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Comparison of Socioeconomic Status and Body Composition of Dietary Energy Under-Reporting and Non-Under-Reporting Youth

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Socioeconomic status (SES) and body composition of dietary energy under-reporting (UR) and non-under-reporting youth (non-UR) were compared. Analyses covered the data obtained from 547 persons aged 15–18 years. SES discriminants included: declared economic situation of the family, the size of the place of residence, mother's/father's educational background and main source of mother's/father's income. This was used as a basis to calculate SES index and to distinguish persons of low, average and high SES. Nutritional patterns were assessed using the 24-h recall method. UR individuals were established on the basis of energy value of diets, according to criterion described by Goldberg *et al*. [1991]. The body composition of respondents was assessed by anthropometric methods. Due to the low participation of the UR boys, the comparison of SES and body composition between the UR and non-UR persons was performed among 278 girls aged 15–17.

One hundred and thirty-six UR individuals were identified (24.8% of total sample). UR boys accounted for 4.0% of total sample, and UR girls for 20.8% of the total sample. More UR than non-UR girls revealed an average SES index level (38.6% *vs*. 26.8%, respectively), and less of them were characterised by a low level of SES index (21.1% *vs*. 35.4%, respectively). Differences in body composition and measurements between UR and non-UR individuals were established only for girls aged 15. UR girls aged 15 had a higher body weight (on average by 6.6 kg), BMI (1.8 kg/m^2), hip circumference (4.0 cm), upper arm muscle circumference (1.9 cm), upper arm muscle area (652.0 mm^2), fat mass (3.9 kg) and fat free mass (2.7 kg).

It was found that under-reporting of energy intake from food was related to sex and SES, and in girls aged 15 years – to body weight and body composition. Energy under-reporting was definitely associated with the female sex and in girls aged 15 – by an increased body weight resulting from the increased amount of fat and muscle tissue. Proper energy reporting by girls was associated with the lowest level of socioeconomic status, which was related to living in a rural area, a low level of father's education and a worse economic situation of the family. The results obtained suggest that for young people, reliability of a nutritional recall can be more dependent on their individual features than the features of the social environment of their family.

INTRODUCTION

The under-reporting of the amount of energy intake from food is a frequent methodical problem in the assessment of nutrition, which is difficult to estimate and eliminate. Problems with precise description of food intake concern the population level as well as individuals [Gibson, 2005; Gronowska-Senger, 2009]. Information obtained from respondents by recall can never be absolutely reliable.

According to Gibson [2005], two types of errors can be distinguished which can influence intake under-reporting. These are the so-called accidental and systematic errors. The significance and scope of these errors depend on the method of the nutrition assessment applied [Gibson, 2005; Goldberg *et al.,* 1991; Gronowska-Senger, 2009]. Both types of errors can be minimised by fully controlling the procedures at each stage of the research. Those errors can be related to: (i) sampling, *e.g.* incorrectly taken or selected sample for the study, neglecting systematic differences between study participants and those who have not completed the study; (ii) a respondent, *e.g.* variability of "day to day" and "person to person" intake, unfamiliarity with food and dishes, insufficiency in short- and long-term memory, incapacity to estimate the amount, inaccurate recording or weighing, conscious or subconscious self-presentation; (iii) method, *e.g.* incorrectly selected method or measure, missing validation of the method, neglecting supplementation or unconventional nutrition patterns, long-term changes in human eating habits, improperly selected interpretation criteria, application of various criteria of assessment in multi-centre studies, errors in calculating the results, partiality during the interview; (iv) a researcher, *e.g.* differences between researchers concerning application and interpretation of the method, improper protection of samples, partiality in collecting data, errors in coding, improper analysis of data, improper interpretation [Gibson, 2005; Goldberg *et al.,* 1991; Goris *et al.,* 2000; Gronowska-Senger, 2009; Scagliusi *et al.,* 2003]. Conse-

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quently, they make it difficult to properly assess the energy and nutritional value of diets.

As it results from literature, the level of energy intake under-reporting is quite varied and may even amount to 500 kcal/day [Goldberg *et al.,* 1991; Novotny *et al.,* 2003; Olendzki *et al.,* 2008; Pietruszka *et al*., 2000]. This is why the researchers are becoming increasingly interested in developing solutions to this problem and identifying energy under-reporting respondents. A method developed by Goldberg *et al.* [1991] is one of such attempts. The method is frequently applied, in spite of some claims that sensitivity for identifying under-reporters at the individual level is limited [Abbot *et al.,* 2008; Bedard *et al.,* 2004; Black, 2000]. As suggested by Black [2000], the Goldberg cut-off can be used to evaluate the mean population bias in reported energy intake, but information on the activity or lifestyle of the population is needed to choose a suitable physical activity level of energy requirements for comparison.

