Original Article

The association between amount of cigarettes smoked and overweight, central obesity among Chinese adults in Nanjing, China

Fei Xu MD, PhD, BEcon[1], Xiao-Mei Yin BM[1] and Youfa Wang MD, PhD[2]

[1]Nanjing Municipal Center for Disease Control & Prevention, P.R. China
[2]Center for Human Nutrition, Department of International Health, Bloomberg School of Public Health, Johns Hopkins University, USA

Objectives: To examine the association between overweight, central obesity and cigarette smoking (total amount of cigarettes smoked [TACS] and status).
Design: Population-based cross-sectional study.
Setting: Administrative villages and neighborhoods (n=45) randomly selected from three urban districts and two rural counties in Nanjing City, China.
Subjects and methods: A representative sample (n=13,463) of permanent local male residents aged 35 years or older; 66.5% were urban residents. The response rate was 90.1%. Overweight (BMI>=24) and central obesity (waist circumference>=85 in men) were defined according to the new Chinese standard. The association between smoking (amount and status) and obesity was examined using logistic and linear regression analysis.
Results: The overall prevalence of overweight was 36.1% (29.7% with 24<=BMI<28 and 6.4% with BMI>=28). After adjusted for age, residence, education, occupation, family income, alcohol drinking, dietary intake, occupational and leisure-time physical activity, the prevalence was significantly lower among current smokers (33.0%) than in non-smokers (39.9%) and ex-smokers (39.2%), respectively ($p<0.05$). The amount of cigarette smoked was reversely associated with BMI (compared to non-smokers, ORs and 95%CIs for smokers with low-, medium- and high-TACS were 0.88 [0.79, 0.98], 0.77 [0.69, 0.86], and 0.77 [0.69, 0.86], respectively). The prevalence of central obesity was 35.9%. Compared to nonsmokers, only male ex-smokers were at increased risk of central obesity (OR=1.38, 95%CI=1.10, 1.74), while there was no significant association with current-smokers (OR=1.02 [0.92, 1.12]). The amount of cigarette smoked was not significantly associated with central obesity.
Conclusions: Cigarette smoking was negatively associated with body weight indicated by BMI but not with central obesity indexed by waist circumference in Chinese men. Cessation of smoking may increase the risk of gaining overall body weight and developing central obesity. Cigarette smoking prevention and cessation should be a public health priority in China.

Key Words: overweight, body mass index, waist circumference, cigarette smoking, prevention, cessation, China, Nanjing

Introduction

The prevalence of cigarette smoking among adult men was 63.0% in Mainland China, the largest producer and consumer of cigarettes in the world.[1, 2] The prevalence of overweight is increasing in China similar as worldwide.[3,4] The evidence shows that smoking is associated with lower body weight and cessation of smoking is associated with weight gain are predominately based on data collected in population in Western societies.[5-9] To our knowledge, limited investigation has been conducted using representative data collected in developing countries.

The goal of the present study is to examine the association between overweight, central obesity, and smoking among adults in China. We aim to study both the impact of total amount of cigarettes people smoked and their smoking status (i.e., current and ex-smokers). According to a national population study, the smoking rate among women is 3.8%,[10] and the figure was only 2.0% among female subjects of this survey. Thus, the present study focuses on men. Our study is designed to quantify the relationship and to test whether it varies by age. The data collected in Nanjing City between October 2000 and March 2001 were used in our analysis.

Materials and methods

Study sample

A large-scale, population-based cross-sectional study was conducted in Nanjing City, which is the capital of Jiangsu province, and is located in eastern China, with a population of about 5.6 million.

Corresponding Author: Assistant Professor Youfa Wang, Center for Human Nutrition, Department of International Health, Bloomberg School of Public Health, Johns Hopkins University, 615 N. Wolfe Street, Baltimore, MD 21205, USA.
Tel: 410-502-3102; Fax: 410-955-0196
Email: ywang@jhsph.edu
Manuscript received 14 June 2006. Revision accepted 14 August 2006.

