Comparison of the nicotine content of tobacco used in bidis and conventional cigarettes

Jennifer L Malson, Kristi Sims, Ram Murty, Wallace B Pickworth

Abstract

Objective—To compare the nicotine content of 12 unfiltered brands of bidi cigarettes (hand rolled cigarettes imported from India) with 8 popular brands of filtered and unfiltered US and conventional cigarettes from India.

Main outcome measures—Identical laboratory procedures were used to determine nicotine content (in duplicate) and physical characteristics.

Results—The nicotine concentration in the tobacco of bidi cigarettes (21.2 mg/g) was significantly greater than the tobacco from the commercial filtered (16.3 mg/g) and unfiltered cigarettes (13.5 mg/g).

Conclusions—Bidi cigarettes contain higher concentrations of nicotine than conventional cigarettes. Therefore, it is logical to presume that bidi smokers are at risk of becoming nicotine dependent. These findings belie a popular belief among US teens that bidis are a safe alternative to commercial cigarettes.

(Tobacco Control 2001;10:181–183)

Keywords: bidis; beedies; youth

A recent estimate of smoking initiation indicates that worldwide between 82 000 and 99 000 young people begin smoking each day.1 In the USA, about 3000 teenagers begin smoking daily, nearly one million a year.2 Despite efforts aimed at decreasing teenage smoking, there has been an increase in smoking among that age group.3 Although many US teenage smokers prefer commercial cigarette brands such as Marlboro and Camels,4 others are attracted to alternative tobacco products such as bidis, cloves, and additive-free, natural tobacco cigarettes.5,6 In a national study, 2.4–5.0% of adolescents were using bidi cigarettes.7,8 A convenience sample from Boston indicates a higher prevalence with 16% of adolescents as current users.9 Although a few are filtered. Highly flavoured varieties of bidi cigarettes, including cherry, menthol, cinnamon, strawberry, vanilla, and raspberry, are widely available in retail outlets and on the internet. Flavour additives may partially account for the popularity of bidis among young consumers. Other explanations for bidi popularity among teens are that they are less expensive than commercially available cigarettes, they easily accessible, and they are trendy.10,11

Toxicological and epidemiological reports indicate that the smoke of bidis, like commercial cigarettes and cheroots, contains phenol, hydrogen cyanide, and benzo(a)pyrenes9 and total particulate matter, a measure directly related to the amount of carcinogenic material.12 Nair and colleagues identified carcinogenic tobacco specific nitrosamines from the smoke of bidis in concentrations similar to those of commercial cigarettes.13 Bidis also deliver considerable amounts of carbon monoxide. Blood carboxyhaemoglobin concentrations were raised in bidi smokers11 and the concentrations of carboxyhaemoglobin were correlated with self-assessed degree of smoke inhalation and number of bidis.12 Compared to the smoke of an unfiltered US cigarette, bidi smoke contained more carbon monoxide, ammonia, hydrogen cyanide, phenol, volatile phenols, benz(a)anthracene, and benzo(a)pyrene.11,12,13 These studies indicate that bidis are hazardous to health. Further, the delivery of nicotine in sufficient quantities initiates and sustains dependence,15 which perpetuates the delivery of toxic components of smoke to the user.

Although some studies have been conducted to establish nicotine and tar levels of bidis on a standard smoking machine, the nicotine concentration of tobacco in bidis has not been examined.11,16 Given the large variety of bidi cigarettes available, it is uncertain how applicable the results of previous studies are to the products currently available. In the present study, the nicotine content and other physical characteristics of 12 popular brands of unfiltered bidi cigarettes, three Indian and four US commercial filtered cigarettes, and a non-filtered “additive-free” cigarette (American Spirit) were compared.

Methods

Commercial cigarettes and bidis (tables 1 and 2) were obtained from local retail outlets for the study. Tobacco weights of the cigarettes were based on an average of 10 cigarettes, while the tobacco weights of the bidis were based on an average of 20 bidis. For each brand of bidi cigarette, the tobacco was removed from...
Analyses were run in duplicate, results are shown for both determinations. Overall averages: 506.2 mg, 215.3 mg, 4.7 mg, and 21.2 mg.