The issue of energy under-reporting concerns 10–45% of respondents and depends on their age, sex, degree of overweight and socioeconomic status (SES) [Bailey *et al.,* 2007; Bedard *et al.,* 2004; Johansson *et al.,* 2001; Okubo & Sasaki, 2004; Olendzki *et al.,* 2008; Pietruszka *et al*., 2000; Subar *et al.,* 2003; Tooze, 2004; Tooze *et al.,* 2004; Yannakoulia *et al.*, 2007]. However, the results of the research are not explicit. In the research of Briefel *et al.* [1997], Tooze *et al.* [2004], and Yannakoulia *et al.* [2007] energy under-reporting was observed most frequently in woman aged 20 to 69 years than in men. Quite to the contrary, in inhabitants of Montreal aged 18–82 years, energy under-reporting was established most frequently for men and elder persons, with higher BMI and a lower level of education [Bedard *et al.*, 2004]. Bailey *et al.* [2007] did not confirm the effect of sex on energy under-reporting in inhabitants of the country aged between 66 and 87 years. Most researchers agree that overweight respondents are conductive to energy under-reporting [Bailey *et al.*, 2007; Huang *et al.,* 2005; Johansson *et al.*, 2001; Livingstone, 2003; Yannakoulia *et al.*, 2007]. Contradictory results were obtained by Okubo & Sasaki [2004]. Those researchers proved that energy under-reporting was prevalent in slim Japanese women aged 18–20 years. Many studies suggest that a low level of education and a worse economic situation favour energy under-reporting [Bailey *et al.*, 2007; Bedard *et al.*, 2004; Briefel *et al.,* 1997; Cook *et al.,* 2000]. The effect of low level of education on dietary energy under-reporting was also confirmed among Polish respondents [Pietruszka *et al.*, 2000]. Nevertheless, Yannakoulia *et al.* [2007] proved that energy under-reporting was associated with a higher level of education, while Tooze *et al.* [2004] did not prove any connection with education. There is little information concerning other features of socioeconomic status, *e.g.* place of residence.

The available Polish literature is deficient in research focusing on energy under-reporting and facilitating descriptions of unreliable respondents. One of the few Polish articles on this subject was written by Pietruszka *et al.* [2000], however, it dealt with adult respondents. Since youth are a frequent subject of nutritional studies, the choice of this group for research on energy under-reporting seems particularly justified. The aim of the study was to compare the socioeconomic status and body composition of energy under-reporting and non-under-reporting girls aged 15–17 years.

SUBJECTS AND METHODS

The study was based on the data collected in 2002–2003. The research was conducted with the approval of the Bioethics Commission at the Warmia and Mazury District Medical Chamber in Olsztyn (decision No. 49/2001). All interviews and measurements were carried out by well-trained interviewers.

Sample

Total available data were made up of results collected from 547 persons (268 boys and 279 girls) aged between 15 and 18 years (on average 16.1±0.44), (Figure 1). The sample under examination was composed of students of various secondary schools located in north-eastern Poland, *i.e.* in small towns and villages of the Suwałki region and in the city of Olsztyn. The sample for research was selected by two-phase random sampling. Initially, 2 or 3 secondary schools were sampled from the city and from small towns and villages of the above mentioned region, and then 2 or 3 classes from each of the schools.

Socioeconomic status assessment

General information on respondents was collected using a survey technique through individual interviews. The socioeconomic status of the youth was specified by application of the following criteria and their categories, which were assigned numerical values (provided in brackets):

- father's/mother's education: primary and vocational (1), secondary (2), higher (3);
- size of the place of residence: country (1), town <50,000 inhabitants (2), town 50,000–100,000 inhabitants (3), city >100,000 inhabitants (4);
- economic situation of the family according to the self-assessment of the youth: poor (1), satisfactory (2), good (3), very good (4);
- main sources of mother's/father's income: no income (1), benefit (2), pension or allowance (3), farm (4), monthly salary (5), own business (6).

The SES index was then calculated based on the above specified six individual SES criteria. It was calculated as a product of numerical values assigned to corresponding verbal statements. SES index values ranged from 1 to 27,720. For example, a SES index of 1 belongs to a person living in a village with a poor economic situation, whose parents both had basic education and did not have stable income. On the other hand, a SES index of 27,720 belongs to a person living in a city populated with over 100,000 citizens with a very good economic situation whose both parents had higher education and received income from their own company. The SES index distribution was not consistent with standard distribution. Afterwards, using a tertile distribution, persons of low (SES index <90; 33.6% of the sample), mean (90–600; 35.5% of the sample) and high SES (>600; 30.9% of the samples) were determined. Tercile, quartile or quintile division into groups is often used in data analysis, however, its

spread is different than the normal spread [Booth *et al.,* 1999; D'Addesa *et al.,* 2010].