A total of 27,168 adults (13,463 men, 13,705 women) from 15,300 households participated in the survey. The response rate among eligible adults was 90.1%. There were no significant differences in their demographic characteristics between respondents and non-participants. The final sample was representative of the city population. In Mainland China, the administrative system consists of five strata: central government, provincial/municipal government, district/county government, street/town government and administrative villages. Nanjing city has 15 administrative units: 10 urban districts and 5 rural counties. The administrative street/village-based samples were selected using a multi-stage sampling method. We first randomly selected three urban districts and two rural counties; then three streets/towns from each chosen district/county; and finally, three neighborhoods or administrative villages in each street/town. This resulted in a total of 45 neighborhoods and villages. Participants aged 35 years or over and had been local residents for at least 5 years in all those 45 neighborhoods and villages were included in our analysis. One month before the household interview, administrators of street, town and administrative village governments were visited and informed. Then with their consent and support, we advertised our program via local TV broadcasting, and sent flyers to each household. Informed personal consent was obtained before household interview.

Quality Control

All the questionnaires were pilot tested before being finalized for use in the survey. All measurement equipments were purchased from the same factory with the same brand and lot number. They were adjusted by a designated investigator each time before use in the field. All interviewers were registered public health professionals with at least a college degree. Two epidemiologists served as quality supervisors to help ensure quality control. These supervisors and interviewers were trained. As part of the training, they were required to conduct a simulative and field pilot interview. Only those who passed these tests were selected to be investigators.

Data collection

Each subject was interviewed by trained healthcare professionals. The questionnaire included questions about the participant's smoking status and amount of cigarettes smoked, general sociodemographic information such as age, gender, area of residence, education, occupation, number of family members, total monthly family income, as well as other specific questions related to physical activity, use of cooking oil, alcohol drinking, and consumption of red meat.

Body weight and height were measured by health-care professionals at designated GP clinics. For a small number of participants who could not attend the examination at GP clinics they were measured at their homes. Participants, wearing light indoor clothing and without shoes, had their weight measured to the nearest 0.1 kilograms using a beam balance scale, and height measured to the nearest 0.01 meter using a stadiometer (Wuxi Weight Factory, Wuxi City, Jiangsu, China). Body mass index (BMI) was calculated by dividing weight (kg) by the square of height (m). Waist circumference (WC) was measured using a non-elastic flexible tape at the midpoint between costal inferior and iliac crest. Hip circumference was measured as the longest girth of hip. Waist-hip ratio (WHR) was calculated by dividing WC by hip circumference. Weight, height, WC, and hip circumference were measured twice and the means of the readings were used in our analysis.

Main study variables

1) Overweight and central obesity: Participants' body weight status was the primary outcome variable. Overweight and central obesity were defined according to the recently released Chinese BMI reference[11, 12]. Participants were classified as non-overweight (BMI<24) and overweight (BMI>=24). Central obesity was defined using WC>=85cm for men. In addition, we also used WHR (>=0.90 for men) to define central obesity.[11, 12]
2) Smoking status: The categories of smoking status were defined as: a) current smoker: smoked at least one cigarette per day continuously for at least one year, or smoked at least eighteen packs in total each year; b) ex-smoker: previously smoked, but subsequently quit smoking for more than one year; and c) non-smokers: those who did not meet the criteria for either current smokers or ex-smokers[10]. Both current smokers and ex-smokers were asked to report the usual number of cigarettes smoked per day and smoking years. Further, the total amount of cigarettes smoked (TACS) was calculated as TACS=(number of cigarettes smoked/per day)*(number of smoking days). TACS tertiles were created to indicate low-, medium- and high-level of smoking. Therefore, participants were categorized into four groups: non-smokers, and smokers with low-, medium- and high-TACS.
3) Age groups: Participants were classified into three age groups: younger (35-49 years), middle (50-64 years) and older (>=65 years).
4) Family income: The total monthly family income was the monthly total earnings of all family members; included salaries, pensions and allowances, income from selling goods and products. For farmers, the estimated market-price value of products consumed by the family was also added. Family average income (FAI): families were grouped using per capita family income tertiles (in Chinese Yuan), low-income (Mean±SE=144.63±0.47), middle-income (Mean±SE=327.11±0.70) and high-income (Mean±SE=815.38±4.66).[13] A family was defined as a group who lived together and shared living-related expenses.
5) Occupation: Subjects' were grouped into blue collar (farmer, factory worker, forestry worker, and fisher), service people (salesperson, house worker) and white collar (office worker, teacher, doctor, and retired people).
6) Other variables: Participants were also categorized into different groups based on the following variables: a) Education, 0-9 yrs, 10-12 yrs and 13+ yrs; b) Occupational physical activity: 'light' (receptionist, office worker, assembly worker), 'moderate' (repairer, electrician, machinist) and 'vigorous' (farmer, steel-maker, lumberman); c) Leisure-time physical activity: 'light' (cooking, flower-growing, watching TV), 'moderate' (jogging, dancing, Chinese Taiji) and 'vigorous' (ball-playing, field-running); and d) Drinkers: Regular users, those who drank alcohol at least 2 times per week on average, for at

least 1 year. Ex-drinkers, those who previously drank, but had not drunk for at least one year. Non-drinkers were those who never drank, or drank occasionally in the past year but less than 2 times per week.

