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BODY COMPOSITION OF MOTHER-DAUGHTER FAMILY PAIRS IN RELATION TO DAIRY PRODUCTS AND CALCIUM INTAKE

Kamila Pabjan[1], Lidia Wądołowska[2], Małgorzata Anna Słowińska[2], Magdalena Czlapka-Matyasik[3], Ewa Niedźwiedzka[2]

[1]Faculty of Physical Education and Tourism, Sain Cross University of Kielce, Kielce, Poland; [2]Department of Human Nutrition, University of Warmia and Mazury, Olsztyn, Poland; [3]Department of Human Nutrition and Hygiene, Poznan University of Life Sciences, Poznań, Poland

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We analysed the body composition of mother-daughter family pairs in relation to calcium and dairy products intake. The study covered 277 mother-daughter family pairs, aged 43.7±5.5 and 17.1±2.3 years, respectively. Dairy products (g/person/day) and usual calcium intake from dairy products and from daily diets (DD) were assessed with the food intake frequency method, using the validated ADOS-Ca questionnaire. Respondents' body composition was evaluated with anthropometric methods. The mother-daughter family pairs were divided into three subgroups (T1, T2, T3) according to tercile ranges of calcium intake from dairy products by mothers (T1: <245.7 mg/day; T2: 245.7÷569.2 mg/day; T3>569.2 mg/day). The T1 daughters consumed significantly less calcium from the DD than the T3 daughters (on average 820 and 1160 mg/day, respectively). The T1 mothers in comparison to the T3 mothers had significantly higher fat content in the body (on average by 3.7 kg), as well as waist (3.6 cm) and hips circumference (2.8 cm), they had more often the waist circumference ≥88cm (38.0% and 19.8% of the sample, respectively) and very high health loss risk resulting from big waist circumference and high BMI (27.2% and 10.4%, respectively). The T2 daughters in comparison to the T3 daughters had significantly greater suprailiac skinfold thickness (on average by 1.7 mm), hips circumference (3.1 cm) and fat content in the body (1.3%). Lower percentage of the T1 than T3 girls had the arm area >2SD (2.2% and 10.4%, respectively) and the arm muscle area >2SD (5.4% and 14.6%, respectively). Summarizing, a higher dairy products and calcium intake by mothers was favourable to a greater consumption of those products by daughters and, as a result, of a lower fat tissue content in women and to some extent in girls.

INTRODUCTION

The influence of family environment on children's nutrition is more dependant on mothers than fathers roles and attitudes. Feunekes *et al*. [1998] showed a significant correlation in food consumption for 76% of products in father-child family pairs and for 87% of products in mother-child family pairs among the 15-year-old Dutch youth. Promotion of health-promoting nutritional behaviours in families may influence children's nutritional status [Guidetti & Carvazza, 2008; Jeżewska-Zychowicz, 2004a]. Women are more sensitive to environmental impulses, thus mothers' positive attitudes towards health may influence more beneficial nutrition of daughters, and in consequence their better health status [Mosca *et al*., 2006]. In addition, the occurrence of nutrition disorders in mothers, such as overweight or obesity, may make them introduce some assortment and quantity modifications in food intake and indirectly determine their children's nutrition. The previous studies of our team showed a relation between the amount of food consumed by mothers and daughters and their relative body mass [Wądołowska *et al*., 2007].

The body mass and content examinations are basic parameters for evaluating fat tissue content and identifying such disorders as obesity and undernutrition [Gibson, 2005]. Improper body mass and size may also be valuable indicators of more complicated diseases such as the metabolic syndrome [Third Report… 2001]. Lemiux *et al.* [2004] proved that increased waist circumference was strongly connected to the BMI and was a good predictor of the occurrence of metabolic disorders. Untill recently the metabolic syndrome was considered as a disorder occurring mainly in adults [Third Report… 2001]. Constantly increasing prevalence of obesity has become a cause of intense studies on the occurrence of the early metabolic syndrome in young age and its health consequences in adult life [Chen *et al.,* 2005; Crespo *et al*., 2007]. In the NHANES III study, the metabolic syndrome was found in about 30% of obese teenagers, about 6% of youth with overweight and 0.1% of youth with proper body mass (BMI<85th centile) [Cook *et al.,* 2003]. The cited works show that overweight or obesity prevention may also be effective in preventing metabolic disorders and diminishing health risks both in young and adult age.

Despite the fact that energy balance is the most important factor in body mass regulation, research results suggest that a significant role in this process may also be played by calcium metabolism [Parikh & Yankowski, 2003; Zemel, 2003].

Author's address for correspondence: Kamila Pabjan, Faculty of Physical Education and Tourism, Sain Cross University of Kielce, ul. E. Orzeszkowej 15, 25-435 Kielce, Poland; tel.: 692 412 069; e-mail: kamila.pabjan@wp.pl

In recent years a number of studies have been published regarding the influence of calcium on overweight or obesity risk decrease [Mélanie *at el*., 2003; Schrager, 2005; Zemel *et al.,* 2004]. Moreover many studies indicate the fact that proper calcium intake is of significance to hypertension, type 2 diabetes and tumours prevention and treatment [Chen *et al.,* 2005; Zemel, 2003]. A high calcium level in a diet may decrease body mass gains and fat accumulation in adipocytes by stimulating lipolysis [Zemel, 2003]. It was observed that after a year the increased calcium intake (in yoghurt form) was accompanied by fat tissue mass decrease by about 5 kg [Zemel *et al.,* 2000]. Another explanation of the increased fat content in the case of a decreased calcium intake is suppressed formation of a calcium-fatty acids complex in intestines [Parikh & Yankowski, 2003]. An important role in decreasing metabolic disorders risk may be played by a DASH diet, recommended by the National Institutes of Health [Sachs *et al.,* 2001]. It is rich in vegetables, fruit, low-fat dairy products, whole grains, poultry, fish, nuts and contains less than 6 g of salt per day and less than 7% of energy from saturated fatty acids. A significant feature of the DASH diet is an increased content of low-fat dairy products. The DASH diet was proved to positively influence a decrease in the occurrence of *i.a*. overweight and obesity, hypertension, high LDL cholesterol level in blood and other metabolic disorders. However, the beneficial for health influence of the dairy products of the DASH diet can hardly be separated from the influence of its other components.