Energy intake assessment

Nutritional patterns were assessed using a 24-h recall [Charzewska *et al.,* 1997; Gibson, 2005; Szponar *et al.,* 2000]. Interviews were conducted once with each examined person on all days of the week. Eighty-eight percent of dietary interviews were carried out on weekdays, while 12% were conducted on holidays. Specifically designed questionnaires were used during the survey, as well as the "Album of photographs of food products and dishes", to determine the amount of food consumed [Szponar *et al.,* 2000]. The energy and nutritional value of all-day diets were calculated using Access 7.0 software, containing a database with a nutritive value of food products [Kunachowicz *et al.,* 1998; Nadolna *et al.,* 1994]. The amount of nutrient intake obtained in this way was reduced by technological and cooking losses, amounting to 10% for energy.

Identification of energy under-reporters (UR)

Energy under-reporters were identified on the basis of energy value of diets (EI) using the method described by Goldberg *et al.* [1991]. Basal metabolic rate (BMR) was calculated according to the Harris-Benedict formula [Gibson, 2005], and then physical activity level (PAL) was determined as a quotient of energy intake and basal metabolic rate (PAL=EI:BMR). To identify under-reporters, the value of PAL<0.9 was assumed as a cut-off point.

One hundred and thirty-six under-reporting respondents aged 15–18 years were identified, including 22 boys and 114 girls (Figure 1). Because of the small number of UR boys, only the girl sample was further analysed. The girl sample was divided into four groups, of girls aged 15, 16, 17 and 18 years. Finally, the analysis was limited to 278 girls aged 15–17 years, since there was only one UR girl aged 18 (Table 2). The proportion of the dietary interviews carried out on weekdays and on holidays in UR and non-UR girls and boys differed significantly ($p>0.7$).

Body composition assessment

Body composition was assessed with the use of anthropometric methods [Gibson, 2005]. The following measurements were taken: weight (kg), height (cm), biceps skinfold thickness (BSF, mm), triceps skinfold thickness (TSF, mm), subscapular skinfold thickness (SCSF, mm), suprailiac skinfold thickness (SISF, mm), waist circumference (WC, cm), hip circumference (HC, cm), and upper arm circumference (AC, cm). Afterwards, the following values were calculated: body mass index (BMI, kg/m^2), upper arm muscle circumference (AMC, cm), upper arm area (AA, mm^2), upper arm muscle area (AMA, mm^2), upper arm fat tissue area (AFTA, mm^2) [Heymsfield & Wiliams, 1998; WHO, 1995]. Body composition was determined by the spectrophotometric method, with the use of FUTREX 5000A/ZL apparatus, and the following indicators were established: fat mass (FM, kg), free fat mass (FFM, kg) and percentage of fat mass (%FM, %). For body mass index, standard deviation indices were calculated (Z-score) [Gibson, 2005; Heymsfield & Wiliams, 1998], assuming developmental standards for Warsaw youth for comparison purposes [Palczewska & Niedźwiecka, 2001].

Statistical analysis

The values of features were expressed with a mean value ($\bar{x}$), and their variability – with a standard deviation (SD). Differences in values of somatic parameters between UR and non-UR respondents were expressed in absolute and relative values. Absolute differences (AD) and relative differences (RD) were calculated according to the following formulas:

$$AD = UR - \text{non-UR}$$

$$RD = (UR - \text{non-UR}) \times 100/\text{non-UR}$$

Comparison of the entire distributions of parameters was achieved with the use of a chi^2 test. A test for structure indicators was applied to compare the percentage of persons in pairs. The mean values of somatic parameters were compared with a T-Student test. Statistical analysis was carried out with the use of Statistica PL v. 9.0 software.

RESULTS

One hundred and thirty-six UR individuals were determined (24.8% of the total sample), aged 15–18 years. Boys UR made up 4.0% of the total sample, and UR girls – 20.8% of the total sample (Figure 1). The UR youth when compared to the non-UR youth significantly underestimated the dietary energy (UR girls by 945 kcal, UR boys by 1516 kcal on average) (Table 1).

None of the girl age groups revealed any differences in UR and non-UR share (Table 2). As regards girls aged 15–17, UR girls made up 20.8% of the total sample, and non-UR girls – 30.0% of the total sample.

Socioeconomic status

More UR girls than non-UR lived in towns of 50,000 to 100,000 inhabitants (28.9% *vs.* 17.7%, respectively, Table 3). Fewer UR girls than non-UR girls had fathers with primary or vocational education (35.1% *vs.* 47.9%, respectively). More

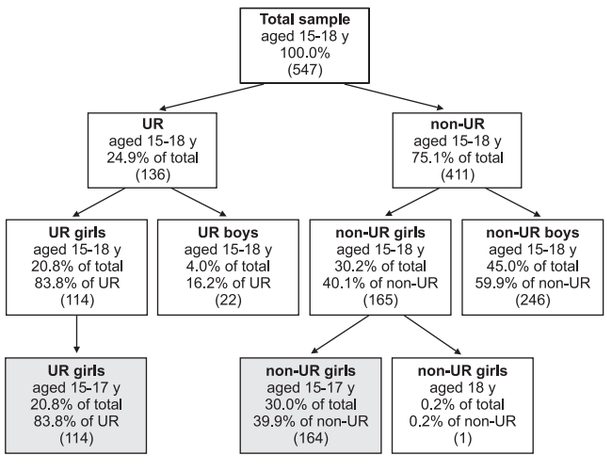

FIGURE 1. Sample selection (number of persons is given in brackets).

