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The Relationship Between Smoking, Body Weight, Body Mass Index, and Dietary Intake Among Thai Adults: Results of the National Thai Food Consumption Survey

Nattinee Jitnarin, PhD¹, Vongsvat Kosulwat, PhD², Nipa Rojroongwasinkul, PhD³, Atitada Boonpradern, MSc³, Christopher K. Haddock, PhD⁴, and Walker S. C. Poston, PhD⁴

¹National Development and Research Institutes, Inc, Public Health Solutions of NYC, New York, NY, USA ²Asia Pacific R&D, Mead Johnson Nutrition (Thailand) Ltd, Bangkok, Thailand ³Mahidol University, Nakhonpathom, Thailand ⁴Institute for Biobehavioral Health Research, National Development and Research Institutes, Inc, KS, USA

Abstract

This study examined the relationship between dietary intake, body weight, and body mass index (BMI) in adult Thais as a function of smoking status. A cross-sectional, nationally representative survey using health and dietary questionnaires and anthropometric measurements were used. Participants were 7858 Thai adults aged 18 years and older recruited from 17 provinces in Thailand. Results demonstrated that smoking is associated with lower weights and BMI. However, when smokers were stratified by smoking intensity, there was no dose–response relationship between smoking and body weight. There is no conclusive explanation for weight differences across smoking groups in this sample, and the results of the present study did not clearly support any of the purported mechanisms for the differences in body weight or BMI. In addition, because the substantial negative health consequences of smoking are far stronger than those associated with modest weight differences, smoking cannot be viewed as an appropriate weight management strategy.

Keywords

smoking; body weight; BMI; dietary intake; Thais

Introduction

The relationship between cigarette smoking and body weight has been studied in Western countries for more than a century, either comparing body weights between current smokers and nonsmokers or evaluating the effect of smoking on weight change over time.¹ Over the

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Corresponding Author: Nattinee Jitnarin, National Development and Research Institutes, Inc, 71 W. 23rd Street, 8th Floor, New York, NY 10010, USA. jitnarin@ndri.org.

Declaration of Conflicting Interests

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years, numerous studies support the notion that smokers tend to weigh less, have a lower body mass index (BMI), and are leaner than nonsmokers,^{2,3} and those who quit smoking are likely to gain weight.⁴ However, data regarding the relationship between smoking status and body weight or BMI in Asian or Southeast Asian samples are minimal, and studies often comprise small, nonrepresentative convenience samples.⁵

Several mechanisms have been proposed to explain the relationship between smoking and body weight, including the effects of nicotine potentially increasing metabolic rate and/or reducing overall appetite in smokers.^{1,6} A meta-analytic review of the relationship between smoking and nutrient intake demonstrated differences in dietary intake patterns between smokers and nonsmokers.^{1,6} For example, smokers had higher fat and alcohol consumption and lower intakes of fruits and vegetables than those who did not smoke.⁷ However, none of the studies reviewed in the meta-analysis included Asian samples, nor did they evaluate the differences in body weight by smoking status.

Because cigarette smoking, obesity, and smoking-related health effects have been recognized as a major public health concern, the purpose of the present study was to evaluate the relationship between smoking status, body weight, BMI, and dietary intake among Thai adults. The present study is unique because very few studies have examined these relationships in Asian samples or in Thailand in particular. In addition, Asian countries typically demonstrate substantially higher rates of smoking among men, whereas smoking rates among women tend to be very low and much lower than those reported in Western samples.⁸ This might be because of cultural and traditional values that influence female smoking behaviors in Asian countries.^{9,10}

Materials and Methods

Study Design and Selection Procedures

The Thai Food Consumption Survey (TFCS), a nationally representative, cross-sectional population-based survey, was conducted from January 2004 to February 2005. This survey was funded by the National Bureau of Agricultural Commodity and Food Standards, Ministry of Agriculture and Cooperative, Thailand. The primary aim of this survey was to evaluate food and nutrient consumption patterns in the Thai population as a whole and to evaluate regional differences.¹¹

A stratified 3-stage sampling method was used to select participants from 4 regions (or strata) of Thailand (75 provinces and Bangkok) and has been described in detail elsewhere.^{12,13} Briefly, in the first stage, all provinces in each stratum were ranked according to the average income per household, from the lowest to the highest. A systematic random sampling was used to select the representative provinces for each stratum, resulting in 17 provinces. Next, representative villages from all province samples were randomly chosen to represent the population within various ages, yielding 293 villages. Within each village, a random sample of households was drawn from the local government registers of households lists, and only 1 individual was randomly recruited from a household. Before the interview, information letters about the study were sent out to 10 255 selected households. In

sum, 7858 individuals agreed to participate and completed interviews and questionnaires, resulting in a final sample of 7858 (or a 76.6% response rate).

