Overweight and Obesity Among Chinese College Students: An Exploration of Gender as Related to External Environmental Influences

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Abstract
While many studies have examined factors associated with overweight and obesity among college students, no study has yet compared gender differences influencing overweight and obesity using a multilevel framework. The present study examines different influences on overweight and obesity between men and women at both individual and environmental levels. Participants were 11,673 college students identified through a multistage survey sampling process conducted in 50 Chinese universities. The prevalence of overweight and obesity was 9.5% (95% CI [7.7, 11.3]) in the overall study sample, 13.9% (95% CI [11.5, 16.7]) in males and 6.1% (95% CI [4.1, 8.1]) in females, respectively. We found that higher family income, perceived life stress, home region GDP, and university city unemployment were associated with higher overweight and obesity levels in males, independent of other individual- and city-level covariates. However, unlike male students, only unemployment was associated with overweight and obesity among females. Our research indicates Chinese males are more susceptible to overweight and obesity, and are more easily influenced by external variants than Chinese females. This information should be considered in formulating gender-specific policies and designing and implementing effective interventions to reduce the prevalence of overweight and obesity among young adult male college students.

Keywords: overweight and obesity, gender, psychological stress, well-being, healthy lifestyles, socioeconomic status, China, college students

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Previous studies have reported factors associated with overweight and obesity among college students, but most were implemented at the individual level (Lowry et al., 2006; Davy, Benes, & Driskell, 2006; Odlaug et al., 2016), little attention has been paid to contextual influences (Singh et al., 2016; Mendes, Pessoa, Padez, Velasquez-Melendez, & Malta, 2013). Many studies have found differences in overweight and obesity prevalence between male and female college students (Davy et al., 2006; Lowry et al., 2006; Pliner & Saunders, 2008; Cluskey & Grobe, 2009). No comparative studies between men and women examining pattern influencing overweight and obesity using a multilevel framework were found. Studies have reported that female college students have better health awareness, greater concern about weight control, maintain lower caloric intake, pay more attention to exercise, select foods lower in fat and sugar, and have higher intakes of fruits and vegetables.

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than male students, but male students are less concerned about their weight (Lowry et al., 2000; Davy et al., 2000; Cluskey & Grobe, 2009; Debate, Topping, & Sargent, 2001). Such extensive behavioral differences between genders could make a significant contribution to overweight and obesity. Ecological models depict overweight and obesity among college students being influenced by both individual and environmental characteristics (Yang, 2007). From this perspective, it is important to examine different patterns affecting overweight and obesity between men and women under a multilevel framework. More specifically, variables examined in this study include individual life stress, as well as the external variables of family income, regional GDP, unemployment rates, and others. Some studies found college student’s socioeconomic status was associated with overweight and obesity (Lowry et al., 2000; Dinsa, Goryakin, Fumagalli, & Suhrcke, 2012; Viswanathan, 2009); however, these studies were implemented in individuals, and the results were contradictory. Researchers have also found individual psychosocial stress to be positively associated with overweight and obesity among college students (Soma, Guha, & Indranil, 2009; Odlaug et al., 2015). However, regional level variables have not been examined.

This study will examine gender differences in both individual and regional contextual socioeconomic status, and psychosocial stressors influencing overweight and obesity.

**Methods**

**Study Area and Participants**

This study reports individual data from the Global Health Professions Student Survey (GHPSS) on Tobacco Control in China GHPSS. While this project primarily focused on smoking and tobacco control, it also was concerned with other aspects of health, including behavioral issues, mental stress, obesity, and others. Students were recruited at 50 of the 60 universities participating in the program to complete the survey and these 50 universities residing in 42 cities across China and differentiated by regional location. Twenty-two of them were medical universities offering only medical programs and 28 were comprehensive universities offering medical and nonmedical programs. A detailed description of the selection process can be found in Yang et al. (2015).