The review of available literature indicates that the relations between dairy products and calcium intake and the body composition and functions have not yet been understood enough. Another issue is explaining the influence of family environment and mothers' role in dairy products and calcium intake by their daughters and the connections between dairy products intake and body composition. The aim of the work was to analyse the body composition of mother-daughter family pairs in relation to calcium and dairy products consumption by mothers.

MATERIAL AND METHODS

Study sample

The study covered 277 mother-daughter family pairs, aged 43.7±5.5 years (from 32 to 57) and 17.1±2.3 years (from 12 to 21), respectively. Recruitment was carried out among inhabitants of villages and towns of the Central, Eastern and Northern Poland (Kielce, Olsztyn, Ostrowiec Świętokrzyski, Tomaszów Mazowiecki, Łomża areas). The studied sample was chosen in a snowball method. Respondents who took part in the studies were later recommending their acquaintances meeting the sample choice requirements. During recruitment we used advertising in local press or announcements in schools, surgeries and information points in towns and also own contacts of interviewers, *i.e*. during Świętokorzyskie Prevention Days. A condition for taking part in the examination was the age of mothers: up to 60 years old, and daughters from 12 years (finished) to 21 years old (before the 21st birthday) and a lack of nutrition disorders in women/girls, not being a professional sportswoman, no diseases, no surgeries in the past, taking no medicaments influencing the hormonal balance, metabolism or bones metabolism of respondents.

Most mother-daughter family pairs lived in villages (59% of the sample; Table 1). Almost 70% of women had secondary education, and over 80% of daughters were at the moment attending a secondary school. Economic situation of family over average was declared by 78% of the sample. About 87% of mothers and daughters were eating as usually, applying no modifications in their diets, and 8% were on a slimming diet at the moment. Over 60% of mothers and over 90% of girls declared good or very good health status.

All nutrition interviews and anthropometric measurements were carried our by well-trained interviewers.

Dairy products and calcium intake assessment

Dairy products intake was determined by the food intake frequency method using the validated ADOS-Ca questionnaire [Szymelfejnik *et al.,* 2006]. On the basis of the questionnaire, we gathered information on the habitual frequency and portion size of usually eaten 11 groups of dairy products: hard cheese, fresh cheese, processed cheese, natural and fruit yoghurt, milk, buttermilk/kefir, cream, ice-cream in and out of season, homogenized cheese, cheese for spreading. Eight categories of products intake frequency were calculated into an average intake frequency (times/day), using the intake fre-

TABLE 1. Sample characteristics.

Variables	Sample percentage (%)	
	Mothers	Daughters
Sample size	277	277
Age* (years)	43.7±5.5	17.1±2.3
Education level		
Primary	12	2
Secondary	69	81
High	20	17
Size of place of residence		
Country	59	
Town < 50,000 residents	8	
Town 50,000÷100,000 residents	31	
City >100,000 residents	2	
Self-declared family economic situation		
Under average	78	
Average	22	
Over average	1	
Type of diet		
Usually diet without modification	87	88
Dieting (nutritional restriction against obesity)	8	8
Self-declared health condition		
Very good	3	28
Good	59	62
Quite good	37	9
Bad	1	1

*expressed as mean and standard deviation.

quency indices agreed during the questionnaire validation [Szymelfejnik *et al.,* 2006], (Table 2). The mean intake of dairy products (g/person/day) was calculated from the mean portion size and mean intake frequency. Next, using the nutritive values tables [Kunachowicz *et al.,* 2006], we calculated a mean calcium intake from separate dairy products and dairy products in total (mg/person/day). Calcium amount in a daily diet (DD) was calculated on the basis of the mean calcium intake from dairy products and regression equation determined during the ADOS-Ca questionnaire validation with the assumption that dairy products are a source of 74% of calcium in a daily diet [Szymelfejnik *et al.,* 2006].

An individual risk of the insufficient intake of calcium from DD was evaluated for each person [Jarosz & Bułhak-Jachymczyk, 2008]. Calculations were made for the z-values of an individual calcium intake (D/SD_D) in respect of the adequate intake (AI) of calcium. The persons with $D/SD_D<-1$ were interpreted as the individuals with insufficient calcium intake. A population risk of an inadequate calcium intake from DD was estimated by determining the percentage of women with calcium intake below the adequate intake (AI).

Body composition assessment

Respondents' body composition was evaluated by anthropometric methods. The following measurements were taken: body mass (kg), height (cm), thickness of four skinfolds (mm): biceps (BSF), triceps (TSF), subscapular (SCSF), suprailiac (SISF), upper arm circumference (AC, cm), waist circumference (WC, cm) and hip circumference (HC, cm) [Gibson, 2005]. Next we calculated somatic indices: body mass index (BMI, kg/m^2), waist-hip ratio (WHR), 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), upper arm muscle index (AMI,%) and upper arm fat index (AFI,%), [Gibson, 2005]. By means of the spectrophotometric method, using the FUTREX 6100 apparatus, we determined fat-free body mass (FFM, kg) and fat tissue *i.e*. body fat mass (FM, kg) and body fat mass percentage (%FM,%).

In girls' body composition evaluation we used growth standards for Warsaw youth [Palczewska & Niedźwiecka, 2001]. The percentage of girls with low (<10 centile) or high (>90 centile) values of somatic parameters showing an undernutrition or overnutrition, overweight/obesity risk was determined. Moreover we calculated the standard deviation indices (Z-score) of these somatic parameters that had developed growth standards for youth [Palczewska & Niedźwiecka, 2001]. The percentage of girls with low (Z-score<–2SD) or high (Z-score>2SD) values of somatic parameters were calculated [Gibson, 2005]. Additionally, we calculated the percentage of girls with undernutrition, overweight or obesity after recalculating the BMI of girls by the international BMI youth standards, that were corresponding to the adults BMI standards amounting to 18.5, 25 and 30 kg/m^2, respectively [Cole *et al.,* 2000, 2007].

TABLE 2. Dairy products intake frequency indices.