Eligible participants who were more than 18 years of age and who were neither pregnant nor breastfeeding were asked to participate in the study. For each individual who agreed to participate, an institutionally approved consent form was signed, and the study protocol was described. The study was approved by the institutional review board (IRB) at the Institute of Nutrition, Mahidol University in Thailand. Trained staff conducted all assessments, including the administration of a structured questionnaire, and performed a physical examination.

Measurements

A total of 7858 adults, aged 18 years and more, were interviewed. The structured questionnaire included questions regarding their basic demographic and socioeconomic status factors (eg, age, gender, marital status, basic education, and occupations), cigarette smoking habit, and alcohol consumption. Cigarette smoking status was determined by the answers to the following questions: Have you smoked? (yes/no); How old were you when you started smoking cigarettes? How many cigarettes do you smoke per day? and How old were you when you stopped smoking cigarettes? Never smokers were defined as individuals who never smoked; current smokers were defined as those who were currently smoking at the time of the study; and former smokers were defined as persons who did not smoke at the time of the survey but reported a history of smoking. In addition, current smokers were classified into 3 groups, depending on the number of cigarettes smoked per day, as follows: light smokers (1–9 cigarettes per day), moderate smokers (10–19 cigarettes per day), and heavy smokers (20 cigarettes or more per day).¹⁴

In addition, participants were asked to indicate their alcohol consumption during the last 12 months: Did you consume any kind of alcohol beverages? (yes/no). They were also asked how often, how much, and which type of alcoholic beverages they drank on average on a monthly basis. In case they consumed more than 1 type of alcoholic beverage, the drinking frequencies were summed across the 4 alcohol types (liquor, beer, wine, and rice wine). For drinking status, participants were classified into 2 main categories: nondrinkers (those who had not consumed alcoholic beverages for more than 12 months) and drinkers.

Dietary intake was recorded using the 24-hour recall method.¹⁵ All foods and drinks consumed over the previous 24-hour period were recorded. To obtain accurate information, the quantity of all foods, drinks, and supplements were estimated using measuring cups and spoons. Pictures of foods and drinks were shown to ensure that the participants reported the correct items. The cooking methods and brand names were also recorded. In addition, a food frequency questionnaire (FFQ) was administered to assess average food consumption patterns and eating habits.¹⁶ A total of 390 foods and dishes were grouped and included in the FFQ. For quality control, 20% of participants were asked to provide their dietary intake data for a second time on the next 3 days using the same instruments from a previous interview. Nutrient intake from 24-hour recall and the FFQ were entered and verified by another person and analyzed using the specialized Thai software INMUCAL-Nutrients

program (version 4.0; 2010, Institute of Nutrition, Mahidol University [INMU], Bangkok, Thailand).

Anthropometric measurement included the measurement of body weight and height, with participants wearing indoor clothes without shoes. Participants' heights and weights were measured to the nearest 0.1 cm and 0.1 kg with a portable wooden stadiometer (locally constructed, INMU, Thailand) and a digital weighing scale (CamryEB6571, Camry Electronic Ltd, Guangdong, China), respectively. BMI was calculated as weight (kg) divided by height squared (m^2) and was rounded to the nearest 0.1 kg/m^2 .

Statistical Analyses

Statistical analyses were performed using SPSS (version 16.0, 2008; SPSS Inc, Chicago, IL). ANOVA was used to examine the differences in food intake, macronutrient and micronutrient intake stratified by smoking status. Body weight and BMI were calculated and then evaluated based on smoking status and stratified by gender. A factorial ANOVA was used to examine differences in BMI by smoking status. To evaluate the effects of drinking status on the relationship between smoking status and body weight, multiple analysis of variance (MANOVA) procedures controlling for age were used. Differences in body weight and BMI between those reporting drinking or smoking and the reference group (never smokers who did not drink) were evaluated. Analyses were gender stratified because of the substantial differences in current smoking prevalence commonly reported in studies with Asian samples.^{5,17} All analyses were stratified by gender, and all statistical analyses were performed at a significance level of $P = .05$.