TABLE 1. Comparison of daily dietary energy (kcal) in UR and non-UR youth aged 15–18 (mean±standard deviation).

Category	UR+non-UR	UR	non-UR	AD	RD (%)	p-value for T test
Girls	(279)	(114)	(165)			
	1702±689	1143±256	2088±627	-945	-45.2	<0.01
Boys	(268)	(22)	(246)			
	2560±1257	1168±180	2684±1237	-1516	-56.5	<0.01

AD – absolute differences: AD=UR – non-UR; RD – relative differences: RD=(UR – non-UR)×100/non-UR; () number of persons is given in brackets; NS – insignificant differences.

UR than non-UR girls described the economic situation of their family as very good (33.3% *vs*. 14.5%, respectively), and fewer UR girls as satisfactory (14.9% *vs*. 27.9%, respectively).

The total assessment of socioeconomic status expressed by the SES index revealed significant differences between the share of UR and non-UR girls (Table 3). More UR than non-UR girls had an average level of SES index (38.6% *vs*. 26.8%, respectively), and fewer UR girls had a low SES index level (21.1% *vs*. 35.4%, respectively).

Body composition

Differences in body composition and measurements between UR and non-UR were established only in girls aged 15 years (Table 4). In comparison to non-UR girls, UR girls aged 15 had a higher body weight (by 6.6 kg on average), BMI (1.8 kg/m^2), hip circumference (4.0 cm), upper arm muscle circumference (1.9 cm), upper arm muscle area (652.0 mm^2), fat mass (3.9 kg) and fat free mass (2.7 kg). The percentage of fat in the body of UR girls was insignificantly higher than in non-UR girls (by 2.2 % units, p>0.05).

Among girls aged 15 years, an excessive body weight (BMI>2SD) was found for 12.5% UR girls and for none of the non-UR girls, but the difference was not statistically significant (Table 5). Additionally, no differences in the distribution of the percentage of persons with various BMI were found between UR and non-UR girls in any of the age groups.

TABLE 2. Comparison of age distribution of UR and non-UR girls aged 15–18 years.

Category	Percentage of the sample (%)			p-value for chi^2 test
	UR+non-UR	UR	non-UR	
15 years	8.6	7.0	9.7	NS
	(24)	(8)	(16)	
16 years	77.4	77.2	77.6	NS
	(216)	(88)	(128)	
17 years	13.6	15.8	12.1	NS
	(38)	(18)	(20)	
18 years	0.4	0.0	0.6	NS
	(1)	(0)	(1)	
Total 15–18 y	100.0	100.0	100.0	–
	(279)	(114)	(165)	
Age* in the 15–17 y group (years)	16.1±0.43	16.1±0.41	16.1±0.44	NS#

*mean±standard deviation; () number of persons is given in brackets; NS – insignificant differences; #p-value for T test.

DISCUSSION

The authors' own research involving about 550 respondents showed that about 25% of young people underreported their energy intake according to the criterion of Goldberg *et al.* [1991]. This value fits within the range indicated by many authors (10–45%) for respondents of various age [Bailey *et al.,* 2007; Bedard *et al.,* 2004; Okubo & Sasaki, 2004; Olendzki *et al.,* 2008; Pietruszka *et al.* 2000; Subar *et al.,* 2003; Tooze, 2004; Tooze *et al.,* 2004; Yannakoulia *et al.*, 2007]. A similar percentage of energy under-reporters (about 24% of total sample) was presented by Bailey *et al.* [2007] for persons aged between 66 and 87 years. More energy under-reporters (31%) were established by Klesges *et al.* [1995] among adult participants in NHANES II research. In the third edition of this project (NHANES III), the percentage of energy under-reporting respondents aged 20+ was even higher and amounted to about 46% [Briefel *et al.,* 1997]. Bedard *et al.* [2004] found that energy intake was underreported by 43% respondents aged 18–82 years. The above-mentioned studies and the results of own research do not lead to an explicit conclusion specifying how much energy under-reporting is affected by the age of respondents. Energy under-reporting depends on a very large number of various errors [Gibson, 2005; Goldberg *et al.,* 1991; Goris *et al.,* 2000; Gronowska-Senger, 2009; Scagliusi *et al.,* 2003]. It should be presumed that those errors change with the age of respondents, to some extent, and make the number of energy under-reporting respondents fit into a broad range of variability.

