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The Contribution of Dairy Products to Nutrition and Growth in Elementary School Students in Shoushtar City, Iran

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ABSTRACT

Introduction: A healthy diet & exercise are key to good physical health. The relationship between nutrition, food choices, and health is well established. Dairy is key to children's healthy growth.

Aim: The purpose of the study was to assess the contribution of dairy products to nutrition and growth among elementary school students.

Methods: A cross-sectional study was conducted in Shoushtar City, Iran, in 2021, involving 248 participants aged 8 to 11 years. Demographic data (age, gender, height, weight, ethnicity, parental education, family income) and FFQ (168 items) were collected. Data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 21.

Results: The prevalence of malnutrition was 7.7% (n=19), and 92.3% (n=229) were normal or overweight/obese. The average daily consumption of various dairy products was significantly higher among boys than among girls (p = 0.003). Average all types of daily yogurt consumption (p=0.001), condensed yogurt (p=0.03), plain yogurt (p=0.001), buttermilk (p=0.001), and both traditional and industrial ice cream (p=0.02) were significantly higher in boys than in girls. Additionally, a weakly significant relationship was observed between body mass index (BMI) (p = 0.018, r =0.151) and dairy product consumption. A positive correlation was found between average daily and monthly dairy intake and increases in height (p=0.000, r=0.282) and weight (p=0.000, r=0.833) among both boys and girls students.

Conclusion: Regular and daily consumption of dairy products was associated with normal growth in height and weight among students, irrespective of other factors such as family income and parental education levels.

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Introduction

Nutrition is a fundamental determinant of health, growth, and development across the life course. Adequate intake of energy and essential nutrients through a balanced diet, together with regular physical activity, forms the cornerstone of disease prevention and optimal physiological functioning. Early-life dietary patterns significantly impact adult health, underscoring the link between nutrition, food choices, and long-term well-being [1–3]. Nutritional status is influenced by a complex interplay of biological, physiological, cultural, socioeconomic, educational, environmental, and household factors. These determinants are particularly influential during childhood and adolescence, which are characterized by rapid physical growth and increased nutritional demands. Inadequate nutrition during these sensitive developmental periods may result in impaired growth, delayed maturation, and an elevated risk of chronic diseases later in life [4–6]. The consumption of a diverse range of foods, regular intake of a nutritious breakfast, and inclusion of healthy snacks throughout the day are recognized as essential components of a healthy dietary pattern in children, with recent evidence showing that breakfast including nutrient-rich foods such as dairy is associated with more complete nutrient intakes and better diet quality among school-aged children. [7]

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Among the major food groups, milk and dairy products play a pivotal role in meeting the nutritional requirements of children and adolescents. Dairy products provide high-quality protein and are rich sources of calcium, phosphorus, magnesium, zinc, vitamin A, vitamin B12, riboflavin, and folate- nutrients that are essential for growth, bone development, and metabolic health [8–11]. Calcium intake during childhood and adolescence is essential for achieving peak bone mass, and recent meta-analyses of randomized controlled trials confirm that supplementation with dairy products significantly increases whole-body bone mineral content and bone mineral density in children and adolescents [12- 14]. Beyond skeletal health, growing evidence indicates that dairy consumption is linked not only to improved bone health but also to enhanced overall nutrient adequacy and lifestyle outcomes. Recent research has found associations between dairy intake at breakfast and higher intakes of key vitamins and minerals, suggesting improved diet quality and potential benefits for nutrient-dependent growth and metabolic pathways [15–18]. Despite these benefits, recent population-based analyses confirm that many children worldwide still fail to meet recommended intakes of calcium-rich foods such as milk and dairy products, leading to persistent nutritional gaps with potential long-term health consequences [19–21]. Dietary guidelines consistently recommend multiple daily servings of dairy products for children and adolescents to help achieve age-specific calcium requirements; global standards indicate that daily calcium intake goals of 800–1300 mg, typically achievable through three to four servings of dairy, are essential for optimal bone accrual and metabolic function during growth [22, 23].

Inadequate dairy intake during childhood may have adverse health effects, including suboptimal bone development and increased susceptibility to dental caries. Milk and dairy products contribute to oral health by supplying calcium, phosphorus, and casein, which promote enamel remineralization. Several school-based studies have demonstrated lower rates of dental caries among children with higher milk consumption [24–26]. To address insufficient dairy intake, school milk programs have been implemented in many countries as a public health strategy to improve children's nutritional status and promote healthy dietary habits. These programs aim to enhance nutrient intake during critical growth periods and support long-term health outcomes [27, 28]. Understanding current consumption patterns and their contributions to growth and nutritional adequacy can inform targeted interventions and improved health outcomes across the lifespan. Accordingly, the present study aimed to assess the contribution of dairy product consumption to nutrition and growth among elementary school students in Shoushtar City in 2021.