Intake frequency	Intake frequency index
Never	0
More seldom than once a week	1/30
Once-twice a week	1/7
3-4 times a week	3/7
5-6 times a week	5/7
Once daily	1
Twice daily	2
3 times daily	3

In the evaluation of women's body composition for the body mass index the WHO criteria [Gibson, 2005] were used and the percentage of women with undernutrition (BMI<18.5 kg/m^2), overweight (BMI≥25 kg/m^2) or obesity (BMI≥30 kg/m^2) was calculated. Moreover obesity occurrence in women was assessed using the criteria developed for: (i) fat percentage in the body (obesity: %FM>30%) and (ii) waist circumference (increased obesity risk: WC≥80 cm; obesity: WC≥88 cm) according to the National Cholesterol Education Program Adult Treatment Panel III [Third Report…, 2001]. In the triceps skinfold thickness (TSF), arm muscles circumference (AMC), arm muscles area (AMA) interpretations we agreed for criteria given by Szczygieł *et al.* [1994] and we calculated the percentage of women with low (<10 centile) or high (>90 centile) values of these indices. Risk for health was evaluated on the basis of waist circumference (WC) and the body mass index (BMI) according to the criteria of the Canadian Guidelines for Body Weight Classification in Adult [Lemiux *et al.,* 2004]:

- Risk increase: WC<88 cm and BMI=25-29.9 kg/m^2 or WC≥88 cm and BMI=18.5-24.9 kg/m^2,
- High risk: WC<88 and BMI=30-34.9 kg/m^2 or WC≥ 88 and BMI=25-29.9 kg/m^2,
- Very high risk: WC≥88 cm and BMI≥30 kg/m^2.

Statistical analysis

All values were expressed by the mean ($\bar{x}$), and their variance by standard deviation (SD). Among girls no age subgroups were separated. Potential differences in somatic parameters connected to girls' age and resultant potential errors in interpretations were corrected by using centiles divisions and the Z-score indices calculation [Gibson, 2005].

The mother-daughter family pairs were divided into 3 subgroups (T1, T2, T3) according to tercile ranges of calcium intake from dairy products by mothers (T1: <245.7 mg/day; T2: 245.7÷569.2 mg/day; T3>569.2 mg/day).

The mean dairy products and calcium intake and the mean values of somatic parameters of women/girls in terciles groups were compared by the single-factor variance analysis (ANOVA, comparison: T1-T2-T3). Moreover we compared the tercile groups in pairs (T1-T2, T2-T3 and T1-T3). Connections between the mean values in consecutive terciles were analysed using the linear regression (the trend evaluation). Due to differences in girls' age, a comparison of the mean values of girls somatic parameters in tercile groups was treated as supplementary to results using. Somatic parameters distributions were compared with the chi^2 test. To compare the percentage of respondents in pairs we used the test for structure indices. The statistical analysis was made in the Statistica PL v. 8.0 computer software.

RESULTS

Dairy products and calcium intake

We confirmed significantly higher calcium amount in daily diets of the T3 mothers in comparison to the T2 and T1 mothers (Table 3). The mean calcium intake by women amounted to 1329 mg/day, 513 mg/day and 196 mg/day, respectively. For daughters the differences in calcium intake were found between the extreme tercile groups. The mean calcium intake by the T3 daughters was higher than for the T1 daughters and amounted to 1160 mg/day and 820 mg/day. Parallel relations between the tercile groups of mothers or daughters were related to calcium intake from dairy products in total (Table 3). Between mothers from extreme tercile groups we found significant differences in the occurrence of the percentage of respondents with a low calcium intake (<AI), showing calcium deficiencies risk. Population risk of inadequate calcium intake (<AI) was found in 100% of T1 and T2 mothers and 43% of T3 mothers (Table 3). Individual risk of insufficient calcium intake ($D/SD_D<-1$) concerned most often the T1 mothers (89% of the sample). No T3 mothers were found at individual risk of insufficient calcium intake. The T1, T2 and T3 girls had no differences in population (67-79% of the sample) or individual (13-21% of the sample) risk of the insufficient calcium intake.

A higher calcium intake in the diet of the T3 than the T1 women was caused by greater consumption of hard cheese (on average by 13.9 g/day), processed cheese (by 14.7 g/day), ice-cream consumed in season (by 9.7 g/day), milk drank as beverages (by 83.4 g/day), milk soups (by 90.4 g/day), buttermilk/kefir (by 91.3 g/day) and homogenized cheese (by 26.9 g/day) and cheese for spreading (by 12.9 g/day; Table 4). In diets of the T3 women all products, apart from cream, supplied significantly higher amounts of calcium in comparison to diets of the T1 women (Table 5). Moreover women in consecutive tercile groups were stated to have a linear increase (p of trend <0.05) in calcium intake from hard cheese, ice-cream consumed in season and ice-cream in total.

Daughters were stated to have few differences in dairy products intake (Table 4). The T2 daughters in comparison to the T1 daughters consumed more fruit yoghurt (on average by 46.5 g/day) and milk soup (by 61.8 g/day). The T3 daughters in comparison to the T1 daughters consumed more calcium from fruit yoghurt (on average by about 54%), total milk (by about 32%) and homogenized cheese (by about 43%; Table 5). For daughters from the consecutive tercile groups we noted a linear increase in calcium intake from homogenized cheese. Moreover for the T3 daughters in comparison to the T2 daughters we noted a significantly lower cream intake (3.9 g and 6.7 g, respectively) and a lower calcium intake from this product (1 mg and 3 mg, respectively; Tables 4 and 5).

Body composition

Dairy products and calcium intake increase in women was connected with a significant decrease of fat content in the body (the mean difference T3 *vs.* T1: 3.7 kg), waist (3.6 cm) and hips circumference (2.8 cm; Table 6). Moreover mothers from consecutive tercile groups we found with a linear trend decrease (p of the trend <0.05) of suprailiac skinfold thickness and the upper arm muscle area, but with no changes in fat-free body mass and upper arm muscle circumference. Overweight according to the BMI criterion (≥ 25 kg/m²) was found for a significantly higher percentage of the T1 mothers than the T2 mothers (about 62% and

TABLE 3. Comparison of calcium intake from total dairy products and daily diets (DD) by mothers or daughters in relation to calcium intake by mothers (mean ± standard deviation).