**Data Collection**

Individual variables were measured via a structured self-administered questionnaire. The questionnaire was administered during regular class meetings and took approximately 30 min to complete. All responses were anonymous. A common research protocol was utilized across all 50 universities to assure homogeneity of questionnaire administration and data collection techniques. A detailed description of the research protocol can be found in Yang et al. (2015). Regional variables were retrieved from the National Bureau of Statistics database (Department of Comprehensive Statistics of The National Bureau of Statistics, 2014; Department of Urban Social Economic survey of the National Bureau of Statistics, 2014).

**Measures**

**Dependent variable.** Height and weight were measured through self-report. Body mass index (BMI) was calculated by dividing body weight (kg) by squared height (m²). Individuals with BMI scores of 24.0–27.9 kg/m² were categorized as overweight, and those with scores of ≥28.0 kg/m² were categorized as obese. These categories are consistent with the national standard for overweight and obesity utilized in China (Department of Disease Control and Prevention, 2003). Self-report measures of overweight and obesity have been shown to be reliable in this population as there is a high correlation with objective measures for these variables (97.1% for the combined prevalence of overweight and obesity, and 98.8% for obesity (Yang, Yang, Yu, Cottrell, & Jiang, 2017).

**Individual-level independent variables.** Sociodemographic questions were included on the questionnaire to determine age, gender ethnicity, father’s and mother’s occupations, and others.

Life stress was operationally defined as something causing college students to worry on a daily basis. It was measured through a standardized questionnaire designed by Yang et al. (T. Yang, X. Y. Yang, Yu, Cottrell, & Jiang, 2017). The instrument had acceptable validity and reliability, and has been used extensively in Chinese research. The questionnaire consisted of eight items covering such issues as financial situation, health status, interpersonal relationships, study stress, and other problems. All items were rated on a 5-point scale where 0 is feeling no stress, 1 is little stress, 2 is some stress, 3 is more stress, and 4 is much more stress. The total score was obtained by summing up the scores for each individual item. Consistent with prior practice, a score of 24 or more signified severe stress (Cui, Rockett, Yang, & Cao, 2012; T. Yang, X. Y. Yang, et al., 2017).

**Regional contextual independent variable.** Several independent variables reflected potential regional variation. The first regional variable included in this study was level of economic development, as measured by per
capita Gross Domestic Product (GDP) in Yuans. Both the GDP of the original home province (home region GDP) which the students came from and of the city (university city GDP) where their university was located were measured. The above data were obtained from the National Bureau of Statistics (Department of Comprehensive Statistics of National Bureau of Statistics, 2014; Department of Urban Social Economic Survey of the National Bureau of Statistics, 2014). The second regional variable was unemployment rate. Unemployment is defined as when people are without work and actively seeking work. Unemployment is associated with problems in economic growth and development that produce stress for residents (Yang et al., 2017).

Unemployment rates in cities where universities are located may also create stressors for college students because of decreased work opportunities and pay levels, as well as feelings of frustration and hopelessness related to future employment, etc. In this study, we included urban unemployment rates as an indicator of regional stress on college students. University city unemployment rate was operationalized as the number of unemployed people (in millions) in the city where the university was located and was based on data obtained from the National Bureau of Statistics (Department of Urban Social Economic Survey of the National Bureau of Statistics, 2014).

Data Analysis

All data were entered into a database using Microsoft Excel. The dataset was then imported into SAS (9.3 version) for statistical analyses. Descriptive statistics were calculated to determine the prevalence of overweight and obesity. A logistic model was utilized to assess associations between the dependent and independent variables. Both unadjusted and adjusted methods were considered in the data analyses, and implemented to examine these associations in males and females, respectively. The unadjusted method used only the key factors of interest as independent variables in the analyses, while the adjusted method added all of the possible confounders listed in Tables 1 and 2 as covariates in the logistic models. Both unadjusted and adjusted methods were considered in the data analyses, and implemented to examine these associations in males and females, respectively. The unadjusted method used only the key factors of interest as independent variables in the analyses, while the adjusted method added all of the possible confounders listed in Tables 1 and 2 as covariates in the logistic models.

