Menthol might directly produce its own addicting effect or increase the reinforcing effects of nicotine. Menthol could potentially facilitate addiction by its sensory effects or its perceived qualities as a healthy substance. In one study of 36 smokers, menthol smokers had increased craving relative to non-menthol smokers. The possibility that menthol could be a factor associated with the lower quit rate among black smokers remains unexplored. Successful quitters smoke fewer cigarettes per day, at least in some studies, yet blacks are less likely to quit than whites despite smoking fewer cigarettes per day.

The smoking habits of almost 20 000 white and black smokers were analysed to determine whether the daily consumption of cigarettes and the quit rate were associated with cigarette menthol content.

### METHODS

The subjects for this cross sectional analysis were current and former smokers who participated in a case–control study of tobacco related cancers. The original study was conducted to determine the relation between the dose of cigarette exposure and lung, head and neck, kidney, and pancreas cancers. In particular, the risk was studied in relation to cigarette formulation, occupation, social class, and diet. For example, it was reported that the histologic specific risk of lung cancer depended on the cigarette “tar” yield. Cigarette additives were also hypothesized to affect the risk of aerodigestive cancers, although no association was observed with the use of mentholated cigarettes (compared to non-mentholated cigarettes).

The study was conducted in several hospitals in New York, Washington, DC and Pennsylvania between 1981 and 1999. Newly diagnosed cancer patients were identified from thoracic and other surgery schedules. Non-surgical patients were sought out in oncology wards. Pathology reports were obtained to
confirm the diagnoses and medical reports were reviewed to ensure that the patient had no previous history of lung cancer. Control patients with medical conditions unrelated to cigarette smoking were frequency matched to the cases by age (within five years), sex, race, hospital, and month of interview. Controls were selected randomly from general hospital admitting rosters. Annual refusal rates were always below 15%. All subjects signed a consent form that was approved by the institutional review boards of the participating institutions. All subjects were administered a structured questionnaire which contained detailed items on smoking history previous to the diagnosis. The questions included years of smoking and cigarettes per day for each cigarette brand smoked. Information on menthol content was obtained. The current analysis was limited to current and former cigarette smokers, and black and white subjects. Ever smokers were defined as having smoked at least one cigarette each day for one year. Current smokers were subjects that smoked at least one cigarette each day for the preceding year. Ex-smokers were ever smokers who did not smoke at least one cigarette each day for the preceding year. Because the same percentage of cases and controls reported smoking mentholated cigarettes, the mean number of years of smoking was 34.8 for blacks and 32.4 for whites. For smokers of mentholated cigarettes, the mean number of years of smoking was 31.7 for blacks and 33.0 for whites. For current smokers, the POR was 0.8 (95% CI 0.4 to 1.2) for the early time period, 0.8 (95% CI 0.5 to 1.2) for the middle time period, and 0.3 (95% CI 0.2 to 0.7) for the late time period. For former smokers the POR was 0.8 (95% CI 0.3 to 2.0), 0.9 (95% CI 0.5 to 1.5), and 0.2 (95% CI 0.1 to 0.7), respectively.

### RESULTS

There were 19 545 subjects, including 16 540 (84.6%) smokers of non-mentholated cigarettes and 3005 (15.4%) smokers of mentholated cigarettes. Eleven per cent of subjects were black. Using \( \chi^2 \) analyses, significant differences were found in the use of mentholated cigarettes by sex, age, smoking status, and cigarettes per day (table 1). Smokers of mentholated cigarettes were significantly more likely to have been women (blacks: 36.6% v 31.3%; whites: 35.1% v 28.8%), less than 55 years of age (blacks: 44.1% v 30.7%; whites: 36.1% v 27.8%), former smokers (blacks), and smoked fewer cigarettes per day (blacks: 18.0 cpd v 20.9; whites: 28.1 v 28.9). There were no differences in the percentage of cases and controls who smoked menthol. For smokers of non-mentholated cigarettes, the mean number of years of smoking was 34.8 for blacks and 32.4 for whites. For smokers of mentholated cigarettes, the mean number of years of smoking was 31.7 for blacks and 33.0 for whites.

Comparing smoking habits between blacks and whites, blacks preferred mentholated cigarettes (34.4% v 13.3%, \( p < 0.01 \)) and were more likely to have been current smokers (66.4% v 48.3%, \( p < 0.01 \)). Whites smoked more cigarettes per day than blacks (men: 30.6 cpd v 20.2 cpd, \( p < 0.01 \); women: 24.0 cpd v 16.6 cpd, \( p < 0.01 \)).

