Effects of smoking cessation on caloric intake and weight gain in an inpatient unit

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Abstract. The present research was designed to assess the amount of weight gain that would occur when male smokers in an inpatient setting were deprived of cigarettes for 10 days, and to evaluate factors that could contribute to that weight gain, such as caloric intake and activity level. Subjects were 17 healthy male smokers who either smoked ad libitum (n = 8) or quit smoking (n = 9) for 10 days after a 3 day smoking baseline. Caloric intake, activity levels, and body weight were assessed daily. Abstainers gained more weight than did smokers and ate more over time. There were no group differences in activity level. An analysis of energy needs versus actual energy intake suggests that caloric intake accounted for a large percentage of the post-cessation weight gain. However, considerable individual variability exists in caloric intake after smoking cessation. In addition, the study found post-cessation increases in caloric intake that were quite similar to those found in studies with females, suggesting that gender may have little to do with overall post-cessation caloric intake. Further research assessing dietary and metabolic changes after smoking cessation in a larger sample of both males and females is needed so that the reasons for and implications of dietary variability can be evaluated.

Key words: Smoking cessation – Body weight – Food consumption

Although there may be several factors contributing to weight gain, there is evidence that precessation smoking rates play a role, with the heaviest smokers tending to gain the most weight (Comstock and Stone 1972; Blitzer et al. 1977; Bosse et al. 1980; Friedman and Siegelaub 1980; Hall et al. 1986; Emont and Cummings 1987). For some smokers, the prospect of weight gain after smoking cessation may serve as a barrier to cessation, and may even contribute to relapse (Klesges and Klesges 1988).

Three possible mechanisms have been considered to account for the weight gain that occurs after smoking cessation: changes in (1) physical activity, (2) metabolic rate, and (3) dietary intake (see reviews by Wack and Rodin 1982; USDHHS 1988; and Klesges et al. 1989). Several studies (Hatsukami et al. 1984; Stamford et al. 1986; Hall et al. 1989) found that activity level did not change after smoking cessation, and Rodin (1987) found increases in physical activity after cessation. All but Rodin’s (1987) study found that weight increased after smoking cessation. Thus, the existing evidence suggests that physical activity in fact plays a negligible role in post-cessation weight gain.

Evidence that nicotine plays a role in energy expenditure has been found. Both tobacco smoking (Hofstetter et al. 1986) and nicotine administration (Perkins et al. 1989, 1990) have been shown to enhance energy expenditure. Perkins et al. (1989) found nicotine-induced increases in energy expenditure during periods of light exercise as compared to rest, and Hofstetter et al. (1986) found that energy expenditure increased 10% during a 24-h period of smoking as compared to a comparable nonsmoking period. However, the long-term effects of smoking cessation on energy expenditure have been somewhat less reliable. For example, Dallosso and James (1984) found that resting metabolic rate decreased only 4% measured at 6–8 weeks after smoking cessation, while Glauser et al. (1970) found a decrease in O_2 consumption 1 month after cessation – although a recent reanalysis of the Glauser data puts that result into question (Klesges et al. 1989). Studies by Barse et al. (1975), Stamford et al. (1986), and Perkins et al. (1990) failed to find signifi-
cant changes in energy expenditure following smoking cessation, although it must be noted that Burse et al. (1975) only included three subjects. Thus, the type of metabolic changes that occur and the relative magnitude of their contribution to weight gain needs further clarification.

Several studies have found dietary changes associated with smoking cessation which may account for increased weight gain. Hatsu et al. (1984) assessed subjects in an inpatient setting and found that average daily caloric intake increased by 254 kcal, while Stanford et al. (1986), Perkins et al. (1990), and Spring et al. (1991) found that average daily caloric intake increased by 227, 383, and 300 kcal, respectively, in an outpatient setting. Not all studies have found significantly increased eating after smoking cessation (Dallosso and James 1984; and Rodin 1987), although Dall et al. (1984) found a significant positive correlation between caloric intake and amount of weight gain.

Despite the negative findings of a few studies, the evidence that increased caloric intake contributes significantly to post-cessation weight gain is somewhat stronger than that for decreased energy expenditure. In addition, there is some limited evidence that increased intake of sweets may account in part for the increased caloric intake (Rodin 1987; Hall et al. 1989). However, because most studies relied on self report of caloric intake, additional controlled studies assuring accurate assessment of post-cessation diet are needed.

The present study was designed to examine the effects of smoking cessation on weight gain in a tightly controlled inpatient environment that allowed for careful monitoring of physical activity, caloric intake, and smoking status. The study is similar to Hatsu et al. (1984) but extends observations over a longer (10 day) post-cessation time course. We hypothesized that abstinence would eat more food and gain more weight than smokers.

