Acta fytotechn zootechn, 24, 2021(3): 243–249
http://www.acta.fapz.uniag.sk

Original Paper

Differences between anthropometric variables among young women depending on milk fat content

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Article Details: Received: 2021-02-25 | Accepted: 2021-04-16 | Available online: 2021-09-30

https://doi.org/10.15414/afz.2021.24.03.243-249

The aim of the work was to assess the effect of consumption of different types of cow's milk according to fat content on selected parameters of body composition. The study group consisted of 165 women aged 23 years. Based on the preference for the type of milk, the group was divided into the following three groups – skimmed (0.5%), semi-skimmed (1.5%) and full-fat (3.5%). We used the questionnaire method to obtain data and the bioelectric impedance method (InBody 720) to evaluate body composition. With the exception of visceral fat area and waist-to-hip ratio, we did not notice significant differences between the groups. In terms of body weight, we found the lowest value in the full-fat group (P >0.05), while this group also had the lowest value of fat mass (P >0.05), visceral fat area (P <0.05), waist-to-hip ratio (P <0.05), body mass index (P >0.05) and the highest value of fat-free mass (P >0.05), skeletal muscle mass (P >0.05) and basal metabolic rate (P >0.05). The results suggest that the consumption of full-fat milk is preferred mainly by physically active consumers, which is also reflected in the values of body composition parameters related to fitness, the level of basal metabolism and muscle mass. The consumption of full-fat milk was positively associated with muscle mass, but not fat mass.

Keywords: dairy, fats, visceral, adiposity, anthropometric

1 Introduction

Milk generally refers to the fluid secreted by the mammary glands of females for the nourishment of their young, as well as milk from an animal used as food by people. Under European Union regulations, milk means exclusively the normal mammary secretion obtained from one or more milkings without either addition thereto or extraction therefrom. Milk products means products derived exclusively from milk (EUR-Lex, 2013). Milk is recognized as an important source of nutrients and contributor in the human diet, especially is important as a part of a young child´s diet (Dror and Allen, 2014; Feeney et al., 2016). Milk is an excellent source of protein (3.3 g per 100 g) and other macro and micronutrients, contains a wide range of minerals (calcium 121 mg per 100 g, potassium 151 mg per 100 g, magnesium 11 mg per 100 g, phosphorus 92 mg per 100 g, iodine 28 µg per 100g) and vitamins (vitamin B_{12} 0.5 µg per 100 g, vitamin B_2 0.19 mg per 100 g, vitamin B_5 0.34 mg per 100 g, vitamin A 24 µg; VÚP, 2013). But the nutritional value and quality of milk depend on a number of factors and fluctuates considerably (Juráček et al., 2020). Consumption of milk and dairy products is subject to current trends. In many cases, dietary habits change under the influence of specific nutritional needs, dietary restrictions due to health reasons or affinity for alternative diets, and milk is replaced by dairy-free products (Thorning et al., 2016). In Slovakia, the consumption of milk and dairy products was 2.5 kg higher (1.5%) than in 2018 (173.6 kg per capita in 2019). However, the consumption was decreased in milk for drinking by 0.6 kg (1.3%). Consumption of milk and dairy products in developed countries is 212.2 kg per year, in which Slovaks lag far behind (WHO, 2018).

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In the view of the fact that milk and dairy products are important sources of calcium and valuable proteins, this low consumption is unfavourable from the nutritive point of view (Sitárová, 2020).

Consumer food preferences are influenced by perceptions of its health effects (Cifelli et al., 2016). When considering intake of milk, special nutrients of concern are fats, especially saturated fat. Whole milk is 3.7% fat, while skimmed milks are low in fat (0.3% to 1.8%). Many guidelines recommend 3–5 portions of dairy per day with an emphasis on the consumption of low-fat alternatives as important components of healthy diet. Fats in milk consist mainly of saturated fat (over 60%; Gálik et al., 2011). Therefore, milk consumption is associated with metabolic health (Hidaka et al., 2012; Lorková et al., 2015, 2017). Some studies have highlighted the health benefits of consuming low-fat dairy products compared to fat-containing products whereas saturated fats are a risk factor of cardiovascular and other disease (Tong et al., 2011; Ralston et al., 2012). Randomized controlled trials suggest that the health effects of saturated fats need to be assessed comprehensively as part of the food matrix. Milk and dairy foods have the same saturated fat content but different effects on the lipid profile (Hjerpsted, Leedo and Tholstrup, 2011; Kratz, Baars and Guyenet, 2013; Soerensen et al., 2014; Rosqvist et al., 2015; Feeney et al., 2017). In addition to cardiometabolic effects, the associations between milk and dairy intake and the risk of obesity are also investigated. Research of Dror (2014) have showed neutral or reduced risk of adiposity in connection with milk and dairy consumption during adolescence. Meta-analyses of Wang, Wu and Zhang (2016) and Lu et al. (2016) showed that dairy consumption was associated with a decreased risk of obesity in children and an increase of one serving per day of dairy products is associated with a 0.65% lower body fat.

