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Selected article

Epidemiological characteristics and influencing factors of combination of obesity and asthma in elementary and middle school students in Shanghai

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Abstract:

[Background] Studies have found an association between obesity and asthma, but the characteristics of health-related behaviors in obese students with asthma are poorly understood.

[Objective] This study is conducted to investigate the prevalence and influencing factors of comorbidity between obesity and asthma in elementary and middle school students in Shanghai and to provide evidence for the prevention and treatment of such disease in the students.

[Methods] Based on the Chinese National Common Diseases and Health Influencing Factors Monitoring Project conducted in Shanghai in 2016, a stratified cluster random sampling method was used to select 12 elementary schools and 12 middle schools in 3 urban and 3 suburban areas in Shanghai. A questionnaire survey was conducted to collect information on allergic diseases, obesity, and related influencing factors of 5 911 students. Proportion was used to describe the distribution of selected demographic characteristics of the subjects. Chi-square test was used to compare the differences in demographic characteristics and lifestyles of the control group, the obesity group, the asthma group, and the obesity with asthma group. Multinomial logistic regression was used to analyze the influencing factors of obesity combined with asthma.

[Results] The prevalence rates of obesity and asthma were 13.2% (779/5 911) and 8.8% (519/5 911), respectively. The boys (17.9%, 10.3%) showed higher prevalence rates of obesity and asthma than the girls (8.3%, 7.2%) ($P<0.05$). The prevalence of obesity with asthma was 1.4%, significantly higher in the boys (2.1%) than in the girls (0.8%) ($\chi^2=18.42$, $P<0.001$), and higher in the urban areas (1.9%) than in the suburban areas (1.0%) ($\chi^2=8.40$, $P<0.01$). The multinomial logistic regression analysis results showed that gender, residence, family history of asthma, and secondhand smoke exposure were associated with the risk of obesity combined with asthma ($P<0.05$); namely, girls and living in suburban areas reduced the risk of reporting obesity with asthma, with *OR* (95% *CI*) of 0.307 (0.188-0.506) and 0.520 (0.324-0.834), respectively, and having a family history of asthma and being exposed to secondhand smoke increased the risk of obesity with asthma, with *OR* (95% *CI*) of 2.916 (1.810-4.699) and 2.122 (1.237-3.640), respectively. In addition, being exposed to secondhand smoke exposure and sweet food intake increased the risk of obesity ,with *OR* (95% *CI*) of 1.473 (1.178-1.841) and 1.542 (1.411-1.713), respectively.

[Conclusion] High obesity rate and asthma rate of elementary and middle school students are found in Shanghai. Besides gender, residence, and family history, secondhand smoke exposure is also a potential factor affecting obesity combined with asthma. In this study, there is no significant difference in exercise and diet between students of obesity with asthma and those without the comorbid condition.

Keywords: elementary and middle school students; obesity; asthma; epidemiological characteristics

上海市中小学生肥胖和哮喘的流行特征及其影响因素 罗春燕，周月芳，严琼，杨东玲，冯晓刚，郭常义（上海市疾病预防控制中心，上海 200336）

摘要：

[背景] 研究发现肥胖和哮喘这两种疾病存在关联，肥胖伴有哮喘的学生其健康相关行为的特征尚不明确。

[目的] 调查上海市中小学生肥胖和哮喘各组合流行状况及其影响因素，为中小学生肥胖及哮喘的防治提供依据。

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[方法] 依托2016年在上海市开展的全国常见病和健康影响因素监测项目，采取分层随机整群抽样的方法在上海市3个中心城区和3个郊区的12所小学和12所初中开展监测。使用问卷调查收集5 911名学生的过敏性疾病、健康状况及影响因素情况。用构成比描述调查对象的一般人口学特征，采用卡方检验比较肥胖、哮喘各组合人群在一般人口学特征及生活行为特征方面的差异，用多分类logistic回归分析肥胖合并哮喘的影响因素。