Results

Table 1 presents the demographic characteristics of male and female participants by smoking status. Among both genders, former smokers were older than either never smokers or current smokers, with a difference of approximately 15 years among men and almost 20 years among women. There were significant differences in smoking prevalence based on place of residence. Regardless of gender, the percentage of current smokers was higher in urban areas (39.5% and 4.5% for men and women, respectively) than in rural areas (43.5% and 2.8% for men and women, respectively). Other statistically significant differences among men were found when considering socioeconomic variables. Compared with their nonsmoking counterparts, male current smokers had less education ($P < .001$), were more likely to be employed ($P < .001$), and had lower annual household income ($P < .001$).

In addition, there were differences among women based on employment status ($P < .05$) and household income ($P < .05$), suggesting that women who smoked were more likely to be employed and had less annual household income than their nonsmoking counterparts. Interestingly, there was a statistically significant difference for education level across smoking status ($P < .001$), indicating that women who had lower education were more likely to be smokers. Finally, among those who were employed, manual laborers smoked more than those in other jobs: 53.9% versus 20.9%, $P < .001$ in men, and 35.8% versus 17.3%, $P < .01$ in women.

Tables 2 and 3 present dietary intake data for total energy and macronutrients and micronutrients stratified by gender. Among male participants, there were statistically significant differences in total energy and macronutrient intakes. Current smokers had higher total caloric intake and consumed more carbohydrates and proteins than their nonsmoking counterparts (see Table 2). However, most of the micronutrient intakes were not statistically different when stratified by smoking status. Compared with never and current smoking groups, former smokers reported consuming significantly more calcium, whereas current smokers reported higher zinc and niacin levels than those who were not smoking. When considering the contribution of macronutrients to energy, never smokers had greater proportions of energy from fat (mean [M] = 23.4%; SD = 10.2) than former (M = 21.3%; SD = 11.2) and current smokers (M = 22.0%, SD = 10.7), P < .001, but had lower proportions of total energy from carbohydrate (M = 60.9%, SD = 11.3) than their counterparts who smoked (M = 62.8%, SD = 12.6, and M = 62.2%, SD = 11.9, for former and current smokers, respectively; P < .001).

Among women, there was no significant difference in total caloric and macronutrient intake based on smoking status (see Table 3). For micronutrient intake, never smokers consumed more potassium and phosphorus than former and current smokers, whereas ex-smokers had a higher intake of zinc than others. The contributions of fat, protein, and carbohydrate to energy differed among smoking groups. Women who never smoked had greater proportions of total energy from fat (M = 23.2%, SD = 10.8) than either current (M = 21.6%, SD = 11.7) or ex-smokers (M = 20.0%, SD = 11.7); P < .05. A small, but statistically significant difference between current and never smokers was found in the proportion of food energy from protein (P < .05). Finally, women who never smoked had higher amounts of potassium and phosphorus, whereas former smokers had a higher zinc intake than other groups.

The results from an ANOVA analysis for testing the differences in BMI and body weight based on smoking status in both genders found that male smokers (M = 21.6 kg/m², SD = 3.4) had significantly lower BMIs compared with ex-smokers (M = 22.2 kg/m², SD = 3.9, odds ratio [OR] = 1.14, 95% confidence interval [CI] = 0.828-0.937) and nonsmokers (M = 22.2 kg/m², SD = 3.5, OR = 1.02, 95% CI = 0.940-1.020); P < .001 (see Table 4). Among female participants, current smokers (M = 22.1 kg/m², SD = 4.6) had lower BMIs than those who never smoked (M = 22.9 kg/m², SD = 4.4, OR = 1.06, 95% CI = 0.968-1.020); P < .05. However, significant BMI differences between former and current smokers were not observed. In terms of body weight, smokers were significantly lighter than those who did not smoke among both genders— P < .001 and P < .001 for men and women, respectively.

