

## Urban-rural Difference in Obesity Rate was not seen among First-year Iwate University Students

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### Abstract

Official statistics indicate that adolescents in the Tohoku district exhibit unusually high rates of obesity, especially in the district's rural areas. At the same time, studies from other countries have shown that higher obesity rates are associated with lower levels of education, and lower obesity rates with higher levels of education. To determine how these two trends interact in northern Japan, we conducted a cross-sectional study of obesity rates among freshmen at a national university in the Tohoku district. A total of 685 freshmen from the Aomori and Iwate prefectures were classified according to the obesity rate in their hometown, as reported in official prefectural statistics, into three categories as follows: normal, with an obesity rate of <12.5% ; relatively high, with an obesity rate of 12.6% – 14.9% ; and high, with an obesity rate of >15.0% ; each of these categories was also divided according to gender. We compared mean BMIs and obesity rates, and found no evidence of obviously higher mean BMIs or obesity rates in male or female freshmen from rural areas. In addition, there were no obese students ( $BMI \geq 30 \text{ kg/m}^2$ ) among the 78 freshmen from high-obesity regions. These results may indicate that body weight control through diet and

physical activity is more common among relatively well-educated adolescents in rural areas, i.e., those who will attend university.

**Keywords:** obesity, educational level, geographic difference, Tohoku district

### Introduction

Various factors are implicated in the development of obesity, including excess energy intake, insufficient physical activity, and genetics. Basically, a positive energy balance results in increased body weight. In general, obesity rates are relatively low in urban areas and higher in rural areas. At the same time, higher obesity rates are associated with lower levels of education, and lower obesity rates with higher levels of education (Drewnowski, 2009). Government statistics indicate an unusually high rate of obesity among adolescents in the Tohoku district of northern Japan. The obesity rates among 12-year-old boys in the Aomori and Iwate prefectures, for example, are 20.18% and 16.03%, respectively; both are significantly higher than the national average of 12.41% (Cabinet Office, Government of Japan, 2008). We examined obesity rates among national

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university students from these regions, expecting that regional trends toward obesity would not be seen among university students from these regions. The purpose of the study was to determine whether freshmen at a national university who come from high-obesity regions exhibit the same obesity rates that are observed in their respective hometowns, and to begin to describe the relationship between educational level and obesity among adolescents in rural areas.

### Methods

An announcement about this study was distributed to all freshmen at Iwate University along with other information. To identify each student's hometown, we referred to the directory of students, which gives information about the high school from which each student graduated. Only students who had graduated from high school in Aomori or Iwate Prefecture were used in our analysis.

The Aomori and Iwate prefectures publish school health statistics containing anthropometric data for children which is categorized according to city and/or region (Aomori Prefectural Government, 2010; Center for Environmental Health of Iwate Prefecture, 2009). The Aomori statistics include all enrolled students from elementary school to senior high school, while the Iwate statistics include only 17.7% of third graders. These anthropometric data are gathered through direct measurement of the body weights and heights of schoolchildren. Obesity is defined as weighing 20% more than the average child of age, sex, and height. We used these school health statistics to classify the cities in the Aomori and Iwate prefectures as follows: Area 1 cities (standard level) have obesity rates of 12.5% or less, Area 2 cities (relatively high level) have obesity rates between 12.6% and 14.9%, and Area 3 cities (high level) have obesity rates of 15.0% or more. Morioka, Ichinoseki, Oshu, and Ofunato were classified as Area 1; Aomori,

Hirosaki, Hachinohe, Kuji, Kitakami, and Ninohe as Area 2; and Goshogawara, Tsugaru, Misawa, Towada, Mutsu, Kamaishi, and Miyako as Area 3. High schools outside these cities were classified into the nearest city with an operational health center.

For the present study, the heights and body weights of participating university freshmen were measured in tenths of centimeters and tenths of kilograms, respectively, at a medical checkup in April 2010. BMI was calculated by dividing weight in kilograms by height in meters squared. Underweight was defined as BMI < 18.5 kg/m<sup>2</sup>, normal weight as BMI between 18.6 and 24.9 kg/m<sup>2</sup>, overweight as BMI between 25.0 and 29.9 kg/m<sup>2</sup>, and obese as BMI ≥ 30.0 kg/m<sup>2</sup>. We adopted an international standard for obesity classification because we wanted to distinguish overweight from obesity. This survey was approved by the Research Ethics Committee of Iwate University.

### Results

Out of the freshman class of 1149 students, 685 (59.6%; 390 males and 283 females) were analyzed. All of these were from Aomori or Iwate Prefecture, as explained above. According to the entrance examination office, 1011 (88.0%) of the 1149 freshmen had entered the university just after graduating from high school, 120 (10.4%) had entered one year after graduating from high school, and 10 (0.87%) had entered two years after graduating from high school. Therefore, 99.3% of the class was between 18 and 21 years old. Only 4 of the students had entered the university more than 4 years after graduating from high school; these include students returning to school after beginning a career. Table 1 shows the students' anthropometric data, sorted by sex and classified according to their hometowns' obesity rates, as described above.

Among the 390 men, 69 (17.6%) were identified as overweight, including 11 (2.8%) who were identified

Table 1. Anthropometric data and distribution according to BMI of freshmen classified with their home town's obesity rate.