[结果] 肥胖和哮喘患病率分别为13.2%(779/5 911)、8.8%(519/5 911)。男生(17.9%，10.3%)均高于女生(8.3%，7.2%)(均$P<0.05$)。肥胖合并哮喘患病率为1.42%(84/5 911)，男生(2.1%)高于女生(0.8%)($\chi^2=18.42$，$P<0.001$)，城区(1.9%)高于郊区(1.0%)($\chi^2=8.40$，$P<0.01$)。多分类logistic回归分析显示性别、地区、哮喘家族史、二手烟暴露与肥胖合并哮喘风险相关(均$P<0.05$)：即女生、居住在郊区可降低学生患肥胖合并哮喘的风险，*OR*(95% *CI*)分别为0.309(0.188~0.506)、0.520(0.324~0.834)；而有哮喘家族史、二手烟暴露因素可增加该风险，*OR*(95% *CI*)分别为2.916(1.810~4.699)、2.122(1.237~3.640)。此外，二手烟暴露、甜食摄入也会增加肥胖的风险，其*OR*(95% *CI*)分别为1.473(1.178~1.841)、1.542(1.411~1.713)。

[结论] 上海市中小学生肥胖率和哮喘率水平较高。除了性别、居住地和家族史之外，二手烟暴露也是肥胖合并哮喘潜在的影响因素。本次研究未发现肥胖合并哮喘的学生在运动、膳食等方面与正常儿童有差异。

关键词：中小学生；肥胖；哮喘；流行特征

The incidences of obesity and asthma in children and adolescents worldwide are on the rise. The majority of obesity in childhood and adolescence are simple obesity, mainly caused by excessive energy intake and insufficient physical activity. Asthma, also known as bronchial asthma, is a common chronic respiratory disease in childhood and adolescence. Epidemiological evidence suggests an association between obesity and asthma[1-3]. A national childhood asthma study has shown that the prevalence of childhood asthma in 16 cities of China in 1990, 2000, and 2010 were 0.96%, 1.66%, and 2.33%, respectively, showing a clear upward trend, and the prevalence in Shanghai was 5.73% in 2010, ranking the first in the 16 cities[4]. A large number of studies have found that childhood asthma is also associated with obesity, and the association may be varied by many factors. Studies have already provided conceptual physiological mechanisms describing associations between obesity and asthma, and evidence connecting obesity to asthma by means of genes, cytokines, and hormones[5]. Obesity may not only affect the incidence of asthma, but also its severity and treatment. Many factors may participate in and affect the co-occurrence of obesity and asthma, such as microbial infection, use of antibiotics, genes, and inflammatory factors[1]. But the mechanism has not been fully unveiled. It is not yet certain whether the two are mutually causal. The 2014 Global Asthma Prevention Initiative listed obese asthma as an asthma phenotype that is not responsive to standard asthma medication[6]. Studies have found that weight loss can improve asthma control, and children with obese asthma present more severe symptoms and longer duration[7-8]. Mastering the epidemiological characteristics and influencing factors of obesity and asthma is key to effective health management. However, epidemiological research on obesity with asthma is rare, and evidence based on population health management is relatively inadequate. The purpose of this study is to analyze the prevalence of obesity with asthma in elementary and middle school students, investigate its influencing factors such as diet and physical activity in different subgroups, and provide more conclusive evidence for inter-departmental joint prevention and control of obese asthma.

1 Subjects and methods

1.1 Study subjects

The study subjects were elementary and middle school students from the listed monitoring schools in the Chinese National Common Diseases and Health Influencing Factors Monitoring Project in Shanghai in 2016. A stratified cluster random sampling method was used to select three urban and three suburban areas in Shanghai. In each area, 2 elementary schools and 2 middle schools were selected, and in each school, 2 classes were selected from each grade (Grade 4-6 of elementary school, and Grade 1-3 of middle school). This study was approved by the Ethics Committee of Shanghai Municipal Center for Disease Control and Prevention (No.2016-17). Informed consent was obtained prior to the survey.

1.2 Methods

1.2.1 Physical examination Quality control measures including unified training for investigators, standard testing methods, and instrument calibration were conducted. Each student's height was measured with

a mechanical height measuring instrument with an accuracy of 0.1 cm. Each student's weight was measured with an electronic scale with an accuracy of 0.1 kg. BMI=body mass (kg)/height (m)^2. The students were required to take off their shoes, caps, and coats and take an upright position during the measurement. The girls were asked to untie her braid.

