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

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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.

Strengths and limitations of this study

- Factors in our study were assessed on the basis of self-reported data only, without experimental measurements.
- In contrast, the response rate and the large number of participants are strengths of the study.

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.[1] Younger age groups are affected, as demonstrated in nearly one-third of the American college students who are overweight or obese.[2] According to the WHO, some 30–80% of adults and about 20% of children and adolescents in Europe are overweight.[3] The situation in Asia is better, with lower prevalences of obesity in Thailand[4] and China,[5] 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,[6] it is nevertheless a strong precursor of obesity and related morbidity in adulthood.[7] Adolescence has been identified as a critical period in the development of overweight/obesity patterns,[8] with the transition to college being another potentially important period of risk for weight increase among young adults.[9] In China, obesity is increasing,[5] 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.[10]

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.[11] 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.[12] 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,[11] 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.[10]

METHODS

Participants

A cross-sectional survey[13] 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/m^2) 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.[14] 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.[15] 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 of >14.9 s were awarded a score of <60; 14.2–14.9 s, 60–69; 13.8–14.1 s, 70–79; 13.2–13.7 s, 80–89; <13.1 s, 90–100, and in women, >17.9 s was awarded a score of <60; 17.4–17.9 s, 60–69; 16.8–17.3 s, 70–79; 16.2–16.7 s, 80–89; <16.2, 90–100. Endurance was evaluated in women with a 800 m run: time >4 min and 24 s were awarded a score of <60; 4 min and 8 s–4 min and 23 s, 60–69; 3 min and 52 s–4 min and 7 s, 70–79; 3 min and 39 s–3 min and 51 s, 80–89; <3 min and 50 s, as 90–100 and a 1 km run for men, with >4 min and 33 s being awarded a score of <60; 4 min and 12 s–4 min and 32 s, 60–69; 3 min and 52 s–4 min and 11 s, 70–79;3 min and 39 s–3 min and 51 s, 80–89; <3 min and 50 s, 90–100.

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.[13]

The self-report questionnaire contained questions about basic information, including student ID, sex, ethnicity, living habits and feelings experienced while in college.[11 13 16] In the questionnaire, the following definitions were used: students who used to reside in cities or the suburbs were urban; those previously residing in villages or pastoral areas were rural; 'only child' was defined 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."[17] 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.[18] We referred to Giannotti *et al*'s[19] 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*[13] which was initially based on the National Centre for Health Statistics.[20] 'Gastrointestinal problems' were defined as recurring symptoms of sufficient significance to alter lifestyle or require chronic treatment according to Stone *et al*'s[21] report, and 'quality of relationships' (poor, medium, good) was self-assessed.

Statistical analysis

A χ^2 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 χ^2 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.

Table 1 Prevalence of overweight by sex

	Total		Men		Women			
Characteristic	**n**	**Per cent**	**N**	**Per cent**	**n**	**Per cent**	**χ^2**	**p Value**
Demographic								
Ethnic	5471		1580		3891		4.68	0.096
Han	3943	7.6	1145	14.4	2798	4.8		
Mongolian	1275	7.4	349	11.5	926	5.8		
Other	253	8.7	86	11.6	167	7.2		
Resident	5451		1573		3878		0.08	0.782
Urban	2209	9.9	642	18.2	1567	6.5		
Rural	3242	5.9	931	10.3	2311	4.1		
Only child	5462						114	<0.000
Yes	1866	10.7	708	16.4	1158	7.2		
No	3596	6.0	868	11.4	2728	4.2		
Socioeconomic grade	5471		1580		3891		42.03	<0.000
1	2362	7.1	577	11.8	1785	5.5		
2	1879	7.7	589	13.6	1290	5.0		
3	1230	8.4	414	16.2	816	4.4		
Monthly expenses (¥)	5457						120.9	<0.000
<300	436	4.8	64	10.9	372	3.8		
300–600	2877	5.9	732	10.0	2145	4.5		
600–1000	1878	9.9	674	16.9	1204	6.0		
>1000	266	13.5	107	19.6	159	9.4		
Relationship	5452						35.48	<0.000
Poor	124	7.3	41	2.4	83	9.6		
Medium	3135	7.2	806	13.5	2329	5.0		
Good	2193	8.1	726	14.3	1467	5.0		
Lifestyle								
Skip breakfast	5466						162.1	<0.000
No	3906	6.6	935	12.2	2971	4.8		
Yes	1560	10.0	643	15.7	917	6.0		
Gastrointestinal discomfort	5373						3.33	0.068
No	4658	7.8	1353	14.2	3305	5.2		
Yes	715	6.2	184	11.4	531	4.3		
Sports	5462						195	<0.000
No	2568	6.7	508	15.2	2060	4.6		
Yes	2894	8.4	1069	12.9	1825	5.7		
Smoke	5471						935	<0.000
No	4976	7.2	1143	14.3	3833	5.1		
Yes	495	11.5	437	11.9	58	8.6		
Stay up	5465						107.5	<0.000
No	4370	6.8	1122	12.7	3248	4.8		
Yes	1095	10.5	455	15.8	640	6.7		
Stress	5471						28.96	<0.000
No	95	9.5	51	15.7	44	2.3		
Yes	5376	7.5	1529	13.5	3847	5.1		

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

Table 2 Univariate (crude OR) and multivariate (adjusted OR) logistic regression analysis of being overweight by sex

