Cigarette smoking and socio-economic indicators as determinants of body fatness in three Southern Chinese communities of China

Linda Grievink[1], Bridget H-H Hsu-Hage[2], Xuxu Rao[3], Mark L Wahlqvist[2], Yi-He Li[3], Kuei Zhang[3], Tie Han Kuang[4], Dao Lin Zhang[5], Zong Rong Dai[6]

1. Department of Epidemiology, Wageningen Agricultraul University, Wageningen, the Netherlands; 2. Dept of Medicine, Monash Medical Centre, Clayton, VIC, Australia; 3. Guangdong Provincial Cardiovascular Institute, Guangzhou, China; 4. Bureau of Public Health, Xinhui County, Guangdong, China; 5. Chaozhou Medical Research Institute, Chaozhou County, Guangdong, China; 6. Meizhou People's (Huagtong) Hospital, Meizhou County, Guangdong, China

Obesity is one of the major risk factors for cardiovascular disease and non-insulin dependent diabetes mellitus. This study describes cigarette smoking and the socio-demographic differences of body fatness in three sub-ethnic distinctive communities in Guangdong Province, China. In this study, 935 adult Chinese (Chauzhou - 203 men and 111 women; Meixian - 169 men and 140 women; Xinhui - 194 men and 118 women) were randomly sampled from three communities. A standard protocol was used to measure stature, body weight, waist and hip circumferences. Body mass index (BMI) and waist-to-hip circumference ratio (WHR) were calculated as measures of total body fatness and abdominal body fatness, respectively. The questionnaire was self-administered and demographic and lifestyle factors were assessed. WHR was positively related to age in men ($p=0.0001$) and in women ($p=0.0001$) while BMI was associated with age only in women ($p=0.0001$). In women, WHR was significantly related to education levels after adjusting for age and BMI ($p=0.0300$). In men, BMI differed by educational level, after adjusting for age and WHR ($p=0.0329$). BMI was significantly associated with occupational status in men, after adjusting for age and WHR ($p=0.0004$). Gross household income was significantly associated with WHR in men, after adjusting for age and BMI ($p=0.0469$). Male smokers had a significantly higher mean BMI than the non-smokers, after adjusting for age and WHR ($p=0.0037$). Marital status was not related to body fatness measurements after adjusting for age and WHR. The differences in body fatness in Chinese living in Southern China can not be totally explained by educational level, occupational status, marital status, gross household income and cigarette smoking, particularly in women. Age was the only consistent predictor of abdominal body fatness in both men and women and also of total body fatness in women.

Introduction

Obesity is a major health problem in many communities[1,2]. Increased total body fatness and abdominal fatness are major risk factors for cardiovascular disease and non-insulin-dependent diabetes mellitus[3,4]. Ethnic differences in the prevalence of diabetes mellitus were found to be attributable to obesity[5-7]. Increasing abdominal body fatness has been correlated with respiratory infectious and abdominal diseases[8]. Other complications found in total obesity are hypertension, hyperlipidaemia, cancer and gallbladder disease[9].

Socio-economic status has been reported to be associated with the prevalence of obesity, which differs from country to country[10]. In developing countries, a strong and positive relationship between obesity and socio-economic status has been shown in men and women[11,12]. On the other hand, the effect of socio-economic status on obesity is less clear in men and women in developed countries. Most studies showed a strong inverse relationship between obesity and socio-economic status in women[13-17]. However, in men, the relationship is less consistent; some studies showed a negative relationship[15-17] and others showed a positive relationship[18-19].

Smoking is an important determinant of body fatness in both men and women. Body mass index is higher in non-smokers compared with smokers[20,21], while smokers had a significantly higher waist-to-hip ratio than non-smokers[22,23]. The aim of the present paper is to examine whether cigarette smoking and socio-demographic factors explain the differences in body fatness (total and abdominal) in three communities in Guangdong Province of China.

Methods

This is a collaborative study between the Monash University, Department of Medicine, in Australia and the Guangdong Provincial Cardiovascular Institute (GPCI) in China. With the GPCI as a collaborative study centre of

Correspondence address: Dr Bridget H-H Hsu-Hage, Monash University Department of Medicine - MMC 246 Clayton Road, Level 5 Block E, Clayton, Victoria 3168, Australia
Tel: +61-3-9550-5522 Fax: +61-3-9550-5524
E-mail: bridget.hsu-hage@med.monash.edu.au

the Melbourne Chinese Health Study, a standardised protocol was used so that compatible data could be obtained[24-26]. Research methods and base-line data have been previously reported elsewhere[27]. Briefly, the study took place in 1989 in three communities in Guangdong Province, in the south of the People's Republic of China. The participants were adult native residents of Chauzhou city, Meixian city and Xinhui county. Free living individuals were recruited at random. The Chauzhou Medicine and Health Institute in Chauzhou city, the Huangtong Hospital in Meixian city and the Public Health Bureau of Xinhui county assisted with surveys in the respective locations. Up to 300 subjects in each community participated.