The aim of the work was to assess the relationship between milk consumption and body composition in relation to the fat content in milk among young women.

2 Material and methods

2.1 Characteristics of the participants

One hundred and sixty-five female participants aged 23.2 ±1.27 years were included in the study. The requirement for participation was the consent with measurement conditions and agree with the processing of personal data. The group of participants was composed of volunteers from the general population, without the severe disease or recommended special dietary regimen. A questionnaire method was used to obtain information on consumption of milk. Each participant completed the questionnaire alone and anonymously. For the purpose of the study, we asked the participants about their preference for milk consumption in terms of fat content. Based on the information obtained, the women were divided into three research groups: skimmed milk group (n = 47), semi-skimmed milk group (n = 58) and full-fat milk group (n = 60).

2.2 Anthropometric measurements

Anthropometric measurements were performed by bioelectrical impedance analysis (InBody 720; Biospace Co. Ltd., Seoul, Republic of Korea) using Lookin'Body 3.0 software. The study participants were acquainted with the conditions of measurement (fasting for 12 hours, limit excessive fluid intake, exclusion of morning physical activity) and with the risks of measurement, while written consent to the measurement and protection of personal data was required. Body height was one of the input data, we determined it using Tanita WB-300. Within the outputs, we focused on fat-free mass (FFM,%), fat mass (FM,%), visceral fat area (VFA, cm^2), skeletal muscle mass (SMM,%) and basal metabolic rate (kcal). Based on the data obtained and using the InBody device, we also determined the recalculated body mass index and the ratio of waist and hips.

2.3 Statistical analysis

Microsoft Office Excel 2010 (Los Angeles, CA, USA), XLSTAT (Version 2019.3.1) and STATISTICA Cz version 10 (TIBCO Software Inc., Palo Alto, California, USA) were used for statistical analysis. The changes between groups were analysed using a one-way analysis of variance (ANOVA) followed by Tukey's post hoc test. The data were presented as the means ± standard deviation (SD). Significance level was determined as P <0.05.

3 Results and discussion

In our study, we focused on the effect of milk consumption according to fat content on anthropometric parameters of young women. The aim was to evaluate the fat as well as muscle components of the body composition. Table 1 shows the basic characteristics of the examined group in terms of individual parameters. The average values of all monitored variables were in the required range.

Body weight is a parameter that continuously changes depending on age, gender, health status, changes can of course also occur due to various pathological changes in the body, and last but not least, physical activity and positive or negative energy balance affect body weight. Total body weight is a numerical expression of the weight of all components of the human body, whether it is active body mass, connective tissue, fat or water, but does not

Table 1 Baseline characteristics

	n	mean	±SD	max	min	mod	med
Age (years)	165	23.2	1.27	30	21	23	23
Weight (kg)	165	61.90	10.27	94.00	46.20	59.70	59.50
Fat-free mass (FFM, %)	165	74.37	8.20	88.05	48.07	ND	75.29
Fat mass (FM, %)	165	25.63	8.20	51.89	11.92	ND	24.75
Visceral fat area (VFA, cm^2)	165	64.65	26.80	151.80	21.22	ND	61.66
WHR	165	0.85	0.05	1.05	0.75	0.85	0.84
BMI (kg m^{-2})	165	22.10	3.40	36.27	17.44	23.93	21.90
Skeletal muscle mass (SMM,%)	165	40.83	4.72	49.11	26.45	ND	41.45
Basal metabolic rate (BMR, kcal)	165	1355	140	1980	1034	1224	1346
Intracellular water (ICW, %)	165	62.12	0.54	63.95	60.71	62.50	62.12
Extracellular water (ECW, %)	165	37.88	0.54	39.29	36.05	37.50	37.88
Total body water (TBW, %)	165	54.48	6.09	64.46	35.19	ND	55.22