Statistical analysis

First, we calculated the prevalence of overweight and central obesity in each population group. Next, we examined the associations between overweight, central obesity, smoking status, and TACS categories using logistic regression analysis. Potential confounders including age, urban-rural residence, education, occupation, family income, alcohol drinking, cooking oil consumption, red meat consumption, vegetable consumption, occupational and leisure-time physical activity were adjusted for in the models. We calculated odds ratios (ORs) and the 95% Confidential Intervals (CIs). Further, we examined the relationship between BMI, waist circumference, and packs of cigarettes smoked, which were treated as continuous variables using linear regression models. Because only a small number of women were current or former smokers (see below) and no significant association between smoking and body weight status was found in women, the present report focused on the 13,463 male participants. Data were double-entered and cleaned using Epi Info (Version 6.04, 2002; CDC, Atlanta, Georgia, USA). Data management and analysis was conducted using SPSS (Version 10.0, 2000; SPSS Chicago, Illinois, USA).

Results

Demographic characteristics of the study participants

Of the 27,168 participants, 49.55% were males. Among male participants, 54.7% were current-smokers and 4.1% were ex-smokers, while in women, the figures were 2.0% and 0.1%, respectively. For male current smokers, the mean±SD of cigarettes smoked per day was 16.9±8.7; and over half (55.1%) of the smokers smoked>=1 pack/day. The selected demographic characteristics of participants were presented in Table 1.

Prevalence of overweight according to participants' smoking status and demographic characteristics

Table 2 presents the prevalence of overweight according to participants' smoking status and TACS levels by age and urban-rural residence. The overall prevalence of overweight was 36.1% (29.7% with 24<=BMI<28 and 6.4% with BMI>=28). The prevalence was significantly lower among current smokers (33.0%) than in non-smokers (39.9%) and ex-smokers (39.2%), respectively (p<0.05).

The highest proportion of excess body weight was found among all middle-aged subjects (50-64 yrs) regardless of their smoking status, and the prevalence of overweight was significantly higher in urban areas than in rural areas within each smoking category.

Table 1. Demographic characteristics of the 13,463 male participants

Variables		% (N)
Age	35-49	44.5 (5995)
	50-64	34.9 (4696)
	65+	21.6 (2772)
Residence	Urban	66.5 (8949)
	Rural	33.5 (4514)
Education	0-9	62.3 (8393)
	10-12	20.0 (2691)
	13+	17.7 (2379)
Occupation*	Blue collar	57.0 (7668)
	Service people	8.3 (1122)
	White collar	34.7 (4673)
Smoking Status	Non-smokers	41.3 (5557)
	Ex-smokers	4.1 (548)
	Current smokers	54.7 (7358)

*Blue collar = farmer, factory worker, forestry worker, fisher; Service people = salespeople, house worker; White collar = office worker, teacher, doctor and retired people.

Table 2. Prevalence (%) of overweight (BMI>=24) among Chinese men, by smoking status, TACS level, age, and urban/rural residence

		Smoking Status (%)			TACS Tertiles among smokers (%n/N)		
		Non-smoker (5557)	Ex-smokers (548)	Current-smokers (7358)	Lower- TACS (2593)	Middle- TACS (2661)	Upper-TACS (2652)
Overall		39.9 (2217/5557)	39.2 (215/548)	33.0 (2431/7358)	37.8 (979/2593)	32.5 (864/2661)	30.3 (803/2652)
Age	35-49	39.3 (844/2147)	39.0 (39/100)	33.5 (1257/3748)	37.7 (645/1710)	29.7 (462/1556)	32.5 (189/582)
	50-64	42.6 (837/1966)	45.0 (86/191)	35.4 (898/2539)	40.6 (265/652)	37.8 (292/772)	32.7 (427/1306)
	65+	37.1 (536/1444)	35.0 (90/257)	25.8 (276/1071)	29.9 (69/231)	33.0 (110/333)	24.5 (187/764)
Residence	Urban	45.6 (1884/4131)	51.3 (173/337)	41.6 (1863/4481)	42.9 (794/1849)	41.2 (671/1630)	42.6 (571/1339)
	Rural	23.4 (333/1426)	19.9 (42/211)	19.7 (568/2877)	24.9 (185/744)	18.7 (193/1031)	17.7 (232/1313)

TACS=Total amount of cigarette smoked.