Under-reporting of energy intake definitely depends on the sex of the young people. Females are conductive to energy under-reporting. The percentage of girls under-reporting energy intake was five times larger than in the case of boys. A similar dependency was reported by Briefel *et al.* [1997] and Pietruszka *et al.* [2000] among adults, but the proportions between women and men were not as large. Briefel *et al.* [1997] established that 28% women and 18% men, while Pietruszka *et al.* [2000] established that 12% women and 7.5% men under-reported their energy intake. The reasons for energy under-reporting by females include higher attention to their silhouette and being on slimming diets, a disturbed perception of one's own body and dissatisfaction with one's own figure [Briefel *et al.,* 1997; Gibson, 2005; Okubo & Sasaki,

TABLE 3. Comparison of socioeconomic status of UR and non-UR girls aged 15–17 years.

Category	Percentage# of the sample (%)			UR/non-UR	p-value for chi² test
	UR+non-UR (278)	UR (114)	non-UR (164)		
Place of residence size					
country	40.7	36.8	43.3	0.8	NS
town <50,000 inhabitants	1.3	1.8	1.2	1.5	NS
town 50,000–100,000 inhabitants	22.5	28.9	17.7	1.6	<0.05
city >100,000 inhabitants	35.5	32.5	37.8	0.9	NS
Father's education					
primary and vocational	42.7	35.1	47.9	0.7	<0.05
secondary	41.9	46.4	38.8	1.2	NS
higher	9.7	13.2	7.2	1.8	NS
Mother' s education					
primary and vocational	33.7	33.3	33.9	1.0	NS
secondary	48.4	50.0	47.3	1.1	NS
higher	15.1	14.9	15.2	1.0	NS
Family economic situation					
poor	1.1	1.8	0.6	3.0	NS
satisfactory	25.4	14.9	27.9	0.5	<0.05
good	58.4	50.0	55.8	0.9	NS
very good	14.3	33.3	14.5	2.3	<0.001
Main source of father's income					
no income	6.1	4.4	7.3	0.6	NS
benefit	4.0	1.8	5.4	0.3	NS
pension or allowance	9.2	8.8	9.8	0.9	NS
farm	19.0	17.5	20.0	0.9	NS
monthly salary	44.1	46.5	42.4	1.1	NS
own business	11.5	15.7	8.5	1.8	NS
Main source of mother's income					
no income	8.6	7.0	9.7	0.7	NS
benefit	8.6	6.1	10.3	0.6	NS
pension or allowance	9.7	6.1	12.1	0.5	NS
farm	16.8	19.3	15.2	1.3	NS
monthly salary	47.0	51.8	43.6	1.2	NS
own business	6.8	7.9	6.1	1.3	NS
SES index					
low	29.5	21.1	35.4	0.6	<0.05
average	31.6	38.6	26.8	1.4	<0.05
high	29.5	33.3	26.8	1.2	NS

() number of persons is given in brackets; NS – insignificant differences; #the values in the columns do not sum up to 100% – some of the questions were left unanswered by the respondents.

2004; Pietruszka *et al.* 2000; Yannakoulia *et al.,* 2007]. This situation contributes to conscious or subconscious self-presentation of respondents and can account for under-reporting of food intake by girls and women who want to be slimmer. Results that differed from the authors' own research and studies quoted above were obtained by Bedard *et al.* [2004]. Those authors reported a higher percentage of persons under-reporting energy intake among men (54%) than among women (35%), and they considered this surprising result of their research as a complex problem which could depend on errors related to the method, the respondent or to the researcher.

The current authors' research found the influence of three features of the socioeconomic status on the under-reporting of energy intake by girls. These features included the size of the place of residence, level of father's education and economic situation of the family. The differences perceived were recorded for individual categories of SES features. It follows that under-reporting of energy intake by girls was facili-

TABLE 4. Comparison of somatic parameters of UR and non-UR girls aged 15–17 years (mean±standard deviation).