Table 2 Differences in variables within groups

	n	Weight (kg)	Fat-free mass (%)	Fat mass (%)	Visceral fat area (cm^2)
Skimmed milk (0.5%)	47	61.4	73.8	26.2	65.4
Semi-skimmed milk (1.5%)	58	62.9	73.1	26.9	69.0a
Full-fat milk (3.5%)	60	60.7	77.3	22.7	55.8b
P value		*P* >0.05	*P* >0.05	*P* >0.05	*P* <0.05
		WHR	BMI (kg m^{-2})	Skeletal muscle mass (%)	Basal metabolic rate (kcal)
Skimmed milk (0.5%)	47	0.85	22.3	40.5	1,346
Semi-skimmed milk (1.5%)	58	0.86a	22.1	40.1	1,350
Full-fat milk (3.5%)	60	0.83b	21.8	42.6	1,377
P value		*P* <0.05	*P* >0.05	*P* >0.05	*P* >0.05

ab – different symbols in the column mean statistically significant differences in mean values

refer to the share of individual components in total body weight or changes in body composition (Gažarová and Lenártová, 2020). The average weight in the group of women preferring low-fat milk was 61.4 kg, in the group of women consuming semi-skimmed milk 62.9 kg and in the group consuming full-fat milk 60.7 kg (Table 2, Figure 1). Body weight did not differ significantly between groups (*P* >0.05).

Fat-free mass is composed of muscle mass, supporting and connective tissues and internal organs without the weight of fat cells. The proportion of fat-free mass in women represents approximately 75–80% of body weight (Kutáč, 2009). The values of fat-free mass gradually decrease with age. As Table 2 and Figure 2 show, the highest value of fat-free mass was found in the full-fat milk group (77.3%), which indicates a higher proportion of muscle mass, and thus physical activity in this group. However, no statistically significant differences were found between the groups (*P* >0.05).