	Men					Women				
		Crude		Adjust			Crude		Adjust	
Factor	n	OR	95% CI	OR	95% CI	n	OR	95% CI	OR	95% CI
Demographic										
Ethnic	215					199				
Han	165	1.000		1.000		133	1.000			
Mongolian	40	0.774	0.535 to 1.121	0.792	0.533 to 1.176	54	1.227	0.886 to 1.700	1.224	0.847 to 1.713
Other	10	0.777	0.393 to 1.536	0.661	0.318 to 1.374	12	1.563	0.845 to 2.890	1.554	0.831 to 2.904
Resident										
Urban	117	1.000				102	1.000		1.000	
Rural	96	1.956	1.460 to 2.620	1.634	1.171 to 2.279	95	1.639	1.229 to 2.186	1.241	0.866 to 1.799
Only child										
Yes	99	1.000		1.000		115	1.000		1.000	
No	116	1.540	1.153 to 2.059	1.111	0.798 to 1.548	83	1.792	1.338 to 2.399	1.488	1.047 to 2.114
Socioeconomic grade										
1	68	1.000		1.000		99	1.000		1.000	
2	80	1.157	0.818 to 1.637	1.094	0.752 to 1.590	64	0.894	0.647 to 1.236	0.830	0.594 to 1.161
3	67	1.472	1.021 to 2.122	1.479	1.000 to 2.187	36	0.818	0.553 to 1.210	0.810	0.540 to 1.213
Monthly expenses (¥)										
<300	7	1.000		1.000		14	1.000		1.000	
300–600	73	0.914	0.401 to 2.084	0.773	0.332 to 1.796	97	1.257	0.709 to 2.227	1.239	0.680 to 2.256
600–1000	114	1.656	0.735 to 3.734	1.168	0.504 to 2.706	72	1.685	0.938 to 3.025	1.414	0.745 to 2.681
>1000	21	2.000	0.795 to 5.029	1.333	0.509 to 3.487	15	2.894	1.358 to 6.164	2.068	0.907 to 4.715
Relationship										
Poor	1	1.000		1.000		8	1.000		1.000	
Medium	109	6.205	0.843 to 45.691	5.780	0.775 to 43.107	116	0.485	0.228 to 1.033	0.415	0.192 to 0.896
Good	104	6.511	0.884 to 47.975	6.163	0.825 to 46.052	74	0.482	0.223 to 1.039	0.363	0.165 to 0.801
Lifestyle										
Skip breakfast										
No	114	1.000		1.000		143	1.000		1.000	
Yes	101	0.746	0.558 to 0.997	0.885	0.640 to 1.225	55	0.775	0.562 to 1.068	0.806	0.571 to 1.140
Gastrointestinal discomfort										
No	192	1.000		1.000		173	1.000		1.000	
Yes	21	0.809	0.500 to 1.310	0.793	0.484 to 1.301	23	0.824	0.528 to 1.288	0.821	0.523 to 1.289
Sports										
No	77	1.000		1.000		94	1.000		1.000	
Yes	138	0.796	0.588 to 1.078	0.872	0.627 to 1.214	104	0.828	0.722 to 0.936	0.934	0.843 to 0.985
Smoke										
No	163	1.000		1.000		194	1.000		1.000	
Yes	52	0.797	0.570 to 1.114	0.782	0.551 to 1.109	5	1.847	0.727 to 4.698	1.632	0.632 to 4.212
Stay up										
No	143	1.000		1.000		156	1.000		1.000	
Yes	72	1.391	1.021 to 1.895	1.253	0.901 to 1.742	43	1.740	1.244 to 2.473	1.481	1.021 to 2.150

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

Sex	Item	Normal weight	Overweight	p Value
Men (mean±SE)	Speed	64.8±0.6	50.9±1.8	0.000
	Vital capacity	66.5±0.5	37.1±1.7	0.000
	Endurance	70.5±0.6	59.3±1.6	0.000
	Flexibility	86.2±0.3	83.7±0.9	0.007
Women (mean±SE)	Speed	62.0±0.3	54.9±1.6	0.000
	Vital capacity	64.7±0.3	46.1±1.6	0.000
	Endurance	73.3±0.3	67.8±1.2	0.039
	Flexibility	92.9±0.2	93.0±0.7	0.951

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 USA[23] 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.[4] 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

Table 4 Trend χ^2 test between physical fitness score and overweight prevalence by sex

Sex	Item	Score (prevalence, %) <60	60–69	70–79	80–89	90–100	p Value
Men	Vital capacity	323 (40.2)	563 (10.5)	307 (2.3)	142 (1.4)	119 (0.8)	0.000
	Endurance	190 (28.5)	480 (17.7)	366 (11.5)	195 (7.7)	223 (3.6)	0.000
	Flexibility	10 (20.0)	149 (20.8)	300 (13.7)	344 (11.6)	651 (13.1)	0.051
	Speed	284 (27.5)	656 (13.6)	243 (7.4)	144 (5.6)	127 (4.7)	0.000
Women	Vital capacity	638 (14.6)	1612 (5.0)	721 (1.5)	296 (0.7)	276 (0.7)	0.000
	Endurance	210 (9.5)	1258 (7.1)	867 (4.4)	612 (3.9)	596 (2.9)	0.000
	Flexibility	6 (0.0)	87 (2.3)	291 (6.2)	654 (5.8)	2505 (5.2)	0.944
	Speed	697 (7.6)	1687 (6.1)	783 (2.9)	262 (2.3)	114 (1.6)	0.000

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.[29]

Besides demographic factors, we also investigated lifestyle factors. Students who stay up late face an increased risk of being overweight. Noland *et al*[30] 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 leptin levels, increased ghrelin levels 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.[11] 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 study[34] 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.[33] 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 are 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.

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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.

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