Results

A total of 12,211 questionnaires were completed by students from 50 universities. Of these responders, 11,954 were fully completed and available for analysis. BMI was calculated for the 11,673 responders who provided complete height and weight data; the remaining 281 (2.7%) had missing data and were eliminated from the analysis. There were no significant differences in demographic characteristics between responders and nonresponders for BMI. Of sample 4,177 (49.1%) were male, 7,496 (50.9%) were female. There were no significantly differences for most variables of the demographic characteristics between male and female (see Table 1).
The prevalence of overweight and obesity combined was 9.5% (95% CI [7.7, 11.3]) in the overall study sample, 13.9% (95% CI [11.5, 16.7]) in males, and 6.1% (95% CI [4.1, 8.1]) in females. Overall obesity prevalence alone was 2.2% (95% CI [1.3%, 3.1]), with a prevalence of 3.0% (95% CI [1.5%, 4.4]) among males and 1.6% (95% CI [0.6, 2.5]) among females (see Table 2). Subsequent analyses focused solely on the combined sample of students who were classified as overweight and obesity.

The unadjusted logistic analysis showed: Father’s occupation, family income, perceived stress in life, home region GDP, and unemployment were associated with being classified as overweight or obese in males. Enrollment in a medical major, father’s and mother’s occupation, university city GDP, and unemployment were associated with being classified as overweight or obese in females (see Table 2). Subsequent analyses focused solely on the combined sample of students who were classified as overweight and obesity.

The final multiple level logistic models showed that higher family income, perceived life stress, home region GDP and university city unemployment were associated with being classified as overweight or obese in males. However, unlike male students, only the regional unemployment was associated negatively with overweight and obesity among females. In demographic characteristics, males with a father’s occupation in staff and administration had a higher likelihood of being overweight and obese; females who did not have a medical major were associated with a higher likelihood of being overweight and obese (see Table 2).

There was no interaction between family income and original region GDP (Parameter estimate: 0.1080, SE: 0.1452, p > .05), and life perceived stress and unemployment (Parameter estimate: 0.6662, SE: 0.5060, p > .05) among male students.

Analyses for multicollinearity indicated low multicollinearity. VIF values were 1.07, 1.11, 1.81, 1.69, and 1.19 in family income, perceived life stress, university type, home region GDP, and unemployment.
### Table 2. Overweight and Obesity Prevalence and Associated Individual and Regional Influences.

| Group               | Male (N = 7,496) | Female (N = 4,177) |
|---------------------|------------------|--------------------|
|                     | N (% of sample)  | Prevalence        | Unadjusted OR (95% CI) | Adjusted OR (95% CI) |
| N (% of sample)     |                  |                   |                        |                      |
| Age (years)         |                  |                   |                        |                      |
| <20                 | 553 (12.9)       | 13.2              | 1.00                   |                      |
| 20-                 | 770 (28.6)       | 14.3              | 0.91 (0.46, 1.81)      | 1.554 (34.3) 3.3     |
| 21-                 | 952 (32.0)       | 11.5              | 0.70 (0.37, 1.31)      | 1.757 (29.6) 8.1     |
| 22-                 | 880 (15.2)       | 13.7              | 0.83 (0.43, 1.56)      | 1.516 (13.9) 8.2     |
| 23-                 | 1,022 (11.0)     | 18.1              | 1.20 (0.63, 2.31)      | 1.391 (9.5) 6.3     |
| Ethnicity           |                  |                   |                        |                      |
| Han                 | 3,927 (95.1)     | 14.1              | 1.00                   |                      |
| Minority            | 250 (5.0)        | 9.5               | 0.61 (0.18, 2.06)      |                      |
| Major               |                  |                   |                        |                      |
| Medical             | 3,505 (14.0)     | 17.0              | 1.00                   |                      |
| Others              | 672 (86.0)       | 13.4              | 0.74 (0.53, 1.02)      | 1.056 (18.6) 4.6     |
| Father’s occupation |                  |                   |                        |                      |
| Operation and       | 3,253 (71.9)     | 12.7              | 1.00                   |                      |
| commercial work     |                  |                   |                        |                      |
| Staff and           | 625 (17.7)       | 18.6              | 1.73 (1.04, 2.92)*     | 2.29 (1.20, 4.32)*   |
| administration      |                  |                   |                        |                      |
| Teacher and         | 299 (10.4)       | 14.1              | 1.26 (0.44, 2.90)      | 424 (8.6) 9.6       |
| scientific and      |                  |                   |                        |                      |
| technical work      |                  |                   |                        |                      |
| Mother’s occupation |                  |                   |                        |                      |
| Operation and       | 3,286 (72.4)     | 13.6              | 1.00                   |                      |
| commercial work     |                  |                   |                        |                      |
| Staff and           | 579 (13.6)       | 16.6              | 1.22 (0.52, 2.89)      | 921 (18.7) 6.4      |
| administration      |                  |                   |                        |                      |
| Teacher and         | 312 (14.0)       | 12.9              | 0.97 (0.58, 1.64)      | 464 (8.6) 12.0     |
| scientific and      |                  |                   |                        |                      |
| technical work      |                  |                   |                        |                      |
| Income in each      | Miss 2,591       |                   |                        |                        |
| person in family    |                  |                   |                        |                      |
| (RMB)               |                  |                   |                        |                      |
| <10,000             | 552 (30.9)       | 5.5               | 1.00                   | 1.219 (36.2) 6.3     |
| 10,000              | 555 (21.2)       | 7.3               | 1.39 (0.72, 2.67)      | 871 (20.5) 10.6     |
| 20,000              | 668 (47.9)       | 12.4              | 2.66 (1.04, 6.81)*     | 1.217 (43.3) 4.9     |
| Perceived life     |                  |                   |                        |                      |
| stress              |                  |                   |                        |                      |
| Low score           | 3,645 (88.7)     | 12.6              | 1.00                   | 6,884 (93.2) 5.9     |
| High score          | 532 (11.3)       | 18.3              | 2.42 (1.17, 5.02)*     | 612 (6.8) 6.9      |

