Factors associated with being overweight among Inner Mongolia medical students in China

Jie Chen, He Yi, Zhiyue Liu, Yancun Fan, Jiang Bian, Wenfang Guo, Wulantuya Chang, Juan Sun

ABSTRACT

Objectives: A major goal of our study was to identify the associations between lifestyle factors and obesity in adolescents and young adults at risk by surveying students in Inner Mongolia Medical University. A second goal was to determine these factors differed by gender.

Design: Cross-sectional study.

Setting: Students grade 1–3 in Inner Mongolia Medical University.

Participants: 5471 grade 1–3 medical students, composed of 3891 female and 1580 male students. Students with body mass index (BMI) ≥25 were defined as overweight.

Results: BMI for male students was 22.1±2.9 and 21.2±2.2 for female students. The prevalence of overweight was 7.6%, with the prevalence being higher for male students compared with females, urban higher than rural and being an only child higher than having sibling children. For male students, urban residence was a risk factor, while for female students being an only child and staying up at night were risk factors, with physical activity a protective factor. A dose-dependency relationship was found between physical fitness and overweight prevalence.

Conclusions: This study shows that being an only child and resident in an urban area are risk factors; staying up late and lack of physical activities increased the risk of being overweight. BMI was associated with declines in physical fitness. Our study provides more insight into adolescent obesity problems.

INTRODUCTION

Globally, obesity has increased among children, adolescents and adults; at least 2.8 million people die each year worldwide as a result of being overweight or obese, with mortality rates being proportional to the degree of obesity. Younger age groups are affected, as demonstrated in nearly one-third of the American college students who are overweight or obese. According to the WHO, some 30–80% of adults and about 20% of children and adolescents in Europe are overweight. The situation in Asia is better, with lower prevalences of obesity in Thailand and China, although China is experiencing a rapid increase in the number of people classified as overweight or obese.

With obesity becoming an overwhelming global public health issue, there are a multitude of obesity-associated diseases, including heart disease, diabetes, hypertension and certain cancers. Although obesity is less prominently associated with morbidity in adolescence, it is nevertheless a strong precursor of obesity and related morbidity in adulthood. Adolescence has been identified as a critical period in the development of overweight/obesity patterns, with the transition to college being another potentially important period of risk for weight increase among young adults. In China, obesity is increasing with the prevalence of overweight or obesity among men in 1991 increasing from 9.6% and 0.6%, respectively, to 20.0% and 3.0%, respectively, in 2000; the figures were comparable for women, in whom there was an increase from 14.5% and 1.8%, respectively, to 26.5% and 5.2%, respectively. Inner Mongolia is a region inhabited by the Mongolian ethnic minority (1 of 5 minority ethnic autonomous regions in China); there is also a large population of Han people in the region. The current study considered the effect of ethnicity on overweight.

A study showed that 1-child families (only child) were a risk factor for obesity. A family-planning policy has been implemented since the 1970s. We considered the effect of 1-child families on overweight.
On the basis of our previous study, the current study focused on demographic, socioeconomic and lifestyle factors in relation to overweight in medical students in Inner Mongolia. To the best of our knowledge, no studies have analysed factors related to overweight among medical students thus far. As medical students are future health professionals, it is also important to measure their body weight to determine whether this is a problem. The health and health habits of health professionals may influence their attitudes towards relevant professional behaviours, which has been demonstrated by studies of weight status in health professionals.

METHODS
Participants
A cross-sectional survey was conducted among medical students at the Inner Mongolia Medical University of China. The survey employed a self-administered questionnaire (see online supplementary file 1).

In terms of ethnicity, there were three categories: Han, Mongolian (the minority) and other. The ethnicity information of the participants was obtained from basic information in the university database.

Physical fitness test data
Physical fitness test data were obtained from the sports department of the school and included height, weight, speed, flexibility, vital capacity and endurance score data. We used height and weight to determine the body mass index (BMI, kg/m²) based on the National Heart, Lung and Blood Institute criteria as follows: ≤18.5 underweight; 18.5–24.9 normal weight; 25–30 overweight; BMI ≥30 was considered obese. In our study, BMI ≥25 were considered as overweight. We categorised the students’ physical health status according to the college student physical health standard defined by the Ministry of Education of China and General Administration of Sport of China. Flexibility was measured by sit-and-reach, and vital capacity by a vital capacity meter; vital capacity was calculated as follows: vital capacity index = vital capacity (mL)/weight index (kg), with <60 as ‘poor’, 60–69 ‘normal’, 70–79 ‘intermediate’, 80–89 ‘good’ and 90–100 ‘excellent’. Speed score was measured by a 100 m run; in men, times ≤16.2, 90 open access

Survey data
The data were collected from December 2010 to January 2011 from 5471 grade 1–3 medical students; there were 3891 women and 1580 men.