	Area 1	Area 2	Area 3
<b>Men</b>			
N	188	156	46
Height, cm	172.7 ± 5.6	171.7 ± 6.3	171.4 ± 5.4
Weight, kg	67.1 ± 11.9	65.2 ± 10.5	65.3 ± 6.6
BMI, kg/m <sup>2</sup>	22.5 ± 3.7	22.1 ± 3.5	22.3 ± 2.3
<18.5, kg/m <sup>2</sup>	17 (9.0%)	15 (9.6%)	2 (4.3%)
18.6-24.9	133 (70.7%)	116 (74.4%)	38 (82.6%)
25.0-29.9	32 (17.0%)	20 (12.9%)	6 (13.0%)
>30.0	6 (3.2%)	5 (3.2%)	0
<b>Women</b>			
N	118	133	32
Height, cm	158.6 ± 6.0	158.3 ± 5.9	157.3 ± 5.1
Weight, kg	53.1 ± 7.6	53.4 ± 7.5	53.8 ± 7.3
BMI, kg/m <sup>2</sup>	21.1 ± 2.7	21.3 ± 2.5	21.7 ± 2.7
<18.5, kg/m <sup>2</sup>	23 (19.5%)	12 (9.0%)	4 (12.5%)
18.6-24.9	86 (72.9%)	112 (84.2%)	23 (71.9%)
25.0-29.9	8 (6.8%)	7 (5.3%)	5 (15.6%)
>30.0	1 (0.8%)	2 (1.5%)	0

Data are expressed as mean ± SD. BMI; body mass index.

Area 1-3 have obesity rate as follows; Area 1 is <12.5%, Area 2 is 12.6%-14.9%, and Area 3 is >15.0%.

as obese; among the 283 women, 23 (8.1%) were overweight, including 3 (1.1%) who were identified as obese. Male students from Area 1 were slightly larger than those from Areas 2 and 3: 1.0 cm and 1.3 cm taller, and 1.9 kg and 1.8 kg heavier, respectively. Therefore a slightly higher obesity rate was observed among Area 1 male students. In women, 5 (15.6%) out of 32 from Area 3 were overweight; this rate is higher than those from Areas 1 and 2 (6.8% and 5.3%, respectively). Twenty-three (19.5%) of the women from Area 1 were underweight; this rate is considerably higher than those among women from Areas 2 and 3, which were 9.0% and 12.5%, respectively. There were no obese students, male or female, from Area 3.

## Discussion

Adults in rural areas generally exhibit greater prevalence of obesity and type 2 diabetes than those in urban areas (Patterson et al., 2004). The lack of formal exercise programs, street lights, sidewalks, and developed public transportation systems in their neighborhoods, as well as their typically lower average socioeconomic status, encourage an inactive lifestyle (Eyler, 2003). We recently reported that white-collar workers in a rural area of the Tohoku district walk 5,500 - 6,000 steps/day, which is 3,000 - 4,000 steps fewer than white-collar workers in urban areas take (Mitsui et al., 2010). Among children, however, this urban-rural difference is not so straightforward: the evidence is more complicated and contradictory. A

cross-sectional study of American adolescents found that rural children have higher obesity rates but engage in more physical activity than their urban counterparts (Liu et al., 2008). In a New Zealand study, however, the trend was apparently reversed: urban and rural children exhibited no significant differences in energy intake, physical activity, or screen time, but the former had higher mean BMIs, waist circumferences, and skinfold measurements (Hodgkin et al., 2010).

In the present study, the overweight/obesity rates are 17.6% for males and 8.3% for females, rather higher than the rates reported for 20-29-year-old males (14.6%) and females (7.7%) in the 2008 Nutritional Survey in Japan (Ministry of Health, Labour and Welfare, 2010). Nevertheless, we did not observe higher BMIs or obesity rates among male university students from rural areas, even among students from the high-obesity areas that we identified based on prefectural school health statistics. The statistics for women from Area 3 are noteworthy: although the number of overweight women (5) is small, the rate (15.6%) is relatively high. Area 1 women, in contrast, exhibit a greater incidence of being underweight (BMI <18.5 kg/m<sup>2</sup>). This observation agrees with a previous study showing that the percentage of young Japanese women who are considered underweight is increasing, especially in urban areas (Takimoto et al., 2004). Our similar result may indicate that the intense desire of young women to be thin is independent of their educational level, especially in urban areas. Also, there were no obese students among the 78 students from Area 3. These results may indicate that body weight control through diet and physical activity is more common among relatively well-educated adolescents in rural areas, i.e., those who will attend university; this conclusion is consistent with those of many other studies that have observed a low prevalence of obesity among populations with more education.

Obesity follows a socioeconomic gradient. Higher obesity rates are observed in populations with low

levels of education and income in the USA and European countries (Gutiérrez-Fisac et al., 1996; Truong and Sturm, 2005; Sulander and Uutela, 2007; Marques-Vidal et al., 2010). Low socioeconomic status is often associated with higher consumption of fatty foods and sugary beverages and lower consumption of fruits and vegetables (Drewnowski, 2009), as well as lower rates of participation in physical activities (Palmer and Jaworski, 2004). Although the socioeconomic gap in Japan has been widening since the late 1990s, there is little information on the effect of educational level on health problems such as obesity in the Japanese population.

There are several limitations to this study. First, we classified students according to their hometowns based on the high school from which they had graduated. This does not take into account the fact that some students, especially those from rural areas, commute to or board at high schools in urban areas. It would have been difficult to identify each student hometown by a more precise means. Second, because the directory provided no information on the ages of individual students, we had to estimate their average age based on the data for all freshmen provided by the entrance examination office.

In conclusion, BMIs and obesity rates are not obviously higher among freshmen at a national university in northern Tohoku who come from rural areas than among those who come from urban areas. It is likely that many of the freshmen from rural areas come from relatively wealthy and well-educated families with both the inclination and the means to send their children to a university. This result may indicate that adolescents and children from relatively well-educated families in rural areas maintain healthier body weights in spite of the high obesity rates in these areas.

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