Category	Total N=277	Terciles of calcium intake by mothers			p for ANOVA	p for trend
		T1 N=92	T2 N=89	T3 N=96		
Mothers						
Age (years)	43.6±5.5	43.7±5.8	43.9±5.2	43.4±5.5	NS	NS
Ca from dairy products in total	511±462	145±65[a,b]	380±95[a,c]	983±486[b,c]	<0.001	NS
(mg/person/day)	(456; 565)	(132; 159)	(360; 400)	(885; 1082)		
Ca from DD	691±624	196±88[a,b]	513±128[a,c]	1329±656[b,c]	<0.001	NS
(mg/person/day)	(617; 764)	(178; 215)	(486; 540)	(1196; 1462)		
Percentage of women with Ca intake <AI (% of the sample)	80	100[a]	100[b]	43[a,b]	<0.001*	NS
Insufficient Ca intake (D/SD_D<-1; % of the sample)	32	89[a,c]	8[a,b]	0[b,c]	<0.001*	NS
Daughters						
Age (years)	17.1±2.3	17.1±2.4	17.0±2.1	17.1±2.5	NS	NS
Ca from dairy products in total	721±644	607±588[a]	690±559	858±744[a]	<0.05	NS
(mg/person/day)	(645; 797)	(485; 729)	(572; 807)	(708; 1009)		
Ca from DD	974±871	820±795[a]	932±755	1160±1005[a]	NS	NS
(mg/person/day)	(871; 1077)	(656; 985)	(773; 1091)	(956; 1364)		
Percentage of girls with Ca intake <AI (% of the sample)	75	79	79	67	NS*	NS
Insufficient Ca intake (D/SD_D<-1; % of the sample)	17	17	21	13	NS*	NS

AI – adequate intake of calcium, D/SDD – z-values of an individual intake of calcium, a-a, b-b, c-c – differences statistically significant between tercile groups, () – mean confidence level, * – p for chi² test.

TABLE 4. Comparison of dairy products intake by mothers and daughters in relation to calcium intake by mothers (mean ± standard deviation; g/person/day).

Dairy products	Total N=277	Terciles of calcium intake by mothers			p for ANOVA	p for trend
		T1 N=92	T2 N=89	T3 N=96		
Mothers						
Hard cheese	44.1±23.8	36.5±22.9[a,b]	45.2±22.7[a]	50.4±23.9[b]	<0.001	<0.1
Processed cheese	42.6±37.7	35.8±31.4[b]	41.1±37.1	50.5±36.9[b]	<0.05	<0.1
Fresh cheese	99.8±61.3	98.4±58.6	95.5±55.7	105.2±68.9	NS	NS
Homogenized cheese	92.3±71.3	77.4±65.0[b]	94.8±68.3	104.3±77.6[b]	<0.05	NS
Natural yoghurt	116.2±106.7	105.6±112.6	104.5±69.1[c]	137.1±125.9[c]	NS	NS
Fruit yoghurt	176.7±108.6	187.5±123.9	163.5±82.0	178.5±114.2	NS	NS
Buttermilk, kefir	127.6±120.3	83.7±97.0[a,b]	121.9±104.7[a,c]	175.0±136.7[b,c]	<0.001	<0.1
Milk in beverages	210.1±115.6	173.4±121.9[b]	197.8±79.7[c]	256.8±122.6[b,c]	<0.001	NS
Milk soup	292.8±197.3	255.4±200.2[b]	274.2±189.2[c]	345.8±192.4[b,c]	<0.05	NS
Ice-creams in season	52.3±20.8	48.1±19.7[b]	50.6±20.3[c]	57.8±21.2[b,c]	<0.05	NS
Ice-creams out of season	11.5±22.6	10.1±22.9	10.7±21.6	13.5±23.2	NS	NS
Cream	6.4±6.4	6.8±6.4	6.4±6.9	6.2±6.1	NS	NS
Cheese for spreading	35.0±39.4	28.0±32.0[b]	35.7±35.9	40.9±47.5[b]	NS	<0.1
Daughters						
Hard cheese	42.5±27.0	38.9±23.6	46.1±31.7	42.7±25.1	NS	NS
Processed cheese	41.8±35.9	42.4±37.8	38.5±32.0	44.3±37.7	NS	NS
Fresh cheese	76.5±59.8	71.2±57.0	85.4±63.2	73.4±58.9	NS	NS
Homogenized cheese	118.5±58.4	113.7±54.0	128.5±49.6	113.7±68.5	NS	NS
Natural yoghurt	96.7±90.9	95.4±82.2	93.5±96.1	100.8±94.6	NS	NS
Fruit yoghurt	206.2±125.5	179.3±94.8[a]	225.8±123.6[a]	213.7±147.9	<0.05	NS
Buttermilk, kefir	121.1±101.7	116.3±93.2	124.2±100.3	122.9±11.2	NS	NS
Milk in beverages	209.6±118.6	199.5±86.9	228.1±155.0	202.1±104.4	NS	NS
Milk soup	238.3±207.9	198.9±198.6[a]	260.7±211.4[a]	255.2±210.2	NS	NS
Ice-creams in season	62.0±20.0	60.9±20.7	60.7±19.2	64.3±20.1	NS	NS
Ice-creams out of season	20.1±24.3	20.1±24.4	21.3±23.4	19.0±25.3	NS	NS
Cream	5.0±6.4	4.5±5.9	6.7±7.9[b]	3.9±5.0[b]	<0.05	NS
Cheese for spreading	30.2±33.6	32.6±34.1	30.7±31.7	27.5±35.0	NS	<0.1

a-a, b-b, c-c – differences statistically significant between tercile groups

44% of the sample, respectively; Table 7). An increased risk of obesity resulting from big waist circumference (≥80 cm) was found more often in the T1 mothers than the T3 mothers (about 62% and about 44%, respectively). Obesity, recognized as the waist circumference ≥88 cm, occurred almost twice more often in the T1 mothers than in the T3 mothers (38.0% and 19.8% of the sample, respectively). The T1, T2 and T3 mothers were stated to have a linear decrease in the percentage of women with obesity, represented by the fat content in the body (>30%), 17.4%, 15.7% and 13.5%, respectively (p of the trend <0.05). A very high risk of health loss resulting from big waist circumference and high BMI was stated over 2.5 times more often for the T1 women than the T3 women (27.2% and 10.4%, respectively). Moreover, the T1 women had higher body mass, the BMI and body fat percentage than the T2 and T3 women, in spite of the fact that the differences where not confirmed statistically.