Parameter		UR+non-UR (278)	UR (114)	non-UR (164)	AD	RD (%)	p-value for T test
Height (cm)							
15 y	(24)	167.3±5.72	168.4±6.67	166.8±5.34	1.6	1.0	NS
16 y	(216)	165.4±5.90	165.8±5.28	165.1±6.30	0.7	0.4	NS
17 y	(38)	165.4±6.02	165.8±5.09	165.1±6.86	0.7	0.4	NS
Total 15–17 years	(278)	165.5±5.90	166.0±5.34	165.2±6.26	0.8	0.5	NS
Weight (kg)							
15 y	(24)	56.1±13.70	60.5±22.26	53.9±6.41	6.6	12.2	<0.01
16 y	(216)	57.5±9.17	58.5±9.53	56.8±8.89	1.7	3.0	NS
17 y	(38)	57.9±7.44	57.3±7.99	58.4±7.07	-1.1	-1.9	NS
Total 15–17 years	(278)	57.4±9.39	58.5±10.52	56.7±8.48	1.8	3.2	NS
BMI (kg/m^2)							
15 y	(24)	20.0±4.46	21.2±7.20	19.4±2.27	1.8	9.3	<0.05
16 y	(216)	21.0±2.90	21.3±3.11	20.8±2.75	0.5	2.4	NS
17 y	(38)	21.2±2.57	20.8±2.76	21.4±2.41	-0.6	-2.8	NS
Total 15–17 years	(278)	20.9±3.02	21.2±3.44	20.8±2.69	0.4	1.9	NS
AC (cm)							
15 y	(24)	23.0±4.21	24.8±5.90	22.2±2.93	2.6	11.7	NS
16 y	(216)	23.5±2.45	23.6±2.55	23.5±2.39	0.1	0.4	NS
17 y	(38)	23.7±2.24	23.4±2.15	24.0±2.35	-0.6	-2.5	NS
Total 15–17 years	(278)	23.5±2.61	23.6±2.82	23.4±2.46	0.2	0.9	NS
WC (cm)							
15 y	(24)	65.2±7.19	66.9±11.32	64.3±4.12	2.6	4.0	NS
16 y	(216)	68.9±7.50	69.6±8.06	68.4±7.09	1.2	1.8	NS
17 y	(38)	67.9±7.57	68.6±9.82	67.3±4.96	1.3	1.9	NS
Total 15–17 years	(278)	68.4±7.52	69.3±8.54	67.9±6.69	1.4	2.1	NS
HC (cm)							
15 y	(24)	89.9±7.82	92.6±11.43	88.6±5.20	4.0	4.5	<0.01
16 y	(216)	91.7±7.41	92.5±7.26	91.1±7.49	1.4	1.5	NS
17 y	(38)	90.2±5.95	90.9±4.85	89.5±6.86	1.4	1.6	NS
Total 15–17 years	(278)	91.3±7.26	92.2±7.25	90.7±7.22	1.5	1.7	NS
TSF (mm)							
15 y	(24)	12.8±6.90	14.2±9.19	12.1±5.64	2.1	17.4	NS
16 y	(216)	12.2±4.29	12.0±4.23	12.4±4.34	-0.4	-3.2	NS
17 y	(38)	14.5±4.70	15.0±5.17	14.0±4.32	1.0	7.1	NS
Total 15–17 years	(278)	12.6±4.66	12.6±4.94	12.5±4.47	0.1	0.8	NS
BSF (mm)							
15 y	(24)	10.9±7.18	12.5±10.20	10.0±5.32	2.5	25.0	NS
16 y	(216)	9.5±5.05	9.3±4.61	9.7±5.35	-0.4	-4.1	NS
17 y	(38)	11.4±5.05	10.3±4.46	12.4±5.46	-2.1	-16.9	NS
Total 15–17 years	(278)	9.9±5.28	9.7±5.16	10.0±5.38	-0.3	-3.0	NS
SCSF (mm)							
15 y	(24)	14.0±10.93	17.2±18.00	12.3±4.86	4.9	39.8	NS
16 y	(216)	13.2±5.83	13.5±6.12	13.0±5.64	0.5	3.8	NS
17 y	(38)	14.9±6.69	15.2±7.09	14.6±6.49	0.6	4.1	NS
Total 15–17 years	(278)	13.5±6.52	14.0±7.59	13.2±5.67	0.8	6.1	NS