1.2.2 Questionnaire survey Health influencing factors data: The data of students' health status and influencing factors, including students' basic information, diet, exercise-related behaviors, smoking, and secondhand smoke exposure, were sourced from the National Common Diseases and Health Influencing Factors Monitoring Project.

Student allergy and asthma history[3]: The self-designed questionnaire on students' history of allergies and asthma was filled by their parents.

1.3 Related definitions

Overweight and obesity were defined according to WS/T 586-2018 *Screening for overweight and obesity among school-age children and adolescents*, and evaluated according to gender- and age-specific BMI thresholds.

Medical history of asthma was asked in the questionnaire for parents. The child who had ever been diagnosed with asthma by a physician was defined as having asthma.

Moderate-intensity physical activities required moderate efforts and made you slightly breathless, sweaty, or tired, including cycling, playing table tennis and badminton, dancing, and moving light objects, and excluding walking. Vigorous-intensity physical activities required great efforts and made you breathless, sweaty, or tired, including running, playing basketball and football, swimming, doing aerobics in the gym, and moving heavy objects.

Secondhand smoke exposure occurred when someone (including parents) smoked in front of the students.

Family history of asthma was defined as any grandparents, parents, or siblings who suffered from asthma.

Participating students who reported asthma history and were graded as obesity were categorized in the obesity with asthma group; those being graded as obesity without reporting asthma were in the only obesity group; those reporting asthma history and not being graded obese were in the only asthma group; and those reporting no asthma and not being graded as obesity were in the control group.

1.4 Statistical analysis

Data were entered into EpiData 3.1 and analyzed by SAS 9.4. Constituent ratios were used to describe the distribution of demographic characteristics of the students. Chi-square test was used to compare the differences in demographic characteristics and lifestyles across the groups. Multinomial logistic regression analysis was used to analyze the influencing factors of obesity with asthma, including demographic characteristics, secondhand smoke exposure, intake of vegetables, fruits, sugary beverage, sweet food, and fried food, and physical activities. $P<0.05$ was considered statistically significant.

2 Results

2.1 Demographic characteristics of study subjects

A total of 5 911 elementary and middle school students were enrolled to this study, including 2 989 (50.6%) boys, and 2 922 (49.4%) girls. The average age was (12.20±1.82) years old. There were 2 666 (45.1%) students under 12 years old, and 3 245 (54.9%) aged 12 years and over. There were 2 989 (49.2%) students in elementary school, 3 003 (50.8%) in middle school. There were 3 013 (51.0%) students living in urban areas, and 2 898 (49.0%) students living in suburban areas. Respectively 2 461 (41.6%) fathers and 2 474 (41.8%) mothers received higher education (Table 1).

2.2 Distribution of demographic characteristics

The prevalence rate of obesity was 13.2%, including 536 boys (17.9%) and 243 girls (8.3%). The prevalence rate of asthma was 8.8%, including 309 boys (10.3%) and 210 girls (7.2%). Both rates were higher in boys than in girls (χ^2=119.41, $P<0.001$; χ^2=18.32, $P<0.001$). The prevalence of obesity with asthma was 1.4%, significantly higher in the boys (2.1%) than in the girls (0.8%) (χ^2=18.42, $P<0.001$), and higher in the urban areas (1.9%) than in the suburban areas (1.0%) (χ^2=8.40, $P<0.01$).

The distributions of age (χ^2=40.63, $P<0.001$), gender (χ^2=135.70, $P<0.001$), school (χ^2=38.25, $P<0.001$), residence (χ^2=44.01, $P<0.001$), parental education (paternal: χ^2=40.46, $P<0.001$; maternal: χ^2=47.07, $P<0.001$), and with or without family history of asthma (χ^2=170.18, $P<0.001$) were significantly different among the designed four subgroups of control, obesity, asthma, and obesity with asthma (Table 1).

Differences in demographic characteristics between

the obesity group and the obesity with asthma group were further compared. The results showed significant differences in residence (χ^2=3.97, P=0.046), parental education (paternal: χ^2=9.29, P=0.002; maternal: χ^2=13.71, P<0.001), and family history of asthma (χ^2=20.54, P<0.001) between the two groups (Table 1).