<table>
<thead>
<tr>
<th>Brand</th>
<th>Average cigarette weight (mg)</th>
<th>Average tobacco weight (mg)</th>
<th>Average nicotine/rod (mg)</th>
<th>Nicotine (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irie Cherry</td>
<td>447.1</td>
<td>173.2</td>
<td>3.6</td>
<td>20.8</td>
</tr>
<tr>
<td>Irie Menthol</td>
<td>456.6</td>
<td>211.4</td>
<td>3.3</td>
<td>15.7</td>
</tr>
<tr>
<td>Irie Cinnamon</td>
<td>432.0</td>
<td>179.1</td>
<td>3.5</td>
<td>18.8</td>
</tr>
<tr>
<td>Irie Strawberry</td>
<td>449.0</td>
<td>219.3</td>
<td>4.5</td>
<td>20.4</td>
</tr>
<tr>
<td>Irie Vanilla</td>
<td>441.0</td>
<td>197.4</td>
<td>3.8</td>
<td>18.6</td>
</tr>
<tr>
<td>Sher Bidis 100</td>
<td>1024.8</td>
<td>466.4</td>
<td>12.4</td>
<td>27.0</td>
</tr>
<tr>
<td>Sher Bidis</td>
<td>368.1</td>
<td>166.2</td>
<td>3.9</td>
<td>23.0</td>
</tr>
<tr>
<td>Shiv Sagar Raspberry</td>
<td>467.9</td>
<td>200.4</td>
<td>4.0</td>
<td>20.1</td>
</tr>
<tr>
<td>Shiv Sagar Chocolate 100</td>
<td>576.3</td>
<td>242.5</td>
<td>5.7</td>
<td>23.3</td>
</tr>
<tr>
<td>Kailis Bidi Menthol</td>
<td>503.4</td>
<td>181.1</td>
<td>3.4</td>
<td>18.7</td>
</tr>
<tr>
<td>Kailis Bidi Strawberry</td>
<td>552.8</td>
<td>190.6</td>
<td>4.0</td>
<td>20.9</td>
</tr>
<tr>
<td>Guru Bidis</td>
<td>555.5</td>
<td>155.5</td>
<td>3.9</td>
<td>24.8</td>
</tr>
<tr>
<td>Overall averages</td>
<td>506.2</td>
<td>215.3</td>
<td>4.7</td>
<td>21.2</td>
</tr>
</tbody>
</table>

*Analyses were run in duplicate, results are shown for both determinations.

**Table 2: Characteristics of commercial cigarettes**

<table>
<thead>
<tr>
<th>Brand</th>
<th>Average cigarette weight (mg)</th>
<th>Average tobacco weight (mg)</th>
<th>Average nicotine/rod (mg)</th>
<th>Nicotine (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unfiltered</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Spirit (US)</td>
<td>1130.5</td>
<td>1064.4</td>
<td>17.7</td>
<td>16.2</td>
</tr>
<tr>
<td>Golconda (I)</td>
<td>823.6</td>
<td>772.4</td>
<td>9.0</td>
<td>11.4</td>
</tr>
<tr>
<td>Charminar (I)</td>
<td>796.5</td>
<td>745.1</td>
<td>9.2</td>
<td>12.5</td>
</tr>
<tr>
<td>Overall averages</td>
<td>916.9</td>
<td>860.6</td>
<td>12.0</td>
<td>13.5</td>
</tr>
<tr>
<td>Filtered</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marlboro (US)</td>
<td>921.8</td>
<td>710.0</td>
<td>12.0</td>
<td>17.0</td>
</tr>
<tr>
<td>Newport Menthol (US)</td>
<td>938.0</td>
<td>715.6</td>
<td>14.0</td>
<td>19.5</td>
</tr>
<tr>
<td>Camel (US)</td>
<td>927.8</td>
<td>716.3</td>
<td>12.1</td>
<td>16.7</td>
</tr>
<tr>
<td>Kool Menthol (US)</td>
<td>915.5</td>
<td>710.9</td>
<td>14.0</td>
<td>19.5</td>
</tr>
<tr>
<td>Gold Flake (I)</td>
<td>992.1</td>
<td>840.0</td>
<td>7.0</td>
<td>8.3</td>
</tr>
<tr>
<td>Overall averages</td>
<td>939.0</td>
<td>738.6</td>
<td>11.8</td>
<td>16.3</td>
</tr>
</tbody>
</table>

US, US brand; I, Indian brand.