Weight was measured to the nearest 0.5 kg in light clothing on a digital scale and height was measured to the nearest 1 cm, without shoes. The waist circumference was measured to the nearest of 1 mm at the level of the umbilicus and the hip circumference was measured to the nearest of 1 mm at the maximal hip diameter in light clothing. Body mass index (BMI) was calculated as weight in kilograms divided by height in metres squared. The Bray's classification[28], for underweight (BMI<19 for men and BMI<18 for women), acceptable weight (19≤BMI<25 for men and 18≤BMI<24 for women), overweight (25≤BMI<30 for men and 24≤BMI<30 for women) or obese (BMI≥30 for men and women) was used to describe the prevalence of overweight and/or obesity. Waist-to-hip circumference ratio (WHR) was calculated as the waist circumference divided by the hip circumference.

The questionnaire was self-administered and measured the principle demographic and lifestyle characteristics, including gender, age, marital status, educational level, gross household income, occupational status and cigarette smoking habits.

Results

A total of 935 adults took part in this study. Of these 314 participants lived in Chauzhou city (203 men and 111 women), 309 participants lived in Meixian city (169 men and 140 women) and 312 participants lived in Xinhui county (194 men and 118 women).

Table 1. Study subject characteristics.

	Men			Women		
	Chauzhou (203)	Meixian (169)	Xinhui (194)	Chauzhou (111)	Meixian (140)	Xinhui (118)
Age (mean years ± SD)	46 ±9.2 [a]	43 ± 10.3 [a]	44 ± 9.6	40 ± 9.2 [a]	37 ± 8.3 [ab]	41 ± 8.2 [a]
Current smoker (%)	57.5	61.5	72.7	2.7	1.4	0.0
Percentage married	98.5	95.9	93.8	91.9	98.6	95.8
Educational level (%)						
0-6 years	17.3	4.2	31.6	31.8	7.2	35.6
7-9 years	17.8	27.0	25.8	35.5	38.1	22.0
10-12 years	28.2	40.1	25.3	21.8	47.5	31.4
13+ years	36.6	28.7	17.4	10.9	7.2	11.0
Occupational status (%)						
Professional & administrative	19.3	11.9	7.7	33.3	12.1	22.9
Clerical & sales workers	49.5	53.0	54.6	55.9	78.6	66.1
Manual workers & home duties	31.2	35.1	37.6	10.8	9.3	11.0
Gross household income (%)						
<5 000 RMB	24.5	3.6	9.4	27.3	1.4	12.0
5 001-10 000 RMB	62.5	63.1	44.0	55.5	57.6	48.7
>10 001 RMB	13.0	33.3	46.6	17.3	41.0	39.3

a,b: Identical superscript indicates significant differences between communities ($p < 0.05$); RMB is the unit of Chinese currency, Ren Men Bi (yuan)

Table 2. Mean and standard deviation (in parentheses) of the anthropometry, by community and gender.

	Chauzhou		Meixian		Xinhui	
	Mean	SD	Mean	SD	Mean	SD
Men	**n=203**		**n=169**		**n=194**	
Stature (cm)	167	6.0	167	6.2	166	5.8
Body weight(kg)	58.8	8.2	59.3	8.5	57.7	9.0
Waist circumference (cm)	76.6	8.0	77.1	8.7	76.1	9.5
Hip circumference (cm)	90.8	5.6	90.4	6.3	89.7	6.2
Waist-to-hip ratio	0.84	0.054	0.85	0.078	0.85	0.071
Body mass index (kg/m^2)	21.2	2.7	21.2	2.7	20.9	3.1
Women	**n=111**		**n=140**		**n=118**	
Stature (cm)	156	5.2	156	5.0	157	5.2
Body weight (kg)	50.5	7.3	51.6	8.1	51.7	7.7
Waist circumference (cm)	72.9	8.8	71.2 [a]	8.1	74.5 [a]	9.0
Hip circumference (cm)	91.7	6.0	91.2	5.8	91.0	6.7
Waist-to-hip ratio	0.79 [b]	0.063	0.78 [a]	0.055	0.82 [ab]	0.065
Body mass index (kg/m^2)	20.8	2.9	21.1	3.0	21.1	2.8

a, b: Identical superscript indicates significant difference between communities ($p < 0.05$)

Table 1 shows the study subject characteristics. There were significant differences in mean age among the three communities for men and women. For men, the mean age was significant lower in Meixian city compared to Chauzhou city, and women in Meixian city were significantly younger compared to women in Chauzhou city and Xinhui county ($p < 0.05$). Educational levels and gross household income differed significantly among the three communities.