Table 3. The association between overweight, central obesity and smoking (OR and 95% CI) in Chinese men

		Overweight (BMI>=24)		Central obesity (waist>=85cm)	
		Prevalence (%)	Adj OR (95% CI)*	Prevalence (%)	Adj OR (95% CI)*
TACS	Level				
	Non-Smokers (ref)	39.9 (2217/5557)	1.00	39.4 (2189/5557)	1.00
	Lower	37.8 (979/2593)	0.88 (0.79, 0.98)	35.9 (932/2593)	0.94 (0.92, 1.05)
	Middle	32.5 (864/2661)	0.77 (0.69, 0.86)	32.3 (860/2661)	0.92 (0.82, 1.02)
	Upper	30.3 (803/2652)	0.77 (0.69, 0.86)	32.3 (857/2652)	0.97 (0.87, 1.08)
Smoking	Status				
	Non-Smoker (ref)	39.9 (2217/5557)	1.00	39.4 (2189/5557)	1.00
	Ex-Smoker	39.2 (215/548)	1.05 (0.87, 1.27)	45.1 (247/548)	1.38 (1.10, 1.74)
	Current-Smoker	33 (2431/7358)	0.79 (0.73, 0.86)	32.6 (2402/7358)	1.02 (0.92, 1.12)

TACS=Total amount of cigarette smoked. *Adjusted for age, urban-rural residence, education, occupation, family average income, alcohol drinking, consumption of cooking oil, red meat and vegetable, occupational physical activity, and leisure-time physical activity in our logistic regression models.

Table 4. The association between overweight, central obesity and smoking in Chinese men, by urban and rural residence

	Overweight (BMI>=24)		Central obesity (waist>=85cm)	
	Prevalence (%)	Adj OR (95% CI)*	Prevalence (%)	Adj OR (95% CI)*
Urban				
TACS Level				
Non-Smoker	45.6 (1884/4131)	1.00	47.6 (1965/4131)	1.00
Lower	42.9 (794/1849)	0.87 (0.77, 0.97)	44.3 (820/1849)	0.96 (0.85, 1.08)
Middle	41.2 (671/1630)	0.81 (0.71, 0.91)	43.8 (714/1630)	0.94 (0.83, 1.06)
Upper	42.6 (571/1339)	0.83 (0.72, 0.95)	49.1 (657/1339)	1.01 (0.88, 1.15)
Smoking status				
Non-Smoker (ref)	45.6 (1884/4131)	1.00	47.6 (1965/4131)	1
Ex-Smoker	51.3 (173/337)	1.13 (0.90, 1.42)	62.9 (212/337)	1.52 (1.20, 1.93)
Current-Smoker	41.6 (1863/4481)	0.81 (0.74, 0.89)	44.2 (1979/4481)	0.93 (0.84, 1.02)
Rural				
TACS Level				
Non-Smoker	23.4 (333/1426)	1.00	15.7 (224/1426)	1.00
Lower	24.9 (185/744)	0.90 (0.72, 1.12)	15.1 (112/744)	0.87 (0.67, 1.13)
Middle	18.7 (193/1031)	0.67 (0.54, 0.82)	14.2 (146/1031)	0.83 (0.66, 1.06)
Upper	17.7 (232/1313)	0.68 (0.56, 0.83)	15.2 (200/1313)	0.87 (0.70, 1.09)
Smoking status				
Non-Smoker (ref)	23.4 (333/1426)	1.00	15.7 (224/1426)	1.00
Ex-Smoker	19.9 (42/211)	0.87 (0.60, 1.26)	16.6 (35/211)	1.03 (0.69, 1.55)
Current-Smoker	19.7 (568/2877)	0.72 (0.61, 0.85)	14.7 (423/2877)	0.85 (0.70, 1.02)

TACS=Total amount of cigarette smoked. *Adjusted for age, education, occupation, family average income, alcohol drinking, consumption of cooking oil, red meat and vegetable, occupational physical activity, and leisure-time physical activity in our logistic regression models.