The survey was carried out in the classroom. In cooperation with faculty management, students were informed of the purposes of the study. They were assured of confidentiality and that participation was voluntary.

Investigators distributed questionnaires and asked students to complete the questionnaires in the classroom. Participants returned the completed questionnaire to the investigators, some of whom checked the questionnaire while others counted the number of questionnaires. Finally, the investigators placed the questionnaires in a sealed envelope.

The self-report questionnaire contained questions about basic information, including student ID, sex, ethnicity, living habits and feelings experienced while in college. The questionnaire, the following definitions were used: students who used to reside in cities or the suburbs were urban; those previously living in villages or pastoral areas were rural; ‘only child’ was defined as a person without siblings. Breakfast was defined according to Alexander: ‘Subjects who did not consume breakfast on both days were categorised as breakfast skippers. Subjects who consumed breakfast on one of the two days were categorised as occasional breakfast eaters, while those that consumed breakfast on both days were classified as breakfast eaters.’ Based on Olds TS’s study about ‘Activity Patterns’ which was recommended by Australian government, ‘sports participant’ was defined as a person who participated in moderate to vigorous physical activity at least 1 h/day over 4 days/week. We referred to Giannotti et al’s research on ‘Evening-types’: significantly later bedtimes on weekdays and weekends, to defined ‘staying up’ as going to bed after midnight over 2 days/week; ‘smoker’ was defined as current daily smoking or occasional smoking according to Bian et al’s which was initially based on the National Centre for Health Statistics. ‘Gastrointestinal problems’ were defined as recurring symptoms of sufficient significance to alter lifestyle or require chronic treatment according to Stone et al’s report, and ‘quality of relationships’ (poor, medium, good) was self-assessed.

Statistical analysis
A χ² test was used to examine the differences of prevalence of overweight by sex according to demographic, socioeconomic and lifestyle factors. Crude ORs were calculated to evaluate the risk of exposure effects in the group studied relative to the reference group and associated 95% CIs. Non-conditional binary logistic regression analysis was used to ascertain factors associated with being overweight. This method was used for analyses with dependent variables in two categories (overweight and normal weight). Adjusted OR used logistic regression models to explore the effect of independent variables on the dependent variable in the model. In the models, OR >1.0 indicated an increased overweight risk.
and OR <1.0 indicated protective factors. An independent-sample t test was used to compare physical scores in overweight versus normal weight groups by sex. The trend χ² test was used to ascertain any dose-dependent relationships between the prevalence of overweight and physical fitness according to sex.

A significance level of p=0.05 was accepted for all analyses. Quantitative data were inputted using EpiData V.3.1 and analysed using SPSS V.13.0.

RESULTS
Sample characteristics
Of 5673 grade 1–3 students registered in the school, 5471 (96.44%) completed our survey. Of 5471 students, 414 were overweight. The overall prevalence of overweight was 7.6%. Because our research focused on overweight, 356 underweight students were not analysed. There were 1580 men and 3891 women. The mean age of the participants was 21.0±1.4 years.

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BMI and prevalence of overweight or obese

The BMI for men was 22.1±2.9; that for women was 21.2±2.2. On an average, men had higher BMI than women.

Overweight-related factors

The prevalence of overweight among men was significantly higher than that among women (13.6% vs 5.1%). The prevalence of overweight in male students who were prior urban residents was nearly twice that of prior rural residents, and in ‘only child’ (table 1). In women, the prevalence of overweight in only children was nearly twice that of those who were not, and nearly 50% higher in prior urban residents compared with prior rural residents. In prior urban residents, the prevalence of overweight for only children was 12.5% vs 7.8% of those with siblings. In prior rural residents, the pattern was similar but overall prevalence was lower: 8.8% vs. 5.8%. In male students, prevalence of overweight was substantially higher as compared with female students when comparing urban versus rural, and then only children versus children with siblings: 21.2% vs. 15.8% and 11.5% vs. 10.6% (men), 8.4% vs. 5.2% and 5.8% vs. 4.3% (women), respectively. The prevalence of overweight was 50% higher in students who skipped breakfast compared with their breakfast-eating counterparts. Similarly, the

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prevalence of overweight in students who were smokers or stayed up late was nearly double compared with those who did not.