The POR of smoking \( > 21 \) cpd associated with mentholated cigarettes was 0.7 (95% CI 0.5 to 0.9) in blacks who currently smoked and 0.9 (95% CI 0.8 to 1.0) in whites who currently smoked (table 2). Very similar findings were observed in former smokers. Blacks were less likely than whites to smoke more than one pack per day, after adjustment for menthol content, smoking status, and other covariates (POR 0.30, 95% CI 0.27 to 0.34). In an analysis limited to control subjects, the findings were nearly identical (data not shown). There were little differences in the POR by time interval, except for a stronger relation among blacks in the most recent time period. For current smokers, the POR was 0.8 (95% CI 0.4 to 1.2) for the early time period, 0.8 (95% CI 0.5 to 1.2) for the middle period, and 0.3 (95% CI 0.2 to 0.7) for the late time period. For former smokers the POR was 0.8 (95% CI 0.3 to 2.0), 0.9 (95% CI 0.5 to 1.5), and 0.2 (95% CI 0.1 to 0.7), respectively.

### Table 1

<table>
<thead>
<tr>
<th>Sex</th>
<th>Black (n=1251)</th>
<th>White* (n=15289)</th>
<th>p Value</th>
<th>Black (n=655)</th>
<th>White* (n=2350)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>860 (68.8)</td>
<td>415 (63.4)</td>
<td>&lt;0.02</td>
<td>10881 (71.2)</td>
<td>1526 (64.9)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Female</td>
<td>391 (31.3)</td>
<td>240 (36.6)</td>
<td>&lt;0.02</td>
<td>4408 (28.8)</td>
<td>824 (35.1)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;45</td>
<td>88 (7.0)</td>
<td>109 (16.6)</td>
<td></td>
<td>1138 (7.6)</td>
<td>257 (10.9)</td>
<td></td>
</tr>
<tr>
<td>45-54</td>
<td>296 (23.7)</td>
<td>180 (27.5)</td>
<td></td>
<td>3076 (20.2)</td>
<td>591 (25.2)</td>
<td></td>
</tr>
<tr>
<td>55-64</td>
<td>532 (42.5)</td>
<td>238 (36.3)</td>
<td></td>
<td>5895 (38.6)</td>
<td>824 (37.2)</td>
<td></td>
</tr>
<tr>
<td>≥65</td>
<td>333 (26.8)</td>
<td>128 (19.5)</td>
<td>&lt;0.01</td>
<td>5160 (33.8)</td>
<td>628 (26.7)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controls</td>
<td>453 (36.2)</td>
<td>257 (39.2)</td>
<td></td>
<td>6459 (42.3)</td>
<td>997 (42.4)</td>
<td></td>
</tr>
<tr>
<td>Cases</td>
<td>796 (63.8)</td>
<td>398 (60.8)</td>
<td>NS</td>
<td>8830 (57.8)</td>
<td>1353 (57.6)</td>
<td>NS</td>
</tr>
<tr>
<td>Smoking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>804 (64.3)</td>
<td>461 (70.4)</td>
<td></td>
<td>7201 (47.1)</td>
<td>1323 (56.3)</td>
<td></td>
</tr>
<tr>
<td>Former</td>
<td>447 (35.7)</td>
<td>194 (29.6)</td>
<td>&lt;0.01</td>
<td>8088 (52.9)</td>
<td>1027 (43.7)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Cigarettes per day</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–10</td>
<td>374 (29.9)</td>
<td>226 (34.5)</td>
<td></td>
<td>2279 (14.9)</td>
<td>424 (18.1)</td>
<td></td>
</tr>
<tr>
<td>11–20</td>
<td>519 (41.5)</td>
<td>294 (44.9)</td>
<td></td>
<td>5195 (34.0)</td>
<td>780 (33.2)</td>
<td></td>
</tr>
<tr>
<td>21–30</td>
<td>167 (13.4)</td>
<td>77 (11.8)</td>
<td></td>
<td>2814 (18.4)</td>
<td>407 (17.3)</td>
<td></td>
</tr>
<tr>
<td>≥40</td>
<td>191 (15.3)</td>
<td>58 (8.9)</td>
<td>&lt;0.01</td>
<td>4972 (32.6)</td>
<td>737 (31.4)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

*Data on cigarettes per day missing for 31 white subjects. NS, not significant.
Cigarette mentholation was not associated with continued smoking. The POR was 1.1 (95% CI 0.8 to 1.4) in blacks and 1.1 (95% CI 1.0 to 1.2) in whites (table 3). Blacks were more likely to have been current smokers than whites for both men (POR 1.4, 95% CI 1.2 to 1.7) and women (POR 1.3, 95% CI 1.1 to 1.7) (table 4). The findings from analyses limited to the control subjects were nearly identical to analyses based on cases and controls combined. When stratified by time period, there were few differences in the POR.