Materials and Methods

This applied, cross-sectional study (ethics committee code: IR.SHOUSHTAR.REC.1400.025) examines daily dairy product consumption among elementary school students in Shoushtar City in 2021. A sample of 248 students was selected from the 22,000 students enrolled in Shoushtar City schools. Written consent was obtained from all participants. The sampling method involved randomly selecting four schools from a total of twelve in a cluster. A total of 62 students from each school, specifically from grades 3 to 5, were randomly chosen for the study. The inclusion criteria consisted of students who were willing to participate, were in third to fifth grade, and attended school in Shoushtar City. The participants' ages were between 8 and 11 years. The exclusion criteria included students who were unwilling to participate, lacked cooperation or parental assistance in completing the questionnaires, or submitted incomplete questionnaires. A demographic questionnaire and a 168-item validated food frequency questionnaire (FFQ) were utilized, demonstrating a validity coefficient of 0.375 and a kappa coefficient ranging from 0.37 to 0.61 [29]. To complete the FFQ, the frequency of consumption for each food item (daily, weekly, monthly, or yearly) was reported by the participants' parents. In cases where parents were illiterate, the researcher completed the FFQ through a face-to-face interview. To mitigate memory bias, consistent food classification methods, comprehensive training, the utilization of a food album, and seasonal and holiday reminders were employed throughout the year. Reported quantities were subsequently converted to daily gram intake by transforming consumption frequencies into daily values and multiplying by the specified quantity and standard portion size. The demographic questionnaire, developed by the researchers, included information on age, gender, height, weight, ethnicity, parental education, and family income. Shoushtar's population comprises three main tribes—Bakhtiari, Arab, and Shoushtari—each with distinct racial, linguistic, and cultural characteristics.

According to statistics from the General Department of Labor Relations and Compensation of Service of the Ministry of Cooperatives, Labor

and Social Welfare in the year 2021 (1400 Solar Hijri) in Iran, the household income levels were categorized into five groups based on the economic conditions of society at the time of this study: poor (income less than 40 million Rials), average (income between 40 and 70 million Rials), good (income between 70 and 100 million Rials), very good (income between 100 and 130 million Rials), and excellent (income exceeding 130 million Rials). This classification has undergone significant changes due to the prevailing economic crisis. Additionally, the parents' years of education were categorized into six groups based on the country's educational system: cycle, diploma, post-diploma, bachelor's degree, master's degree, Ph.D., or higher.

Students' heights were measured three times using a Chinese-made Model PORSA portable height gauge, which has a measurement error of 1 mm. Measurements were taken at 5-minute intervals while the students were barefoot and in an anatomical position. The average of the three measurements was recorded for statistical analysis. Students' weights were measured three times using a Chinese-made Model MEDISANA portable weight gauge, with a measurement error of 0.1 kg. Weight measurements were taken at 5-minute intervals with students' bare feet and wearing minimal clothing after urination. The average of the three measurements was recorded for statistical analysis. Body Mass Index (BMI) for children aged 8 to 11 was assessed using the World Health Organization (WHO) 2007 percentiles, with separate charts for boys and girls.

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 21. Due to logistical limitations, the study included 248 students. While this sample size is smaller than the calculated requirement of 379 students based on the Morgan table [Krejcie & Morgan, 1970], it still provides meaningful preliminary insights into dietary patterns among school-aged children. A post-hoc power analysis indicated that, with the obtained sample, the study achieved approximately 70% statistical power to detect the expected effect sizes. All statistical analyses were performed using appropriate methods for the sample size, including the calculation of 95% confidence intervals for proportions and means. After adjustment for the confounding factor of pubertal status, which was assumed to be randomly distributed among participants, reducing the likelihood of systematic bias in growth outcomes. The normality of the data was assessed using the Kolmogorov-Smirnov test, with a significance level set at $p > 0.05$. Frequencies and percentages were employed to analyze qualitative indicators. The Chi-square test was used to examine the association between two categorical variables. Pearson correlation test was performed to measure the strength and direction of a linear relationship between two continuous normally distributed variables, such as height, weight, BMI, and dairy products. The Spearman correlation test was applied to measure the strength and direction of a monotonic relationship between two ordinal variables or not normally distributed data. The Kruskal–Wallis test was used to compare three or more independent groups when the assumptions of one-way ANOVA were not met. The Mann-Whitney U test was used to compare two independent groups when the data did not meet the assumptions of the independent t-test (e.g., normally distributed or ordinal data). The Kolmogorov-Smirnov test revealed that dairy products were not normally distributed ($p = 0.000$).