Factors associated with being overweight
Students who were prior urban residents were at higher risk for being overweight. Although male students who were only children or stayed up late were at higher risk for being overweight in univariate analysis; there was no difference in multivariate analysis. There was no difference in overweight between Mongolian and Han ethnicities (table 2).

In female students, only children had nearly 1.5 times higher risk of being overweight compared with those who had siblings; staying up late was associated with a similar level of risk. However, unlike men, participating in sports was protective for women. While univariate analysis revealed a significantly higher risk of being overweight with higher monthly expenses, this risk became non-significant in multivariate analysis. Quality of relationships had no impact on being overweight.

Physical fitness in overweight and normal-weight students
The physical scores of normal weight and overweight students were compared for male and female students, respectively (table 3). A reduced physical score was found for all items in men and three items (speed, vital capacity and endurance) in women. The highest reduction between normal weight and overweight participants was for vital capacity.

Dose-dependent relationship between overweight prevalence and physical fitness score
Analysing the associations between physical fitness score and the prevalence of overweight, we found that as physical fitness score increased, the prevalence of overweight decreased in the categories of speed, vital capacity and endurance (table 4). This suggested a dose-dependent relationship between physical fitness and the prevalence of overweight. However, we did not find this trend with regard to flexibility for both sexes.

### Table 3 Comparison of physical score between normal weight and overweight by sex

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<th>Overweight</th>
<th>p Value</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men (mean±SE)</strong></td>
<td>Speed</td>
<td>64.8±0.6</td>
<td>50.9±1.8</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vital capacity</td>
<td>66.5±0.5</td>
<td>37.1±1.7</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Endurance</td>
<td>70.5±0.6</td>
<td>59.3±1.6</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flexibility</td>
<td>86.2±0.3</td>
<td>83.7±0.9</td>
<td>0.007</td>
<td></td>
</tr>
<tr>
<td><strong>Women (mean±SE)</strong></td>
<td>Speed</td>
<td>62.0±0.3</td>
<td>54.9±1.6</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vital capacity</td>
<td>64.7±0.3</td>
<td>46.1±1.6</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Endurance</td>
<td>73.3±0.3</td>
<td>67.8±1.2</td>
<td>0.039</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flexibility</td>
<td>92.9±0.2</td>
<td>93.0±0.7</td>
<td>0.951</td>
<td></td>
</tr>
</tbody>
</table>

DISCUSSION
While many studies have reported that demographic, socioeconomic and lifestyle factors are associated with adolescent obesity, the results are not always consistent; therefore, we carried out a survey to investigate whether these factors constituted a risk for being overweight in medical students.

The prevalence of overweight was 7.6%. This is considerably lower compared with the reported prevalence among the general Chinese population.22 The prevalence of overweight in the current study was also lower compared with other reports of college students in the USA23 and in European countries such as Greece.24 Consistent with other research,2 4 the male students in our study had significantly higher mean BMI than the female students, although the values were considerably lower compared with American college students,2 but higher than that in Thai college students.1 Our results suggest that overweight was significantly more prevalent in male students than in female students. This finding is consistent with the recently reported data.2 11 The higher prevalence of overweight and obesity among men may be partially due to the fact that male students are usually satisfied with their weight and body image, in addition to bulking up and increasing muscle/weight.2

Thus, female college students are more likely to perceive themselves as overweight and attempt to lose weight more often.25 These factors may explain the sex discrepancy in BMI prevalence.

The demographic factor of being an only child in relation to overweight has been studied.26 In our study, ‘only children’ were distinguished from that in other countries as China is one of the few countries to enforce a family planning policy, and since the advent of the family planning policy in the 1970s, children without siblings—only children—have become more numerous as a group. The prevalence of overweight in only children is higher because the only child always lives in more favourable conditions. Our study showed that about 60% of all only children had monthly expenses >¥600, while <30% of students with siblings spent the same amount monthly.

Our results also provide some support for the type of residency being important in relation to being overweight. Numerous studies have reported that adolescents residing in urban areas have a higher risk of being overweight. For example, this is the case in Thailand.27 Conversely, the authors of a Canadian study reported that there was a trend for increasing overweight or obesity among adolescents as the degree of living in a rural area improved.27 Over the past three decades, China has enjoyed economic development and the population has experienced lifestyle changes. Reductions in physical activity and labour intensity in urban and rural areas have been observed, and in 2010, the prevalence of overweight or obesity in men was higher than in women and in urban residents compared with rural residents.28 This result appears to originate
from cultural attitudes and beliefs. For urban students, the perception is that the pursuit of academic excellence holds greater status than physical activity. Typically, parents encourage their children to engage in educational and spiritual activities rather than physical activities, but rural students are additionally expected to participate in some physically demanding farming activities.