(continued)
| Group                  | Male (N = 7,496) | Female (N = 4,177) |
|-----------------------|------------------|-------------------|
|                       | N (% of sample)  | Prevalence | Unadjusted OR (95% CI) | Adjusted OR (95% CI) | N (% of sample)  | Prevalence | Unadjusted OR (95% CI) | Adjusted OR (95% CI) |
| Home region GDP       |                  |            |                      |                     |                  |            |                      |                     |
| <50,000               | 2,012 (54.8)     | 10.9       | 1.00                 | 1.00                | 3,856 (48.5)     | 5.7        | 1.00                 | 1.00                |
| 50,000-               | 1,275 (24.9)     | 15.4       | 1.56 (0.87, 2.80)    | 1.46 (0.76, 0.78)   | 2,208 (28.6)     | 5.7        | 1.03 (0.60, 1.78)     |                     |
| 100,000-              | 890 (20.3)       | 19.8       | 1.26 (1.11, 1.44)**  | 1.24 (1.07, 1.42)** | 1,432 (22.9)     | 7.0        | 1.02 (0.87, 1.19)     |                     |
| University city GDP   |                  |            |                      |                     |                  |            |                      |                     |
| <50,000               | 1,460 (14.1)     | 12.2       | 1.00                 |                     | 2,543 (17.6)     | 8.0        | 1.00                 |                     |
| 50,000-               | 2,209 (62.0)     | 11.9       | 0.98 (0.57, 1.67)    |                     | 4,054 (60.4)     | 6.4        | 1.72 (0.87, 3.40)     |                     |
| 100,000-              | 580 (23.9)       | 18.3       | 1.62 (0.89, 2.93)    | 1.63 (1.05, 2.60)   | 899 (22.0)       | 8.0        | 2.39 (1.05, 5.48)**   |                     |
| Unemployment persons/one million | | | | |<100> | 1,474 (42.1) | 10.5 | 1.00 | 1.00 | 2,676 (35.5) | 6.4 | 1.00 | 1.00 |
| 100-                  | 2,269 (50.8)     | 16.1       | 1.64 (1.11, 2.41)*   | 1.63 (1.05, 2.60)   | 3,820 (59.1)     | 6.0        | 0.97 (0.50, 1.88)     | 0.80 (0.43, 1.50)   |
| 200-                  | 434 (7.2)        | 18.3       | 1.90 (1.16, 3.14)**  | 1.88 (1.06, 3.46)** | 1,000 (5.4)      | 3.1        | 0.48 (0.28, 0.81)**   | 0.44 (0.23, 0.80)** |