Continued on the next page

TABLE 4. Continued

Parameter		UR+non-UR (278)	UR (114)	non-UR (164)	AD	RD (%)	p-value for T test
SISF (mm)							
15 y	(24)	12.4±7.84	14.6±12.71	11.2±3.86	3.4	30.4	NS
16 y	(216)	13.8±5.52	13.6±5.51	13.9±5.55	-0.3	-2.2	NS
17 y	(38)	14.6±5.27	15.3±5.30	14.0±5.29	1.3	9.3	NS
Total 15–17 years	(278)	13.8±5.73	13.9±6.17	13.7±5.42	0.2	1.5	NS
AMC (cm)							
15 y	(24)	19.0±2.31	20.3±3.25	18.4±1.40	1.9	10.3	<0.05
16 y	(216)	19.7±1.95	19.8±2.15	19.6±1.81	0.2	1.0	NS
17 y	(38)	19.2±1.67	18.7±1.48	19.6±1.77	-0.9	-4.6	NS
Total 15–17 years	(278)	19.5±1.95	19.7±2.17	19.4±1.79	0.3	1.5	NS
AA (mm^2)							
15 y	(24)	4355±1808.4	5119±2740.0	3973±1021.4	4.7	0.1	NS
16 y	(216)	4447±947.0	4478±968.7	4426±935.0	52.0	1.2	NS
17 y	(38)	4515±858.0	4411±820.8	4609±900.7	-198.0	-4.3	NS
Total 15–17 years	(278)	4448±1031.3	4512±1147.8	4403±943.6	109.0	2.5	NS
AMA (mm^2)							
15 y	(24)	2918±770.7	3352±1136.1	2700±397.0	652.0	24.1	<0.05
16 y	(216)	3109±619.6	3159±678.2	3075±576.1	84.0	2.7	NS
17 y	(38)	2947±507.1	2811±435.7	3069±545.7	-258.0	-8.4	NS
Total 15–17 years	(278)	3070±621.0	3117±694.9	3037±564.2	80.0	2.6	NS
AFTA (mm^2)							
15 y	(24)	1437±1099.2	1768±1657.3	1272±695.5	496.0	39.0	NS
16 y	(216)	1338±549.9	1319±538.6	1351±559.2	-32.0	-2.4	NS
17 y	(38)	1568±573.7	1600±624.8	1540±538.3	60.0	3.9	NS
Total 15–17 years	(278)	1378±619.8	1395±687.9	1366±569.9	29.0	2.1	NS
FM (kg)							
15 y	(24)	14.5±7.80	17.1±12.29	13.2±4.20	3.9	29.5	<0.05
16 y	(216)	16.7±5.87	17.0±6.25	16.6±5.61	0.4	2.4	NS
17 y	(38)	16.4±5.14	16.4±5.16	16.4±5.25	0.0	0.0	NS
Total 15–17 years	(278)	16.5±5.96	16.9±6.60	16.2±5.49	0.7	4.3	NS
%FM (%)							
15 y	(24)	24.2±7.12	25.7±8.45	23.5±6.53	2.2	9.4	NS
16 y	(216)	28.3±5.43	28.0±6.10	28.4±4.94	-0.4	-1.4	NS
17 y	(38)	27.9±6.23	28.1±5.43	27.7±7.01	0.4	1.4	NS
Total 15–17 years	(278)	27.9±5.79	27.8±6.15	27.9±5.54	-0.1	-0.4	NS
FFM (kg)							
15 y	(24)	41.6±6.25	43.4±10.07	40.7±3.16	2.7	6.6	<0.05
16 y	(216)	40.9±4.50	41.7±4.44	40.3±4.48	1.4	3.5	NS
17 y	(38)	41.5±4.55	40.9±4.19	42.0±4.90	-1.1	-2.6	NS
Total 15–17 years	(278)	41.0±4.66	41.7±4.94	40.6±4.42	1.1	2.7	NS

AD – absolute differences: AD=UR – non-UR; RD – relative differences: RD=(UR – non-UR)×100/non-UR; AC – arm circumference; WC – waist circumference; HC – hip circumference; TSF – triceps skinfold thickness; BSF – biceps skinfold thickness; SCSF – subscapular skinfold thickness; SISF – suprailiac skinfold thickness; AMC – upper arm muscle circumference; AA – upper arm area; AMA – upper arm muscle area; AFTA – upper arm fat tissue area; FM – fat mass; FFM – fat free mass; %FM – percentage of fat mass; () number of persons is given in brackets; NS – insignificant differences.

tated by the fact of living in larger, urbanised areas, a higher level of father's education and a better economic situation of the family. A thorough analysis of the results supports a conclusion which, to a large extent, applies more to the girls who are non-energy under-reporters than to energy under-reporters. Non-under-reporting of energy intake by girls was

TABLE 5. Comparison of BMI distribution of UR and non-UR girls aged 15–18 years.

BMI categories	Percentage of the sample, %			UR/non-UR	p-value for chi² test
	UR+non-UR	UR	non-UR		
15 years	(24)	(8)	(16)		
<-2 SD	8.3	12.5	6.2	2.0	NS
-2÷2 SD	87.5	75.0	93.8	0.8	NS
>2 SD	4.2	12.5	0.0	0.0	NS
16 years	(216)	(88)	(128)		
<-2 SD	0.0	0.0	0.0	0.0	NS
-2÷2 SD	93.1	92.0	93.8	1.0	NS
>2 SD	6.9	8.0	6.2	1.3	NS
17 years	(38)	(18)	(20)		
<-2 SD	0.0	0.0	0.0	0.0	NS
-2÷2 SD	100.0	100.0	100.0	1.0	NS
>2 SD	0.0	0.0	0.0	0.0	NS
Total 15–17 years	(278)	(114)	(164)		
<-2 SD	0.8	0.9	0.6	1.5	NS
-2÷2 SD	93.5	92.1	94.6	1.0	NS
>2 SD	5.7	7.0	4.8	1.5	NS

() number of persons is given in brackets; NS – insignificant differences.

favoured by living in the country, a low level of father's education and a worse economic situation of the family.