Discussion

The bidis tested contained less tobacco than other cigarettes. However, their tobacco contains significantly higher concentrations of nicotine than the tobacco of commercial cigarettes. One measure of the addictive potential of tobacco products is the amount of nicotine available to the consumer. Benowitz and Henningfield have theorised that a minimum threshold level of nicotine delivery is necessary to initiate and sustain dependence. Although cigarette manufacturers describe their products as “ultra lights,” “lights” and “full flavor” cigarettes, the nicotine content of the tobacco rods are similar. Cigarette smokers can titrate the amount of nicotine they obtain from a cigarette by changing their smoking behaviour. Smokers may titrate the amount of nicotine delivery from bidis just as they adjust the nicotine delivery from commercial cigarettes. However, preliminary results from a clinical study that measured plasma nicotine concentrations indicate that higher concentrations of nicotine were seen after smoking bidi cigarettes (Pickworth et al, 11th World Congress on Tobacco OR Health, abstract, 2000, unpublished data).

Bidi cigarettes are smoked differently than commercial cigarettes. For example, bidi cigarettes must be re-lit several times because they self-extinguish if they are not puffed at least two times a minute. The time to smoke and number of puffs were significantly greater while smoking a Sher bidi than commercial cigarette smoking in a clinical study (Malson...
Nicotine in bidis and conventional cigarettes

and Stanton, Eastern Psychological Association, abstract, 2000, unpublished data). Finally, there is less air dilution through the tendu leaf than conventional cigarettes. Low combustibility forces a smoker to inhale more deeply resulting in greater delivery of carbon monoxide, nicotine, and other components of tobacco smoke. All of these factors may exaggerate the health risks associated with nicotine and other components of bidi smoke. All of these factors may exaggerate the health risks associated with nicotine and other components of bidi smoke.

In addition to the well documented accounts of the toxic chemicals in bidi smoke, their delivery of nicotine poses a risk for the development of dependence. All smoked tobacco products have a potential abuse liability and the ability to initiate and sustain nicotine dependence. Even rapid delivery nicotine replacement products such as the gum and the nasal spray have a potential for abuse. The dependence potential of bidis is further evident in India where bidi smoking accounts for 40% of tobacco consumption.

A recent study of urban US youth indicated that 40% had smoked bidis at least once and 16% were current users. There were no significant differences between race, ethnicity, and sex. “Better taste” was the reason most often endorsed for preference of bidis over commercially available cigarettes. Highly flavoured and smokeless tobacco products tend to appeal to a youthful market. The flavouring additives may mask the harshness of the concentrated nicotine in the bidis and may allow for deeper inhalation while smoking. Teens are drawn to bidi cigarettes because they are highly flavoured and marketed as alternative products. Furthermore, teens are also attracted to bidi cigarettes because they are trendy, cheaper, and easier to buy than commercial cigarettes.

Our interest in this research was to examine the nicotine concentrations of tobacco of several (12) popular brands of bidis. Because of the inherent variability in the production of a hand rolled tobacco product, another study could be conducted to determine the tobacco content and nicotine concentration within a single brand of bidi cigarettes. Other studies are needed to demonstrate the effect of bidi smoking on plasma concentrations of nicotine, exhaled carbon monoxide, and other physiologic effects.

In summary, results show that the nicotine concentration of the tobacco of bidi cigarettes is higher than the concentration of nicotine in commercial cigarettes. As a result of the nicotine exposure, bidi smokers are at risk for tobacco dependence. These findings refute the notion among US teens that bidi smoking is a safe alternative to commercial cigarettes.

What this paper adds
Bidis are hand rolled cigarettes from India that are popular among US teenagers. Some adolescents believe bidis are healthy alternatives to conventional cigarettes. The nicotine content and delivery characteristics from bidis have not been published. These are important determinants of abuse liability.

The present study showed that the tobacco in bidi cigarettes has a higher concentration of nicotine than the tobacco in filtered and unfiltered commercial cigarettes. Like conventional cigarettes, bidi cigarettes have the potential to initiate and sustain tobacco dependence. This belies the notion of US teenagers that bidis are a safe alternative to cigarettes.

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