

# The effects of milk and yogurt consumption on the anthropometric measurements of adolescents

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**Summary.** Milk consumption during adolescence is associated with growth, but the relationship between consumption of milk and BMI is currently discussed. The aim of this study is to determine the relationship between consumption of milk and yogurt and the anthropometric measurements of adolescents. This study was conducted with 544 adolescents who were 14-17 years old. Their milk and yogurt consumption frequencies and amounts were obtained, and their anthropometric measurements were recorded. Milk consumption alone was associated with height ( $p<0.05$ ), but not BMI ( $p>0.05$ ). Total milk and yogurt consumption were associated with height and weight ( $p<0.05$ ), but not BMI ( $p>0.05$ ). Milk and yoghurt consumption support growth, but are not related with obesity.

**Key words:** adolescents, anthropometric measurements, milk, yogurt

## Introduction

Adolescence is the fastest period of growth and development in life (1). Eating behaviors and nutritional preferences change at the same time as physical changes occur in this period (2).

Milk and its products contain many nutrients such as protein, calcium, B<sub>2</sub> (riboflavin) and B<sub>12</sub> vitamins. The rate of growth and development during adolescence increases the importance of this food group. The recommended daily consumption of dairy products for the optimal growth of adolescents (10-18 years old) is three servings according to American Heart Association (AHA) (3), American Academy of Pediatrics (AAP) (4) and Turkey Dietary Guidelines (5).

According to 2016 data for Turkey, 1.275.211 tons (86%) of drinking milk was marketed as UHT, about 158,278 tons as pasteurized milk and 54 tons as sterilized milk. Total drinking milk production was 1,433,541 tons. The consumption of drinking milk per capita in 2016 was about 34 kg, the consumption of yogurt and ayran was 30 kg and 15.6 kg respectively (6).

Children and adolescents' consumption of milk and *ayran* (a traditional beverage made from yogurt) in Turkey is very low (10-25%) (7). The effects of milk and dairy products on BMI and obesity have recently been discussed. Milk and dairy products have been reported to have a preventive effect on abdominal obesity in adolescent men (8). This study was conducted to determine the relationship between consumption of milk and yogurt and the anthropometric measurements of 14-17-year-old adolescents.

## Material and method

### *Subjects and Design*

The study was carried out from November 2015 to February 2016 included 544 adolescents from high schools in the Middle Anatolia (Ankara, Çorum provinces) and Black Sea Region (Düzce, Samsun and Karabük provinces) of Turkey. They were 14-17 years old. The data were collected using a questionnaire. The questionnaire includes socio-demographic character-

istics and dairy consumption of the students. Then height, body weight and arm span of the students were measured by the researchers. All studies were conducted according to the guidelines laid down in the Declaration of Helsinki. The study protocol was approved by the high schools' institutional review boards. Written informed consent was obtained from all adolescents and their parents.

#### *Dairy Product Consumption*

This study recorded the frequency and amount of the participants' milk, yogurt and *ayran* consumption. *Ayran* is a traditional dairy beverage which is made from yogurt in Turkey. The amount of *ayran* consumed was divided into two and added to the yogurt consumption (because it is a 50% dilution with salty water). Three categories were formed: milk consumption, yogurt consumption (including yogurt and *ayran*) and dairy consumption (including milk, yogurt and *ayran*). Cheese consumption was not included to questionnaire and it wasn't calculated. Because there are more than 130 kinds of cheese in Turkey (9). And only few of them were analyzed to their nutrient contents. As well as, calcium contents of cheeses which were analyzed vary 290 mg to 715 mg per 100 g (10), because of this it would be wrong to sum all cheeses under a category. All around we decided not to ask the consumption of cheeses due to the fact that the content of many cheese is unknown and there is difficulty in standardization.

#### *Anthropometric Measurements*

Height and weight were measured by standard methods, and BMIs were also calculated.

Height was measured using a height measurement with 0.1 accuracy while having no shoes on, in a standing position, looking straight ahead, and placing the shoulders and back of the feet in one direction.