A total assessment of the socioeconomic status expressed by SES index confirmed those observations. Non-under-reporting of energy intake by girls was favoured by the lowest level of SES index while under-reporting of energy intake by girls was favoured by an average level of SES index. Among girls with a higher SES index, a difference between non-energy under-reporting and energy under-reporting girls was not statistically significant and its character was that of a tendency. The highest level of SES index was conductive to under-reporting of energy intake by girls. Different results were obtained by Bailey *et al.* [2007], Bedard *et al.* [2004], Olendzki *et al.* [2008], Pietruszka *et al.* [2000] and Scagliusi *et al.* [2003]. Those researchers claimed that under-reporting of energy intake was associated with older age, a lower level of education, physical work, low income or lack of income, having children at school age, living in the country or a small town and poor health. Those conclusions concerned mainly adult respondents and their socioeconomic status. In the current authors' own research, most SES criteria were directly related to their parents and family (*e.g.* parents' education, economic situation of the family), specifying conditions of social environment of the youth. The SES criteria assumed did not describe personal predispositions of youth, such as their intellectual level or general and specialist knowledge concerning food and nutrition. It could be assumed that young people living in the country knew the range of food products better, which contributed to better quality and quantity specification of food and dishes intake. Such assumptions are strengthened by observations carried out by Gawęcki and his team [Gawęcki *et al.*, 2002]. Those researchers showed the increased reliability of the 24-h interview for students with better knowledge in the field of nutrition. The results suggest that in the case of young people, the reliability of a nutritional interview can be more dependent on their individual features than on the features of the social environment of their families.

Comparison of body measurements and composition for UR girls and non-UR girls provides interesting data. UR girls aged 15 had a significantly higher body weight (by 6.6 kg) as compared to those who properly assessed their energy intake. This was affected by their higher mean BMI and depended on a higher mean content of muscle and fat tissue. UR girls at the age of 15, in comparison to non-UR ones, tended to reveal a higher percentage share of fat in their body. This indicates that body composition in UR girls can be generally assessed as good, but without clearly increased body fat. This is confirmed by the lack of differences in the occurrence of excessive body weight (BMI>2SD) between UR and non-UR girls. Nevertheless, girls could perceive their figure as obese or with an excessive body weight [Woynarowska & Mazur, 1999]. Tabak *et al.* [2007] found that over 30% of Polish girls aged 13–15 years with proper body weight indicated a figure with body weight deficiency as the desired figure. The conviction of being too fat was held by 50% of girls aged 15 years, and almost 80% girls at that age wanted to introduce some changes in their appearance [Woynarowska & Mazur, 1999]. A negative self-assessment of their figure by the girls could confirm their belief that they require a slimming diet. Such an attitude could affect under-reporting of their food intake [Briefel *et al.,* 1997; Okubo & Sasaki, 2004].

These results are consistent with the majority of reports. They show that under-reporting of energy intake is frequently accompanied by an increased body mass index, regardless of sex [Bailey *et al.,* 2007; Bedard *et al.,* 2004; Johansson *et al.,* 2001; Klesges *et al.,* 1995; Olendzki *et al.,* 2008; Tooze *et al.,* 2004; Yannakoulia *et al.*, 2007]. A novelty of the current research is the claim that a higher body weight of 15-year-old girls under-reporting energy intake depended on their increased mass of fat and muscle tissue. This may suggest that every increase in body weight, regardless of its reason, can favour under-reporting of energy intake by girls aged 15 years.

It still remains to be established why the differences noted in body measurements and composition concerned only the youngest age group – girls aged 15. The lack of differences in somatic parameters in older UR and non-UR girls could partially result from a higher number of older age groups, particularly girls aged 16 (more than 200 persons), which could result in better representation of this age group. It appears that the differences observed in the somatic parameters between UR and non-UR girls aged 15 were very high (*e.g.* 6.6 kg for body weight), which rather excludes a coincidental occurrence of the result related to a relatively small size of this group (24 persons). However, unbalanced numbers of age groups of girls should be considered as a limitation of this study. The problem introduced here requires to be clarified in further research.

CONCLUSIONS

It was shown that in young people aged between 15 and 18 years, under-reporting of energy taken in with food was related to their sex and socioeconomic status, and in girls aged 15 – to their body weight and composition. Under-reporting of en-

ergy intake was definitely favoured by the female sex and to a lower extent, by a higher socioeconomic status. The group of under-reporting girls was 5 times larger than the group of under-reporting boys. Proper energy reporting by girls was favoured by the lowest level of socioeconomic status, which was related to the fact of living in the country, a low level of father's education and a worse economic situation of the family.

In girls aged 15 years, under-reporting of energy intake was related to higher body weight, resulting from a higher amount of fat and muscle tissue. This suggests that regardless of the cause, each increase in body weight can favour under-reporting of energy intake by girls. The results indicate that in the case of young people, the reliability of the nutritional interview can be more dependent on their individual features than on the features of the social environment of their family.

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