The T2 daughters in comparison to the T3 has significantly bigger suprailiac skinfold thickness (the mean difference T2 *vs.* T3: 1.7 mm), hips circumference (3.1 cm) and body fat content (1.3%; Table 6). Moreover, the T2 daughters had higher mean body mass, the BMI, waist circumference, hips circumference, upper arm fat content and body fat mass than the T3 daughters; however the differences were not proved statistically (Table 6). The T2 daughters' percentage with the upper arm circumference ≥90 centile and the upper arm area ≥90 centile was higher than in the T1 daughters (15.7% *vs.* 5.4% and 20.2% *vs.* 8.7%, respectively; Table 7). In the T3 daughters in comparison to the T1 daughters we found a higher percentage of girls with the upper arm area with Z-score>2SD (10.4% and 2.2%, respectively) and the upper arm muscle area with the Z-score>2SD (14.6% and 5.4%, respectively), (Table 8). Low BMI values, *i.e.* ≤10 centile, were stated almost four times more often for the T3 daughters than the T2 daughters (17.7%

TABLE 5. Comparison of calcium intake from dairy products by mothers or daughters in relation to calcium intake by mothers (mean ± standard deviation; mg/person/day)

Dairy products	Total N=277	Terciles of calcium intake by mothers			p for ANOVA	p for trend
		T1 N=92	T2 N=89	T3 N=96		
Mothers						
Hard cheese	93±126	33±35[a,b]	93±95[a,c]	151±173[b,c]	<0.001	<0.05
Processed cheese	24±62	9±11[a,b]	19±29[a,c]	45±98[b,c]	<0.001	NS
Fresh cheese	17±36	9±12[b]	14±19[c]	27±55[b,c]	<0.05	NS
Homogenized cheese	8±14	4±9[b]	6±8[c]	12±21[b,c]	<0.001	NS
Natural yoghurt	48±167	11±16[a,b]	32±57[a,c]	97±272[b,c]	<0.001	NS
Fruit yoghurt	62±134	25±27[a,b]	54±66[a,c]	104±210[b,c]	<0.001	<0.1
Buttermilk, kefir	21±53	3±4[a,b]	8±9[a,c]	51±83[b,c]	<0.001	NS
Milk in beverages	157±251	25±31[a,b]	105±125[a,c]	331±342[b,c]	<0.001	NS
Milk soup	64±131	15±20[a,b]	34±45[a,c]	138±197[b,c]	<0.001	NS
Milk in total	221±293	40±41[a,b]	139±125[a,c]	469±364[b,c]	<0.001	NS
Ice-creams in season	20±35	12±16[b]	20±46	29±34[b]	<0.05	<0.05
Ice-creams out of season	1±3	0±1[b]	0±1[c]	2±5[b,c]	<0.05	NS
Ice-creams in total	9±15	5±7[b]	9±19	13±16[b]	<0.001	<0.05
Cream	5±9	5±9	5±9	6±9	NS	NS
Cheese for spreading	4±25	1±2[a,b]	2±5[a]	10 ±42[b]	<0.05	NS
Daughters						
Hard cheese	182±292	170±359	217±275	162±229	NS	NS
Processed cheese	45±97	42±111	34±50	59±114	NS	NS
Fresh cheese	10±20	8±20	14±26	9±14	NS	NS
Homogenized cheese	23±43	17±33[b]	23±47	29±46[b]	NS	<0.05
Natural yoghurt	43±102	41±85	36±93	51±123	NS	NS
Fruit yoghurt	126±194	83±99[b]	112±130[a]	181±282[b,a]	<0.001	NS
Buttermilk, kefir	29±116	23±50	13±26	50±187	NS	NS
Milk in beverages	153±200	124±165	159±198	174±229	NS	NS
Milk soup	69±169	60±185	49±98	95±200	NS	NS
Milk in total	221±275	184±259[b]	208±247	269±307[b]	NS	NS
Ice-creams in season	81±86	86±98	65±71[a]	92±86[a]	NS	NS
Ice-creams out of season	2±7	2±5	1±3	3±12	NS	NS
Ice-creams in total	35±37	37±41	28±31	40±37	NS	NS
Cream	2±4	2±5	3±5[a]	1±3[a]	<0.05	NS
Cheese for spreading	4±19	2±4	3±12	7±30	NS	NS

a-a, b-b, c-c – differences statistically significant between tercile groups

and 4.5%, respectively; Table 7). The percentage of the T3 daughters with the upper arm muscle circumference ≤10 centile or the upper arm muscle area ≤10 centile was about twice higher than for the T1 daughters (24% *vs.* 13% and 25% *vs.* 13%, respectively). Moreover, daughters in the consecutive tercile groups were noted to have a linear increase in the percentage of respondents (p of the trend <0.05) with small upper arm circumference (Z-score<-2SD; Table 8).

DISCUSSION

Studies on different groups of people indicate a low calcium intake by Poles, and especially by women and girls [Górnicka & Gronowska-Senger, 2005; Jeżewska-Zychowicz, 2004b; Szponar *et al.,* 2003]. It results mainly from an insufficient intake of dairy products, which according to different sources supplies from 60% to 80% of total calcium [Waśkiewicz *et al.,* 2005; Szymelfejnik *et al.,* 2006]. Our results concerning calcium and dairy products intake by women are consistent with works of many Polish and foreign authors [Górnicka & Gronowska-Senger, 2005; Ilich & Kerstetter, 2000; Szponar *et al.,* 2003]. In the WOBASZ studies it was found that adult Polish women consumed on average 460 mg of calcium a day (below 60% of the dietary recommended intake) [Waśkiewicz *et al.,* 2005]. On the other hand, in all-Poland household studies the calcium intake by women aged

TABLE 6. Comparison of somatic parameters of mothers or daughters in relation to calcium intake by mothers (mean ± standard deviation).