Weight was measured twice with 0.1 kg accuracy using a scale (Tanita BC 532) while having no shoes on, wearing minimal clothing and after excretion. In the case of a difference between the two measurements of more than 0.1 kg, the average was calculated after the third measurement.

Body mass index was calculated by dividing weight (in kg) by square of height (in m) (11). The

BMI for age percentiles were calculated according to WHO growth chart. The 5th, 15th, 85th and 95th percentiles were chosen as reference values (12).

Arm span was measured with a steel tape measure from the tip of the middle finger on one hand to the tip of the middle finger on the other hand with the individual standing with back to the wall and both arms abducted to 90°, the elbows and wrists extended and the palms facing directly forward (13).

Wrist circumference was measured to the nearest 0.1 cm using a tape measure. The subjects were asked to hold up their wrist's anterior surface, and the superior border of the tape measure was placed distal to the prominences of the radial and ulnar bones. The wrist circumference was measured without any pressure from the tape measure (14).

#### *Statistical Analyses*

The statistical analyses were done using SPSS 22.0 (SPSS Inc, Chicago, Illinois). The threshold for significance was  $p < 0.05$ . Chi-square tests were used for comparing age of the adolescents with gender and BMI percentile values of the adolescents with gender. Numeric variables such as anthropometric data were reported as means and standard deviations for parametrical tests. Other anthropometric data were reported as medians and interquartile ranges (IQR) for non-parametric tests. Independent t-tests were used to test differences of normally distributed variables between groups. Mann Whitney U tests were used for variables that did not have normal distribution. Mann Whitney U tests were used to compare anthropometric measurements, daily milk and dairy consumption by gender. Spearman's correlation test was used to determine relationships between the anthropometric measurements and milk and dairy consumption.

## **Results**

This study was conducted with 544 adolescents, 225 of whom were male (41.4%), and 319 of whom were female (58.6%). Their mean age was  $15.4 \pm 1.1$  years.

Of the adolescents, 28.1% were fifteen, and 27.2% were fourteen years old (Table 1).

Of the adolescents, 91.4% consume milk regularly, and 8.6% said they never consume milk. 56.9% of male adolescents and 65.2% of female adolescents were between the 15-85 percentiles. There was no significant relationship between gender and BMI

percentiles of the adolescents.

There was no significant difference between the BMI values by gender, but the height, body weight, arm span and wrist circumference of the male adolescents were significantly higher than those of the female students ( $p < 0.05$ ).

Mean daily milk and total dairy consumption were 84.0 (159.0) mL and 256.5 (230.0) mL for the males and 84.0 (158.0) mL and 196.0 (221.0) mL for the females.

The male adolescents statistically consumed more milk, yogurt and dairy products than the female adolescents ( $p < 0.05$ ).

This study found positive correlations between adolescents' milk consumption and height and arm span. As milk consumption increases, height and arm

**Table 1.** Age distribution of the adolescents

Age (years)	Male (n: 225)		Female (n: 319)		Total (n: 544)	
	n	%	n	%	n	%
14	58	25.3	91	28.6	148	27.2
15	70	31.2	83	26.0	153	28.1
16	60	22.2	75	23.5	125	23.0
17	48	21.3	70	21.9	118	21.7

$$\chi^2 = 1.8 \text{ p}=0.61^a$$

<sup>a</sup> Chi-square test

**Table 2.** BMI percentile values of the adolescents by gender

	Male (n:225)		Female (n:319)		Total (n:544)	
	n	%	n	%	n	%
5 <sup>th</sup> percentile and below	10	4.4	13	4.0	23	4.1
5 <sup>th</sup> to 15 <sup>th</sup> percentile	24	10.7	28	8.8	52	9.6
15 <sup>th</sup> to 85 <sup>th</sup> percentile	128	56.9	208	65.2	336	61.8
85 <sup>th</sup> to 95 <sup>th</sup> percentile	28	12.4	36	11.3	64	11.8
95 <sup>th</sup> percentile and above	35	15.6	34	10.7	69	12.7

