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ORIGINAL

BMI of students of School of Sport – facts and self-assessment in the context of physical activity and parents' education. Long-standing research

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

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abstract

Background The objective of this study is self-recorded BMI among 20-year-old female students in the context of their physical activity, weight, body height, parent's education and the time factor.

Material/Methods Statistical analysis of the data was based on anthropometric measurements and a survey conducted among female students (N = 1,394) from the first year of full-time studies at the Gdansk University of Physical Education and Sport (AWFiS) in the years 2003–2010. The relationship between variables and logistic models was analyzed (Student's test, Duncan's test, analysis of variance, logistic regression). Statistical analysis was conducted using Statistica 6.0 software.

Results At the background of the research results it may be claimed that incorrect self-reported BMI favors sport (OR = 0.71), father's elementary or basic vocational education (OR = 1.44), higher weight (OR = 0.90) and BMI (OR = 0.76) and lower height (OR = 1.07). 29.77% women did not evaluate their BMI correctly during the whole 8-year research process. The correct BMI was reported by 70.23% of the students; 26.76% overestimated their BMI and 3.01% underestimated it. A high percentage of women who practice sport and who incorrectly determined their own BMI (31.25%) is disquieting, including 8.82% of the students who underestimated their BMI, and 91.18% who overestimated it.

Conclusions Failure to correctly evaluate BMI may lead to nutrition disorders, low self-esteem and serious health consequences. It is reasonable to develop regular and skillful evaluation of BMI among young people by institutions and people involved in health promotion.

Key words female students, BMI, self-assessment, physical activity, parents' education, long-standing research

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INTRODUCTION

Taking care of one's body, through body weight control and connected with it well-balanced diet, among other things, reduces a risk of many diseases [1, 2, 3, 4]. There is a common belief that slim people have easier life. It is easier for them to find a partner, good job; they are happy, sexually attractive and, in consequence, more confident [5, 6, 7, 8]. Obese people are seen as stereotypically lazy, slow and less confident, and by this emotionally unstable. Media have a special impact on the formation of these patterns. Anxiety, a sense of gap between the "ideal body" forged by mass media and one's own "real body", is often at the root of psychological and social problems (low self-esteem, social alienation, depression). How people imagine their own body and compatibility of this image with reality essentially affects human thinking, experience and activity [6, 9, 10]. Wrong BMI evaluation tends to cause irresponsible eating habits, which can result in serious health problems.

The objectives of the study included:

- learning the skill of correct BMI self-assessment by female students of Gdansk University of Physical Education and Sport (AWFiS) and comparing it with anthropometric measurements;
- assessing the likelihood of correct self-assessment in the context of young women's physical activity, height and weight, as well as the level of their parents' education and the time factor.

MATERIAL AND METHODS

Statistical analysis of the data was based on anthropometric measurements and a survey conducted among female students (N = 1.395) from the first year of full-time studies at Gdansk University of Physical Education and Sport (AWFiS) in the years 2003–2010. The examined students were healthy, fit and physically active women at the turn of adolescence and adulthood. The mean age of the sample was 20.28 years. The average value of body weight was 60.61 kg, body height 167.61 cm, and BMI 21.55 kg/m^2. The level of the subjects' physical activity varied a lot. 34.58% of the students had participated in extra activities (beyond the curriculum, for at least 1 year under supervision of a coach), whereas 21.95% of students had never participated in such classes and 43.47% of them had been active some time ago but not during the study period. Some of the respondents refused to give their consent to use the information for research purposes, which had an impact on the number of observations during different stages of analyses.

Anthropometric measurements were performed each year in the same period by the same person. Before proceeding to the anthropometric measurements, the tested students filled in a questionnaire which asked them, among others, about the most satisfying for them BMI category (underweight, normal weight, overweight, obesity, extreme obesity). Measurements of the body weight and the body height were performed in accordance with the rules with a use of medical scales (body weight) and an anthropometer (body height). The value of the proper body mass was defined using the Body Mass Index (BMI):

$$\text{BMI= body mass [kg]:(B – v)}^2\text{[m].}$$

The following ranges of BMI values were considered [11]:

BMI < 18.5 kg/m^2 – underweight,
18.5 kg/m^2 ≤ BMI < 25.0 kg/m^2 – normal weight,
25.0 kg/m^2 ≤ BMI < 30.0 kg/m^2 – overweight,
30.0 kg/m^2 ≤ BMI < 40.0 kg/m^2 – obesity,
40.0 kg/m^2 ≤ BMI – extreme obesity.

