

JOURNAL

of Health Inequalities

National survey of body mass and dietary behaviour for middle school, high school and university students

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ABSTRACT

Introduction: According to a report from the European Association for the Study of Obesity (EASO), there are 200 million overweight and obese school children in the world today. To assess body mass for students in Poland, in middle schools, high schools and universities, according to growth charts and BMI. Also, to investigate the link between chosen dietary habits and the risks to these subjects of being overweight and obese.

Material and methods: The 13,566 subjects surveyed in 2011 consisted of middle school (3,548), high school (4,423) and university (5,595) students. The two younger groups received a questionnaire that had been devised by GIS (Poland's Chief Sanitary Inspectorate) based on one previously used for the WHO's global school-based student health survey (GSHS). An electronic questionnaire was used for the university students, made available at a designated internet site.

Results: Overweight rates of 13%, 11% and 16% were found in students from middle-school, high-school and university. Overall obesity rates were 3%. Most subject ate three meals daily, although almost 1 in 5 said they ate only 1 to 2 meals daily. Snacking between meals was admitted by 84%, 89% and 89% of students, respectively, whereas corresponding rates for nighttime eating were 24%, 37% and 36%.

Conclusions: The survey demonstrated that overweight status, according to growth charts and BMI, occurs in 13%, 11% and 16% of subjects in each student group, respectively. Overall, obesity accounts for 3% of respondents. Numerous instances of abnormal dietary habits were found, highlighted by irregular meal-times, between-meal snacking and nighttime eating.

KEY WORDS: overweight, obesity, nutrition, students.

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INTRODUCTION

In the final decade of the last century, obesity rates increased in all countries worldwide. In some countries, such increases were very steep, but in others (e.g. the USA and West European countries) they were gradual. It is estimated that globally there are 2.3 billion overweight

people, of whom 704 million are obese [1]. According to the International Society for Obesity Investigation, there are 200 million overweight and obese schoolchildren worldwide, of whom 40-50 million are obese [2].

Genetic, socio-economic and psychological factors are among many contributors to the obesity epidemic.

The most significant factor, however, is environmental, including abnormal eating habits and lack of physical activity [3].

The health consequences of adolescent obesity are numerous metabolic disorders, which in turn increase the risks of contracting diseases such as Type II diabetes, cardiovascular disease and hypertension [4-8]. In addition, abnormalities in blood lipid profiles are observed: increases in 'bad' LDL cholesterol levels and triglycerides occur, coupled with reduced concentrations of desirable HDL cholesterol, leading to the development of arteriosclerosis [9]. Obesity, hypertension, dyslipidaemia and insulin resistance are factors contributing to metabolic syndrome (Syndrome X, Raeven syndrome). Nearly one-third of obese adolescents exhibit features of early Syndrome X [10-13].

When considering the size of this problem, as well as its rate of growth and adverse impact on human health, the World Health Organization (WHO) recognises overweight and obesity as a globalised epidemic that poses a serious public health threat to all age groups and socio-economic strata. Because of the increasing rates of overweight and obesity in adolescents, an important issue in global public health is constant BMI monitoring of children and adolescents, so threats can be quickly identified in order to prevent diet-related modern-day diseases from occurring.

STUDY AIMS

1. To assess the body mass of middle school, high school and university students according to growth charts and BMI.
2. To investigate the relationship between adopted dietary habits and the risk of overweight and obesity occurring in the three groups of students.

METHODS

In 2011, 15,868 randomly selected students from 569 randomly selected middle schools, high schools and universities in Poland were surveyed. Of these 3,548, 4,423 and 7,314 from each group, respectively, were qualified for statistical analyses. Approximately 77% of respondents correctly completed their questionnaires. Females and males constituted 1,742 and 1,806, 2,275 and 2,148 and 3,315 and 2,280 of the middle school, high school and university students, respectively.

A questionnaire was employed for the middle and high school students which had been devised by the Chief Sanitary Inspectorate and based on previous GSHS studies (Global School-based Student Health Survey). The survey was performed by educational staff units of the State Sanitary Inspectorate. Questions concerned healthy behaviours and adverse-health behaviours of the surveyed subjects.

Random sampling for the survey was performed in two stages: first by school, then by class. Subjects from

the chosen classes who completed an anonymous survey questionnaire were enrolled for the study. Schools and institutions were selected randomly from the Ministry of Education's database on 30 September 2008. The schools thus surveyed were grouped according to the population of their district, the type of community (urban, rural), the province (i.e. voivodeship; there being 16 of these in Poland), type of school (middle school, high school, technical school). Schools were randomised using the STATISTICA 12 system. The questionnaire provided to university students differed slightly in that the survey was performed electronically via a website hosted by the Institute of Agricultural Medicine in Lublin. Data on types of university and student's area of residence were also collected, serving to stratify sampling as it was being performed and allowing, appropriate sampling corrections to be made to specific groupings. Surveying students in this manner may have introduced certain systematic errors, depending on the extent to which respondents were informed about the need for them to be reliable, as well as their willingness to take the time to complete the questionnaire. The correction procedure therefore used an 'over-sampling' process and excluded those questionnaires containing errors and repetition, i.e. structural sampling adjustments were made.