Association between smoking and overweight

We studied the association between overweight and smoking using the total amount of cigarettes people smoked (TACS=pack year). We compared the average number of cigarettes smoked by participants of different weight status. With logistical regression analysis we tested the association between TACS, smoking status and overweight (see Table 3). After adjusted for potential confounders, current smokers were less likely to be overweight than non-smokers (OR = 0.79, 95% CI = 0.73, 0.86). Ex-smokers were not at increased risk of overweight compared to nonsmokers (OR=1.05, 95% CI=0.87, 1.27) but were more likely to gain overall body weight than current-smokers (OR=1.33, 95% CI=1.09, 1.62). Our analysis suggests a linear trend in the reverse association between TACS and overweight. The adjusted OR decreased from 0.88 from low-TACS to 0.77 in high-TACS. We also conducted the analysis stratified by urban and rural residence. In both urban and rural area, compared to non-smokers, current smokers and smokers with higher TACS level were less likely to be overweight (Table 4).

To further explore the association between body weight and the amount of cigarettes smoked, we conducted linear regression analysis using BMI as the outcome variable and packs of cigarettes smoked (TACS) as the exposure variable (Table 5). Smoking could only explain a very small proportion (3.9%) of the variation in the participants' BMI. BMI was negatively associated with packs of cigarettes smoked ($p<0.05$). On average, an increase of 1 pack was associated with 0.006 unit decrease in BMI.

Table 5. The association between BMI and total amount of cigarette smoked (TACS) in Chinese men *

	β	SE	*p* value
Model 1			
TACS (pack year)	-0.006	0.002	0.005
Model 2**			
Low TACS Tertile	-0.157	0.100	0.116
Medium TACS Tertile	-0.348	0.010	0.000
High TACS-Tertile	-0.228	0.101	0.024

* Age, urban-rural residence, education, occupation, family average income, alcohol drinking, consumption of cooking oil, red meat and vegetable, occupational physical activity, and leisure-time physical activity were controlled for in the linear regression models. ** Non-smokers were the reference group.

However, the association was not a linear one. Thus, we also conducted analysis using TACS tertiles. Compared to non-smokers, male smokers in the medium- and upper-TACS tertiles had BMIs lowered by 0.35 and 0.23 unit, respectively.

Association between smoking and central obesity

Central obesity (reflects the amount of abdominal fat) is a good predictor of the risk of cardiovascular disease and type 2 diabetes.[14-16] It is recommended that WC is a better measure of central obesity than WHR,[14,15] and the US National Institutes of Health (NIH) recommends using WC, but not WHR[14]. The prevalence of central obesity was 35.9% among this sample population. Using similar approaches, we studied the association between central obesity and smoking. Different from overweight, based on BMI, no significant difference was found between the prevalence of central obesity among non-smokers and current-smokers (OR=1.02, 95% CI =0.92, 1.12) However, male ex-smokers were more likely to have central obesity than non-smokers and current-smokers, respectively (OR=1.38, 95%CI=1.10, 1.74 and OR=1.53, 95% CI=1.25, 1.87, respectively). Central obesity assessed using WC was not inversely associated with the amount of cigarettes smoked in men (Table 3). Our linear regression analysis did not detect any statistically significant association between WC and TACS in men (β=-0.002, *p*=0.80). The association between WHR and smoking was not statistically significant (see Appendix).

Discussion

In the present study, we studied the relationship between cigarette smoking and excess body weight using data collected from a large male Chinese sample (n=13,463) in Mainland China. Most previous studies that have reported a negative association between smoking and body weight have been conducted in Western countries. Further, in many of these studies, data on the amount of cigarettes smoked were not available, and thus the research subjects were simply classified as non-smokers, ex-smokers and current-smokers. To examine the relationship, besides testing the association between smoking status (categorized as non-smokers, ex-smokers and current-smokers) and overweight, we also examined the relationship by using a quantitative measure of smoking, total number of cigarettes smoked. This allowed us to provide quantitative estimates of the association between smoking and body weight. Our findings provide a number of important insights into the relationship between smoking and obesity.