Results

The study included 248 students (124 boys, 124 girls), with the following age distribution: 62 (8 years), 59 (9 years), 58 (10 years), and 69 (11 years). The ethnic composition comprised 84 Bakhtiari, 83 Shoushtari, and 81 Arab students. Household income levels were distributed as follows: low (3), medium (41), good (120), very good (47), and excellent (37). The Chi-square test demonstrated a significant association between ethnicity and parental years of education ($p < 0.001$). The Chi-square test showed no major difference in income between genders ($p = 0.174$). Likewise, there were no significant income differences among various ethnic groups ($p = 0.135$), as shown in Table 1. Body mass index (BMI) was calculated and classified according to the 2007 World Health Organization (WHO) growth reference charts and guidelines for children aged 5-19 years, as mentioned in the method section. The mean BMI values for boys and girls were 17.42 ± 3.4 and 17.26 ± 3.6, respectively. Among the students assessed, 7.7% were underweight/malnourished, 62.9% had a normal BMI, and 29.4% were overweight/obese. Although girls had a higher prevalence of underweight/normal weight and boys of overweight/obesity, these differences were not statistically significant between the two genders (Mann-Whitney U, $p = 0.692$). Bakhtiyari students had a more favorable mean of BMI than the other ethnic groups, but this difference was also not statistically significant (Chi-square, $p = 0.142$) (Table 2).

Table 1. Demographic Characteristics of Participants (n= 248)

Variables	Variables	Number (n)	Percentage (%)	p
Gender	Boys	124	50	0.174[b]
	Girls	124	50	
Ethnicity	Shoushtari	83	33.5	
	Bakhtiyari	84	33.9	0.000*[a]
	Arab	81	32.6	0.135[c]
Age (year)	6-7	-	-	
	8	62	25	
	9	59	23.8	
	10	58	23.4	
	11	69	27.8	
Family income/ month (IRR)	Low <40x10^6	3	1.2	0.174[b]
	Medium 40-70 x10^6	41	16.5	0.135[c]
	Good 70-100x10^6	120	48.4	
	Very good 100-130 x10^6	47	19	
	Excellent> 130 x10^6	37	14.9	
Years of parents' education	Cycle	40	16.2	
	Diploma	117	47.2	
	Post-diploma	110	44.3	0.000*[a]
	Bachelor's	190	76.6	
	Master's	35	14.1	
	Ph.D. and above degrees	4	1.6	

*[a] p<0.05 is significant using the Chi-square test (between ethnicity and the years of parents' education)
b p>0.05 is not significant using the Chi-square test (between gender and income level)
c p>0.05 is not significant using the Chi-square test (between ethnicity and income level)

Table 2. Body Mass Index (BMI) Status of Participants (n= 248)

Variable	Variable	BMI Mean ± sd	BMI	Number (n)	Percentage (%)	p
Gender	**Boys**	17.42±3.4	Malnourished	19	7.7	0.692[a]
			Healthy weight	156	62.9	
			Overweight& Obese	73	29.4	
	Girls	17.26±3.6	Malnourished	11	8.9	
			Healthy weight	80	64.5	
			Overweight & Obese	33	26.6	
Ethnicity	**Shoushtari**		Malnourished	7	8.4	0.142[b]
			Healthy weight	50	60.3	
			Overweight & Obese	26	31.3	
	Bakhtiyari		Malnourished	2	2.4	
			Healthy weight	55	65.5	
			Overweight & Obese	27	32.1	
	Arab		Malnourished	10	12.5	
			Healthy weight	51	63	
			Overweight & Obese	20	24.7	

[a] p.> 0.05 is not significant using the Mann-Whitney test (between gender and mean of BMI)
[b] p > 0.05 is not significant using the Chi-square test (between ethnicity and categorical BMI)