Table 3. The prevalence of overweight as defined by the Bray's classification,[28] by community and gender

	Chauzhou		Meixian		Xinhui	
	n	%	n	%	n	%
Men						
Underweight (BMI < 19)	42	20.7	39	23.1	68	35.1
Acceptable weight (BMI ≥ 19 and < 25)	145	71.4	115	68.1	106	54.6
Overweight (BMI ≥ 25 and < 30)	15	7.4	15	8.9	17	8.8
Obese (BMI > 30)	1	0.5	0	0	3	1.6
Women						
Underweight (BMI < 18)	20	18.0	22	15.7	15	12.7
Acceptable weight (BMI ≥ 18 and < 24)	73	65.8	92	65.7	86	72.9
Overweight (BMI ≥ 24 and < 30)	18	16.2	26	18.6	17	14.4
Obese (BMI > 30)	0	0	0	0	0	0

Table 2 shows that the waist circumference for women in Xinhui county was significantly greater than that for women in Meixian city. The waist-to-hip circumference ratio was significantly different among the three communities in women, with a higher WHR in Xinhui county compared to Chauzhou city and Meixian city.

Table 3 shows the prevalence of overweight and obesity. There were no differences between communities, with virtually no obesity.

Table 4 gives the mean WHR and BMI in three different age groups for the total and for each of the three communities, separately for men and women. For all communities combined, BMI in women and WHR in men and women increased with age. Separate community analyses showed that BMI in men did not differ among the age groups.

Table 5 shows that there was no significant relationship between WHR in men and BMI in women with education. BMI in men was significantly different by educational level, even after adjusting for age and WHR ($p=0.0329$), with a significantly greater BMI for more educated men. However this trend was not linear. In women, age adjusted WHR was not significantly different among the various educational levels ($p=0.0625$). The age and BMI adjusted WHR, however, differed significantly among the various educational levels ($p=0.0300$). A significantly higher WHR was found in less educated women compared to average educated women.

Table 6 shows that the BMI ($p=0.0001$) and the WHR ($p=0.0399$) differed significantly by occupational status in men after adjustment for age. However, after adjustment for age and BMI, the association between WHR and occupational status was no longer significant ($p=0.7400$). BMI remained significantly associated with occupational status, after adjustment for age and WHR ($p=0.0004$). The clerical and sales workers had a significantly lower mean BMI compared to transport and service workers. In women both BMI and WHR were independent of occupational status after adjusting for age and, the residual effect of body fatness (eg WHR for BMI and BMI for WHR).

Table 4. Body mass index and waist-to-hip circumference ratio by age group, communities and gender.

	Total			Chauzhou			Meixian			Xinhui		
	n	mean	SD	n	mean	SD	n	mean	SD	n	mean	SD
Men												
BMI (kg/m²)												
< 35	96	20.48	2.31	25	20.27	1.44	41	20.23	2.56	30	21.00	2.52
35-44	188	21.12	2.57	68	21.34	2.61	52	21.71	2.19	68	20.44	2.67
45+	280	21.28	3.17	110	21.30	2.95	76	21.44	3.06	94	21.13	3.51
F-test		0.0595			0.1942			0.0227			0.3701	
WHR												
< 35	96	0.82	0.046	25	0.81	0.045	41	0.82	0.044	30	0.82	0.050
35-44	190	0.84	0.056	68	0.85	0.055	52	0.85	0.058	70	0.83	0.054
45+	280	0.86	0.078	110	0.85	0.054	76	0.87	0.099	94	0.87	0.081
F-test		0.0001			0.0102			0.0172			0.0002	
Women												
BMI (kg/m²)												
< 35	132	19.96	2.50	34	19.14	2.11	66	20.03	2.44	32	20.70	2.79
35-44	136	21.32	2.92	39	21.07	2.79	48	21.74	3.13	49	21.11	2.81
45+	101	21.89	2.99	38	21.94	2.98	26	22.53	3.16	37	21.38	2.87
F-test		0.0001			0.0001			0.0002			0.6100	
WHR												
< 35	132	0.77	0.056	34	0.76	0.053	66	0.76	0.051	32	0.79	0.064
35-44	136	0.79	0.060	39	0.79	0.056	48	0.78	0.045	49	0.82	0.070
45+	101	0.83	0.057	38	0.83	0.060	26	0.82	0.060	37	0.84	0.052
F-test		0.0001			0.0001			0.0001			0.0069	

* For BMI, WHR was used as body fatness index; for WHR, BMI was used as body fatness index # Significance level of F-test

Table 5. Body mass index and waist-to-hip circumference ratio by educational level, for men and women.