Our findings of an inverse association between smoking and BMI in Chinese men are consistent with those of previous studies predominately based on data collected from industrialized communities.[5-9] Compared with non-smokers, current-smokers were less likely to be overweight. The dose-response relationship between the number of cigarettes smoked and overweight found in our sample provides stronger evidence. Among these male participants, we found a gradient decrease in the adjusted ORs (ORs = 0.88, 0.77, and 0.77 for smokers with lower-, middle- and upper-TACS levels compared to non-smokers, respectively). Our linear regression analysis based on continuous variables, body mass index and packs of cigarettes smoked, yielded consistent findings of an inverse association between body weight and the amount of cigarettes smoked in men.

The dose-response relationship we detected between the number of cigarettes smoked and overweight in this large Chinese sample may indicate that the amount of cigarettes, rather than the behavior of smoking alone, affects weight gain. Based on their findings, few socio-demographic or behavioral characteristics were the predictors of weight gain among U.S. respondents who quit smoking. Flegal and her colleagues argued that weight gain after smoking cessation was a physiologic rather than a behavioral change effect.[5]

In our study, after controlling for a number of eating and physical activity variables, we found that ex-smokers were at higher risk of gaining overall body weight relative to current-smokers, and that compared to nonsmokers and current-smokers, ex-smokers were more likely to have central obesity. This added to the evidence that cessation of smoking is associated not only with overall overweight (i.e. elevated BMI) but also with central obesity indicated by WC. On average, the ex-smokers in our sample had quit smoking for 7.56 years. It is likely that at the time of our survey most ex-smokers had adapted regular lifestyles and behaviors after quitting smoking a number of years ago. Our findings may suggest that smoking has a longer-term effect on central obesity than on overall obesity assessed using BMI. Prospective studies are needed to test this hypothesis.

An important implication of our findings is that smoking status should be considered when one studies the influences of body weight status on health outcomes, especially in populations where smoking is prevalent. Otherwise, the findings may be misleading. This is because smoking is an important potential confounder that can bias information about the association between body weight and health outcomes.

A limitation of our study is that smoking years and the number of cigarettes smoked were self-reported. Participants were asked to report how long they had smoked and how many cigarettes they smoked on a typical day. The number of cigarettes smoked by the same subject might be different at different times. Therefore, misclassifications could happen when we used the self-reported information. In addition, the cross-sectional nature of our data does not allow us to test causality.

Smoking has a large number of adverse effects on health. The health benefits of smoking cessation far exceed the risks of body weight gain.[17-21] Therefore, it is very important to prevent the initiation of smoking in young people and to encourage smoking cessation among smokers, although present efforts to prevent weight gain after smoking cessation through the use of nicotine gum or behavioral weight-control programs are not successful.[22,23] Considering the current high prevalence of smoking in men,[1] and the rise of overweight in China,[4,24,25] China should make great effort to address these two major public health threats. Effective health education programs and related government regulations should be developed and implemented to reach all people at risk. The efforts are likely to be more effective if targeted at people of younger ages to help them to develop lifelong healthy lifestyle habits. Based on successful experience in controlling smoking gained in other countries such as the Untied States, the central government should play an important role in these efforts, in particular, to develop and implement new regulations to regulate the production and marketing of cigarettes and to prohibit smoking in public areas. In conclusion, our results suggest that cigarette smoking was negatively associated with overall body weight indicated by BMI, but not significantly linked with central obesity indexed by waist circumference in Chinese men. For smokers, cessation of smoking may increase the risk of gaining overall body weight and developing central obesity. Cigarette smoking prevention should be a public health priority in China.

Acknowledgements
We are most grateful to Nanjing Municipal Department of Health for their generous financial support to this study. Our special thanks also go to the following for their support: Departments of Health of Xuanwu District, Jianye District, Dachang District, Jiangpu County and Gaochun County, the Centers for Disease Control & Prevention of Jiangsu Province, Xuanwu District, Jianye District, Dachang District, Jiangpu County and Gaochun County, and the interviewers and investigators participated.