As a means of verification, responses were compared with data from Poland's Central Data Statistical Office (GUS), where significant differences were found. It was thus decided to correct the student sampling by 'over-sampling' of a relatively small portion, whereby its structure approached accordance with categories of provinces (voivodeships), gender and age as per the nationwide GUS data. This correction did not remove all the differences, but did significantly improve the representativeness of the sample, a compromise between representativeness and numbers. Making any further corrections would have led to further reductions in the target sample size, thus hindering the capacity for testing statistical hypotheses.

The data so obtained were subjected to statistical analyses, by means of entering the paper-based survey data into a database. The analyses were performed by the STATISTICA 12 system. Testing the dependence of variables on a discrete-scale for multi-field tables was performed by the χ^2 test. For continuous or sequential variables, the Kruskal-Wallis test or variance analysis test was used depending on the nature of the variable (e.g. distribution compliance). Statistical significance was taken as *p* not greater than 0.05.

RESULTS

The nationwide survey demonstrated that roughly 72% of students in Poland, from middle school through university had normal body mass. This was however observed in only 50% of subjects in the younger age

group, where 33% were in fact underweight. Overweight rates of 13%, 11% and 16% were found in students from middle-school, high-school and university. Excess body mass/overweight was observed more frequently in males than females, a difference most pronounced in university students (22% and 9%). Observed obesity rates were around 3% regardless of age (Table 1). In calculating BMI, subjects' replies for their body weight and height were used. The body mass of subjects was assessed according to universally adopted WHO standards for those aged below 18 years, where the following criteria apply: a BMI < 5 centile represents underweight, BMI ≥ 5 centile and < 95 centile is normal, BMI ≥ 85 and < 95 centile is overweight and a BMI ≥ 95 centile represents obesity [14]. For persons aged above 18 years, the WHO

recommends another set of criteria, also universally recognised, as follows: < 16 severe thinness (Class III), 16.0-16.99 moderate thinness (Class II), 17.0-18.49 mild thinness (Class I), 18.8-24.9 normal range (lowest risk), 25.0-29.9 overweight (pre-obese, increased risk), 30.0-34.9 obese Class I (moderately increased risk), 35.0-39.9 obese Class II (seriously increased risk) and > 40 obese Class III (very seriously increased risk).

According to the principles of appropriate nutrition, eating 4 to 5 meals daily has been recommended [15]. The study however shows that subjects most often ate 3 meals per day, whilst almost 1 in 5 ate just 1-2 daily meals (Fig. 1). This indicates large irregularities in the eating of meals which increase with age.

A cause for concern is that respectively 84%, 89% and 89% of middle-school, high-school and university students snack between meals, $p < 0.001$ (χ^2). They also have a liking for nighttime meals, with corresponding rates of 24%, 37% and 36%. Underweight females more often snack between meals and eat at night compared to males. However overweight and obese males more frequently snack and eat at nighttime than females. The proportion of overweight and obese males is also higher than females (Tables II & III) for all age groups studied; especially university students. Subjects snacking between meals commonly eat fruit (61%), yoghurt (76%), pastries (51%) and, fast-food (41%); $p < 0.001$ (χ^2). Snacking between meals of ten involves high-calorie foodstuffs resulting in a high calorific intake. This in turn leads to excessive body mass gains as confirmed by this study.

Over half the subjects ate at night less than once weekly, nevertheless every tenth declared they did so every night or almost every night (Fig. 2). Foodstuffs most often eaten in such cases were confectionery (53%), crisps (62%) and other high calorie foods (23%); $p < 0.001$ (χ^2).

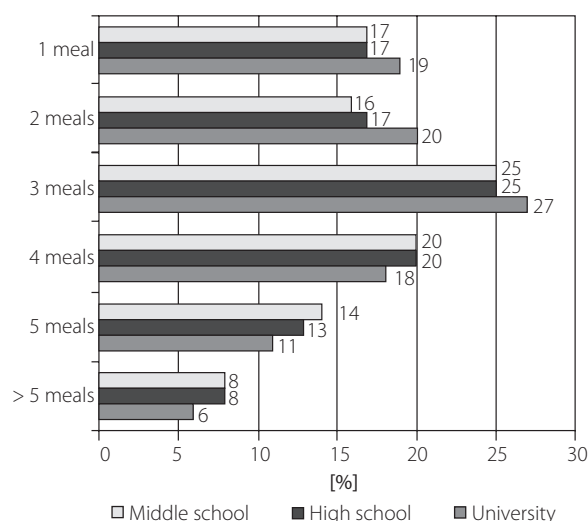


FIG. 1. Number of daily meals consumed according to survey responses from middle school, high school and university students $p < 0.001$ (χ^2)