	n	Crude mean	SD	Age adj. mean	SD	ABFI* adj. mean	SD
Men							
BMI (kg/m²)							
0-6	101	20.47	2.71	20.41	2.80	20.55	2.39
7-9	130	21.23	2.75	21.26	2.84	21.08	2.40
10-12	172	20.85	2.98	20.90	2.75	21.04	2.39
13+	154	21.60	2.73	21.56	2.84	21.46	2.39
Significance level for F-test		0.0102		0.0096		0.0329	
WHR							
0-6	102	0.84	0.078	0.84	0.066	0.85	0.057
7-9	130	0.85	0.057	0.85	0.067	0.85	0.057
10-12	172	0.84	0.057	0.84	0.067	0.84	0.056
13+	155	0.84	0.080	0.85	0.066	0.85	0.057
Significance level for F-test		0.1434		0.1856		0.5095	
Women							
BMI (kg/m²)							
0-6	87	21.26	2.87	20.93	2.78	20.63	2.47
7-9	118	20.87	3.05	20.84	2.70	21.04	2.42
10-12	127	20.93	2.85	21.28	2.81	21.28	2.48
13+	35	20.87	2.70	20.55	2.74	20.62	2.40
Significance level for F-test		0.7789		0.4711		0.2441	
WHR							
0-6	87	0.82	0.064	0.81	0.057	0.81	0.049
7-9	118	0.79	0.057	0.79	0.055	0.79	0.049
10-12	127	0.79	0.061	0.80	0.057	0.79	0.051
13+	35	0.80	0.074	0.79	0.055	0.80	0.048
Significance level for F-test		0.0010		0.0625		0.0300	

*ABFI= Age and body fatness index

Table 6. Body mass index and waist-to-hip circumference ratio by occupational status, for men and women.

	n	Crude mean	SD	Age adj. mean	SD	ABFI* adj. mean	SD
Men							
BMI (kg/m²)							
Professional & administrative	74	21.04	2.42	21.05	2.73	21.15	2.36
Clerical & sales	294	20.59	2.65	20.60	2.74	20.71	2.38
Farming & mining	46	21.86	3.22	21.92	2.75	21.44	2.37
Transport, trades, services & others	148	21.92	3.10	21.86	2.79	21.73	2.40
Significance level for F-test		0.0001		0.0001		0.0004	
WHR							
Professional & administrative	74	0.84	0.067	0.84	0.066	0.84	0.056
Clerical & sales	295	0.84	0.072	0.84	0.067	0.85	0.057
Farming & mining	46	0.87	0.066	0.87	0.066	0.86	0.056
Transport, trades, services & others	149	0.86	0.059	0.85	0.066	0.84	0.057
Significance level for F-test		0.0325		0.0399		0.7400	
Women							
BMI (kg/m²)							
Professional & administrative	81	21.00	2.91	21.10	2.77	21.19	2.42
Clerical & sales	250	20.71	2.81	20.80	2.68	20.80	2.43
Farming & mining	12	22.48	3.03	22.34	2.62	22.14	2.32
Transport, trades, services & others	26	22.93	2.87	21.86	2.90	21.66	2.54
Significance level for F-test		0.0006		0.1013		0.0969	
WHR							
Professional & administrative	81	0.79	0.062	0.79	0.056	0.79	0.049
Clerical & sales	250	0.79	0.062	0.80	0.057	0.80	0.049
Farming & mining	12	0.81	0.042	0.80	0.053	0.79	0.047
Transport, trades, services & others	26	0.84	0.062	0.80	0.060	0.80	0.052
Significance level for F-test		0.0013		0.7672		0.7400	

* For BMI, WHR was used as body fatness index; for WHR, BMI was used as body fatness index

*ABFI = Age and body fatness index

Table 7. Mean and standard deviation (in parentheses) for body mass index and waist-to-hip circumference ratio by gross household income, for men and women.

	n	Crude mean	SD	Age adj. mean	SD	ABFI* adj. mean	SD
Men							
BMI (kg/m²)							
< 5 000 RMB	72	20.64	2.89	20.65	2.86	20.60	2.42
5 001-10 000 RMB	315	20.99	2.57	21.01	2.84	21.15	2.43
> 10 001 RMB	170	21.45	3.28	21.42	2.86	21.18	2.43
Significance level for F-test		0.0859		0.1241		0.1986	
WHR							
< 5 000 RMB	73	0.85	0.071	0.85	0.065	0.85	0.056
5 001-10 000 RMB	315	0.84	0.056	0.84	0.066	0.84	0.057
> 10 001 RMB	171	0.86	0.082	0.86	0.065	0.85	0.056
Significance level for F-test		0.0082		0.0259		0.0469	
Women							
BMI (kg/m²)							
< 5 000 RMB	46	20.63	2.94	20.75	2.75	21.05	2.42
5 001-10 000 RMB	198	20.86	2.88	20.93	2.81	20.94	2.44
> 10 001 RMB	122	21.31	2.92	21.15	2.75	21.02	2.44
Significance level for F-test		0.2745		0.6526		0.9450	
WHR							
< 5 000 RMB	46	0.78	0.051	0.78	0.056	0.79	0.049
5 001-10 000 RMB	198	0.79	0.061	0.80	0.056	0.80	0.049
> 10 001 RMB	122	0.81	0.068	0.80	0.056	0.80	0.050
Significance level for F-test		0.0284		0.1527		0.2220	