Besides demographic factors, we also investigated lifestyle factors. Students who stay up late face an increased risk of being overweight. Noland et al. reported that students with fewer hours of sleep were significantly more likely to be overweight; other researchers have found that shorter sleep periods are associated with decreased appetite and increased hunger and appetite.31 32

Although lack of physical activity increases the risk of obesity, being overweight also is associated with poor physical fitness. We found that overweight adolescents generally had poorer physical fitness than their normal-weight counterparts. This result is in agreement with our previous medical student study.31 In the present study, overweight students had lower speed, endurance and vital capacity, a finding similar to that of another investigation.33 There was no difference in flexibility between overweight and normal-weight students. This is in line with a Taiwanese study34 but contrasts a Western report in which overweight girls achieved slightly better sit-and-reach results than normal-weight girls.35 Flexibility, therefore, appears to be consistently less influenced by body weight. There was a dose-dependent relationship in our study, with physical fitness score increasing as prevalence of overweight declined. The authors of another Chinese study reported that obese children are less mobile and less self-confident, which make them participate in less physical activities, leaving them at risk for chronic disease.36 Again, this suggests a vicious cycle: being overweight leads to less physical activities and poor physical fitness, in turn increasing the risk of being overweight.

Socioeconomic factors were not related with overweight. However, it is worth mentioning that good relationships may stimulate participation in more sports activities, which could reduce the risk of obesity.36

In our study of lifestyle factors, skipping breakfast and being a smoker did not affect overweight. The result was similar to that of two previous reports.37 38

Although the association of the factors above with being overweight is well known, and medical students are future health professionals, some have the persistent habits of staying up late and engaging in less physical activities. They do not have deep understanding of the significance of the potential danger of these habits. This could be a reflection of the attitude of our college students regarding these well-known factors. Changing their attitude is the key to reducing the risk factors for inappropriate body weight.

There are limitations to this study. Overweight-related factors were assessed on the basis of self-reported data only, without experimental measurements. The response rate and the large number of participants are strengths of the study.

**Contributors** JC, ZL, JB and JS designed the study, acquired and analysed the data and prepared the manuscript. JS, ZL, WG and WC assisted in the data analysis and interpretation. YE supervised the study.

**Funding** The study was supported by the Natural Science Foundation of Inner Mongolia in China and 2013MS1193 from the Ministry of Science and Technology.

**Competing interests** None.

**Ethics approval** Ethical approval to conduct the study, in which consent was required from all study participants, was obtained from the Ethical Committee of Inner Mongolia.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data sharing statement** No additional data are available.

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**REFERENCES**


Supplementary File 1: The questionnaire about College students' behavior and health

Student ID: ___________________

1. Gender:
   1) Male 2) Female

2. Age: _______years

3. Ethnicity:
   1) 1) Han 2) Mongolian 3) Other

4. Class years of education:
   1) 1 2) 2 3) 3 4) 4 5) 5

5. Monthly expenses (Yuan):
   1) <300 2) 300-600 3) 600-1000 4) >1000

6. Residence:
   1) City 2) Rural 3) Pastoral 4) Suburbs

7. Faculty:
   1) Clinical Medicine
   2) Public Administration and Information Management
   3) Medicine
   4) Nurse
   5) Traditional Chinese Medicine and Mongolian Medicine
   6) Other