When stratified by number of cigarettes smoked per day, only male smokers demonstrated statistically significant differences in body weight and BMI based on the number of cigarettes smoked. Light smokers (M = 21.3 kg/m², SD = 3.4) had significantly lower BMIs than moderate smokers (M = 21.8 kg/m², SD = 3.2, OR = 1.02, 95% CI = 0.953–1.089), P < .05, and heavy smokers (M = 22.2 kg/m², SD = 3.6, OR = 1.22, 95% CI = 0.700–2.110), P < .001. The trend was similar for body weight comparison, with moderate (M = 59.8 kg, SD = 10.2, OR = 1.01, 95% CI = 0.987–1.030), P < .001, and heavy smokers (M = 61.4, SD = 10.6, OR = 1.03, 95% CI = 1.003–1.061), P < .001, being heavier than light smokers (M =

58.3, SD = 10.9). Both BMIs and body weights among male current smokers showed a positive or direct relationship with number of cigarettes smoked per day (see Table 5)

When considering alcohol consumption as a potential confounder in the relationship between smoking and body weight, and BMI, there was a significant main effect for smoking and drinking status on BMI and body weight (see Table 6). However, a statistically significant interaction between smoking and drinking status was not observed. When stratified by drinking status, among nondrinking males, never smokers ($M = 60.5$ kg, SD = 10.7; or $M = 22.1$ kg/m², SD = 3.5) were significantly heavier than smokers ($M = 58.3$ kg, SD = 10.8, and $M = 21.6$ kg/m², SD = 3.5); $P < .001$ for weight comparison and $P < .01$ for BMI comparison, respectively. The same trends were also found in nondrinking women. Current female smokers had the lowest mean body weight ($M = 51.6$ kg, SD = 12.8), $P < .001$, and BMI ($M = 21.9$ kg/m², SD = 4.9), $P < .01$. For those who were drinkers, male smokers ($M = 21.7$ kg/m², SD = 3.4) had lower BMIs than nonsmokers ($M = 22.2$ kg/m², SD = 3.2) and ex-smokers ($M = 22.8$ kg/m², SD = 4.1); $P < .001$. However, there were no statistically significant BMI or body weight differences among female drinkers with regard to smoking status.

Discussion

Data regarding the relationship between smoking status and body weight or BMI in Asian or Southeast Asian samples are minimal and typically not from nationally representative studies. Few previous studies have examined the prevalence of smoking and the association between cigarette smoking with BMI and body weight in Asia, or in Thailand specifically. However, there are numerous studies in Western countries that have examined the relationship between smoking and body weight, and they typically find that current smokers tend to have lower BMIs and body weight than former or never smokers.^{2,3} In addition, former smokers report gaining weight after stopping smoking.⁴

Several studies have attempted to determine the underlying mechanisms regarding the relationship between cigarette smoking and body weight or BMI. Differences in metabolic rates and dietary patterns among smoking groups are the 2 primary mechanisms that have the greatest acceptance.^{1,18,19} The purpose of this study was to provide valuable epidemiological data to improve our understanding of the relationship between smoking status (smokers, former smokers, and never smokers), body weight, and BMI in a large, nationally representative sample of Thai adults. A secondary aim of the present study was to evaluate the associations between dietary intake and smoking status of this population.

In the present study, the relationship between smoking status and macronutrients was statistically significant among men only. Compared with nonsmokers, male smokers actually had higher intakes of total energy (kcal), protein (g), and carbohydrate (g). This finding is consistent with other studies showing that smokers had higher energy intakes than nonsmokers.⁶ However, this finding of higher intake of total energy does not support the notion that smokers have lower body weights than nonsmokers because of the appetite-suppressing effects of smoking. It should also be noted that some studies have not documented this relationship.^{20,21} Differences in the consumption of protein, fat, and

carbohydrate by smoking status were less clear in the present study. Whereas male current smokers consumed higher amounts of protein and carbohydrate than their counterparts who smoked, there was no significant difference in those macronutrient intakes based on smoking status among female participants. A number of studies found that smokers had a higher intake of total fat and lower intake of protein and carbohydrate,²¹ but several studies did not find these differences.^{7,22}

There were few differences among the smoking categories for micronutrients in male participants. The results showed that only zinc and potassium intakes were found to be significantly different in this sample. The findings from this study were not consistent with other studies, which found lower intakes of micronutrients, specifically antioxidant vitamins, in smokers compared with nonsmokers.²³ However, studies of micronutrient intake in smokers, nonsmokers, and ex-smokers have reported inconsistent results, with both higher intake, lower intake, and no differences being reported for smokers when compared with nonsmokers.^{23,24} No consistent patterns in dietary habits were observed among women, likely because of the small number of female smokers in this sample (ie, 151 smokers among 3997 women).