* For BMI, WHR was used as body fatness index; for WHR, BMI was used as body fatness index

Table 8. Mean and standard deviation (in parentheses) for body mass index and waist-to-hip circumference ratio by cigarette smoking status, for men and women.

	n	Crude mean	SD	Age adj. mean	SD	ABFI* adj. mean	SD
Men							
BMI (kg/m²)							
Smokers	361	20.88	2.93	20.89	2.85	20.87	2.39
Non-smokers	203	21.47	2.63	21.45	2.84	21.48	2.40
Significance level for F-test		0.0188		0.0241		0.0037	
WHR							
Smokers	362	0.85	0.063	0.85	0.067	0.85	0.056
Non-smokers	204	0.85	0.075	0.85	0.067	0.84	0.056
Significance level for F-test		0.9164		0.7467		0.0618	
Women							
BMI (kg/m²)							
Smokers	5	21.46	4.11	21.08	2.48	20.67	2.18
Non-smokers	364	20.98	2.89	20.99	2.86	21.00	2.44
Significance level for F-test		0.7179		0.9411		0.7641	
WHR							
Smokers	5	0.83	0.068	0.81	0.050	0.81	0.049
Non-smokers	364	0.80	0.063	0.80	0.055	0.80	0.050
Significance level for F-test		0.2906		0.4769		0.4427	

* For BMI, WHR was used as body fatness index; for WHR, BMI was used as body fatness index

There were no significant differences in mean BMI among families of various income levels for both men and women (Table 7). The middle income families had a lower WHR compared to the higher income families after adjusting for age and BMI (p=0.0469). In women, WHR was independent of household income, after adjusting for age and BMI (p=0.2220; Table 7).

There were no significant differences between smokers and non-smokers for either BMI or WHR in women or WHR in men (Table 8). There was, however, a greater BMI in non-smoking men compared to smoking men after adjusting for age (p=0.0241) and after adjusting for age and WHR (p=0.0037; Table 8).

There were no significant differences in mean BMI among families of various income levels for both men and women (Table 7). The middle income families had a lower WHR compared to the higher income families after adjusting for age and BMI (p=0.0469). In women, WHR was independent of household income, after adjusting for age and BMI (p=0.2220; Table 7).

There were no significant differences between smokers and non-smokers for either BMI or WHR in women or WHR in men (Table 8). There was, however, a greater BMI in non-smoking men compared to smoking men after adjusting for age (p=0.0241) and after adjusting for age and WHR (p=0.0037; Table 8).

Married men had a greater WHR (p=0.0429) compared to those who never married, after adjustment for age (Table 9). After adjusting for age and BMI, differences in WHR between the ever married and never married men were no longer significant (p=0.1919; Table 9). BMI was independent of marital status after adjusting for age in men (p=0.0917; Table 9). In women, no significant differences were found for BMI or WHR by marital status (Table 9).

Discussion

In this study, age was the most important determinant of total and abdominal body fatness. BMI and WHR increased with increasing age. This is consistent with other studies[20,21,29]. We adjusted BMI and WHR for each other, because BMI was positively related with WHR in these communities. Thus, determinants of BMI or WHR could be assessed independent of each other. No other confounding factors were identified in the assessment of relationships between socio-demographic factors and body fatness. There were consistent differences in educational and income levels among the three communities in this study. The prevalence of overweight did not differ between the three communities.

In women, we did not find any significant associations between BMI or WHR, and the socio-demographic variables and cigarette smoking, after adjusting for age. However WHR was positively related to education, after adjusting for age and total body fatness. The same relationship was reported in one other study[8]. Other studies have showed that associations between socio-economic status or socio-demographic factors and BMI or WHR were more evident for women than for men in developed countries and in developing countries[20,21,30-32]. There is no apparent explanation as to why there is a lack of relationships in women in this study, except that the prevalence of cigarette smoking was much lower among the Chinese women compared with their Caucasian counterparts living in Australia[33]. A positive correlation between smoking and WHR in women has been reported in other studies[23,34,35]. As the prevalence of cigarette smoking is almost at the rate of zero in Chinese women, an effect of smoking on body fatness is unlikely to be detected. In this study, a significant and positive relationship between BMI and education was found in men. The same relationship is only reported in developing countries or in Western communities two decades ago[10,29]. In other studies, a negative association between education and BMI has been reported[8,20,29]. In the Pitt County study and in a study of Asians, however, no significant relationship was found in men[13,21].