8. Did you have breakfast:
   1) Yes 2) No (skipping breakfast)

9. Gastrointestinal upset:
   1) Yes 2) No

10. How about your relationships:
    1) Good 2) Medium 3) Poor
The 11-18 questions only answered by smokers

11. Number of cigarettes smoked per day:
   1) <5   2) 5–9   3) >10

12. Number of smoking friends:
   1) <5   2) 5–10   3) >10

13. Parent smoker:
   1) Yes   2) No

14. Quit smoking (times):
   1) Never   2) 1–2   3) >3

15. The first time smoking:
   1) University   2) High School   3) Junior high school

16. The attitude of your family on you smoking:
   1) Opposed   2) Don't Care   3) Approve

17. An hour not smoking:
   1) No discomfort   2) Can endure   3) Intolerable

18. You feel after smoking:
   1) Better   2) Worse   3) No change

For the 19-35 questions, please answer “Yes” or “No” to express your opinion

19. Do not care about people smoking around you:
   1) Yes   2) No

20. Smoking is a sign of civilization:
   1) Yes   2) No

21. Smoking is one of the causes of air pollution:
   1) Yes   2) No

22. Teachers should not smoke:
   1) Yes   2) No

23. The State should take measures to stop smoking:
   1) Yes   2) No

24. Eliminate smoking on campus:
1) Yes \hspace{1cm} 2) No

25. Eliminate smoking in classroom:
   1) Yes \hspace{1cm} 2) No

26. Smoking is harmful to one’s health:
   1) Yes \hspace{1cm} 2) No

27. Smoking is harmful to the health of others:
   1) Yes \hspace{1cm} 2) No

28. You are the only one child in your family:
   1) Yes (only children) \hspace{0.5cm} 2) No (sibling children)

29. You do sports at least one hour once a week:
   1) Yes \hspace{1cm} 2) No

30. Did you go to bed after 00:00 in the last week:
   1) Yes \hspace{1cm} 2) No

31. Feeling stress:
   1) Yes \hspace{1cm} 2) No

32. I find myself very concerned about the grades I am likely to receive this semester:
   1) Yes \hspace{1cm} 2) No

33. I am spending a lot of time thinking about how this semester’s grades could negatively affect my educational and career goals:
   1) Yes \hspace{1cm} 2) No

34. I am worrying a great deal about the effect this semester’s grades will have on my future:
   1) Yes \hspace{1cm} 2) No

35. I find myself very concerned about the grades I am likely to receive this semester:
   1) Yes \hspace{1cm} 2) No

Definition:

1. Smoke: Smoked every day in the last 30 days
2. Urban: Come from city or suburb
3. Rural: Come from village or pastoral area
4. Stay up: staying up was defined as going to bed after midnight
5. Gastrointestinal problems were defined as recurring symptoms that were significant enough to alter lifestyle or require chronic treatment
6. Stress: Occurs when an individual perceives that environmental demands tax or exceed his or her adaptive capacity.
7. We defined breakfast per the Student Nutrition Dietary Assessment, which is any food or beverage consumption between awakening and 45 minutes after the start of school. Subjects who did not consume breakfast on one of two days or neither day were categorized as breakfast skippers, while those that consumed breakfast on both days were classified as breakfast eaters.
The questions addressing smoking and their response options

1. Gender :
   1) Male   2) Female

2. Ethnicity :
   1) Han   2) Mongolian   3) Other

3. Class years of education :
   1) 1   2) 2   3) 3   4) 4   5) 5

4. Monthly expenses (Yuan) :
   1) <300   2) 300-600   3) 600-1000   4) >1000

5. Residence :
   1) City   2) Rural   3) Pastoral   4) Suburbs

6. Faculty :
   1) Clinical Medicine
    2) Public Administration and Information Management
    3) Medicine
    4) Traditional Chinese Medicine and Mongolian Medicine
    5) Other

For the 7-15 questions, please answer “Yes” or “No” to express your opinion

7. Do not care about people smoking around you :
   1) Yes   2) No

8. Smoking is a sign of civilization :
   1) Yes   2) No

9. Smoking is one of the causes of air pollution :
   1) Yes   2) No

10. Teachers should not smoke:
    1) Yes   2) No

11. The State should take measures to stop smoking :
1) Yes   2) No

12. Eliminate smoking on campus:
1) Yes   2) No

13. Eliminate smoking in classroom:
1) Yes   2) No

14. Smoking is harmful to one’s health:
1) Yes   2) No

15. Smoking is harmful to the health of others:
1) Yes   2) No

The 16-23 questions only answered by smokers

16. Number of cigarettes smoked per day:
1) <5   2) 5–9   3) >10

17. Number of smoking friends:
1) <5   2) 5–10   3) >10

18. Parent smoker:
1) Yes   2) No

19. Quit smoking (times):
1) Never   2) 1–2   3) >3

20. The first time smoking:
1) University   2) High School   3) Junior high school

21. The attitude of your family on you smoking:
1) Opposed   2) Don’t Care   3) Approve

22. An hour not smoking:
1) No discomfort   2) Can endure   3) Intolerable

23. You feel after smoking:
1) Better   2) Worse   3) No change