It is well documented that cigarette smoking is inversely associated with body weight and BMI,^{2,3} and smoking cessation is related to weight gain.⁴ The results of the present study confirm this relationship, indicating that those who currently smoked had significantly lower BMIs than never smokers or those who had quit smoking among both genders. The trends remained the same in the whole sample (regardless of gender), with current smokers having significantly lower BMIs than nonsmokers and former smokers. These findings are consistent with several previous studies that observed the same results in military personnel both in the United States²⁵ and Thailand.²⁶

When men who smoked were divided into light, moderate, and heavy smokers, the results showed that light smokers weighed the least, and heavy smokers weighed more than moderate smokers. A similar pattern was observed in women. In the overall sample, the relationship between BMI and smoking status was nonlinear or U-shaped. This U-shaped association has been observed by previous studies.²⁷ In addition, results from a Greek study¹⁴ and a Swiss study²⁸ showed that heavy smokers had an increased risk of obesity compared with nonsmokers and tended to have higher mean BMI when compared with light smokers. Sneve and Jorde³ also reported a U-shaped relationship between BMI and number of cigarettes smoked per day. Smokers who consumed 11 to 20 cigarettes daily had the same BMI level as nonsmokers, and those who smoked more than 20 cigarettes per day had higher BMIs than those who never smoked. Although this U-shaped relationship is contradictory to the theory that smoking affects body weight through its effect on metabolism, several studies suggested that heavy smokers had higher body weight and BMI because of unhealthy lifestyles such as alcohol consumption, less exercise, and high dietary fat consumption.²⁹

It has been observed in several studies that smoking and the consumption of alcoholic beverages is correlated.^{30,31} Therefore, the higher alcohol consumption observed among smokers could influence the relationship between smoking and BMI because of energy from alcohol intake. However, there were no differences in the associations between BMI and

smoking status after adjustment for alcohol consumption in this sample, suggesting that energy intake from alcohol consumption did not have an effect on the relationship between BMI and smoking among Thai adults.

Although the present findings were consistent with several previous studies that found that smokers tended to have lower BMIs and lower body weights than nonsmokers or former smokers, there were no substantial differences in nutrient intakes based on smoking status that might help explain these weight differences in either men or women. Several other studies also have shown that dietary patterns were similar among current, former, and never smokers.^{32,33} Thus, it does not appear that differences in food intake are the likely reason for BMI and body weight differences observed in our sample. An alternate explanation for the observed differences in BMI is the potential metabolic effects of nicotine. Perkins³⁴ has suggested that nicotine intake from smoking may increase metabolic rate as the primary mechanism rather than decrease energy intake because of appetite suppression. Thus, smokers may use energy faster than nonsmokers, resulting in them having lower body weights than their nonsmoking counterparts. However, this notion also was not supported by our subanalysis of the relationship between body weight and smoking intensity among smokers only.

Several potential limitations to this study should be considered. First, the small sample size of female smokers (ie, 151 smokers among 3997 women) limited the statistical power and ability to detect differences in the study outcomes among women. In addition, female smoking is not well accepted in Asian societies, and it is not culturally appropriate for women to admit to smoking because of sociocultural beliefs and social norms,^{9,10,17} which could result in underreported smoking among women. In addition, the dietary intake data were based on self-report and may be biased by differences in the validity and/or reliability of the 24-hour recall method data. However, the 24-hour dietary recall method is considered to be one of the best methods for estimating dietary intake and, according to Margetts and Nelson,³⁵ is very effective for examining dietary patterns in large samples. Thus, this method should allow a reasonable estimate of dietary patterns among Thai people. Another limitation is that this study is a cross-sectional one, which can lead to limited study conclusions, given that the direction of the relationship between smoking and body weight ultimately cannot be determined when it cannot be established that the exposure preceded the outcome of interest. Therefore, a longitudinal study needs to be conducted to confirm the results and the causal relationship between smoking and its influence on BMI. In addition, data from a longitudinal study could provide important information regarding dietary patterns among Thais and provide more insight into food consumption trends based on smoking status over time compared with data from a cross-sectional study.