$$\chi^2 = 7.5 \text{ p}=0.82^a$$

<sup>a</sup> Chi-square test

**Table 3.** Anthropometric measurements of adolescents by gender

	Male (n=225)		Female (n=319)		p
	Median (IQR)	Min-Max	Median (IQR)	Min-Max	
Height (cm)	174.0 (10.0)	150.0-193.0	162.0 (8.0)	146.0-182.0	<0.001 <sup>b</sup>
Weight (kg)	64.0 (18.0)	41.0-118.0	55.0 (14.7)	37.0-96.3	<0.001 <sup>b</sup>
Arm Span (cm)	171.7±7.7 <sup>*</sup>	149.0-191.0	159.07.3	140.0-181.0	<0.001 <sup>c</sup>
Wrist Circumference (cm)	16.5 (1.0)	14.0-20.0	15.0 (1.5)	13.5-23.0	<0.001 <sup>b</sup>
BMI (kg/m <sup>2</sup> )	21.9 (5.0)	14.9-41.3	21.2 (4.4)	14.9-36.3	0.82 <sup>b</sup>

<sup>\*</sup>Mean SD; <sup>b</sup> Mann Whitney U test; <sup>c</sup> Student t test

**Table 4.** Distribution of the average daily milk and dairy consumption of the adolescents by gender

	Male (n=225)		Female (n=319)		Total (n=544)		P
	Median (IQR)	Min-Max	Median (IQR)	Min-Max	Median (IQR)	Min-max	
Daily milk consumption (mL)	84.0 (159.0)	0-600	84.0 (158.0)	0-600	84.0 (190.0)	0-600	0.01 <sup>b</sup>
Daily yogurt consumption (mL)	129.0 (173.9)	0-550	107.0 (136.0)	0-450	117.5 (157.0)	0-550	0.01 <sup>b</sup>
Daily dairy consumption (mL)	256.5 (230.0)	0-1000	196.0 (221.0)	0-864.5	223.4 (241.6)	0-1000	<0.001 <sup>b</sup>

**Table 5.** Correlation Between the Milk Consumption, Dairy Consumption and Anthropometric Measurements of the Adolescents

	Correlation Coefficient (r) <sup>d</sup>	
	Daily Milk Consumption	Daily Dairy Consumption
BMI	-0.05	0.33
Height	0.11*	0.13**
Weight	0.03	0.09*
Arm Span	0.10*	0.12**

<sup>d</sup> Spearman Correlation tests; \* $p < 0.05$ ; \*\* $p < 0.01$

span increases ( $p < 0.05$ ). It also found a significant positive correlation between daily dairy consumption and height, body weight and arm span ( $p < 0.05$ ).

## Discussion

Growth and development play a key role in adolescence, and nutrition has a direct effect on them. This study found that only 8.6% of the adolescents did not consume milk at all. However, Balkış (15) conducted a study with 270 adolescents aged 14 to 18 and reported that 18.5% of them did not consume milk at all. This study found that 24.5% of the students were overweight or obese. Gümüşler (16) reported the rate of overweight or obese adolescents to be 15.7% in a study conducted with 1,710 adolescents. In the study conducted by Balkış (2011) with 270 adolescents who were 14 to 18 years old, 5.2% of them were reported to be overweight, and none were obese. These results may differ because of the variety of the samples (15). However, Gümüşler (16) has indicated that the prevalence of slightly overweight and obese adolescents may have increased since 2006.

This study was conducted with adolescents who were 14 to 17 years old, and it found mean daily milk consumption to be 84.0 (158.0) g for the females and 84.0 (159.0) g among males. Although the mean milk consumption of both the male and female adolescents seemed to be the same in this study, the mean rank of the males was found to be statistically significantly higher than that of the females. A study conducted in Belgium with adolescents aged 15 to 18 found the daily milk consumption to be 139.2 g for females and

181.4 g for males (17). Another study conducted in France with 425 adolescents aged 15 to 17 found this rate to be 168.2 g for females and 116.4 g for males (18). Although this study found a difference between genders for milk consumption, the study conducted in France by Lioret et al. (2010) reported no significant difference by gender (18). International differences of milk consumption are associated with societies' dietary habits. Yogurt, in addition to milk, is a commonly consumed dairy product in Turkey. Thus, the daily consumption of dairy products including yogurt was found to be 196.0 (221.0) g among female adolescents and 256.5 (230.0) g among male adolescents. This consumption is too insufficient according to national daily dairy recommendation but it is important to keep in mind that we did not add the cheese consumption. Regarding the issue a study conducted in Australia with adolescents aged 14 to 16 found the daily consumption of dairy products to be 445.9 g for females and 287.3 g for males (19). As we mentioned before this study excluded dairy products such as cheese, milk puddings, etc., while the study conducted in Australia included milk and all dairy products, which may be the reason why their results differ.