Statistical analysis of the results was conducted using Statistica 6.0 software. Logistic regression, non-parametric chi-square test, analysis of variance, t-test for independent samples, Duncan's test, and units odds ratio (OR) were used for the study. The following variables and their categories were analyzed in the study:

independent variables (x_1–x_7)

x_1 – year of study (3 = 2003, 4 = 2004, 5 = 2005, 6 = 2006, 7 = 2007, 8 = 2008, 9 = 2009, 10 = 2010),

x_2 – physical activity (0 = students who never participated in regular extra sports classes with a coach, beyond curriculum, for minimum 1 year, 1 = students who had participated in the past or at the time of the study in regular extra sports classes with a coach, beyond curriculum, for minimum 1 year),

x_3 – mother's educational background (0 = primary or vocational, 1 = high or university),

x_4 – father's educational background (0 = primary or vocational, 1 = high or university),

x_5 – body weight [kg] (anthropometric measurements),

x_6 – body height [cm] (anthropometric measurements),

x_7 – BMI [kg/m^2] (calculated on the basis of anthropometric measurements).

dependent variable (Y)
Y – probability of self-reported BMI in comparison with real life, i.e. BMI calculated on the basis of anthropometric measurements: (0 = self-reported BMI inconsistent with reality, 1 = self-reported BMI in line with reality).

RESULTS

Correct self-reported BMI was made by 70.23% of the students, 26.76% overestimated the results and 3.01% underestimated the values. Students who calculated BMI in line with reality have significantly lower body weight and BMI than those students who decreased or increased their values; however, body height has similar values for all students (Tables 1 and 2). A lack of significant differences in the mean values of body weight, height and BMI in students over or underestimating their BMI was observed (Tables 1 and 2).

Table 1. AWFiS female students self-assessing BMI – mean values of BMI, body weight and height determined on the basis of anthropometric measurements

	Body weight [kg]		Body height [cm]		BMI [kg/m^2]	
Self-recorded BMI compared with the calculated BMI on the basis of anthropometric measurements:	M	SD	M	SD	M	SD
Consistent (a)	59.53	7.04	167.58	6.199	21.17	1.98
Inconsistent (b)	63.16	8.26	167.69	6.46	22.42	2.30
The significance of differences between a and b	t = -8.34 p = 0.000000		t = -0.30 p = 0.8		t = 10.26 p = 0.000000	
Overstated (c)	63.13	7.36	167.70	6.54	22.41	1.86
Undervalued (d)	63.42	14.08	167.55	5.79	22.56	4.70
The significance of differences between a , c and d	F = 34.81 P = 0.000000		F = 0.06 P = 0.9		F = 52.74 P = 0.000000	

t – test t for independent samples, F – statistics F, p – level of statistical significance

Table 2. The significance of differences between mean values of weight, height and BMI of students properly evaluating it (a), overestimating values (c) and underestimating values (d) of their self BMI – Duncan's test

	Body weight				Body height				BMI			
	a	c	d		a	c	d		a	c	d	
a		*	*							*	*	
c	*								*			
d	*								*			

* level of statistical significance $p < 0.01$

There was a significant relationship between self-reported BMI compatible and incompatible with reality and the year of research, physical activity and father's education. There is no such relationship in case of mother's education (Table 3).

Table 3. Self-recorded BMI made by the students taking into account the category of qualitative independent variables

Independent variables	Self-recorded BMI compared with the calculated BMI on the basis of anthropometric measurements							
	Consistent		Inconsistent		Undervalued		Overstated	
	N	%	N	%	N	%	N	%
Year of study (x_1)	$\chi^2 = 15.698$ p = 0.03				$\chi^2 = 9.05$ p = 0.3			
2003	195	71.43	78	28.57	9	3.30	69	25.27
2004	113	63.84	64	36.16	3	1.69	61	34.46
2005	97	60.25	64	39.75	3	1.86	61	37.89
2006	103	73.05	38	26.95	3	2.13	35	24.82
2007	100	75.76	32	24.24	3	2.27	29	21.97
2008	142	74.35	49	25.65	6	3.14	43	22.51
2009	120	71.86	47	28.14	8	4.79	39	23.35
2010	109	71.71	43	28.29	7	4.61	36	23.68
Physical activity (x_2)	$\chi^2 = 5.19$ p = 0.02				$\chi^2 = 3.48$ p = 0.06			
students who never participated in regular extra sports classes with a coach, beyond curriculum, for minimum 1 year	231	75.49	75	24.51	12	16.00	63	84.00
students who participated in the past or at the time of the study in regular extra sports classes with a coach, beyond curriculum, for minimum 1 year	748	68.75	340	31.25	30	8.82	310	91.18
Mother's educational background (x_3)	$\chi^2 = 0.03$ p = 0.9				$\chi^2 = 0.06$ p = 0.8			
primary or vocational	107	70.86	44	29.14	4	9.09	40	90.91
high or university	869	70.14	370	29.86	38	10.27	332	89.73
Father's educational background (x_4)	$\chi^2 = 4.45$ p = 0.03				$\chi^2 = 0.02$ p = 0.9			
primary or vocational	201	65.47	106	34.53	11	10.38	95	89.62
high or university	768	71.71	303	28.29	30	9.90	273	90.10