This study also had several methodological strengths. First, it was conducted in a nationally representative sample covering all geographic regions of Thailand. The data from this study can be used to calculate national prevalence estimates for a variety of health issues and have provided important insight into the issue of improving and enriching the daily diet of Thais. Next, the heights and body weights of participants were actually measured, rather than using self-reported values, resulting in much more accurate assessments of BMI than typically found in most population-based studies. It is important to note that all the survey data are

based on interviewer-administered questionnaires. It has been demonstrated that using interviewer-administered questionnaires yields more accurate results of smoking prevalence. Furthermore, because socioeconomic status information and its statistical association with smoking are discussed, the present results provided the most up-to-date and useful data to explain the relationship between social class and smoking in the Thai population.

Conclusion

This study of the general population in Thailand showed that smokers have lower body weight and BMIs than their nonsmoking counterparts. These findings are consistent with those of many previous studies. Differences based on smoking status in body weight could not be explained by the differences in dietary intake patterns. Based on data from the present study, it is possible that nicotine intake may increase metabolic rate and therefore increase energy expenditure enough to affect BMI. However, others have noted that weight differences associated with smoking status are less than those that could be achieved with diet and exercise.³² In addition, because the substantial negative health consequences of smoking are far stronger than those associated with modest weight differences, smoking cannot be viewed as an appropriate weight management strategy.

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Table 1Demographic Characteristics of Participants According to Smoking Status.^a

Variables	Smoking Status				P Value
	Total (n = 7858)	Never (n = 5603)	Former (n = 511)	Current (n = 1744)	
Men	n = 3861	n = 1805	n = 463	n = 1593	
Age (years)	47.1 ± 20.8	44.9 ± 21.6	60.4 ± 17.2	45.6 ± 19.3	< .001
Any alcohol consumption	1510 (39.5)	460 (25.9)	157 (34.3)	893 (56.3)	< .001
Place of residence					.016
Urban	2159 (55.9)	1053 (58.3)	253 (54.6)	853 (53.5)	
Rural	1702 (44.1)	752 (41.7)	210 (45.4)	740 (46.5)	
Education level					< .001
Elementary	2292 (59.6)	934 (52.0)	334 (72.5)	1024 (64.4)	
Secondary	1301 (33.8)	676 (37.6)	112 (24.3)	513 (32.2)	
High	255 (6.6)	186 (10.4)	15 (3.2)	54 (3.4)	
Employment status					< .001
Employed	2522 (66.0)	1084 (61.0)	252 (55.1)	1186 (74.9)	
Retired	466 (12.2)	193 (10.9)	126 (27.6)	147 (9.3)	
Unemployed	831 (21.8)	501 (28.1)	79 (17.3)	251 (15.8)	
Annual household income (\$)	3203.0 ± 3288.9	3451.7 ± 3327.6	3235.9 ± 4234.6	2913.4 ± 2887.1	< .001
Women	n = 3997	n = 3798	n = 48	n = 151	
Age (years)	47.1 ± 20.3	46.6 ± 20.4	66.6 ± 13.9	54.2 ± 17.2	< .001
Any alcohol consumption	281 (7.1)	231 (6.2)	6 (12.8)	44 (29.5)	< .001
Place of residence					.023
Urban	2238 (56.0)	2110 (55.6)	27 (56.2)	101 (66.9)	
Rural	1759 (44.0)	1688 (44.4)	21 (43.8)	50 (33.1)	
Education level					< .001
Elementary	2627 (65.9)	2453 (64.8)	45 (93.8)	129 (85.4)	
Secondary	1073 (26.9)	1049 (27.7)	2 (4.2)	22 (14.6)	
High	286 (7.2)	285 (7.5)	1 (2.1)	0	
Employment status					.034

Variables	Smoking Status				P Value
	Total (n = 7858)	Never (n = 5603)	Former (n = 511)	Current (n = 1744)	
Employed	2019 (55.9)	1918 (56.2)	21 (43.8)	80 (53.3)	
Retired	442 (12.2)	416 (12.2)	12 (25.0%)	14 (9.3)	
Unemployed	1149 (31.8)	1078 (31.6)	15 (31.2%)	56 (37.3)	
Annual household income (\$)	3099.6 ± 3137.0	3130.1 ± 3135.0	2410.5 ± 2348.1	2558.9 ± 3344.9	.030

^aValues are means ± standard deviation or n (%).