Parameter	Total N=277	Terciles of calcium intake by mothers			p for ANOVA	p for trend
		T1 N=92	T2 N=89	T3 N=96		
Mothers						
Height (cm)	164.8±5.5	164.6±6.4	165.1±4.7	164.9±5.4	NS	NS
Body mass (kg)	69.3±11.4	71.0±11.7	68.5±11.4	68.4±11.0	NS	NS
BMI (kg/m^2)	25.5±3.8	26.2±3.8	25.1±3.8	25.1±3.7	NS	NS
BSF (mm)	17.4±5.0	17.4±4.9	16.8±5.0	18.1±5.0	NS	NS
TSF (mm)	14.7±5.1	15.2±5.4	13.7±5.2[a]	15.2±4.5[a]	NS	NS
SCSF (mm)	18.4±5.9	19.1±6.0	18.2±6.3	18.0±5.5	NS	NS
SISF (mm)	16.9±6.4	17.6±6.6	16.9±6.3	16.3±6.2	NS	<0.05
Sum of 4 SF (mm)	67.5±19.0	69.3±18.7	65.6±20.0	67.5±18.5	NS	NS
WC (cm)	82.5±10.5	84.6±11.1	82.0±9.6	81.0±10.6	<0.05	NS
HC (cm)	101.9±9.1	103.3±9.4	101.9±8.8	100.5±8.8	<0.05	NS
WHR	0.81±0.06	0.82±0.06	0.80±0.06	0.80±0.05	NS	NS
AC (cm)	28.8±3.0	28.9±2.9	28.6±3.2	28.9±2.9	NS	NS
AA (mm^2)	6674±1383	6740±1371	6581±1455	6697±1336	NS	NS
AMC (cm)	23.3±2.6	23.5±2.7	23.3±2.6	23.2±2.6	NS	NS
AMA (mm^2)	4385±993	4447±1050	4380±1007	4330±928	NS	<0.05
AMI (%)	66.0±7.9	66.1±7.9	67.0±7.9	64.9±7.9	NS	NS
FFM (kg)	45.4±5.5	45.6±6.3	45.3±5.4	45.0±4.7	NS	NS
AFTA (mm^2)	2289±731	2293±698	2202±755	2367±738	NS	NS
AFI (%)	34.0±7.9	33.9±7.9	33.0±7.9	35.1±7.9	NS	NS
FM (kg)	24.5±10.7	26.7[a]±13.4	23.8±10.8[a]	23.0±6.7	<0.05	NS
%FM (%)	34.2±8.7	35.1±8.7	33.6±8.6	33.9±8.8	NS	NS
Daughters						
Height (cm)	165.1±6.5	165.5±6.7	164.9±6.2	165.1±6.7	NS	NS
Body mass (kg)	56.6±9.0	56.6±9.2	57.4±8.8	55.9±8.9	NS	NS
BMI (kg/m^2)	20.7±2.7	20.6±2.7	21.0±2.5	20.5±2.9	NS	NS
BSF (mm)	12.9±4.7	12.4±5.0	13.7±4.5	12.7±4.5	NS	NS
TSF (mm)	10.9±4.3	10.9±4.8	10.6±3.9	11.2±4.3	NS	NS
SCSF (mm)	13.1±4.9	13.2±5.2	13.6±4.5	12.6±5.0	NS	NS
SISF (mm)	12.4±5.0	12.1±4.8	13.4±5.5[a]	11.7±4.7[a]	NS	NS
Sum of 4 SF (mm)	49.4±16.0	48.6±17.2	51.3±15.6	48.3±15.2	NS	NS
WC (cm)	70.0±6.8	69.7±6.7	70.9±6.6	69.4±7.2	NS	NS
HC (cm)	92.0±7.3	92.0±7.3	93.6±7.3[a]	90.5±7.0[a]	NS	NS
WHR	0.76±0.05	0.76±0.06	0.76±0.04	0.77±0.05	NS	NS
AC (cm)	24.6±2.7	24.4±2.4	24.9±2.7	24.5±3.0	NS	NS
AA (mm^2)	4871±1081	4787±952	5000±1079	4831±1194	NS	NS
AMC (cm)	20.5±2.3	20.5±1.9	20.6±2.4	20.5±2.5	NS	NS
AMA (mm^2)	3398±758	3378±620	3429±794	3389±845	NS	NS
AMI (%)	70.2±8.8	71.2±9.4	68.8±8.6	70.6±8.2	NS	NS
FFM (kg)	41.1±5.2	41.3±4.8	41.0±5.6	41.0±5.2	NS	NS
AFTA (mm^2)	1472±613	1409±636	1570±593	1442±604	NS	NS
AFI (%)	29.8±8.8	28.8±9.4	31.2±8.6	29.4±8.2	NS	NS
FM (kg)	15.3±6.2	15.2±5.3	16.3±7.9	14.6±5.1	NS	NS
%FM (%)	26.0±4.5	26.3±4.6	26.5±3.7[a]	25.2±4.9[a]	NS	NS

BMI – body mass index, BSF – biceps skinfold thickness, TSF – triceps skinfold thickness, SCSF – subscapular skinfold thickness, SISF – suprailiac skinfold thickness, Sum of 4 SF – sum of four skinfolds, WC – waist circumference, HC – hip circumference, WHR – waist hip ratio, AC – upper arm circumference, AA – upper arm area, AMC – upper arm muscle circumference, AMA – upper arm muscle area, AMI – upper arm muscle index (in%), FFM – fat-free body mass (in kg), AFTA – upper arm fat tissue area, AFI – upper arm fat index (in%), FM – body fat mass (in kg), %FM – body fat mass percentage (in%), a-a – differences statistically significant in pairs of tercile groups.

TABLE 7. Somatic parameters distribution for mothers or daughters (% of the sample) in relation to calcium intake by mothers.