TABLE 1. Body mass for middle school, high school and university students according to growth charts and BMI by gender

BMI	Middle school			High school			University		
	Total	Females	Males	Total	Females	Males	Total	Females	Males
	N = 3548	N = 1742	N = 1806	N = 4423	N = 2275	N = 2148	N = 5595	N = 3315	N = 2280
Underweight	1173	650	523	715	500	215	541	468	73
	33%	37%	29%	16%	22%	10%	8%	14%	3%
Normal	1784	887	897	3117	1570	1547	4074	2473	1601
	50%	51%	50%	71%	69%	72%	73%	75%	70%
Overweight	472	178	294	482	182	300	791	292	499
	13%	10%	16%	11%	8%	14%	16%	9%	22%
Obesity	119	27	92	109	23	86	189	82	107
	4%	2%	5%	2%	1%	4%	3%	2%	5%
$p; (\chi^2)$	<0,001			<0,001			<0,001		

TABLE 2. Rates of snacking in-between meals for middle school, high school and university students according to gender and BMI

BMI	Middle school			High school			University		
	Total	Females	Males	Total	Females	Males	Total	Females	Males
	N = 2907	N = 1496	N = 1411	N = 3875	N = 2239	N = 2121	N = 4947	N = 2977	N = 1970
Underweight	958	547	411	635	496	218	483	424	59
	33%	37%	29%	16%	22%	10%	10%	14%	3%
Normal	1490	782	708	2760	1547	1534	3627	2230	1397
	51%	52%	50%	71%	69%	72%	73%	75%	71%
Overweight	373	147	226	393	173	287	669	249	420
	13%	10%	16%	10%	8%	14%	14%	8%	21%
Obesity	86	20	66	87	23	81	168	74	94
	3%	1%	5%	2%	1%	4%	3%	2%	5%
<i>p</i> ; (χ^2)	< 0.001			< 0.001			< 0.001		

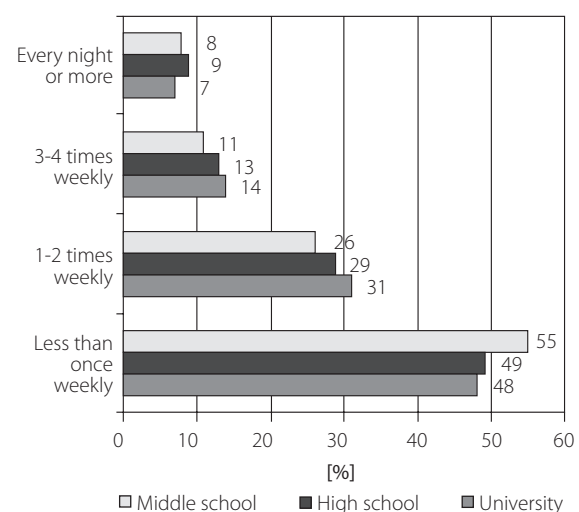
TABLE 3. Rates of nighttime eating for middle school, high school and university students according to gender and BMI

BMI	Middle school			High school			University		
	Total	Females	Males	Total	Females	Males	Total	Females	Males
	N = 819	N = 333	N = 486	N = 1609	N = 691	N = 918	N = 2024	N = 964	N = 1060
Underweight	292	138	154	291	198	93	203	167	36
	36%	41%	32%	18%	29%	10%	10%	17%	3%
Normal	403	156	247	1145	455	690	1451	695	756
	49%	47%	51%	71%	66%	75%	72%	72%	71%
Overweight	107	35	72	134	30	104	295	76	219
	13%	10%	15%	8%	4%	11%	15%	8%	21%
Obesity	17	4	13	39	8	31	75	26	49
	2%	1%	3%	2%	1%	3%	4%	3%	5%
<i>p</i> ; (χ^2)	< 0.001			< 0.001			< 0.001		

DISCUSSION

Obesity is a global health problem reflecting social, economic and cultural changes. In children and adolescents, it basically results from excessive consumption of calories as compared to calorific expenditure, which brings about so-called simple obesity (primary). This constitutes around 98% of all obesity cases for this age.

