240</td>
<td>4.0 (3.0 to 5.4)</td>
<td>3.9 (2.8 to 5.6)</td>
<td>163 (74%)</td>
</tr>
<tr>
<td>Former</td>
<td>47</td>
<td>77</td>
<td>2.7 (1.7 to 4.1)</td>
<td>2.6 (1.6 to 4.3)</td>
<td>29 (92%)</td>
</tr>
<tr>
<td>Current</td>
<td>173</td>
<td>163</td>
<td>4.6 (3.4 to 6.4)</td>
<td>4.7 (3.2 to 6.9)</td>
<td>136 (79%)</td>
</tr>
</tbody>
</table>

*Never smokers (reference group) does not include cigarette smokers, bidi smokers, or users of other forms of tobacco who consumed other forms of tobacco only. Ever smokers include former and current cigarette or bidi smokers. Current smokers include current smokers of cigarettes or bidis.

**Table 2**

<table>
<thead>
<tr>
<th>Smoking status</th>
<th>Median (cigarette or bidi per day)</th>
<th>Cases (n)</th>
<th>Controls (n)</th>
<th>Age and hospital adjusted RR (95% CI)</th>
<th>Multivariate RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never smokers</td>
<td>0</td>
<td>82</td>
<td>359</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Bidi smokers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;10 per day</td>
<td>4</td>
<td>16</td>
<td>39</td>
<td>1.9 (1.0 to 3.6)</td>
<td>2.0 (0.9 to 4.4)</td>
</tr>
<tr>
<td>&gt;10 per day</td>
<td>20</td>
<td>71</td>
<td>39</td>
<td>8.8 (5.2 to 14.8)</td>
<td>8.1 (4.3 to 15.3)</td>
</tr>
<tr>
<td>Cigarette smokers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;10 per day</td>
<td>3</td>
<td>44</td>
<td>65</td>
<td>3.1 (1.9 to 4.9)</td>
<td>3.2 (1.8 to 5.7)</td>
</tr>
<tr>
<td>&gt;10 per day</td>
<td>15</td>
<td>61</td>
<td>28</td>
<td>9.4 (5.4 to 16.2)</td>
<td>9.1 (4.7 to 17.7)</td>
</tr>
</tbody>
</table>

*Never smokers does not include bidi smokers, cigarette smokers, or users of other forms of tobacco. Current smokers of bidis and cigarettes are represented.

†Approximately n = 19 cases and n = 8 controls smoked both cigarettes and bidis and are represented in both groups.
different disease patterns, access to care, and differences in smoking patterns. The ongoing Registrar General of India's one million death study will provide further data on smoking hazards in different regions including rural India and among different background disease rates.

The implication for tobacco control is clear: that reduced smoking will reduce the leading cause of adult death in India. Tobacco prevention in India is beginning to be addressed at the national level with legislation that bans advertising, sponsorship of sports, and cultural events by tobacco companies, smoking in public places, and sale of tobacco products to people younger than 18 years of age.

Our results add additional impetus in particular to cessation: some 70–80 million males over the age of 30 smoke, with vascular disease, tuberculosis and cancers being the major cause of premature mortality and disability among these men. Avoidance of tobacco related disease over the next few decades will require current smokers to quit, with the greatest benefits if quitting occurs before the onset of disease.

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Authors’ affiliations

T Rastogi, Department of Nutrition, Harvard School of Public Health, Boston, Massachusetts, USA

P Jha, Public Health Sciences, University of Toronto, Toronto, Canada
K S Reddy, D Prabhakaran, All India Institute of Medical Sciences, New Delhi, India
D Spiegelman, Departments of Biostatistics and Epidemiology, Harvard School of Public Health
M J Stamper, W C Willett, A Ascherio, Departments of Nutrition and Epidemiology, Harvard School of Public Health

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Correspondence to: Dr Tanuja Rastogi, National Cancer Institute, Division of Cancer Epidemiology & Genetics, Nutritional Epidemiology Branch, 6120 Executive Blvd, EPS 320, Rockville, MD 20852, USA; TRASTOGI@post.harvard.edu

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