Note. GDP = gross domestic product; CI = confidence interval; OR = odds ratio; RMB = Ren Min Bi (Chinese Currency). '*' only signifies the age group sectionalization.
respectively among male students. Those values are lower than 10 and well below a value of 2.5 for even a weak model. It was therefore, determined that adjustments to deal with the presence of multicollinearity were not warranted (see Table 3). In the null model, the random effect of original regions and university city were estimated 9.0553 and 1.3152 among female students, and 9.8249 and 1.3150 among male students respectively, but they all declined in the full model (see Table 3). This finding likely reflects significant overweight and obesity variation between original regions and university city regardless of gender.

**Discussion**

This study was the first empirical study in China or elsewhere to use a multilevel framework to examine gender differences in overweight and obesity. Results indicated that the prevalence of overweight and obesity among college students was 9.5%, with a specific prevalence of 13.5% in males and 6.1% in females. The overall prevalence of overweight and obesity was lower in this sample than in many countries (Peltzer et al., 2014; Wharton et al., 2008; Cluskey & Grobe, 2009), but higher than in some Eastern countries (Peltzer et al., 2014; Sultana et al., 2011; Nojomi & Najamabadi, 2006). In any case, college presents a time of transition for young adults that often involves adaptation to a new environment. Many studies of college students reveal weight gains occurring during this time (Economos, Hildebrandt, & Raymond, 2008; Pliner & Saunders, 2008). From this perspective, weight and obesity issue of college students should highly be an attention.

Gender differences related to overweight and obesity in college students have not been sufficiently explored. Results from the current study indicate that male students are more susceptible to overweight and obesity than female students in China. This trend is consistent with many studies among college students (Davy et al., 2006; Lowry et al., 2000; Pliner & aunders, 2008, Cluskey & Grobe, 2009), but did not consistent with some studies (Hoffman, Policastro, Quick, & Lee, 2006; Economos et al., 2008). From individual perspective the gender difference may be mainly influenced from different behavioral styles between men and women.

This study mainly explored gender differences related to external environmental influences on overweight and obesity. Higher family income and higher home region GDP were associated with a higher likelihood of being classified as overweight and obese among male students, but these associations were not found among female students. This trend may indicate male students are more sensitive to external environment factors than female students who seem better able to avoid excess food consumption even in the context of readily available economic resources. Socially, it may be more acceptable for Chinese men to be overweight or obese than it is for females to be overweight or obese. Many people think that strong is the symbol of men’s masculinity in China, but they mistakenly link overweight and obesity with strength. In China size matters. As young adults, giving the appearance of strength through large size contributes to social status (Yang, 2007). For Chinese female college students being small and petite is more highly valued than strength, thus they may be more motivated to control their diet to maintain the preferred body size.

This study showed that higher perceived life stress and regional unemployment were associated with being classified as overweight and obese in males. However, unlike male students, only regional unemployment was associated with overweight and obesity among females, and in this case the relationship was inverse. This may indicate that male students have less behavior control over food consumption under stressful situations than their female counterparts.

Although it is plausible that young adults’ interpretations of and response to regional unemployment rates and, therefore their levels of stress, may reflect important gender differences in future career expectations. Other factors are also likely at play and there is a need for additional research to more clearly identify these relationships. Courtenay argued

| Group                           | Parameter Estimates From Multiple Level Models. |
|--------------------------------|-----------------------------------------------|
|                                | Women                                         | Men                                          |
| Random parameters between original regions | 9.0553 (0.3249) (t:22.10)** | 9.8249 (0.4658) (t:21.09)** |
| Random parameters between university city | 1.3152 (0.497)** | 1.3150 (0.4073) (t:3.22)** |
| Fixed parameters               | 4.8795 (0.0992) (t:49.15)**                 | 3.0157 (0.2093) (t:14.41)**                 |
|                                | 3.4811 (0.4214) (t:8.26)**                   | 8.7344 (0.4459) (t:19.59)**                 |
| Random parameters between university city | 1.0134 (0.4214) (t:8.26)**                  | 1.0584 (0.3992) (2.65)**                   |
| Fixed parameters               | 3.7748 (0.2135) (17.68)**                    | 2.1533 (0.2355) (9.14)**                    |