Results of the Consumption of Dairy Products Status

A validated 168-item FFQ [29] revealed that boys consumed significantly more dairy products daily than girls (3.91± 1.9 vs. 3.22± 1.19 servings, p = 0.003). While dairy intake was higher among Arab students compared to the other groups, the difference was not significant (p = 0.209). Conversely, girls consumed significantly more milk than boys (0.97±0.66 servings/day, p = 0.037). Milk consumption varied across ethnic groups, with Arabs having the highest and Shoushtaris the lowest consumption, though these differences were not significant (p = 0.360). Girls' consumption of whole and low-fat milk was higher than boys', but not significant (p > 0.05) (Table 3). Whole milk consumption was highest among Arabs and lowest among Bakhtiari individuals, without statistical significance (p = 0.371). Total yogurt consumption, categorized as plain, condensed, and full-fat, averaged 1.93 ± 0.77 servings per day. Boys consumed significantly more yogurt overall (p = 0.001), including plain (p = 0.001) and condensed yogurt (p = 0.030), compared to girls. Yogurt intake did not significantly differ among racial groups (p = 0.101). While boys consumed more full-fat yogurt than girls, this difference was not statistically significant (p = 0.194) (Table 3). Boys consumed significantly more buttermilk daily (0.61 ± 0.7 servings) than girls (0.37 ± 0.47 servings, p = 0.001). Buttermilk consumption varied among tribes, with the Bakhtiyari tribe consuming the most and the Shoushtari tribe the least; however, these differences were not significant (p = 0.132). Boys also consumed

significantly more ice cream daily (0.6 ± 0.62 servings) than girls (p = 0.029). This trend held for both industrial (p = 0.011) and traditional ice cream (p = 0.052), with boys consuming more of both (Table 3).

Boys consumed slightly more kashk daily (0.232 ± 0.1 servings) than girls (0.15 ± 0.09 servings), though this difference was not statistically significant (p = 0.32). This contrasts with the typical food culture of southwestern Iran, where girls tend to consume more kashk. When examining the daily intake of dairy products among the participants, the results indicated that their consumption aligned with the U.S. Department of Agriculture (USDA) Dietary Guidelines recommendation of 2-3 servings per day.

Table 3. The Daily Consumption of Dairy Products per Standard Serving Size among Participants by Gender (n= 248)

Variables	Gender	Mean ± sd	95% CI	P
All types of dairy products	Girls	3.22 ± 1.19	3.01 – 3.43	0.003*a
	Boys	3.91±1.91	3.57 – 4.25	
Milk (whole & low fat)	Girls	1.04± 0.64	0.93 – 1.15	0.037*a
	Boys	0.9± 0.7	0.78 – 1.02	
Low-fat milk	Girls	0.57±0.62	0.46 – 0.68	0.195
	Boys	0.49±0.59	0.39 – 0.59	
Whole milk	Girls	0.47±0.62	0.36 – 0.58	0.78
	Boys	0.41±0.53	0.32 – 0.50	
All types of yogurt	Girls	1.2±0.54	0.33 – 0.75	0.001*a
	Boys	1.58±0.92	0.64 – 1.20	
Plain yogurt	Girls	0.47±1.72	0.17 – 0.77	0.001*a
	Boys	0.706±0.53	0.62 – 0.80	
Condense yogurt	Girls	0.3 ±1.97	-0.05 – 0.65	0.03*a
	Boys	0.44±2.44	0.01 – 0.87	
Buttermilk	Girls	0.37±0.47	0.29 – 0.45	0.001*a
	Boys	0.61±0.7	0.49 – 0.73	
Ice cream	Girls	0.51±0.508	0.42 – 0.60	0.029*a
	Boys	0.7±0.715	0.57 – 0.83	
Traditional ice cream	Girls	0.28±0.42	0.21 – 0.35	0.052
	Boys	0.36±0.5	0.27 – 0.45	
Industrial ice cream	Girls	0.23±0.28	0.18 – 0.28	0.011*a
	Boys	0.34±0.49	0.25 – 0.43	
Kashk	Girls	0.15 ± 0.09	0.13 – 0.17	0.32
	Boys	0.23 ± 0.1	0.21 – 0.25	

*a p<0.05 is significant using the Mann-Whitney test. Confidence intervals were calculated based on a large-sample approximation.

Results of the Relation between Dairy Products and BMI Components

Pearson Correlation analysis showed a weakly significant positive correlation between the mean of dairy consumption and the mean (r = 0.151, p = 0.018). Higher daily dairy intake was associated with increased BMI, specifically in both height (r = 0.282, p = 0.000) and weight (r = 0.833, p = 0.000). No significant correlation was found between the mean of dairy consumption and either individual years of parents' education (r = 0.069, p = 0.281) or the mean of household income (r = 0.016, p = 0.806) using Spearman's Correlation analysis (Table 4).