Table 2Mean of Nutrient Intake Among Male Participants According to Smoking Status.^a

Energy and Nutrients	Smoking Status			P Value
	Never (n = 1805)	Former (n = 463)	Current n = 1593)	
Energy (kcal)	1505.9 ± 607.5	1483.2 ± 636.6	1594.9 ± 646.8	<.001
Total fat (g)	39.5 ± 25.7	35.8 ± 28.6	38.5 ± 27.0	.031
Protein (g)	57.7 ± 26.8	57.5 ± 29.6	60.5 ± 28.7	.007
Carbohydrate (g)	227.2 ± 103.0	230.2 ± 110.7	242.2 ± 113.5	<.001
Percentage energy from fat	23.4 ± 10.2	21.3 ± 11.2	22.00 ± 10.7	<.001
Percentage energy from protein	15.7 ± 4.5	15.8 ± 4.8	15.8 ± 4.5	.590
Percentage energy from carbohydrate	60.9 ± 11.3	62.8 ± 12.6	62.2 ± 11.9	<.001
Cholesterol (mg)	222.4 ± 184.3	192.8 ± 186.9	221.3 ± 206.8	.010
Potassium (mg)	1293.7 ± 626.4	1278.9 ± 690.6	1323.5 ± 657.4	.272
Calcium (mg)	286.2 ± 236.6	328.6 ± 308.5	296.4 ± 250.6	.005
Copper (mg)	0.5 ± 0.4	0.5 ± 0.4	0.5 ± 0.4	.121
Sodium (mg)	3388.2 ± 2445.1	3219.9 ± 2441.3	3627.7 ± 6021.9	.113
Iron (mg)	10.1 ± 9.9	9.4 ± 5.9	10.3 ± 8.2	.148
Phosphorus (mg)	638.4 ± 322.1	630.0 ± 348.8	660.2 ± 332.4	.083
Zinc (mg)	2.8 ± 2.6	2.9 ± 2.7	3.2 ± 3.0	.003
Vitamin A (µg)	491.7 ± 1556.8	430.3 ± 1495.9	559.9 ± 2491.1	.389
Vitamin B ₁ (mg)	1.1 ± 1.0	1.0 ± 1.0	1.0 ± 1.0	.091
Vitamin B ₂ (mg)	0.8 ± 0.5	0.7 ± 0.5	0.8 ± 0.6	.110
Niacin (mg)	15.4 ± 7.3	15.0 ± 7.6	16.4 ± 7.7	<.001
Vitamin C (mg)	46.9 ± 56.9	48.3 ± 56.8	45.1 ± 54.6	.451

^aValues are means ± standard deviation.

Table 3Mean of Nutrient Intake Among Female Participants According to Smoking Status.^a

Energy and Nutrients	Smoking Status			P Value
	Never (n = 3798)	Former (n = 48)	Current (n = 151)	
Energy (kcal)	1279.6 ± 543.7	1264.7 ± 623.9	1315.9 ± 579.6	.709
Total Fat (g)	33.8 ± 23.8	27.6 ± 21.9	33.6 ± 29.0	.203
Protein (g)	50.1 ± 25.9	45.8 ± 23.5	49.2 ± 26.4	.493
Carbohydrate (g)	193.2 ± 90.9	207.3 ± 116.7	198.1 ± 86.3	.471
c energy from fat	23.2 ± 10.8	20.0 ± 11.7	21.6 ± 11.7	.030
Percentage energy from protein	15.9 ± 4.9	14.9 ± 4.1	15.1 ± 4.2	.050
Percentage energy from carbohydrate	60.9 ± 12.0	65.1 ± 12.1	63.3 ± 13.39	.004
Cholesterol (mg)	184.0 ± 172.6	151.8 ± 134.3	175.1 ± 180.8	.366
Potassium (mg)	1150.4 ± 622.4	933.5 ± 411.4	1095.8 ± 659.9	.034
Calcium (mg)	295.4 ± 296.3	252.3 ± 220.2	282.5 ± 263.7	.530
Copper (mg)	0.4 ± 0.4	0.5 ± 0.4	0.5 ± 0.5	.103
Sodium (mg)	3194.2 ± 2752.5	2540.8 ± 1621.3	2919.8 ± 2052.2	.127
Iron (mg)	9.3 ± 8.5	8.3 ± 5.3	8.7 ± 5.9	.507
Phosphorus (mg)	568.7 ± 322.2	455.1 ± 209.2	550.5 ± 394.5	.045
Zinc (mg)	2.4 ± 2.2	3.27 ± 2.79	2.8 ± 2.5	.002
Vitamin A (µg)	410.6 ± 1733.2	186.07 ± 336.50	397.1 ± 1274.2	.662
Vitamin B ₁ (mg)	0.9 ± 0.9	0.7 ± 0.5	0.9 ± 0.9	.080
Vitamin B ₂ (mg)	0.7 ± 0.5	0.6 ± 0.4	0.7 ± 0.6	.183
Niacin (mg)	12.7 ± 6.9	10.5 ± 4.9	12.4 ± 8.1	.075
Vitamin C (mg)	52.4 ± 66.4	51.3 ± 67.3	46.7 ± 51.7	.578

^aValues are means ± standard deviation.

