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Family average income and body mass index above the healthy weight range among urban and rural residents in regional Mainland China

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Abstract

Objective: To explore the relationship between family average income (FAI; an index of socio-economic status) and body mass index (BMI; a widely used, inexpensive indicator of weight status) above the healthy weight range in a region of Mainland China.
Design: Population-based cross-sectional study, conducted between October 1999 and March 2000 on a sample of regular local residents aged 35 years or older who were selected by random cluster sampling.
Setting: Forty-five administrative villages selected from three urban districts and two rural counties of Nanjing municipality, Mainland China, with a regional population of 5.6 million.
Subjects: In total, 29 340 subjects participated; 67.7% from urban and 32.3% from rural areas; 49.8% male and 50.2% female. The response rate among eligible participants was 90.1%.
Results: The proportion of participants classified as overweight was 30.5%, while 7.8% were identified as obese. After adjusting for possible confounding variables (age, gender, area of residence, educational level, occupational and leisure-time physical activity, daily vegetable consumption and frequency of red meat intake), urban participants were more likely to be overweight or obese relative to their rural counterparts, more women than men were obese, and participants in the lowest FAI tertile were the least likely to be above the healthy weight range.
Conclusions: The proportion of adults with BMI above the healthy weight range was positively related to having a higher socio-economic status (indexed by FAI) in a regional Chinese population.

Keywords
Obesity
Overweight
Prevalence
Mainland China
Body mass index
Socio-economic status

The proportion of overweight and obese adults is increasing at an alarming rate world-wide[1–9]. There is evidence that being overweight or obese leads to adverse metabolic effects on blood pressure, cholesterol, triglycerides and insulin resistance[10–12].

A sedentary lifestyle and poor diet are strongly associated with obesity[13–18]. Socio-economic status (SES) is a risk marker for such lifestyle behaviours. SES is negatively associated with overweight and obesity in developed societies[19–25] and positively associated in developing countries[26,27]. Because SES is a complex construct, the different variables used to measure it provide different information on participants' relative socio-economic position within their community and can reflect different specific exposures[28]. In this study, we developed family average income per capita (FAI) as a new and specific index of SES. This may have utility as a single measure of SES since it may be a more realistic reflection of material measures and social standing than other indicators such as educational attainment, occupation, total household income or deprivation score[29]. Income is a direct (although incomplete) measure of economic resources. However, total household income does not reflect income per capita in families because, with the same household income, a larger family will have different life quality from a smaller family. Although education and occupation partially determine a participant's adult SES, in areas such as Mainland China where the economy is undergoing a rapid transition, the relationship may be of less value than in a more settled economy as people are in a position to change occupation more readily.

With the economy growing rapidly in China, there is an increasing transition within the population towards more

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Westernised behaviour patterns[30]. Diseases related to being overweight are becoming increasingly burdensome and present urgent public health challenges[30], and preventive strategies are required. In this context, it is important to explore the relationship between SES and overweight in China. In the present paper, we examine the associations of SES with body mass index (BMI) using data obtained through a large population-based survey conducted in both urban and rural areas of regional Mainland China between October 1999 and March 2000.

Methods

Sample selection

A large-scale, population-based, cross-sectional study was conducted in Nanjing municipality. Nanjing, the capital of Jiangsu province, is located in the east of China and has a population of more than 5.6 million. It has 15 administrative units, 10 urban and five rural. Sampling was undertaken using a multi-stage method. First, we randomly selected three urban districts and two rural counties, then three streets/towns from each chosen district/county. Finally, three administrative villages in each street/town were randomly selected. This resulted in a total number of 45 villages. To be eligible for inclusion in the study, participants had to be aged 35 years or more and have been a local resident for at least 5 years.

Questionnaire and definitions

The questionnaire was administrated by household interview. It included questions on age, gender, the number of family members, total monthly income of the family, body weight and height, and other basic demographic information.

Participants, wearing light indoor clothing and without shoes, had their weight measured to the nearest 100 g using a beam balance scale, and their height measured to the nearest millimetre using a stadiometer. Weight and height were measured twice and the mean value of the readings was used for the analysis. BMI was calculated by dividing weight (kg) by the square of height (m). Participants with BMI of 24 kg m^{-2} or greater were classed as being above the healthy weight range, and categorised as overweight (BMI between 24 and 28 kg m^{-2}) or obese (BMI greater than 28 kg m^{-2})[11,31].