References

1. Yang G, Fan L,Tan J, Qi G, Zhang Y, Samet JM, Taylor CE, Becker K, Xu J. Smoking in China: Findings of the 1996 National Prevalence Survey. JAMA 1999; 282: 1247-53.
2. Office on Smoking and Health (1986): Smoking, tobacco and health: a fact book. Rockville, Maryland: Department of Health and Human Resources, PHS.
3. World Health Organization (WHO).Obesity: Preventing and managing the global epidemic--Report of a WHO consultation. WHO Technical Report Series, No. 894, Geneva: WHO 2000.
4. Wang WJ, Wang KA, Li TL, Xiang HD, Ma LM, Fu ZY, Chen JS, Liu ZY, Bai J, Feng JG, Jin SX, Li YQ, Qin RL, Chen H. Obesity epidemic Patterns of Chinese Adults: Prevalence Survey of Overweight and Obesity. Chin J Epidemiol 2001; 22: 129-132.
5. Flegal KM, Troiano RP, Pamuk ER, Kuczmarski RJ, Campbell SM. The influence of smoking cessation on the prevalence of overweight in the United States. N Engl J Med 1995; 333: 1165-1170.
6. Fulkerson JA, French SA. Cigarette smoking for weight loss or control among adolescents: gender and racial/ethnic differences. J Adolesc Health 2003; 32: 306-313.
7. Klesges RC, Meyers AW, Klesges LM, La Vasque ME .Smoking, body weight, and their effects on smoking behavior: a comprehensive review of the literature. Sychol Bull 1989; 106: 204-230.
8. Perkins KA. Metabolic effects of cigarette smoking. J Appl Physio1992; l 72: 401-419.
9. Idem .Weight gain following smoking cessation. J Consult Clin Psychol 1993; 61: 768-777.
10. Yang G, Fan L, Tan J, Qi G, Zhang Y, Samet JM, Taylor CE, Becker K, Xu J. Smoking in China: Findings of the 1996 National Prevalence Survey. JAMA 1999; 282: 1247-53.
11. Cooperative meta-analysis group of China obesity task force. Predictive values of body mass index and waist circumference to risk factors of related diseases in Chinese adult population. Chin J Epidemiol 2002; 23: 5-8. (in Chinese)
12. Wang WJ, Wang KA, Li TL, Xiang HD, Ma LM Fu ZY, Chen JS, Liu ZY, Bai J, Feng JG, Jin SX, Li YQ, Qin RL, Chen H. A discussion on utility and purposed value of obesity abdomen obesity when body mass index, waist circumference, waist to hip ratio used as indices hypertension and hyper blood glucose. Chin J Epidemiol 2002; 23:16-19. (in Chinese)
13. Xu F, Yin X-M, Zhang M, Leslie E, Ware R, Owen N .Family average income and body mass index above the healthy weight range among urban and rural residents in regional Mainland China. Public Health Nutr 2005; 8: 47-51.
14. National Institutes of Health (NIH), National Heart, Lung, and Blood Institute's (NHLBI), North American Association for the Study of Obesity (NAASO). The practical guide: Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. NIH Publication Number 00-4084, 2000.
15. Wang Y, Rimm EB, Stamper MJ, Willett WC, Hu FB. Comparison of abdominal adiposity and overall obesity in predicting risk of type 2 diabetes among men. Am J Clin Nutr. 2005; 81: 555-563.
16. Li G, Chen X, Jang Y, Wang J, Xing X, Yang W and Hu Y. Obesity, coronary heart disease risk factors and diabetes in Chinese: an approach to the criteria of obesity in the Chinese population. Obe Rev 2002; 3: 167-172.
17. Department of Health and Human Services (1990): The health benefits of smoking cessation: a report of the Surgeon General. Washington, D.C.: Government Printing Office 1990. (DHHS publication no. (CDC) 90-8416.)

18. Tuomilehto J, Salonen JT, Marti B, Jalkanen L, Puska P, Nissinen A, Wolf E. Body weight and risk of myocardial infarction and death in the adult population of eastern Finland. BMJ 1987; 295: 623-7.
19. Wannamethee SG, Shaper AG. Body weight and mortality in middle aged British men: impact of smoking. BMJ 1989; 299: 1497-1502.
20. Garrison RJ, Castelli WP. Weight and thirty-year mortality of men in the Framingham Study. Ann Intern Med 1985; 103: 1006-1009.
21. Higgins M, Kannel W, Garrison R, Pinsky J, Stokes J III. Hazards of obesity — the Framingham experience. Acta Med Scand 2002; S723: 23-36.
22. Hall SM, Tunstall CD, Vila KL, Duffy J. Weight gain prevention and smoking cessation: cautionary findings. Am J Public Health 1992; 82: 799-803.
23. Pirie PL, McBride CM, Hellerstedt W, Jeffery RW, Hatsukami D, Allen S, Lando H. Smoking cessation in women concerned about weight. Am J Public Health 1992; 82: 1238-1243.
24. Li LM, Rao KQ, Kong LZ, Yao CH, Xiang HD, Zhai FY, Ma GS, Yang XG. A description of the Chinese National Nutrition and Health Survey in 2002. Chin J Epidemiol. 2005; 26: 478-484 (in Chinese).
25. Wu YF, Zhou BF, Tao SQ, Wu XG, Yang J, Li Y, Zhao LC, Xie GQ. Prevalence of overweight and obesity in Chinese middle-aged population: current status and the trend of development. Chin J Epidemiol 2002; 23: 11-16 (in Chinese).

