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.

Myocardial 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. 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 tembunri leaf—is well established in India and has been recently documented as a major cause of death among Indian men, with much of this resulting from vascular and respiratory disease. Smoking of cigarettes and bidis has been associated with a twofold risk for fatal MI in India.

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%. 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. The risks of smoking for non-fatal MI were among a younger population than that seen in the Interheart or other western studies. 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 used standard conditional logistic regression, first controlling for age and hospital, and then, in addition, other potential risk factors demonstrated in previous studies. 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 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). Population attributable risk was calculated using the prevalence of smoking in the adult (30+) male urban population (prevalence 31%) 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 percent 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 are about double that shown for fatal MI in India. This would tend to lower our observed risk ratios. Notably, our results are remarkably consistent with an earlier retrospective study of 300 cases and 300 controls (93% of which were males) from one hospital in India. An unadjusted pooled Mantel-Haenszel RRs for MI with smoking for the two studies among current smokers is 3.7 (95% CI 2.9 to 4.6, test for heterogeneity 0.13, p = 0.7).

The observed current smoking prevalence among our controls of 29% is about the same as that seen in urban males in India in two surveys of 100 000 households, and of one million households (Jha P, personal communication, 2005) Thus, we estimate that smoking causes 53% (95% CI 47% to 64%) of MIs among urban males in India (using a male adult smoking prevalence of 31%).

The observations of higher RRs for non-fatal MI is consistent with findings from the study, overall participation rates were high. Controls were slightly more educated but had lower incomes than cases. However, controlling for recorded socioeconomic factors did not alter our findings significantly. Differential recall of smoking history was likely to be modest because smoking is recalled relatively easily. Our study provides risk estimates for tobacco smoking in urban India among males. Rural areas have an estimated male adult smoking prevalence of 31% (95% CI 28% to 34%), and 5% (1% to 9%) of females (95% CI 4% to 7%).

controls is significantly higher than that reported in the general population. This implies that the early detection of MI risk among cases or clinical attention and access to hospital care among controls might lead to higher quit rates. The observed differences in smoking prevalence among our controls of 29% is about the same as that seen in urban males in India in two surveys of 100 000 households, and of one million households (Jha P, personal communication, 2005).

Table 1: Relative risk (RR) of acute incident myocardial infarction (MI) among males according to smoking history

<table>
<thead>
<tr>
<th>Smoking status*</th>
<th>Cases (n=309)</th>
<th>Controls (n=618)</th>
<th>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>-</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>
</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>
</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>
</tr>
</tbody>
</table>

Test for trend: p value

<table>
<thead>
<tr>
<th>Cigarette smokers</th>
<th>&lt;10 per day</th>
<th>&gt;10 per day</th>
<th>&lt;0.0001</th>
<th>&lt;0.0001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test for trend: p value</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bidi smokers</th>
<th>&lt;10 per day</th>
<th>&gt;10 per day</th>
<th>&lt;0.0001</th>
<th>&lt;0.0001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test for trend: p value</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*pNever smokers (reference group) does not include cigarette smokers, bidi smokers, or users of other forms of tobacco (n = 7 cases and n = 19 controls used other forms of tobacco only). Ever smokers include former and current cigarette or bidi smokers. Current smokers include current smokers of cigarettes or bidis.
†Smoking associated number of MI cases calculated as (1–1/risk ratio) × number of cases who smoked in that group.

Table 2: Relative risk (RR) of acute incident myocardial infarction (MI) among males according to amount of current cigarette or bidi smoking

<table>
<thead>
<tr>
<th>Smoking status*</th>
<th>Median (cigarette or bidi per day)</th>
<th>Cases (n)</th>
<th>Controls (n)</th>
<th>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>

*pNever 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.
What this paper adds

This study adds evidence on the adverse effect of tobacco smoking on the risk for non-fatal myocardial infarction (MI) in men in urban India. Importantly, we provide evidence on the risk associated with bidi smoking. First, we observed an over fourfold increase in risk associated with current smoking (bidi or cigarette) in this population compared to never smokers. More specifically, men smoking 10 or more bidi per day were over seven times more likely to have an MI than never smokers. Finally, we estimate that nearly 60% of MI in males in urban India can be attributed to tobacco smoking.

different disease patterns, access to care, and differences in smoking patterns.13 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.14

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.13

Our results add additional impetus in particular to cessation: some 70–80 million males over the age of 30 smoke,29 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.13

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Competing interests: none declared

Study design and data collection were done by TR, AA, WCW, KSR, DP, DS. Data analysis and interpretation were done by TR, PJ, AA, WCW, MJS, DS. Manuscript preparation was done by TR and PJ with critical feedback on the manuscript provided by AA, WCW, MJS, KSR, DP, DS.

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