A family was defined as those who lived together and shared living-related expenditures. The total monthly income of all family members is the monthly total earnings of the whole family; including salaries, pensions and allowances, money from selling goods and products, and the estimated market-price value of products for personal/family consumption. Family average income (FAI), the average total monthly income of all family members, was divided into tertiles to derive three categories: lower, middle and higher. Previously reported predictors of obesity in adults assessed were age, gender, educational attainment, sedentary lifestyle and poor diet[13–27]. These covariates were also reported to be predictors of obesity in Chinese adults[32], so we chose age, gender, area of residence (rural or urban), educational attainment (0–9 years; 10–12 years; 13 years or more), occupational physical activity (classified as 'light' – receptionist, office worker, assembly worker; 'moderate' – repairer, electrician, machinist; or 'vigorous' – farmer, steel-maker, lumberman), leisure-time physical activity (classified as 'light' – cooking, flower-growing, watching television; 'moderate' – jogging, dancing, Chinese Taiji; 'vigorous' – ball sports, field-running), amount of vegetable consumption ('low' – <100 g day^{-1}; 'moderate' – 100–500 g day^{-1}; 'high' – >500 g day^{-1}) and frequency of red meat consumption ('low' – <6 times/week; 'moderate' – 6–18 times/week; 'high' – >18 times/week) as the covariates in the analysis.

Data management and analysis

This survey was conducted by health-care professionals who were trained in correct interview procedures prior to survey administration. The data were double-entered and cleaned via Epi Info 6.04 (Centers for Disease Control and Prevention, Atlanta, GA, USA), and managed and analysed via SPSS version 10.0 (SPSS Inc., Chicago, IL, USA). Demographic variables were compared across FAI tertiles via odds ratios.

Results

The total number of survey respondents was 29 353. The response rate was 90.1%, with no significant demographic difference between responders and non-responders. There were 67.7% urban and 32.3% rural residents; 49.8% were male and 50.2% female. Table 1 shows demographic characteristics of the sample participants with different FAI in this study.

The proportion of participants identified as having BMI above the healthy weight range was 38.2%; 30.5% were overweight and 7.8% obese. Table 2 presents the prevalence of overweight and obese adults by main covariates.

After adjusting for age, gender, educational level, occupational and leisure-time physical activity, daily vegetable consumption and frequency of red meat intake, urban residents were more likely to be both overweight (odds ratio (OR) 1.74, 95% confidence interval (CI) 1.61–1.88) and obese (OR 3.23, 95% CI 2.79–3.73) than their rural counterparts.

Table 3 presents data on proportions above the healthy weight range within categories of FAI by area of residence and gender. It shows that women were more likely than men to be obese, and that participants in the lower FAI tertile were less likely to be overweight or obese than participants in the upper two FAI tertiles.

Table 1 Demographic characteristics of the sample participants with different family average income (FAI) in regional Mainland China

	FAI level			
	Lower	Middle	Higher	Total
Area				
Urban	9589 (48.3)	6229 (31.3)	4055 (20.4)	19 873
Rural	9092 (95.9)	301 (3.2)	87 (0.9)	9480
Gender				
Male	9183 (62.9)	3334 (22.8)	2091 (14.3)	14 608
Female	9498 (64.4)	3196 (21.7)	2051 (13.9)	14 745
Age group (years)				
35–49	9007 (68.2)	2920 (22.1)	1287 (9.7)	13 214
50–64	5840 (58.6)	2426 (24.4)	1696 (17.0)	9962
65 +	3834 (62.1)	1184 (19.2)	1159 (18.8)	6177
Educational attainment (years)				
0–9	15 890 (80.1)	3014 (15.2)	933 (4.7)	19 837
10–12	2412 (43.9)	2061 (37.6)	1015 (18.5)	5488
13 or more	379 (9.4)	1455 (36.1)	2194 (54.5)	4028
Total	18 681	6530	4142	29 353

Values are expressed as *n* (%), where *n* is the number of participants within each subgroup and % is the percentage of participants within each subgroup.

Table 4 shows that, in all three categories, middle-aged participants were more likely to be overweight or obese. Participants in the lowest FAI stratum were the least likely to be above the healthy weight range, for each age group.