Parameters	Total N=277	Terciles of calcium intake by mothers			p for trend	p for chi² test
		T1 N=92	T2 N=89	T3 N=96		
Mothers						
BMI						
<18.5 kg/m²	0.4	0.0	1.1	0.0	NS	NS
≥25 kg/m²	51.6	62.0[a]	43.8[a]	49.0	NS	NS
≥30 kg/m²	11.6	15.2	10.1	9.4	NS	NS
TSF						
≤10 centile	24.5	27.2	29.2	17.7	NS	NS
≥90 centile	0.0	0.0	0.0	0.0	-	
AMC						
≤10 centile	5.1	3.3	3.4	8.3	NS	<0.05
≥90 centile	13.0	9.8[a]	21.3[a,c]	8.3[c]	NS	<0.05
AMA						
≤10 centile	5.1	3.3	3.4	8.3	NS	<0.05
≥90 centile	13.4	10.9[a]	21.3[a,c]	8.3[c]	NS	
Obesity occurrence						
Increased obesity risk WC≥80	53.8	62.0[b]	56.2	43.8[b]	NS	<0.05
Obesity WC≥88	27.4	38.0[a,b]	24.7[a]	19.8[b]	NS	<0.05
Obesity%FM>30	15.5	17.4	15.7	13.5	<0.05	NS
Risk for health*						
Risk increase	1.1	3.3	0.0	0.0	NS	<0.05
High risk	9.7	10.9	9.0	9.0	NS	
Very high risk	17.4	27.2[a,b]	14.6[a]	10.4[b]	NS	
Daughters						
Body mass						
≤10 centile	7.9	10.9	6.7	6.3	NS	NS
≥90 centile	12.3	14.1	14.6	8.3	NS	
BMI						
≤10 centile	11.2	10.9	4.5[a]	17.7[a]	NS	NS
≥90 centile	11.6	12.0	14.6	8.3	NS	
≤18.5**	9.7	8.7	3.4[a]	16.7[a]	NS	<0.01
≥25**	9.4	7.6	13.5	7.3	NS	NS
≥30**	1.1	1.1	0.0	2.1	NS	NS
TSF						
≤10 centile	32.1	33.7	28.1	34.4	NS	NS
≥90 centile	9.7	9.8	11.2	8.3	NS	
SCSF						
≤10 centile	3.2	6.5[a]	0.0[a]	3.1	NS	NS
≥90 centile	22.7	26.1	24.7	17.7	NS	
AC						
≤10 centile	13.7	15.2	12.4	13.5	NS	NS
≥90 centile	10.8	5.4[a]	15.7[a]	11.5	N S	
AA						
≤10 centile	14.1	15.2	13.5	13.5	NS	NS
≥90 centile	14.4	8.7[a]	20.2[a]	14.6	NS	
AMC						
≤10 centile	17.0	13.0[a]	13.5	24.0[a]	NS	<0.05
≥90 centile	15.2	10.9	14.6	19.8	<0.1	

TABLE 7. continued Somatic parameters distribution for mothers or daughters (% of the sample) in relation to calcium intake by mothers.

Parameters	Total N=277	Terciles of calcium intake by mothers			p for trend	p for chi^2 test
		T1 N=92	T2 N=89	T3 N=96		
AMA						
≤10 centile	17.7	13.0[a]	14.6	25.0[a]	NS	<0.05
≥90 centile	15.9	10.9	16.9	19.8	NS	
AFTA						
≤10 centile	28.5	31.5	23.6	30.2	NS	NS
≥90 centile	9.0	5.4	13.5	8.3	NS	

Notations as for Table 6

*categories of risk for health based on waist circumference and BMI: risk increase WC<88 cm and BMI=25-29.9 kg/m2 or WC≥88 cm and BMI=18.5-24.9 kg/m^2, high risk WC<88 and BMI=30-34.9 kg/m^2 or WC≥88 and BMI=25-29.9 kg/m^2, very high risk WC≥88 cm and BMI≥30 kg/m^2, **after recalculating the girls' BMI into BMI 18.5, 25 and 30 kg/m^2 in adults, respectively, by international youth standards.

TABLE 8. Distribution of the Z-score indices for daughters (% of the sample) in relation to calcium intake by mothers.

Indices	Total N=277	Terciles of calcium intake by mothers			p for trend	p for chi^2 test
		T1 N=92	T2 N=89	T3 N=96		
Body mass						
Z-score<-2	0.4	0.0	0.0	1.0	NS	NS
Z-score>2	7.2	7.6	10.1	4.2	NS	
BMI						
Z-score<-2	0.0	0.0	0.0	0.0	-	<0.05
Z-score>2	4.3	1.1[a]	9.0[a]	3.1	NS	
TSF						
Z-score<-2	4.7	8.7	2.2	3.1	NS	NS
Z-score>2	5.4	3.3	7.9	5.2	NS	
SCSF						
Z-score<-2	0.0	0.0	0.0	0.0	-	NS
Z-score>2	17.7	20.7	21.3	11.5	NS	
AC						
Z-score<-2	1.1	0.0	1.1	2.1	<0.05	NS
Z-score>2	4.7	2.2	5.6	6.3	NS	
AA						
Z-score<-2	0.0	0.0	0.0	0.0	-	NS
Z-score>2	6.9	2.2[a]	7.9	10.4[a]	<0.1	
AMC						
Z-score<-2	1.4	2.2	1.1	1.0	NS	NS
Z-score>2	9.0	4.3	11.2	11.5	NS	
AMA						
Z-score<-2	1.1	2.2	0.0	1.0	NS	NS
Z-score>2	11.2	5.4[a]	13.5	14.6[a]	NS	
AFTA						
Z-score<-2	2.2	4.3	1.1	1.0	NS	NS
Z-score>2	5.1	2.2[a]	9.0[a]	4.2	NS	

Notations as for Table 7.

26-60 years was noted at the level of 520 mg/day [Szponar *et al.,* 2003]. A bit higher calcium intake, amounting on average to 650 mg/day, was stated for American girls and women [Ilich & Kerstetter, 2000]. In our studies we showed that mothers consumed on average almost 700 mg of calcium a day, which may be considered as a satisfactory level of calcium intake and slightly higher than in the cited literature. However, about 33% of the women (1st tercile) consumed less than 200 mg of calcium a day, while in total 32% of the total sample was at risk of calcium deficiencies (individual insufficient calcium intake). The results obtained prove an individual variation and confirm a high frequency of an insufficient calcium intake by adult Poles.