x_1–x_4 – independent variables and their categories are described in the Material and methods section

Incorrect self-reported BMI was more frequently presented by students who practice or practiced sport regularly with a coach and in extra classes beyond the curriculum than by those who had never participated in such classes. Fathers' elementary or basic vocational education is also connected with more

frequent incorrect calculations of BMI made by their daughters (Table 3).

There were no statistically significant relationships between over and underestimated BMI values and the qualitative variables; although a slightly higher percentage of women overestimating their BMI in 2003–2005 with a downward trend in subsequent years was observed. It was also found that students who took or take extra sports classes more often (7.18%) had higher self-recorded BMI values than completely non-active students (Tab. 3). Worrying is a high percentage of students athletes whose self-recorded BMI is incorrect (31.25%). Overestimation (91.18% of wrong BMI self-assessment) seems to be a common phenomenon, while only 8.82% of the self-recorded BMI was underestimated.

After the estimation using Rosenbrock and quasi-Newton methods, a model of logistic regression was obtained, for which the value of the difference between the model composed of 6 independent variables (x_1–x_6) and the model with an absolute term is only significant. However, parameters for variables x_2 and x_3 are not statistically significant. Interaction between x_1–x_7 variable force to create 3 separate models allowing an evaluation of the probability of correct BMI self-assessment. They all substantially differ from a model with only the absolute term, and parameters for each considered variable are statistically significant (Tab. 4). Such created models take the form of:

$$\text{Logit } P = -5.61999 + 0.068915x_1 + 0.363246x_4 - 0.10093x_5 + 0.07135x_6$$

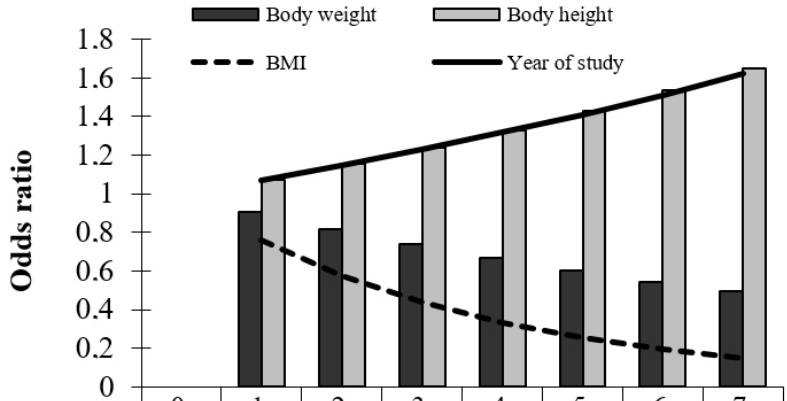
$$\text{Logit } P = 1.12493 - 0.33647x_2$$

$$\text{Logit } P = 6.829 - 0.27455x_7$$

Table 4. Independent variables x_1, x_2, x_4, x_5, x_6, x_7 and the probability of correct BMI self-assessment by the students – logistic regression