Transport and service workers had a significantly higher mean BMI than the clerical and sales workers, in an age and WHR adjusted analysis. Occupational status as a determinant of body fatness has been reported in many other studies of Western communities[10]. In one other study, the same result as in Hispanic America was reported[20]. Occupational status has also been strongly related to BMI in Europeans and Pacific Islanders, in whom a higher BMI is found among blue collar workers than desk workers. The same relationship has not been confirmed in an Asian population.[13] Occupational status was not significantly related to WHR after adjusting for age and BMI in these Chinese communities. Thus, occupational status does not appear to be an important determinant of WHR in Chinese men living in these communities.

Men of a middle gross household income had a significantly lower mean WHR compared with their higher income counterparts. This has not been reported in any other studies. This suggests that the gross household income level may predict abdominal body fatness in some populations, or that our result was a chance one.

Male smokers had a lower BMI than non-smokers. This has also been seen in other studies[20,21,31]. Other studies also report a higher WHR among smokers when age and total body fatness are considered[22,35,36]. This was not found in the present study.

Marital status was positively related to WHR in men, after adjusting for age, but not after adjusting for age and

Table 9. Body mass index and waist-to-hip circumference ratio by marital status and gender.

	n	Crude mean	SD	Age adj. mean	SD	ABFI* adj. mean	SD
Men							
BMI (kg/m²)							
Never married	22	19.81	2.79	20.06	2.84	20.70	2.42
Ever married	542	21.14	2.85	21.13	2.79	21.10	2.42
Significance level for F-test		0.0313		0.0917		0.4595	
WHR							
Never married	22	0.80	0.053	0.82	0.064	0.83	0.055
Ever married	544	0.85	0.068	0.85	0.065	0.85	0.056
Significance level for F-test		0.0019		0.0429		0.1919	
Women							
BMI (kg/m²)							
Never married	16	20.52	2.88	20.94	2.67	21.15	2.37
Ever married	353	21.01	2.90	20.99	2.81	20.98	2.44
Significance level for F-test		0.5055		0.9430		0.7896	
WHR							
Never married	16	0.77	0.054	0.79	0.054	0.79	0.046
Ever married	353	0.80	0.063	0.80	0.056	0.80	0.049
Significance level for F-test		0.1494		0.5192		0.4882	

* For BMI, WHR was used as body fatness index; for WHR, BMI was used as body fatness index

BMI. In our study, married men were older and had a greater abdominal fatness. The greater abdominal fatness is age dependent and the marital relationship may in part be due to the increased total body fatness with age. One study found insignificant relationships between marital status and BMI[21]. In women, marital status per se had no significant effect on body fatness. As the Chinese population is relatively young (mean age around 40 years), any relationship to menopausal status is less likely to be detected[37,38].

Conclusion

Age was a consistent predictor of total and abdominal body fatness in both men and women. For other variables, there was a lack of consistent relationship between cigarette smoking and socio-demographic factors for body fatness (total and abdominal) in men and, especially, in women in the Guangdong Province of China. There may be several explanations. First, the mean BMI was very low compared to the other studies (about 21 for both men and women), with virtually no obesity in this population, a phenomenon reported in the populations of developing countries. However, a strong negative relationship between body fat and socio-demographic parameters rather than no relationship has been found in both men and women[11,12]. Secondly, the basis of comparison for a particular Asian population may be different from one which is Caucasian, for example, in socio-economic development or biological characteristics. Yet another explanation for the lack of relationships could be that socio-economic indicators may not have a similar impact on body fatness in socialistic societies as in capitalistic societies. In a socialistic society any difference in socio-economic status between individuals or population groups do not correspond to those in a capitalistic society. Factors other than age and socio-economic status are required to account for more of the variation in body fatness and will be of potential importance to the health status of these communities.

Cigarette smoking and socio-economic indicators as determinants of body fatness in three Southern Chinese communities of China