Discussion

In this study, our focus was on the relationship between SES (defined by FAI) and BMI above the healthy weight range in the context of Mainland China. The overall prevalence of obesity in Mainland China was lower than the figures reported for developed countries, but higher than has been reported for Malaysia and Cameroon[2–8]. The proportion of participants categorised as being above the healthy weight range (38.2%) in our study was similar to that documented in a national report from China[30]. We found that urban people were more likely to be overweight and obese, men were less likely to be obese than women, and participants in the lower FAI category were the least likely to be above the healthy weight range. Our findings are consistent with other studies that show positive associations between higher SES and obesity in developing countries[26,27].

Table 2 Prevalence of overweight and obese adults by main covariates in Mainland China

Covariate	Overweight	Obese
Educational attainment (years)		
0–9	29.3 (5817/19 839)	8.2 (1620/19 839)
10–12	32.1 (1759/5488)	7.7 (420/5488)
13 years	34.4 (1383/4026)	6.3 (255/4026)
Occupational physical activity		
Light	32.0 (6418/20 071)	8.7 (1750/20 071)
Moderate	32.3 (969/3004)	7.1 (212/3004)
Vigorous	25.0 (1572/6278)	5.3 (333/6278)
Leisure-time physical activity		
Light	30.6 (7253/23 700)	8.3 (1963/23 700)
Moderate	30.5 (1574/5155)	6.0 (309/5155)
Vigorous	26.5 (132/498)	4.6 (23/498)
Amount of vegetable consumption		
Light	29.7 (461/1550)	7.0 (108/1550)
Moderate	30.4 (4696/15 424)	7.7 (1189/15 424)
High	30.7 (3802/12 379)	8.1 (998/12 379)
Frequency of red meat consumption		
Light	24.7 (1610/6513)	6.8 (444/6513)
Moderate	30.1 (3547/11 797)	7.4 (868/11 797)
High	34.4 (3802/11 043)	8.9 (983/11 043)

Values are expressed as % (*n*/*N*), where % is the percentage of overweight/obese participants, *n* is the number of overweight/obese participants and *N* is the total number participants within the subgroup.

There was no significant association between FAI categories and being above the healthy weight range in urban areas. However, in rural areas, participants in the lower FAI category were less likely to be above the healthy weight range than were participants in the higher and middle FAI categories. This may be explained by lifestyle and behaviour patterns that tend to be much more Westernised in urban areas and may affect all social groups, more so than in the rural areas in China[30].

Women were more likely to be above the healthy weight range relative to men in the lower FAI tertile, but were less likely to be above the healthy weight range relative to men in both higher and middle FAI categories. One possible explanation for this phenomenon is that, for men within the higher and middle categories of SES, it is culturally more acceptable to adopt Western lifestyles and behaviour patterns (such as eating out and consuming alcohol) than it is for women in China.

A limitation of the study is that family average incomes were self-reported. Participants may have underestimated their earnings and the value of home-grown foods and informal barter arrangements that are common practice in rural areas. Another limitation is that some 9.9% of eligible subjects were not interviewed. These people were mostly young men in rural areas, who had temporarily vacated their permanent residence to undertake casual work. The proportion of overweight adults in this group is relatively low, so the general prevalence may be overestimated in this regional population. While it is possible that more than one participant may have come from the same household, the data did not identify this so it was not possible to control for clustering in the analyses.

More studies, especially with prospective designs, that examine such factors need to be conducted to explore the relationship between SES and the likelihood of being overweight or obese under different circumstances in countries undergoing demographic and epidemiological transitions such as those currently taking place in Mainland China.

Conclusions

The proportion of adults with BMI above the healthy weight range was positively related to SES in the current

Table 3 Prevalence of overweight and obese adults by area of residence and gender, within family average income (FAI) categories in Mainland China