Appendix: The association between central obesity (assessed using waist-to-hip ratio) and smoking in Chinese men *

	Prevalence (%)	Adj OR (95% CI)*
TACS Level		
Non-Smokers (ref)	28.6 (1589/5557)	1.00
Lower	27.3 (708/2593)	0.97 (0.87, 1.09)
Middle	29.7 (790/2661)	1.11 (0.99, 1.24)
Upper	30.1 (798/2652)	1.09 (0.97, 1.21)
Smoking Status		
Non-Smoker (ref)	28.6 (1589/5557)	1.00
Ex-Smoker	33.2 (182/548)	1.15 (0.94, 1.41)
Current-Smoker	28.7 (2114/7358)	1.05 (0.96, 1.14)

*Age, urban-rural residence, education, occupation, BMI, family average income, alcohol drinking, consumption of cooking oil, red meat and vegetable, occupational physical activity, and leisure-time physical activity were adjusted for in the logistic regression models. TACS=Total amount of cigarette smoked.

Original Article

The association between amount of cigarettes smoked and overweight, central obesity among Chinese adults in Nanjing, China

Fei Xu MD, PhD, BEcon[1], Xiao-Mei Yin BM[1] and Youfa Wang MD, PhD[2]

[1]Nanjing Municipal Center for Disease Control & Prevention, P.R. China
[2]Center for Human Nutrition, Department of International Health, Bloomberg School of Public Health, Johns Hopkins University, USA

中國南京成人抽菸量與過重、中央型肥胖間的關係

目的：評估過重、中央型肥胖與抽菸的相關(抽菸的總量[TACS]及狀態)。
設計：族群基礎橫斷性研究。
地點：隨機選取自中國南京市三個城市轄區及兩個鄉村地區的行政村(n=45)。
研究對象與方法：當地年齡在 35 歲或以上的男性永久居民的代表性樣本(n=13,463)；66.5%為城市住民。回應率為 90.1%。過重(BMI>=24)及中央型肥胖(男性腰圍>=85)的定義是依據新中國標準。抽菸(量與狀態)與肥胖相關性的評估是採用羅吉斯與線性迴歸分析。
結果：整體過重盛行率為 36.1%(29.7%為 24<=BMI<28 和 6.4%為 BMI>=28)。在校正年齡、居住地、教育程度、職業、家庭收入、飲酒、飲食攝取、職業及休閒體能活動後，目前仍有抽菸者(33.0%)盛行率顯著較非抽菸者(39.9%)及已戒菸者(39.2%)低($p<0.05$)。抽菸量與 BMI 呈現負相關(與非抽菸者相比，抽菸者低、中、高的 TACS 的 ORs 及 95%CI 分別為 0.88 [0.79, 0.98]、0.77 [0.69, 0.86]和 0.77 [0.69, 0.86])。中央型肥胖的盛行率為 35.9%。與非抽菸者相比，只有已戒菸者中央型肥胖的危險性增加(OR=1.38，95%CI=1.10, 1.74)，與目前仍有抽菸者則沒有顯著相關(OR=1.02 [0.92, 1.12])。抽菸量與中央型肥胖並未有顯著的相關。
結論：在中國男性中抽菸與以 BMI 當體重指標有負相關，但是以腰圍當中央性肥胖的指標則無相關性。中斷抽菸可能會提高體重增加與中央型肥胖的危險性。抽菸的預防與中斷是目前中國公共衛生優先的課題。

關鍵字：過重、身體質量指數、腰圍、抽菸、預防、中斷、中國、南京。