During human development, adipose tissue content changes according to age and gender. This begins at the foetal stage, and later gathers pace; being especially intensive during critical periods at 1 to 2 years of age and at puberty. Also vital are years 5 to 7, when following a decline in adipose tissue development, the child's BMI rises and the number of adipose cells increases. This is termed the 'adipose rebound' phase (AR). In its early stages, it constitutes an indicator of obesity risk in adulthood. In Poland, it is estimated that 15% of children are overweight, of whom close to 2% are obese [16]. Such

**FIG. 2.** Frequencies of nighttime eating for middle school, high school and university students; $p = 0.001$ (χ^2)

rates rise year by year and are ten fold higher than the rates seen in the 1970s [17]. According to growth charts and BMI, this all-Poland study demonstrates overweight rates of 13%, 11% and 16% for respectively middle school, high school and university students. The corresponding rates for obesity are 4%, 2% and 3%. Overweight and obesity rates in European are diverse. The highest rates are observed in Southern and Western Europe. A German study on adolescents demonstrated a 21% overweight rates and 10% obesity [18]. An HBSC survey (Health Behaviour in School-Aged Children) from 2010 on Italian teenagers aged 11 to 15 years yielded results similar to those in Poland. Young Italian males are more vulnerable to being overweight and obese compared to females 28%, 25% and 25% for respectively 11, 13 and 15 year-olds. Correspondingly in females the rates were 19%, 16% and 12% [19]. As part of the same study, but undertaken on Portuguese adolescents, overweight and obesity was seen in 17% of females and 20% of males aged 11 to 17 years [20]. A Greek study from 2010-2012 on 12 to 19 year-old students showed 19% and 28% overweight in females and males with obesity rates of 6% and 9% [21].

On a worldwide scale, obesity is most common in the USA, where epidemiological studies over the last 25 years have shown that obesity rates have doubled in children and adolescents and increased threefold to 17% in adults. It is estimated that by 2030, 86% of adult Americans could be overweight or obese [22, 23]. Increases in overweight and obesity are also observed in developing countries (e.g. Brazil, Mexico and Egypt), which in the last few years have witnessed economic changes. Brazilian studies on children and adolescents aged 2 to 19 years have shown overweight rates of 26 to 29% (depending on place of residence) and obesity rates of 10% to 15% [24]. Mexico, along with Greece, Italy and the USA, show the highest increases in overweight and obesity in children and adolescents. Over 70% of Mexicans aged 30-60 years are overweight and obese [25]; males have higher overweight rates than females, and obesity rates are directly proportional. Although in most African countries underweight is a significant problem, the aforementioned GSHS project also stresses the high rates of overweight and obesity seen in youth. A study on 11 to 17 year-olds found that 31% are overweight and 9% are obese in Egypt, where the causes appear to involve genetic and economic factors [26].

Epidemiological studies demonstrate that the most common abnormalities in dietary and nutritional habits contributing to the development of overweight and obesity are an inappropriate number of daily meals and snacking between meals. The study presented here shows that youth most commonly consumes 3 meals per day. This does not comply with the international recommendations of 4-5 meals daily, at intervals of not more than 4 hours [15]. Snacking between meals can lead to excessive intakes of total calories in the form of carbohy-

drates and saturated fats through frequent eating of high calorie foodstuffs [27-29].

This all-Poland study found that as much as 84%, 89% and 89% of respectively middle school, high-school and university students snacked between meals; the most commonly eaten foodstuffs being crisps, confectionery and fast-food. These findings have been confirmed by a study from Cracow, showing that most teenagers snack between meals of which 39% do so regularly. Fast-food is very popular amongst youth [30]. A study conducted on Filipino schoolchildren demonstrated that obesity most commonly occurs in those that drank sweet carbonated drinks or ate high-calorie snacks [31]. Children that ate lower calorie snacks were less vulnerable to suffer from obesity [32].

CONCLUSIONS

This survey demonstrated that overweight and obesity, according to growth charts and BMI, in middle school, high school and university students were respectively 13% 11% and 16%. Obesity rates were around 3% for all subjects. Both overweight and obesity may increase dietary-related disease.

Study subjects followed many dietary practices considered to be inappropriate such as irregular mealtimes, snacking between meals and nighttime eating. This is linked with an excess calorific balance resulting in excessive body mass increase.

In order to promote a healthy lifestyle, it is therefore necessary to educate adolescents to take responsibility for their nutritional behaviour, as their being unaware of such issues can lead to inappropriate dietary habits becoming adopted for good.

ACKNOWLEDGEMENTS

Editors would like to acknowledge the invaluable assistance of Mr. Scott Thompson in the preparation of the final version of this article.

DISCLOSURE

Authors report no conflict of interest.

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AUTHORS' CONTRIBUTIONS

PWB, WŻŚ, AW prepared the research concept and design of the publication. TB, WŻŚ, ZChM and KJ collected data. PWB, TB, KW, ZChM and KJ analysed data. PWB and CW wrote the article. AW critically reviewed the publication. HK finally approved the publication.