Our observations concerning the mean calcium intake by girls are different from results of other authors [Górnicka & Gronowska-Senger, 2005; Szponar *et al.,* 2003; Tanasescu *et al.,* 2000; Zemel *et al.,* 2004]. The mean calcium content in girls' daily diets amounted nearly to 1000 g/day in the total sample, while the adequate intake for Polish girls aged 10-18 years is equal to 1300 mg/day and for young women aged 19-30 years to 1000 mg/day [Jarosz & Bułhak-Jachymczyk, 2008]. However, the nutrition evaluation carried out only on the basis of average values might be shallow [Gibson, 2005]. It is confirmed by the analysis of the too low calcium intake occurrence frequency in girls. In total every fourth girl was at risk of calcium deficiencies (inadequate calcium intake), and the calcium deficiencies risk concerned even girls from the upper tercile (13% of them). It documents a great individual variance in calcium intake by girls, similarly to variance stated for the mothers. In this depiction our results seem to be coherent with studies of other authors [Tanasescu *et al.,* 2000].

Calcium content in girls' diets resulted mainly from a high consumption of three products: cheese, milk and fruit yoghurt. These products constituted the main sources of calcium in girl' diets. The studied girls were characterised with a relatively high mean intake of dairy products in comparison to literature data and our previous studies [Jeżewska-Zychowicz, 2004b; Wądołowska *et al.*, 2007]. Explanation for these differences may be found in: (i) proved high variance of individual intake, which was mentioned above, and (ii) sample choice method. The carried out MODAF study project required getting an agreement for taking part in the study from two persons and also commitment and devoting some amount of time by mother and daughter. It could exclude from the study people less interested in nutrition and health, and as a result also people with less adequate nutrition. The exclusion effect could be stronger than in normally carried out nutrition studies because it depended on attitudes of two persons: mother and daughter. The described problems do not exclude a possibility to carry out a comparative analysis between mothers and daughters, which was the aim of this study.

The results obtained showed a beneficial influence of calcium and dairy products intake on women's body composition [Dicker *et al.*, 2008; Mélanie *et al.,* 2003; Schrager, 2005]. Mothers with the highest daily calcium intake had the lowest fat tissue content and were characterised with the lowest BMI in comparison to the mothers with the lowest calcium intake. Similarly in the studies of Pereira *et al.* [2002] a 20% reduction was stated in the percentage of respondents with overweight after including greater amounts of dairy products in a diet. Zemel *et al.* [2004] proved in obese respondents a significant influence of a diet rich in calcium on decreasing fat tissue in the body. The likely mechanism of this dependency was shown by Melanson *et al.* [2003]. They stated that a high calcium intake influenced a decrease of fat deposition in adipocytes by impairing lipogenesis. On the other hand, a relation between calcium intake and waist circumference was proved *e.g.* by Dicker *et al.* [2008]. These authors revealed that women consuming more calcium in a diet had waist circumference showing a lower health risk (*i.e.* below 88 cm) [Lemiux *et al.,* 2004; Third Report…, 2001]. Our studies have also shown a smaller percentage of women (about twice) with waist circumference over 88 cm among those that consumed more calcium.

The above-mentioned studies concerned adults. The effect of calcium and dairy products intake on the body mass or fat tissue amount decrease was also noted for children and youth [Tanasescu *et al.*, 2000; Zemel *et al.,* 2000]. In our studies, daughters whose mothers consumed higher amounts of calcium and dairy products, also consumed greater amounts of these products and calcium. It proves the occurrence of a family similarity in consumption and confirms results achieved by other authors [Feunekes *et al*., 1998; Guidetti & Carvazza, 2008; Jeżewska-Zychowicz, 2004a; Mosca *et al*., 2006; Wądołowska *et al*., 2007]. Moreover, the girls with the highest calcium and dairy products intake had a lower fat tissue content in the body, expressed as the suprailiac skinfold thickness, hips circumference and body fat content. A positive correlation between dairy products consumption and obesity occurrence was shown in children aged 7-10 years living in Puerto Rico [Tanasescu *et al.,* 2000]. In the studies of Zemel *et al.* [2000] a significantly lower risk of obesity occurrence was stated among girls consuming the greatest amounts of calcium. These authors summarized that dairy products intake may have some significance in stopping the body mass increase in obese children and youth. They postulated encouraging children and youth to regular consumption of food rich in calcium, *i.e*. dairy products.

The range of variance in daughters' body composition against dairy products consumption was a bit smaller than in the mothers. Apart from the above described differences in fat tissue content some differences in muscles tissue content were found as well. In daughters along with dairy products and calcium intake increase we noted an increase in the percentage of girls with small arm circumference (below 2 SD), however at a very low level (from 0% to 2.1%). It should be presumed that the observed trend depended, to a greater extent, on changes in fat tissue (and its decrease) than in the muscles tissue. It is shown by almost five times higher percentage of girls with a big arm circumference (over 2 SD) and almost three times higher percentage of girls with big arm muscle area (over 2 SD) in the daughters from the upper tercile in comparison to the lower tercile of dairy products intake. In these circumstances, the noted percentage of girls with undernutrition (BMI≤10 centile), greater for daughters from the upper than from the middle tercile, seems to be of little importance, especially that an index calculated in such a way did not include the modification connected to girls age. For this reason, a greater impact should be ascribed to the analysis of the standard deviation indices. Our results are in accordance to findings of other authors [Zemel *et al.,* 2004]. A literature review made by Schrager [2005] confirms a negative relation between calcium and/or dairy products intake and body mass, fat tissue content and obesity occurrence. Similarly to our study, these investigations (published in the years 2000-2004) did not confirm an influence of calcium and/or dairy products intake on the fat-free body mass content. It is interesting that calcium from dairy products seems to have a greater influence than calcium from supplements [Schrager, 2005].

In conclusion, the current number of evidence still proves a relation between an increased calcium intake from dairy products with body mass and fat tissue content decrease in people of different age [Schrager, 2005]. Our results showed a correlation between calcium intake and body composition of the mother-daughter family pairs studied. A relation between calcium and/or dairy products intake and the body composition was more visible in the case of mothers than daughters. It resulted from a greater variance in consumption stated for the women than for the girls. The effects of dairy products intake on body composition were noticed in a wide range of their consumption, but were more visible in the respondents with a low intake of dairy products and calcium.

CONCLUSIONS

A similarity was proved in dairy products and calcium intake for the mother-daughter family pairs. A higher intake of dairy products and calcium by mothers was beneficial for a higher intake of these products and calcium by daughters, and in consequence for a smaller fat tissue content in women and to some extent in girls. The results obtained suggest that the proper intake of calcium from milk and dairy products may be an element of obesity prophylactics aimed at preventing metabolic complications.

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