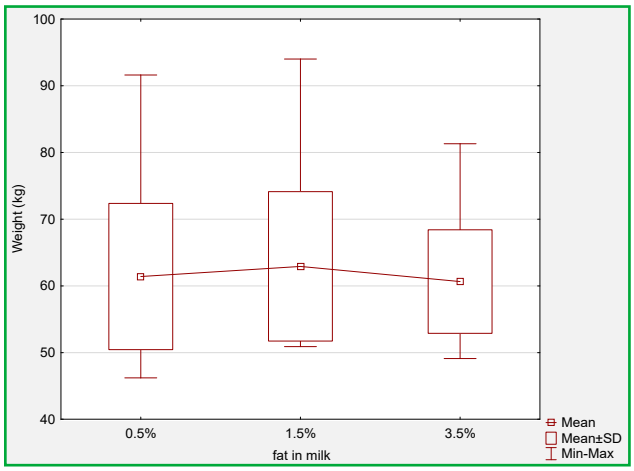

Figure 1 Weight according to milk fat content

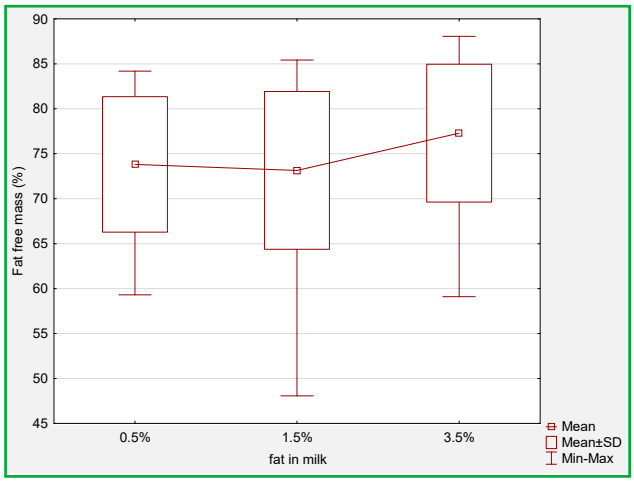

Figure 2 Fat-free mass according to milk fat content

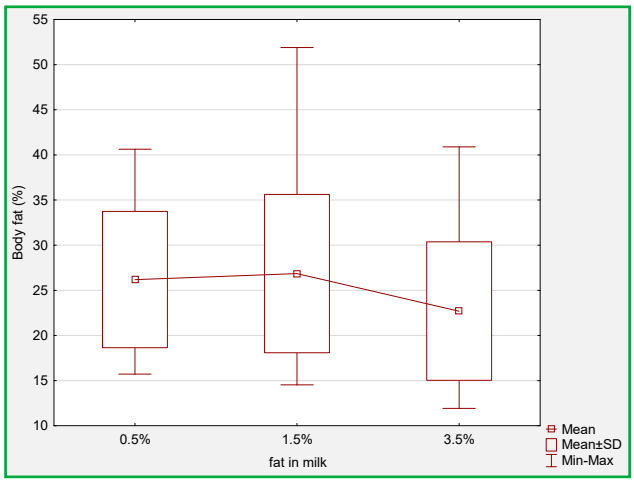

Figure 3 Body fat according to milk fat content

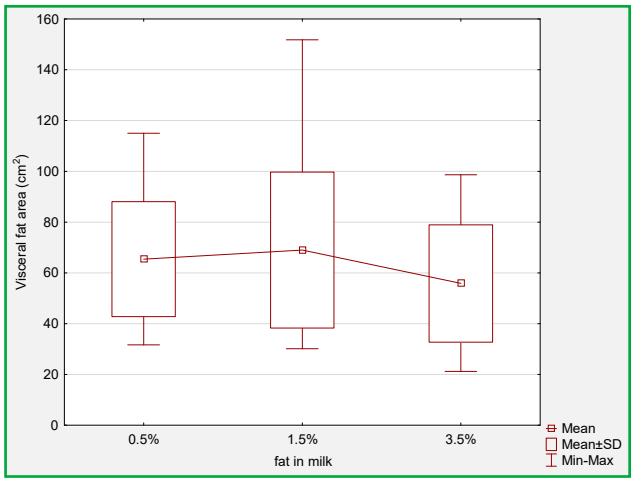

Figure 4 Visceral fat area according to milk fat content

Body fat is the most frequently evaluated parameter due to the fact that it is an important indicator of health status. Both high and low levels of fat in the body are at risk to an individual's body because a certain amount of fat is necessary to maintain vital functions and processes. As a result of a significant increase in body fat, the risk of developing diseases of civilization increases, while at the same time the performance and physical fitness of the individual decreases (Riegerová, Přidalová and Ulbrichová, 2006; Kutáč, 2009). Grasgruber and Cacek (2008) report a proportion of body fat in non-athletic women between 20–25%. According to Biospace (2020), a maximum value of the percentage of fat by weight of up to 28% is determined for women. We found non-significant differences between the study groups in relation to the proportion of fat in body weight (P >0.05), but as shown in Table 2 and Figure 3, we found the lowest percentage of fat in the full-fat milk group (22.7%). Skimmed and semi-skimmed groups had approximately the same average values of the observed parameter.

From the point of view of risk assessment, it is more important to focus attention on the place of distribution and concentration of fat, subsequently on its amount (Gažarová and Lenártová, 2020). Visceral adiposity is associated with higher metabolic morbidity and mortality due to higher levels of inflammatory processes compared to adiposity that occurs in another area of the body (Yu et al., 2019). While in the case of fat mass we did not find significant differences between the groups, in the case of visceral fat area we found a statistically significant difference between the semi-skimmed and full-fat milk groups (69.0 cm^2 and 55.8 cm^2, respectively; P <0.05). In the skimmed group, the value of visceral fat was found to be 65.4 cm^2 (Table 2, Figure 4). As we expected, the central adiposity was also manifested in relation to the waist-to-hip ratio (Table 2, Figure 5). Also in this case, we observed a significant difference between semi-skimmed and full-fat milk groups (0.86 and 0.83, respectively; P <0.05). The waist-to-hip ratio is an anthropometric index used to determine the overweight and risk of abdominal obesity. This index shows how much fat is stored in the waist and hips (Gažarová and Lenártová, 2020).