In this study, higher consumption of milk indicated significantly greater height. However, no significant relationship was found between other anthropometric parameters and milk consumption. Wiley et al. (2005) conducted a cross-sectional study with 1,149 adolescents aged 12 to 18 and found no significant relationship between milk consumption and height (20). A meta-analysis of 12 studies conducted with children older than 2 years of age and with adolescents found that every additional milk intake of 245 ml increased height by 0.4 cm per year (21). A positive relationship was found between milk intake among children and the presence of an insulin-like growth factor, a key growth regulator, in blood. This explicit indication may provide insight into the relationship between insulin-like growth factors and dietary proteins (22). Height is an anthropometric value that is in direct proportion to arm span. Therefore, a significant relationship was found between milk consumption and arm span since greater height indicated greater arm span. This study found no significant relationship between milk consumption among adolescents and their weight and

BMI. Forshee et al. (23) conducted a study in the USA with 3311 individuals aged 6 to 19 and found that the BMIs of males who consumed more milk did not change while those of females decreased. Abrou et al. (2012) conducted a study with 1001 adolescents aged 15 to 18 and found a reverse relationship between milk consumption among females and their BMIs. However, no relationship was found between milk consumption among males and their BMIs (8). Berkey et al. (2005) did a study with children aged 9 to 14 and found that weight increased as more milk was consumed, although they reported that this was caused by high-calorie foods added to the milk (24). Bradlee et al. (25) conducted a study with adolescents aged 12 to 16 and found that children with waist circumferences above the 87th percentile consumed significantly less milk. This study found no significant relationship between milk consumption and weight and BMI, which may have been caused by the sample size and the presence of socioeconomic and sociocultural factors that affected the sample.

This study found a significant increase in height and arm span of the adolescents as the consumption of milk and dairy products (milk, yogurt, *ayran*) increased. Another study conducted in the USA with approximately 5100 females aged 9 to 14 determined the frequency of food consumption and dairy products consumption, and similarly found that as the consumption of dairy products (milk and yogurt) increased, height also increased. Protein in dairy products has been reported to have a strong effect on height (26). This study estimates that increased arm span may have resulted from increased height.

In addition, this study found that as the consumption of dairy products increased, the weight of the adolescents also increased, but no significant change was found in their BMIs. A study, which is conducted with female adolescents found that dairy products intake did not affect BMI. Furthermore, dairy products consumption was not found to affect body fat once physical activity, daily calorie intake and daily protein intake were improved (27). Similarly, O'Sullivan (28) conducted a study with Australian adolescents and found no relationship between dairy products consumption and obesity determined by BMI classification. Additionally, a two-year follow-up study conducted with 91

females aged 15 and 16 showed that dairy products consumption did not have any effect on height, weight or lean tissue mass. Small sample size may have affected the results of this study (29). In general, greater height indicated greater weight in this study. However, no significant increase in BMI was observed. Obesity is determined by comparing age with BMI. Thus, this study implies that there was no relationship between the consumption of milk and dairy products among adolescents and obesity; however, milk and dairy products have been proven to support growth and development in adolescence.

## Conclusion

We found that average dairy (milk, yogurt, *ayran*) consumption was low among adolescents. We also found that dairy intake in that age group was significantly associated with increasing in height and weight but not with BMI. Thus, we can say dairy intake promotes growth of adolescents but not obesity. Therefore, this study supports consumption of three servings of milk/dairy daily as recommended by AAP and AHA for adolescents. As well as we assert that adolescents should be encouraged for consuming recommended dairy intake. Further studies are needed to explain that which factors affect milk and dairy consumptions among adolescents.

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