		Overweight		Obese	
FAI level		Prevalence	Adjusted OR (95% CI)	Prevalence	Adjusted OR (95% CI)
Overall					
All levels		30.5 (8959/29 353)		7.8 (2295/29 353)	
Lower		27.8 (5201/18 681)	1.00	7.3 (1358/18 681)	1.00
Middle		35.1 (2295/6530)	1.14 (1.06–1.22)	9.1 (598/6530)	0.999 (0.89–1.12)
Higher		35.3 (1463/4142)	1.17 (1.07–1.28)	8.2 (339/4142)	0.96 (0.82–1.12)
Area					
All levels	Rural	22.0 (2086/9480)	1.00	3.8 (357/9480)	1.00
	Urban	34.5 (6854/19 873)	1.74 (1.61–1.88)	9.7 (1928/19 873)	3.23 (2.79–3.73)
Lower	Rural	21.6 (1960/9092)	1.00	3.8 (343/9092)	1.00
	Urban	33.6 (3225/9589)	1.76 (1.62–1.92)	10.5 (1009/9589)	2.92 (2.50–3.41)
Middle	Rural	32.2 (97/301)	1.00	3.7 (11/301)	1.00
	Urban	35.3 (2198/6229)	1.09 (0.82–1.44)	9.4 (584/6229)	4.59 (2.33–9.05)
Higher	Rural	33.3 (29/87)	1.00	3.4 (3/87)	1.00
	Urban	35.3 (1431/4055)	1.15 (0.70–1.91)	8.3 (335/4055)	3.42 (1.02–11.55)
Gender					
All levels	Female	30.9 (4553/14 745)	1.00	9.0 (1332/14 745)	1.00
	Male	30.0 (4387/14 608)	0.95 (0.90–0.99)	6.5 (953/14 608)	0.73 (0.67–0.80)
Lower	Female	30.0 (2845/9498)	1.00	8.9 (846/9498)	1.00
	Male	25.5 (2340/9183)	0.78 (0.73–0.83)	5.5 (506/9183)	0.60 (0.53–0.67)
Middle	Female	32.9 (1050/3196)	1.00	9.9 (315/3196)	1.00
	Male	37.3 (1245/3334)	1.24 (1.11–1.38)	8.4 (280/3334)	0.97 (0.81–1.17)
Higher	Female	32.1 (658/2051)	1.00	8.3 (171/2051)	1.00
	Male	38.4 (802/2091)	1.34 (1.17–1.53)	8.0 (167/2091)	0.98 (0.77–1.23)

OR – odds ratio; CI – confidence interval.
Prevalence values are expressed as % (*n*/*N*), where % is the percentage of overweight/obese participants, *n* is the number of overweight/obese participants and *N* is the total number of participants within the subgroup.

Table 4 Prevalence of overweight and obese adults by age, within family average income (FAI) categories in Mainland China

		Overweight		Obese	
FAI level	Age (years)	Prevalence	Adjusted OR (95% CI)	Prevalence	Adjusted OR (95% CI)
Overall	35–49	29.5 (3892/13 214)	1.00	6.2 (824/13 214)	1.00
	50–64	34.1 (3395/9962)	1.21 (1.14–1.28)	9.1 (906/9962)	1.48 (1.33–1.64)
	65 +	36.8 (1653/6177)	0.86 (0.80–0.93)	9.0 (555/6177)	1.42 (1.26–1.61)
Lower	35–49	28.6 (2578/9007)	1.00	6.3 (565/9007)	1.00
	50–64	30.2 (1765/5840)	1.13 (1.05–1.22)	8.5 (497/5840)	1.43 (1.25–1.63)
	65 +	22.0 (842/3834)	0.70 (0.64–0.78)	7.6 (290/3834)	1.22 (1.04–1.44)
Middle	35–49	31.7 (926/2920)	1.00	6.4 (187/2920)	1.00
	50–64	39.4 (955/2426)	1.34 (1.19–1.51)	10.8 (262/2426)	1.61(1.31–1.98)
	65 +	35.0 (414/1184)	1.10 (0.94–1.29)	12.3 (146/1184)	1.67 (1.30–2.15)
Upper	35–49	30.1 (388/1287)	1.00	5.6 (72/1287)	1.00
	50–64	39.8 (675/1696)	1.46 (1.25–1.71)	8.7 (147/1696)	1.61 (1.19–2.18)
	65 +	34.3 (397/1159)	1.21 (1.02–1.45)	10.3 (119/1159)	1.82 (1.32–2.51)

OR – odds ratio; CI – confidence interval.
Prevalence values are expressed as % (*n*/*N*), where % is the percentage of overweight/obese participants, *n* is the number of overweight/obese participants and *N* is the total number of participants within the subgroup.

Chinese context at the population level. People in the lower SES category were less likely to be above the healthy weight range, irrespective of their gender and age. In urban areas, no significant differences were detected for the proportions of adults with weight above the healthy range between all three FAI categories; in rural areas, participants in the lower FAI category were less likely to have BMI above the healthy weight range.

Observed associations between overweight/obesity and SES are consistent with other effects of epidemiological transition and identify a need for preventive initiatives.

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