Linda Grievink, Bridget H-H Hsu-Hage, Xuxu Rao, et al

Asia Pacific Journal of Clinical Nutrition (1995) Volume 4, Number 4: 376-383

吸煙和社會經濟狀態與中國南方三個地區人群的肥胖的關系

摘要

肥胖是心血管病和非胰島素依賴性糖尿病的主要危險因素之一。該研究描述中國廣東省三個不同地區人群身體脂肪與吸煙和社會人口因素的關系，該項研究從三個地區隨機抽樣調查 935 名成年人（潮州 — 男性 203 名，女性 111 名；梅縣 — 男性 169 名，女性 140 名；新會 — 男性 194 名，女性 118 名）。用標準方法測量身高、體重、腰和髖圍，分別測量總體脂肪和腹部脂肪，並用於計算 BMI 和腰對髖圍比率（WHR）。採用自填問卷方式，包括一般資料和生活習慣。WHR 與年齡的關系在男性組（$p = 0.0001$）和女性組（$p = 0.0001$）都是陽性，而 BMI 和年齡仅在女性組有陽性關系（$p = 0.0001$）。在女性組，在校正年齡和 BMI 後，WHR 與教育水平有明顯相關性（$p = 0.03$）。在男性組，在校正年齡和 WHR，BMI 與教育水平相關（$p = 0.0329$）。在男性組，在校正年齡和 WHR 後，BMI 和職業有顯著相關性（$p = 0.0004$）。在男性組，年齡和 BMI 校正後，家庭總收入和 WHR 有顯著相關性（$p = 0.0469$）。在年齡和 WHR 校正後，平均 BMI 在男性吸煙者顯著高於非吸煙者（$p = 0.0037$）。在年齡和 WHR 校正後，婚姻狀況與身體脂肪測量無關。居住中國南方居民身體脂肪的不同不能全部由教育水平、職業、婚姻、家庭總收入、吸煙來解釋，特別在女性，年齡是唯一恆定指標，用於比較男性和女性腹部脂肪，和女性全身脂肪的關系。

References

1. McGinnis JM and Ballard-Barbash RM. Obesity in minority populations: policy implications of research. Am J Clin Nutr 1991; 53: 1512s-1514s.
2. Birkbeck JA. Obesity, socioeconomic variables and eating habits in New Zealand. J Biosoc Sci 1981;13:299-307.
3. Despres JP. Obesity and lipid metabolism: relevance of body fat distribution. Current Opinion in Lipidology 1991;2:5-15.
4. Wahlqvist ML and Hsu-Hage BH-H. Clinical ponderal indices of diabetes susceptibility: the interplay of ethnicity and intra-abdominal obesity. The proceedings of the International Conference on lifestyle and disease trends, 4-6 December 1992, Singapore.
5. McKeigue PM, Shah B., Marmot MG. Relation of central obesity and insulin resistance with high diabetes prevalence and cardiovascular risk in South Asians. Lancet 1991;337:382-386.
6. Dowse GK, Gareeboo H, Zimmet PZ, Alberti KG, Tuomilehto J, Fareed D; Brissonnette LG and Finch CF. High prevalence of NIDDM and impaired glucose tolerance in Indian, Creole, and Chinese Mauritians. Mauritians Noncommunicable Disease Study Group. Diabetes 1990;39(3):390-396.