Table 1 Distribution of demographic characteristics among control group, only obesity group, only asthma group, and obesity with asthma group (*n*, %)

Characteristics	Total	Prevalence		Subgroup					
		Obesity	Asthma	Control	Only obesity	Only asthma	Obesity with asthma	χ^2	*P*
Age (years)									
<12	2 666 (45.1)	424 (15.9)	266 (10.0)	2 022 (75.8)	378 (14.2)	220 (8.3)	46 (1.7)	40.63	**<0.001**
⩾12	3 245 (54.9)	355 (11.0)	253 (7.8)	2 675 (82.4)	317 (9.8)	215 (6.6)	38 (1.2)		
Gender									
Male	2 989 (50.6)	536 (17.9)	309 (10.3)	2 206 (73.8)	474 (15.8)	247 (8.3)	62 (2.1)	135.70	**<0.001**
Female	2 922 (49.4)	243 (8.3)	210 (7.2)	2 491 (85.3)	221 (7.6)	188 (6.4)	22 (0.8)		
School									
Elementary school	2 908 (49.2)	446 (15.3)	297 (10.2)	2 215 (76.2)	396 (13.6)	247 (8.5)	50 (1.7)	38.25	**<0.001**
Middle school	3 003 (50.8)	333 (11.1)	222 (7.4)	2 482 (82.6)	299 (10.0)	188 (6.3)	34 (1.1)		
Residence*									
Urban	3 013 (51.0)	440 (14.6)	328 (10.9)	2 301 (76.4)	384 (12.7)	272 (9.0)	56 (1.9)	44.01	**<0.001**
Suburban	2 898 (49.0)	339 (11.7)	191 (6.6)	2 396 (82.7)	311 (10.7)	163 (5.6)	28 (1.0)		
Father's educational level*									
Below higher education	3 450 (58.4)	472 (13.7)	237 (6.9)	2 779 (80.5)	434 (12.6)	199 (5.8)	38 (1.1)	40.46	**<0.001**
Higher education	2 461 (41.6)	307 (12.5)	282 (11.5)	1 918 (77.9)	261 (10.6)	236 (9.6)	46 (1.9)		
Mother's educational level*									
Below higher education	3 437 (58.2)	470 (13.7)	231 (6.7)	2 771 (80.6)	435 (12.7)	196 (5.7)	35 (1.0)	47.07	**<0.001**
Higher Education	2 474 (41.8)	309 (12.5)	288 (11.7)	1 926 (77.8)	260 (10.5)	239 (9.7)	49 (2.0)		
Family history of asthma*									
No	5 054 (85.5)	666 (13.1)	344 (6.8)	4 102 (81.2)	608 (12.0)	286 (5.7)	58 (1.1)	170.18	**<0.001**
Yes	857 (14.5)	113 (13.2)	175 (20.4)	595 (69.4)	87 (10.2)	149 (17.4)	26 (3.0)		
Total	5 911 (100.0)	779 (13.2)	519 (8.8)	4 697 (79.5)	695 (11.7)	435 (7.4)	84 (1.4)		

[Note]*: Indicates that there are differences in the frequency of demographic characteristics between the only obesity group and the obesity with asthma group.

2.3 Distribution of selected lifestyle factors

The distributions of secondhand smoke exposure (χ^2=21.13, P<0.001), vegetable intake (χ^2=9.48, P=0.024), and sweet food intake (χ^2=33.55, P<0.001) showed significant differences among the designed four groups. However, there were no significant differences in the distributions of fruit intake, sugary beverage intake, fried food intake, or moderate- and vigorous-intensity physical activity frequency and time (Table 2).

Further differences in life behavior between the obesity and the obesity with asthma groups were observed. The results showed that there was a significant difference in the frequency of fruit intake (χ^2=4.96, P=0.026).

2.4 Influencing factors for the combination of obesity and asthma

Multinomial logistic regression analysis was conducted with different combinations of obesity and asthma as dependent variables, and with children's age, gender, residence, parental education, family history of asthma, secondhand smoke exposure, vegetable intake, fruit intake, sugary beverage intake, sweet food intake, fried food intake, moderate-intensity physical activity frequency, vigorous-intensity physical activity frequency, moderate- and vigorous-intensity physical activity time as independent variables. The variable assignment was shown in Table 3.