The body mass index is used to determine the approximate degree of obesity. The disadvantage of this method is that it cannot be applied to adults with a high degree of muscle mass, to children and people over 65 years of age or to pregnant women. Higher body mass index values indicate overweight or obesity, but without specification, which caused this overweight. Either multiplied and excess adipose tissue is possible, or it may be an active muscle mass, e.g. in athletes (Gažarová and Lenártová, 2020). In our study, the lowest body mass index values were found in full-fat milk consumers (21.8 kg m^{-2}; Table

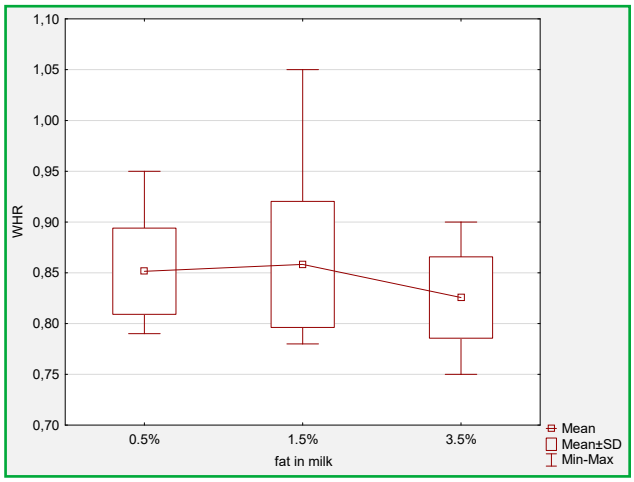

Figure 5 WHR according to milk fat content

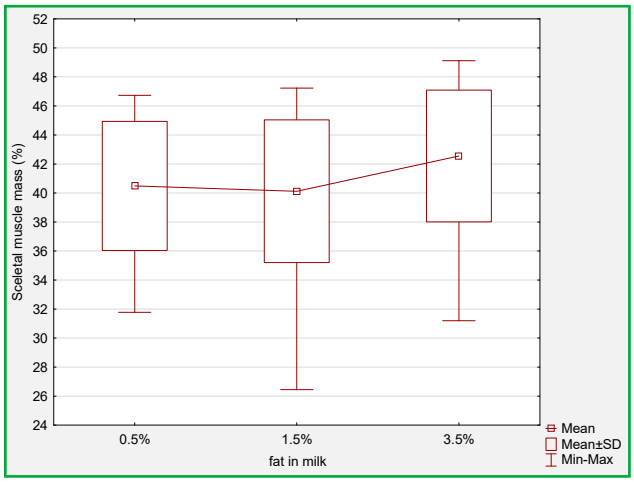

Figure 7 SMM according to milk fat content

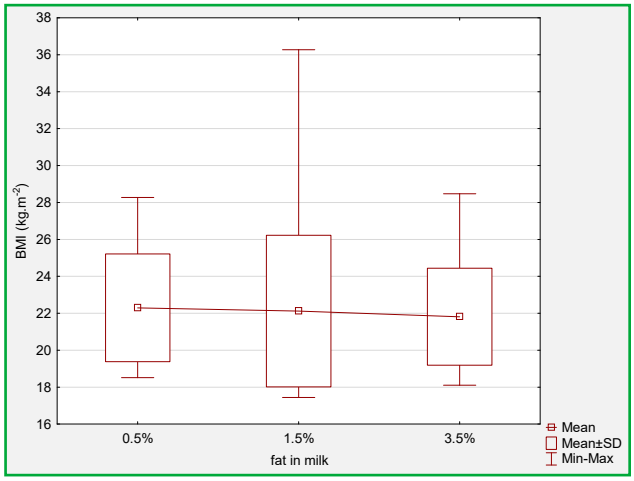

Figure 6 BMI according to milk fat content

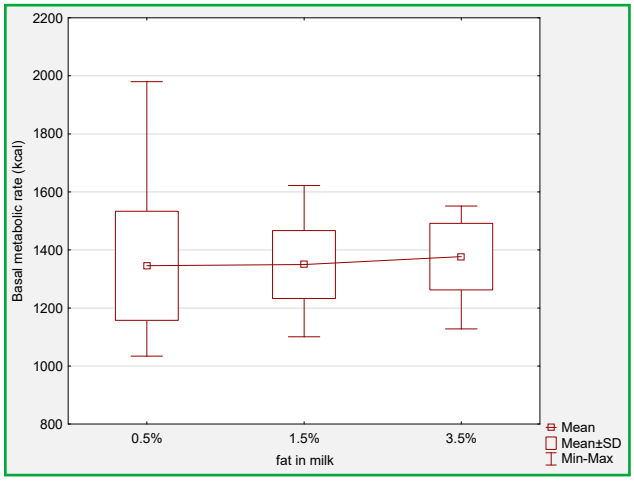

Figure 8 BMR according to milk fat content

2, Figure 6). We found the highest body mass index in the skimmed milk group (22.3 kg m^{-2}). However, we did not find significant differences between the groups (P >0.05). We found similar relationships in the case of skeletal muscle mass and basal metabolic rate. As expected, consumers of full-fat milk had the highest proportion of muscle mass and the highest values of basal metabolic rate (42.6% and 1,377 kcal, respectively; Table 2, Figs 7, 8). No significant differences were found compared to the other groups (P >0.05).