Table 4Mean Body Weight, BMI, and Odds Ratios (95% Confidence Intervals) by Smoking Status.^a

	Smoking Status		
	Never	Former	Current
Men (n = 3852)	n = 1802	n = 461	n = 1589
Weight (kg)	60.9 ± 10.7 ***	60.1 ± 11.6	59.2 ± 10.6
	1.01 (0.978–1.004)	1.03 (1.009–1.051) *	
BMI (kg/m ²)	22.2 ± 3.5 ***	22.2 ± 3.9 ***	21.6 ± 3.4
	1.02 (0.940–1.020)	1.14 (0.828–0.937) ***	
Women (n = 3990)	n = 3792	n = 47	n = 151
Weight (kg)	55.2 ± 11.1 **	50.4 ± 11.8	52.2 ± 12.1
	1.05 (0.921–0.991) *	1.05 (0.970–1.131)	
BMI (kg/m ²)	22.9 ± 4.4 *	21.6 ± 4.7	22.1 ± 4.6
	1.06 (0.968–1.155)	1.09 (0.752–1.112)	

^aValues are means ± standard deviation. Significant difference from current smokers:* $P < .05$;** $P < .01$;*** $P < .001$.

Table 5

Mean Body Weight, BMI, and Odds Ratios (95% Confidence Intervals) by Number of Cigarettes Smoked per Day Among Smokers.^a

	Numbers of Cigarettes per Day		
	1–9	10–19	20
Men (n = 1554)	n = 757	n = 564	n = 233
Weight (kg)	58.3 ± 10.9	59.8 ± 10.2 **	61.4 ± 10.6 ***
		1.01 (0.987–1.030)	1.03 (1.003–1.061)*
BMI (kg/m ²)	21.3 ± 3.4	21.8 ± 3.2 *	22.2 ± 3.6 ***
		1.02 (0.953–1.089)	1.02 (0.896–1.070)
Women (n = 146)	n = 112	n = 30	n = 4
Weight (kg)	51.7 ± 11.8	54.5 ± 14.1	58.7 ± 5.9
		1.04 (0.952–1.140)	1.02 (0.793–1.204)
BMI (kg/m ²)	21.9 ± 4.5	22.8 ± 5.2	24.9 ± 3.8
		1.06 (0.738–1.200)	1.22 (0.700–2.110)

^aValues are means ± standard deviation. Significant difference from light smokers (1–9 cigarettes per day):

* $P < .05$;

** $P < .01$;

*** $P < .001$.

Table 6Mean Body Weight and BMI among Participants by Smoking and Drinking Status.^a

Drinking Status	Smoking Status	n	Weight (kg)	BMI (kg/m ²)
Men (n = 3810)				
Nondrinkers	Never	1312	60.5 ± 10.7 ***	22.1 ± 3.5 ***
	Former	299	58.9 ± 10.9	21.9 ± 3.7
	Current	692	58.3 ± 10.8	21.6 ± 3.5
Drinkers	Never	460	61.9 ± 10.0 ***	22.2 ± 3.2 *
	Former	157	62.3 ± 12.3 *	22.8 ± 4.1 ***
	Current	890	59.9 ± 10.4	21.7 ± 3.4
Women (n = 3935)				
Nondrinkers	Never	3510	55.2 ± 11.1 ***	22.9 ± 4.5 *
	Former	40	49.2 ± 10.7	21.1 ± 4.39
	Current	105	51.6 ± 12.8	21.9 ± 4.9
Drinkers	Never	230	55.1 ± 11.1	22.8 ± 4.4
	Former	6	57.7 ± 17.6	24.8 ± 6.6
	Current	44	53.7 ± 10.7	22.4 ± 3.9

^aValues are means ± standard deviation. Significant difference from current smokers:* $P < .05$,** $P < .01$,*** $P < .001$.