The multinomial logistic regression analysis results showed that girls had a lower risk of reporting obesity, asthma, and obesity with asthma than boys, with *OR* (95% *CI*) of 0.438 (0.369-0.520), 0.650 (0.530-0.797), and 0.309 (0.188-0.506), respectively, and students in suburban areas were at lower risk for obesity, asthma, and obesity with asthma than students in urban areas, with *OR* (95% *CI*) of 0.728 (0.616-0.860), 0.627 (0.507-

0.774), and 0.520 (0.324-0.834), respectively.

Being exposed to secondhand smoke ⩾5 d/week increased the risks of reporting obesity and obesity with asthma, with *OR* (95% *CI*) of 1.473 (1.178-1.841) and 2.122 (1.237-3.640), respectively. The students with a family history of asthma increased the risks of reporting asthma and obesity with asthma, with *OR* (95% *CI*) of 3.464 (2.782-4.312) and 2.916 (1.810-4.699), respectively. The students aged 12 years and older had a lower risk of reporting obesity than those younger than 12 years, with *OR* (95% *CI*) of 0.656 (0.557-0.773). Sweet food intake increased the risk of reporting obesity, with *OR* (95% *CI*) of 1.542 (1.411-1.713). In addition, the students whose mothers' education level was higher education showed a higher risk of reporting asthma, with *OR* (95% *CI*) of 1.339 (1.026-1.749) (Table 4).

Table 2 Distribution of selected lifestyle factors reported in past week among control group, only obesity group, only asthma group, and obesity with asthma group (*n*, %)