Materials and methods

Subjects

Subjects were 17 healthy male smokers recruited from the community to participate in a paid inpatient study on smoking. To be eligible for the study, subjects were required to (1) be 18-25 years old; (2) report smoking at least one pack of cigarettes per day for at least 5 years; (3) weigh at least 67.5 kg (to avoid possible floor effects), and not be under- or overweight, according to the 1983 Metropolitan Height and Weight Tables; (4) report no use of mood altering drugs, with the exception of occasional use of alcohol or marijuana; (5) pass a urine screen for drugs and breathalyzer screen for alcohol; (6) report a stable lifestyle regarding living, eating, and recent weight change; (7) provide a screening breath sample with carbon monoxide readings > 20 ppm; (8) report using no more than five caffeinated beverages per day; and (9) be in good health, by self report and as determined by a physical exam (including ECG) during screening.

During the screening process, subjects were informed that smoking cessation might be required, but that they would not be informed about their smoking requirements until the end of the baseline period. Subjects were informed about and signed a statement indicating that monetary penalties would be imposed for failure to abide by study rules. Signed consent was then obtained from each subject.

Table 1 shows baseline characteristics of the 17 study participants by treatment group. There were no significant differences between the groups.

Study procedures

Eligible subjects were admitted into the hospital Clinical Research Center (CRC) in pairs and shared a room. Throughout the study, subjects were required to go to the nurses station each hour for data collection, were not allowed to sleep during the day, were allowed to engage in only non-aerobic exercise (e.g. stretching and walking), and were required to spend an average of 2 h each day engaging in light work activity, such as sorting X-rays or mail. Smoking status was verified at each hourly visit via a MiniCO breath carbon monoxide (CO) indicator (Catalyst Research Corporation, Model 1000). Breath CO readings ≥ 8 were indicative of smoking.

Between periods of data collection, subjects were allowed off the unit only to go to and from activities or to take short, supervised walks around the hospital grounds. Subjects were encouraged to bring reading or game materials with them, and were allowed to use the games, television, and a video cassette recorder maintained on the unit. Subjects were also allowed scheduled visitors.

Upon entry into the hospital, subjects began a 4-day baseline period. During the baseline period, subjects could smoke their own brand of cigarettes ad lib, but were required to get them each hour from the nurses station. When new cigarettes were passed out to the subjects, butts from the previous hour were collected and counted.

On the evening of the fourth baseline day, subjects were assigned by cohort to either smoke ad libitum (n = 8) or quit smoking (n = 9) for a period of 10 days. Subjects in the smoking condition continued collecting cigarettes (and returning butts) at the nurses station, and were allowed to smoke ad lib. Subjects in the abstinent group were not allowed to smoke after midnight on the last day of baseline. All data collection procedures remained the same as during baseline, including breath CO. Upon completion of the study, subjects were paid for their participation and released from the hospital.

Dependent measures

Body weight. Weight was measured at 7 a.m. daily using a balance beam scale.

Diet. Subjects were allowed to order unlimited food from the standard hospital menu three times a day, though retaining un eaten food was not allowed. The menu was on a 21 day rotating schedule. All but three subjects were allowed three 100 calorie snacks each day, which could be eaten at any time between 7 a.m. and 10 p.m.

Table 1. Baseline characteristics of study participants

<table>
<thead>
<tr>
<th></th>
<th>Smokers (n = 8)</th>
<th>Abstainers (n = 9)</th>
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<tbody>
<tr>
<td>Racc (% white)</td>
<td>75%</td>
<td>56%</td>
</tr>
<tr>
<td>Age</td>
<td>33.4 (3.0)</td>
<td>36.1 (2.7)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>74.7 (2.8)</td>
<td>73.4 (3.1)</td>
</tr>
<tr>
<td>Years smoked</td>
<td>17.8 (3.0)</td>
<td>20.3 (2.1)</td>
</tr>
<tr>
<td>Cigarettes per day</td>
<td>26.2 (2.6)</td>
<td>31.4 (3.5)</td>
</tr>
<tr>
<td>Breath carbon monoxide</td>
<td>37.3 (2.5)</td>
<td>38.8 (7.0)</td>
</tr>
<tr>
<td>Cigarette nicotine</td>
<td>0.9 (0.1)</td>
<td>1.1 (0.1)</td>
</tr>
<tr>
<td>Cigarette carbon monoxide</td>
<td>13.7 (0.9)</td>
<td>14.2 (0.8)</td>
</tr>
</tbody>
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Note: Values are mean (SEM)