Some meta-analyses have pointed to a more beneficial health effects of low-fat dairy products compared to full-fat dairy products, whether milk, yoghurt or other products (Ralston et al., 2012). However, based on the results of other studies, it appears that consumers of full-fat milk products have a lower weight gain over time and are leaner than consumers who restrict milk fat content (Kratz, Baars and Guyenet, 2013; Sayón-Orea et al., 2015). Rautiainen et al. (2016) prospectively investigated how dairy product intake was associated with weight change and risk of becoming overweight or obese in 18,438 women aged ≥45 years initially normal-weight. Greater intake of high-fat dairy products, but not intake of low-fat dairy products, was associated with less weight gain. Lee et al. (2016) found no significant differences in body mass index when compared low-fat milk consumption (400 mL) to habitual intake of adults with the metabolic syndrome. Findings of Faghih et al. (2011) indicate that a high milk diet can lead to a higher reduction in waist circumference and WHR. Romaguera et al. (2011) found that higher dairy products consumption was associated with a lower gain in waist circumference. Researchers observed that every 100 kcal increase in milk was associated with a decrease in waist circumference in both gender, whereas no significant association between a 100 kcal increase in full-fat, and skimmed or low fat milk could be found. According to Feeney et al. (2017) increased total milk intake was associated with a reduced body mass index with a trend towards higher muscle mass and lower body fat in those with the highest milk consumption.

Faghih et al. (2010) found that the reductions in weight and BMI were significantly greater in the high-milk group than in the control group. Faghih et al. (2011) compared the effects of cows' milk, calcium fortified soy milk and calcium supplement on weight and body fat reduction in premenopausal overweight and obese women and found that increasing low-fat milk consumption significantly reduces the general and central obesity beyond a low calorie diet. Feeney et al. (2017) found that high consumer group of total dairy had significantly lower BMI, body fat and waist circumference compared with the low consumer group, and also lower WHR compared with medium or low consumers. High intake of milk and dairy products seems to have a positive effect not only on body weight and weight gain, but also other health parameters compared to those who have restricted its consumption. Consumers of full-fat milk have higher intake of fats as well as saturated fats than those who prefer low-fat milk and dairy products. Energy intake, source of which are also saturated fatty acids, is higher for full-fat milk consumers than for low-fat milk ones. Nevertheless, according to Feeney et al. (2017), low-fat milk and dairy products consumers have higher cholesterol and triglycerides levels. As reported by Feeney et al. (2017), consumers of low-fat milk have received much more energy from food such as rice, grains, cereals and bread. This is related to the claim that increased carbohydrate intake is associated with increased triglyceride levels (Parks and Hellerstein, 2000; Yannakoulia et al., 2008). According to various studies, consumers who prefer low-fat milk due to reduction fat intake receive a higher percentage of energy from cereals, suggesting that a low-fat, high-carbohydrate diet may be less healthy than other nutritional patterns.

4 Conclusions

From the point of view of human nutrition, milk contains very valuable substances. Although it contains full-value proteins and many vitamins and minerals, it also contains fat and saturated fatty acids, which are associated with serious cardiovascular and other diseases. However, as various epidemiological, observational studies and meta-analyses suggest, the health effects of selected food need to be assessed comprehensively (as food matrix), not only on the basis of the content of some compounds. Based on previous knowledge, the consumption of full-fat milk and dairy products was not associated with obesity or excessive weight gain over time, on the contrary, it was positively related to muscle mass, which is confirmed by our study.

Acknowledgments

Thanks to the Grant Agency of Faculty of Agrobiology and Food Resources SUA in Nitra (05-GA FAPZ SPU-19); Slovak Research and Development Agency under the Contract no. APVV-18-0227; Operational Programme Integrated Infrastructure for the project: Long-term strategic research of prevention, intervention and mechanisms of obesity and its comorbidities (IMTS 313011V344) co-financed by the European Regional Development Fund; and Cultural and Educational Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic (004SPU-4/2019).

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