Lifestyle	Total	Prevalence		Subgroup					
		Obesity	Asthma	Control	Only obesity	Only asthma	Obesity with asthma	χ^2	*P*
Secondhand smoke exposure									
<5 d/week	5 175 (87.5)	644 (12.5)	452 (8.7)	4 145 (80.1)	578 (11.2)	386 (7.4)	66 (1.3)	21.13	**<0.001**
⩾5 d/week	736 (12.5)	135 (18.3)	67 (9.1)	552 (75.0)	117 (15.9)	49 (6.7)	18 (2.4)		
Vegetable intake									
Never	50 (0.9)	8 (16.0)	6 (12.0)	38 (76.0)	6 (12.0)	4 (8.0)	2 (4.0)	9.48	**0.024**
<1 time/d	1 018 (17.2)	144 (14.1)	74 (7.3)	810 (79.6)	134 (13.1)	64 (6.3)	10 (1.0)		
1 time/d	1 898 (32.1)	251 (13.3)	146 (7.7)	1 525 (80.3)	227 (12.0)	122 (6.4)	24 (1.3)		
⩾2 times/d	2 945 (49.8)	376 (12.8)	293 (9.9)	2 324 (78.9)	328 (11.2)	245 (8.3)	48 (1.6)		
Fruit intake*									
<1 time/d	1 929 (32.6)	245 (12.7)	141 (7.3)	1 560 (80.9)	228 (11.8)	124 (6.4)	17 (0.9)	10.59	0.102
1 time/d	2 273 (38.5)	300 (13.2)	210 (9.2)	1 800 (79.2)	263 (11.6)	173 (7.6)	37 (1.6)		
⩾2 times/d	1 709 (28.9)	234 (13.7)	168 (9.9)	1 337 (78.2)	204 (11.9)	138 (8.1)	30 (1.8)		
Sugary beverage intake									
Never	1 510 (25.5)	203 (13.4)	140 (9.3)	1 184 (78.4)	186 (12.3)	123 (8.2)	17 (1.1)	3.16	0.368
<1 time/d	3 681 (62.3)	484 (13.2)	323 (8.8)	2 932 (79.6)	426 (11.6)	265 (7.2)	58 (1.6)		
⩾1 time/d	720 (12.2)	92 (12.8)	56 (7.8)	581 (80.7)	83 (11.5)	47 (6.5)	9 (1.3)		
Sweet food intake									
Never	685 (11.6)	142 (20.8)	59 (8.6)	494 (72.1)	132 (19.3)	49 (7.1)	10 (1.5)	33.55	**<0.001**
<1 time/d	3 958 (67.0)	493 (12.7)	337 (8.8)	3 170 (80.1)	441 (11.1)	285 (7.2)	52 (1.6)		
⩾1 time/d	1 268 (21.4)	134 (10.5)	113 (8.9)	1 033 (81.5)	122 (9.6)	101 (8.0)	12 (0.9)		
Fried food intake									
Never	1 940 (32.8)	274 (14.1)	175 (9.0)	1 520 (78.4)	245 (12.6)	146 (7.5)	29 (1.5)	3.26	0.353
<1 time/d	36.28 (61.4)	459 (12.7)	324 (8.9)	2 895 (79.8)	409 (11.3)	274 (7.5)	50 (1.4)		
⩾1 time/d	343 (5.8)	46 (13.4)	20 (5.9)	282 (82.2)	41 (11.9)	15 (4.4)	5 (1.5)		
Moderate-intensity physical activity frequency									
<5 d/week	3 905 (66.1)	519 (13.3)	345 (8.9)	3 098 (79.3)	462 (11.8)	288 (7.4)	57 (1.5)	0.20	0.976
⩾5 d/week	2 006 (33.9)	260 (13.0)	174 (8.7)	1 599 (79.7)	233 (11.6)	147 (7.3)	27 (1.4)		
Vigorous-intensity physical activity frequency									
<5 d/week	4 827 (81.7)	644 (13.3)	432 (8.9)	3 821 (79.2)	574 (11.9)	362 (7.5)	70 (1.4)	1.57	0.667
⩾5 d/week	1 084 (18.3)	135 (12.5)	87 (8.0)	876 (80.8)	121 (11.2)	73 (6.7)	14 (1.3)		
Moderate- and vigorous- intensity physical activity time									
<30 min/d	695 (11.8)	97 (14.0)	54 (7.8)	552 (79.4)	89 (12.8)	46 (6.6)	8 (1.2)	1.52	0.677
30-60 min/d	999 (16.9)	124 (12.4)	95 (9.5)	791 (79.2)	113 (11.3)	84 (8.4)	11 (1.1)		
⩾60 min/d	4 217 (71.3)	558 (13.3)	370 (8.8)	3 354 (79.5)	493 (11.7)	305 (7.2)	65 (1.6)		
Total	5 911 (100.0)	779 (13.2)	519 (8.8)	4 697 (79.5)	695 (11.7)	435 (7.4)	84 (1.4)		

[Note]*: Indicates that there is a difference in the frequency of fruit intake between the only obesity group and the obesity with asthma group.

Table 3 Multinomial logistic regression analysis variable assignment

Variable	Assignment
Independent variable	
Age (years)	1=<12, 2=⩾12
Gender	1=Male, 2=Female
School	1=Elementary school, 2=Middle school
Residence	1=Urban area, 2=Suburban area
Father's educational level	1=Below higher education, 2=Higher education
Mother's educational level	1=Below higher education, 2=Higher education
Family history of asthma	1=No, 2=Yes
Secondhand smoke exposure	1=<5 d/week, 2=⩾5 d/week
Vegetable intake	1=Never, 2=<1 time/d, 3=1 time/d, 4=⩾2 times/d
Fruit intake	1=<1 time/d, 2=1 time/d, 3=⩾2 times/d
Sugary beverage intake	1=Never, 2=<1 time/d, 3=⩾1 time/d
Sweet food intake	1=Never, 2=<1 time/d, 3=⩾1 time/d
Fried food intake	1=Never, 2=<1 time/d, 3=⩾1 time/d
Moderate-intensity physical activity frequency	1=<5 d/week, 2=⩾5 d/week
Vigorous-intensity physical activity frequency	1=<5 d/week, 2=⩾5 d/week
Moderate- and vigorous-intensity physical activity time	1=<30 min/d, 2=30-60 min/d, 3=⩾60 min/d
Dependent variable	
Classification of study subjects	1=Control, 2=Only obesity, 3=Only asthma, 4=Obesity with asthma