Variable/ constant	Assessment	Standard error	Wald Chi²	p	OR	-95%L	+95%L
The probability of making a correct BMI self-assessment				Chi² = 109.60	p = 0.0000		
Constant	-5.61999	1.78470	9.91607	0.002	0.00362	0.00011	0.12016
x_1	0.068915	0.025860	7.101940	0.008	1.071346	1.018353	1.127096
x_4	0.363246	0.143976	6.365386	0.01	1.437990	1.084165	1.907288
x_5	-0.10093	0.01063	90.08878	0.00000	0.90400	0.88534	0.92305
x_6	0.07135	0.011252	32.44852	0.00000	1.07395	1.04789	1.10067
The probability of making a correct BMI self-assessment				Chi² = 5.3341	p = 0.02		
Constant	1.12493	0.13282	71.73387	0.00000	3.08000	2.37354	3.99674
x_2	-0.33647	0.14801	5.16795	0.02	0.71429	0.53429	0.95492
The probability of making a correct BMI self-assessment				Chi² = 97.168	p = 0.0000		
Constant	6.829	0.649	110.670	0.00000	924.013	258.622	3301.344
x_7	-0.27455	0.02952	86.48582	0.00000	0.75991	0.71715	0.80522

x_1, x_2, x_4, x_5, x_6, x_7 – independent variables and their categories are described in Material and methods, Assessment – the value of the estimator of a model parameter, p – the level of likelihood in Wald test, OR – units odds ratio, -95%L – the lower limit of 95% confidence interval for odds ratio (unit changes), +95%L – the upper limit of 95% confidence interval for odds ratio (unit changes)



	0.	1.	2.	3.	4.	5.	6.	7.
Body weight		0.90	0.82	0.74	0.67	0.60	0.55	0.49
Body height		1.07	1.15	1.24	1.33	1.43	1.53	1.65
BMI		0.76	0.58	0.44	0.33	0.25	0.19	0.15
Year of study		1.07	1.15	1.23	1.32	1.41	1.51	1.62

Fig. 1. Probability of compatible with the reality self-recorded BMI made by the students (body weight, body height, BMI, year of study)

Incorrect BMI self-assessment is fostered by: father's education below the secondary level (OR = 1.496), practicing sport (OR = 0.717), higher body weight (OR = 0.904) and BMI (OR = 0.7599), and lower height (OR = 1.704). In each subsequent year the subjects were characterized by a higher probability of correct self-recorded BMI (OR = 1.071) (Table 4, Fig. 1).

DISCUSSION

Dissatisfaction with the actual body build often leads to health (subjective evaluation of one's own appetite as too big), psychological and social (low self-esteem, social isolation and depression) problems [12]. Overestimation of BMI is a known phenomenon [13]. This study shows that overestimation of body weight is much lower (26.76%) than in a group of women tested by Wong (51.4%) [14]. Among those who incorrectly self-recorded their BMI, 91.18% are female students of Gdansk University of Physical Education and Sport who practiced or practice sport (Table 3). Probably not without significance is the type of college they study at. Higher sports level is often associated with a slim figure and a low percentage of fatty tissue, which disrupts self-assessment. Results of logistic regression confirm previous suppositions (Table 4, Fig. 1). The more the figure fits into the fashion figure as mass media idea of perfection (lower body weight and BMI), the higher the chance for correct self-recorded BMI. The observed increase in the probability of proper self-assessment together with increasing father's education may be associated with a higher level of general knowledge about health passed on to children in everyday life (Table 4). Why were such dependencies not noted in mothers? Maybe a higher role of the father in bringing up children is one of the reasons. An attempt to explain it will be made in further studies.

Undoubtedly, the causes of inadequate to reality self-recorded BMI are complex. The time of turning from adolescence to adulthood brings huge changes of the physical (changes in the composition and proportions of the body) and mental nature (formation of a new body image, and as a consequence one's own identity). These extremely turbulent changes take place in the background of commonly prevailing and promoted by mass media idea of "thinner is better". Thus the assessment of one's own body is mostly made by comparing it to generally accepted ideal of a woman – a slim figure [12, 15, 16]. As pointed out by Rovia [17], young people do not have enough knowledge about their body weight appropriate for their age and height. Probably, this is another reason for inadequate self-recorded BMI in the group of women; however, an increase in the probability of a proper BMI self-assessment in the subsequent research year is optimistic (Table 4, Fig. 1). The study is ongoing, which will confirm or verify the results.

CONCLUSIONS

As the results demonstrate, the BMI evaluation cannot be based only on information obtained from self-assessment made by young women. Very often, they do not have such a skill, mainly those who practiced or still practice sport. Far from reality self-assessment means a strong possibility of improper nutrition, which may result in serious health consequences.

Preventing such a behavior should be an important part of health education, especially among the young. There is, therefore, a need to teach children, young people and their guardians regular and objective methods of their body weight evaluation. Nurses who perform screening, coaches during a routine examination of body weight and height, and teachers should play a huge role in these activities.

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