Note. *p < 0.05. **p < 0.01.
that the socially constructed gender roles have far-reaching influence on the ascriptive guidelines of what is considered appropriate for each gender, such gendered social roles ascribe masculinity with risk-taking behaviors and define normative feminity with risk-avoidance and generally health-protective behaviors. Men who subscribe to their socially constructed gender roles are particularly at risk of overweight and obesity through a lack of concern for body shape and eating habits (Courtenay, McCreary & Merighi, 2002). Chinese society is dominated by a patriarchy. Performing and manifesting masculinity is deeply rooted in the cultural mandates of any patriarchy, which expects men to be the leaders of society and the heads of their families (Mao & Bottom, 2016). In a parochial society, men are expected to take primary responsibility in maintaining the economic well-being of their society and family, while women are relegated with subordinate roles reserved in the domestic sphere. Thus, men are also particularly at risk of the negative impact of employment instability on their health outcomes. At a structural level, regional unemployment rates are associated with the pace of economic development, labor absorption capacity, and social stability. It is found among college students that the stressors originate from unemployment worries include lack of demand in the market, low or no pay, feelings of frustration and hopelessness about future employment (Lou, Zhou, & Wu, 2005). The structural economic strain placed on employment prospect may have an amplified effect on male students due to the socially prescribed gender roles that elevate the necessity of financially supporting a potential family to the level of the existential meaning associated with being a man. As a consequence, male students may compensate this insecurity by unhealthy behaviors that ultimately manifest in eating problems and substance use.

This study found there is no interaction between family income and original region GDP, and life-perceived stress and unemployment among male students. This indicates that individual and regional economic status, and stress status, influencing on overweight and obesity are more independent, there is no obvious phenomenon of mutual promotion.

Although the association between psychological stress and unhealthy weight has not been well understood in China, the findings of this study provide a basis for further exploration. Further, these findings may assist in the development and evaluation of new approaches to prevent and treat overweight and obesity by focusing on psychological perspectives. In addition, universities should focus on creating environments which reduce stressors for students and support their overall mental health and well-being.

Participants in this study were mainly college students pursuing a medical degree. Given this specific characteristic and assuming their health knowledge is superior to the general population, the students might be expected to be less prone to overweight and obesity. But the reason why differences between medical students and other students were only found in females is unclear. Perhaps the social pressure to appear big and strong in men is so prominent that male medical students intentionally try to gain weight despite their medical knowledge. As a result, their weights are similar to other college students. Women on the other hand try to remain small and petite using their medical knowledge to assist in this process.

This study presents a number of limitations. First, the study was based on a cross-sectional design, which precludes causal inference. Longitudinal studies are necessary to further confirm these findings in the future. Second, this work only focused on college students. More research needs to be done on those who are not in college and are still facing significant amounts of individual and regional stress in a country undergoing significant changes. Obesity was measured using height and weight. Some participants may have had more muscle mass and thus were classified as overweight or obese when in fact they were not. To control for this limitation, more sophisticated methods for determining obesity would need to be utilized. Finally, further investigation on the impact of external and environmental influences on gender differences in overweight and obesity is essential, and to fully understand the mechanisms underlying the influence of socioeconomic variables and psychological stress on the prevalence of overweight or obesity.

**Conclusion**

Our research indicates males were more susceptible to overweight and obesity, and were more easily influenced by external variants than were females in China. Considering these influences, gender sensitive strategies are needed on campuses to enable adoption of healthy foods and physical activity, and support stress management to prevent overweight and obesity. International efforts are underway to transform campus cultures and environments in ways that support the health and well-being of students, staff, and faculty, and may be useful in guiding the development and implementation of system-wide action strategies.

**Declaration of Conflicting Interests**

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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