Table 4 Multinomial analysis of only obesity, only asthma, and obesity with asthma among elementary and middle school students in Shanghai

Variable	*b*	*P*	*OR*	95% *CI* for Exp(*b*)	
				Lower limit	Upper limit
Only obesity					
Age	−0.422	**0.000**	0.656	0.557	0.773
Gender	−0.825	**0.000**	0.438	0.369	0.520
Residence	−0.318	**0.000**	0.728	0.616	0.860
Secondhand smoke exposure	0.387	**0.001**	1.473	1.178	1.841
Sweet food intake	0.613	**0.000**	1.542	1.411	1.713
Only asthma					
Gender	−0.431	**0.000**	0.650	0.530	0.797
Residence	−0.467	**0.000**	0.627	0.507	0.774
Mother's educational level	0.292	**0.032**	1.339	1.026	1.749
Family history of asthma	1.242	**0.000**	3.464	2.782	4.312
Obesity with asthma					
Gender	−1.176	**0.000**	0.309	0.188	0.506
Residence	−0.654	**0.007**	0.520	0.324	0.834
Family history of asthma	1.070	**0.000**	2.916	1.810	4.699
Secondhand smoke exposure	0.752	**0.006**	2.122	1.237	3.640

3 Discussion

This study found that family history of asthma is a risk factor for reporting asthma and obesity with asthma, confirming the family cluster of asthma. The decline of lung function and immunity caused by obesity is believed to be the causes of aggravating asthma. In clinical context, asthmatic children with obesity are also found to have a severer condition, with increased serum inflammatory cytokines, and thus they are more difficult to treat[9]. The rapidly increasing incidence of obesity suggests that more attention should be paid to the impact factors on obesity.

Some studies have suggested that obese people have an imbalanced dietary structure, such as excessive intake of fat and inadequate intakes of vitamins and minerals. This study did not provide direct evidence that asthma can lead to obesity, as there was no significant difference in poor lifestyles such as inadequate physical activities and imbalanced diet between the obesity with asthma group and the other groups. Because this is a cross-sectional study, it is impossible to establish a causal association between lifestyles and obesity, and the recall bias during the questionnaire survey may weaken the behavior measurement accuracy. A long-term cohort study may provide stronger evidence. Although many health-related behavior monitoring projects of students in China use questionnaires to collect information, there are few reports addressing the validity of the questionnaires. There is no doubt that questionnaire survey is simpler and more economical than other methods, but its accuracy requires improvements. Using behavioral diaries, motion accelerometers, health monitoring bracelets, miniature cameras, etc. to record and measure participant's daily life patterns can achieve more accurate results, but the cost may be much higher. The most common method is using small and accurate surveys to validate tools for large-scale population surveys (such as questionnaires), and variables such as dietary intake should be as precise and quantifiable as possible.

Previous studies have shown a large difference in the prevalence of asthma among students in different gender and age groups. Boys were more likely to suffer from asthma than girls at the age of 2 to 13 years. After 14 years old, girls showed a higher risk of having asthma[10-11]. In this study, the proportion of male students having obesity with asthma was higher than that of female students, which may be the combined results of obesity presenting at all stages of childhood and adolescence, and the proportion of male students are higher than female students. Exposure to secondhand smoke relates to childhood obesity,

and a large-scale epidemiological survey in China has found that the rate of obesity is higher in children with obese fathers[12-13]. Braithwaite et al.[14] have found that elevated BMI in children aged 6-7 years and adolescents aged 13-14 is associated with parents' smoking behavior. The results of this paper are basically consistent with previous studies. Shanghai is a very large city, and there are gaps in the environmental and socio-economic conditions between urban and suburban areas. This study found that in the population of obesity, asthma, and obesity with asthma, the gap between the areas was obvious and the health problems of urban students were more prominent, and this may be related to less physical activity and excessive calorie intake.

Obesity in childhood and adolescence causes a variety of adverse health outcomes. Excessive nutrition and inadequate physical activity are the real causes of obesity, which is closely related to socio-economic development and people's literacy. Creating a smoke-free environment, providing a reasonable diet, and ensuring sufficient physical activity intensity and time can help promote the health of children and adolescents.

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