7. Dowse GK, Zimmet PZ, Gareeboo H, George K, Tuomilehto J, Finch CF, Chitson P and Tulsidas H. Abdominal obesity and physical inactivity as risk factors for NIDDM and impaired glucose tolerance in Indian, Creole, and Chinese Mauritians. Diabetes Care 1991;14(4):271-282.
8. Lapidus L, Bengtsson C, Hallstrom T and Bjorntorp P. Obesity, adipose tissue distribution and health in women-Results from a population study in Gothenburg, Sweden. Appetite 1989; 12:25-35.
9. Atkinson RL. Massive obesity: complications and treatment. Nutr Rev 1991;49(2):49-53.
10. Sobal J and Stunkard AJ. Socioeconomic status and obesity: A review of the literature. Psychol Bulletin 1989;105(2):260-275.
11. Driver ED and Driver AE. Social class and height and weight in metropolitan Madras. Soc Biol 1983;30:189-204.
12. Okeke EC, Nnanyelu DO and Ngwu E. The prevalence of obesity in adults by age, sex and occupation in Anambra State, Nigeria. Growth 1983;47:263-271.
13. Dryson E, Metcalf P, Baker J and Scragg R. The relationship between body mass index and socioeconomic status in New Zealand: ethnic and occupational factors. NZ Med J 1992;105:233-235.
14. Bahhage FS, Mueller WH, Hanis CL, Barton SA and Schull WJ. Socioeconomic status, obesity and non-insulin dependent diabetes in Mexican Americans in Star County, Texas. Ecol Food and Nutr 1988;20:163-170.
15. Jeffery RW, Folsom AR, Leupker RV, Jacobs DR, Gillum RF, Taylor HL, Blackburn H. Prevalence of overweight and weight loss behaviour in a metropolitan adult population: The Minnesota Heart Survey experience. Am J Public Health 1984;74:349-352.
16. Evers S. Economic and social factors associated with obesity in adult Canadians. Nutr Research 1987;7:3-13.
17. Baecke FS, Burema J, Frijters J, Hautvast J and Weiz-Wetzels W. Obesity in young Dutch adults: I. Socio-demographic variables and body mass index. Int J Obes 1983;7:1-12.
18. Ross CE and Mirowsky J. Social epidemiology of overweight: A substantive and methodological investigation. J Health Soc Behavior 1983;24(3):288-298.
19. Garn SM and Ryan AS. Replicating the income reversal of fatness. Ecol Food and Nutr 1981;10:237-239.
20. Jeffery RW, Forster JL, Folsom AR, Luepker RV, Jacobs DR and Blackburn H. The relationship between social status and body mass index in the Minnesota Heart Health Program. Int J Obes 1989;13:59-67.
21. Croft JB, Strogatz DS, James SA, Keenan NL, Ammerman AS, Malarcher AM and Haines PS. Socioeconomic and behavioral correlates of body mass index in black adults: The Pitt county study. Am J Public Health 1992;82(6):821-826.
22. Selby JV, Newman B, Quesenberry CP, Fabsitz RR, Carmelli D, Meaney FJ and Slemenda C. Genetic and behavioral influences on body fat distribution. Int J Obes 1990;14:593-602.
23. Haffner SM, Stern MP, Hazuda HP, Pugh J, Patterson JK and Malina R. Upper body and centralized adiposity in Mexican Americans and non-Hispanic whites: relationship to body mass index and other behavioral and demographic variables. Int J Obes 1986;10:493-502.
24. Hage BH-H, Oliver RG, Powles JW and Wahlqvist ML. Telephone directory listings of presumptive Chinese surnames: An appropriate sampling frame for a dispersed population with characteristic surnames. Epidemiology 1990;1:405-408.
25. Hage BH-H. Food habits and cardiovascular health status in adult Melbourne Chinese. Thesis, Monash University, Department of Medicine, 1992.
26. Hsu-Hage BH-H and Wahlqvist ML. Cardiovascular risk in Melbourne Chinese. Aust J Pub Hlth 1993;17(4):306-13.
27. Rao X, Hsu-Hage BH-H, Wahlqvist ML, Li Y, Liu X, Zhang K, Kuang T, Zhang D, Dai Z, and the Australia-P.R.China Collaborative Study team. An Epidemiological Study of food habits and Cardiovascular Risk Factor prevalence in Three adult Chinese Communities in Guangdong Province of China: Baseline report on study populations, anthropometry, blood pressure, serum lipids and fasting glucose levels. Asia Pac J Clin Nutr 1995; 4(3): 278-286.
28. Bray GA. Definition, measurement and classification of the syndromes of obesity. Int J Obes 1978;2:99-112.
29. Flegal KM, Harlan WR and Landis JR. Secular trends in body mass index and skinfold thickness with socioeconomic factors in young adult men. AM J Clin Nutr 1988a;48:544-551.
30. Flegal KM, Harlan WR and Landis JR. Secular trends in body mass index and skinfold thickness with socioeconomic factors in young women. AM J Clin Nutr 1988b;48:535-543.
31. Fehily AM, Phillips KM and Yarnell JWG. Diet, smoking, social class, and body mass index in the Caerphilly Heart Disease Study. Am J Clin Nutr 1984;40:827-833.
32. Hazuda HP, Haffner SM, Stern MP and Eifler CW. Effects of acculturation and socioeconomic status on obesity and diabetes in Mexican Americans. The San Antonio Heart Study. Am J Epidemiol 1988;128(6):1289-1301.
33. Hsu-Hage BH-H, Wahlqvist ML and Idema KT. Anthropometric indices amongst the adult Melbourne Chinese. Asia Pac J Clin Nutr 1995;4:81-87.
34. Shimokata H, Muller DC, Andres R. Studies in the distribution of body fat. III. Effects of cigarette smoking. JAMA 1989; 262 (9): 1185-1186.
35. Laws A, Terry RB, Barrett-Connor E. Behavioral covariates of waist-to-hip ratio in Rancho Bernardo. Am J Public Health 1990;80(11):1358-1362.
36. Troisi RJ, Heinold JW, Vokonas PS and Weiss ST. Cigarette smoking, dietary intake, and physical activity: effects on body fat distribution - the Normative Aging Study. Am J Clin Nutr 1991;53:1104-1111.
37. Colditz GA, Willet WC, Stampfer MJ, Rosner B, Speizer FE and Hennekens CH. Menopause and the risk of coronary heart disease in women. N Engl J Med 1987;316:1105-1110.
38. Lapidus L, Bengtsson C and Lindquist O. Menopausal age and risk of cardiovascular disease and death. A 12-year follow-up of participants in the population study of women in Gothenburg, Sweden. Acta Obstet Gynecol Scand Suppl 1985;130:37-41.

Further reading:

- SAS Institute Inc. SAS Procedure Guide, Release 6.03 edition. Cary: SAS Institute Inc, 1988a.
- SAS Institute Inc. SAS/STAT User's Guide, Release 6.03 edition. Cary: SAS Institute Inc, 1988b.