The independent predictors of currently smoking and smoking more than one pack per day are shown in table 4. In a model that simultaneously adjusted for sex, race, age, and other covariates, the association with menthol was consistent with previous analyses. Menthol was not associated with continued smoking, and was inversely associated with smoking with other covariates, the association with menthol was consistent in a model that simultaneously adjusted for sex, race, age, and other factors. The percentage of both black and white smokers of mentholated cigarettes consume fewer cigarettes per day than whites after statistical adjustment for cigarette menthol content and other factors.

The limitations of the current study include its cross sectional design and some potential biases. It used a convenience sample and not a random population based sample. Because most subjects were older adults, it is not possible to generalise the findings to younger persons. There might have been a selection bias in the smoking habits among blacks because the participating institutions were large academic medical centres that treat predominantly white populations.

The study was conducted for almost 20 years and therefore the results might have been influenced by temporal changes in cigarette smoking patterns or in the formulation of mentholated cigarettes. However, when the results were stratified by three time periods, there were little differences in the PORs, with the exception of a higher inverse association between menthol and cigarette amount in blacks in the most recent years of the study. This might simply reflect variability in sub groups, or possibly a trend related to social, demographic or other factors. The percentage of both black and white subjects who smoked mentholated cigarettes is lower than has been reported in national surveys that were conducted during this time period, but this difference could be due to the older ages of the current study subjects or to other factors.
The market share of mentholated cigarettes has increased substantially over the past several decades. In many inner urban areas, it is the most common type of cigarette smoked. Because of its cooling sensation, menthol has been shown to alter smoking inhalation patterns in comparison to non-mentholated cigarettes. Among blacks who smoke cigarettes, the lower numbers of cigarettes smoked per day and the lower quit rate compared to white smokers could be due to their preference for mentholated cigarettes. A cross sectional analysis of 19,545 ever smokers found that mentholated cigarettes was not related to quitting smoking in both blacks and whites. Both blacks and white smokers of mentholated cigarettes smoked fewer cigarettes per day than smokers of other cigarettes. The findings suggest that menthol does not increase the addictive properties of tobacco nicotine.

geographic preferences for menthol. The current data are consistent with other reports that showed blacks were about twice as likely to smoke mentholated cigarettes as whites.6 It has been reported that the burning of menthol does not produce carcinogens,7,8 although one study found that burned menthol produced polycyclic aromatic hydrocarbons.9 In experimental animals that were treated with tobacco carcinogens, menthol supplementation in their drinking water did not alter the tumour burden.10 Despite the findings, it is unknown whether tobacco sprayed with menthol might burn differently from untreated tobacco, or whether the tobacco blend of mentholated cigarettes is different. Smokers of mentholated cigarettes take fewer numbers of puffs per cigarette, but have higher levels of expired carbon monoxide. Although cigarette mentholation was not associated with an increased cancer risk in several studies, there are no studies of mentholated cigarettes and risk of cardiovascular disease. It is well established that tobacco advertisements of specific menthol brands are targeted to young black consumers, and the lower quit rate compared to white smokers could be due to their preference for mentholated cigarettes. Differences in serum cotinine levels of cigarette smokers: Third National Health and Nutrition Examination Survey, 1988–1991. JAMA 1998;280:150–58.

REFERENCES

Authors’ affiliations

J E Muscat, J P Richie Jr, S D Stellman, American Health Foundation, Valhalla, New York, USA


27 Moore DJ, Williams JD, Qualls WJ. Target marketing of tobacco and alcohol-related products to ethnic minority groups in the United States. Ethn Dis 1996;6:85–98.


Mentholated cigarettes and smoking habits in whites and blacks

J E Muscat, J P Richie, Jr and S D Stellman

*Tob Control* 2002 11: 368-371
doi: 10.1136/tc.11.4.368

Updated information and services can be found at:
http://tobaccocontrol.bmj.com/content/11/4/368

These include:

**References**
This article cites 31 articles, 7 of which you can access for free at:
http://tobaccocontrol.bmj.com/content/11/4/368#BIBL

**Email alerting service**
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/