Table 4. Correlation between Dairy Products, BMI Components, and Demographic Factors

Variables	Dairy products		Age	
	r	p	r	p
BMI	0.15	0.018*a		
Height	0.28	0.000*a		
Weight	0.83	0.000*a	0.54	0.000*b
Years of parents' education	0.027	0.67		
Household income	0.07	0.28		

*a p<0.05 is significant using the Pearson Correlation test
*b p<0.05 is significant using the Spearman Correlation test

Discussion

In this study, the average BMI for girls and boys was 17.26 ± 3.546 and 17.42 ± 3.413, respectively. These results differ from previous research, which indicated that boys typically have a lower average BMI than girls [30]. In the current study, a higher percentage of boys (32.2%, n = 40) were classified as overweight/obese compared to girls (26.6%, n = 33). Conversely, the prevalence of malnutrition was greater among girls (8.9%, n = 11) than among boys (6.55%, n = 8). A 2017 study employing BMI adjustments indicated a notably elevated prevalence of overweight and obesity

among South Asian children in England, a trend not evident in unadjusted data. Conversely, adjusted data showed a decreased prevalence of overweight and obesity in Black children, except for older girls [31]. A 2022 study indicated that South Asian children, despite having a similar average BMI to their white counterparts, exhibited a higher prevalence of overweight and obesity, with approximately a 10% greater proportion. Furthermore, the percentage of children with total body fat (TBF) exceeding 35% was 22% and 16% higher in South Asian boys and girls, respectively [32]. The BMI results of the current study also were not supported by the study in 2016, which reported girls aged 7, 9, 10, and 11 had higher mean BMI ($p<0.05$). Overweight was more common in girls (9.7% vs 5.5% in boys), but obesity was ~3.5x higher in boys [33]. In this study, boys consumed significantly more dairy than girls (3.91 ± 1.91 servings vs. 3.22 ± 1.19 servings per day). Although girls had higher average milk consumption, boys consumed more of all kinds of dairy products except milk. A statistically significant positive correlation was found between dairy consumption and BMI, height, and weight. Increased dairy consumption was associated with taller stature and higher BMI. Likewise, students with greater weight consumed more dairy products in a month. These findings align with a study of male elementary students in Birjand, which also found a positive correlation between BMI and dairy/milk consumption [34]. Although a systematic review showed that supplementing the usual diet with dairy products significantly increased bone mineral content during childhood [35]. A systematic review and meta-analysis concluded that dairy product supplementation promotes linear growth, substantiating the theory that shifts in dairy consumption during the 19th and 20th centuries influenced height trends [36]. A 2022 study, controlling for age, sex, BMI-z-score, and socioeconomic status, found that each increment of unsweetened dairy intake was associated with a 0.04 higher height-for-age z-score (HAZ), equivalent to a 0.3–0.4 cm increase ($p < 0.05$), and a reduced risk of relatively short stature (RSS) (OR 0.90, 95%CI: 0.84, 0.97, $p < 0.01$). Sweetened dairy products did not demonstrate similar associations [37]. The present study revealed that all participants adhered to the U.S. Food and Drug Administration's (FDA) recommended daily dairy intake of 2-3 servings, as per established food pyramid guidelines. However, another study did not confirm these findings. It showed that 59% of boys and 55% of girls drank less milk than recommended [38]. Children's milk consumption correlated with their education but not with their sex. Milk consumption patterns are linked to children's sex/education and parents' education/occupation. Milk knowledge is linked to the mother's education/occupation, not the child's sex [38]. The discrepancies between the present findings and previous studies may be attributed to differences in the demographic and ethnic characteristics of the study populations, age and sex distribution, methods used for BMI classification, and whether adjusted or unadjusted BMI measures were applied. In addition, BMI may not fully reflect body fat distribution or total body fat percentage in children. Variations in dietary habits, particularly dairy intake, socioeconomic status, parental education, lifestyle factors, and temporal changes in nutrition patterns may also explain the observed differences. In the present study, boys consumed significantly more dairy products than girls, and dairy intake was positively correlated with BMI, height, and weight, which may partly account for the higher prevalence of overweight/obesity among boys compared with girls.

Conclusion

Dairy consumption in 8-11-year-olds was generally within recommended ranges. Boys consumed more dairy, yogurt, buttermilk, and ice cream, while girls drank more milk, indicating gender-based preferences. Ethnic variations in dairy intake existed but were not significant. Nearly one-third were overweight/obese, yet BMI didn't significantly differ by gender or ethnicity. Total dairy intake correlated positively with BMI, weight, and height, possibly reflecting growth rather than unhealthy weight gain. Dairy intake wasn't linked to parental education or income, suggesting cultural habits, preferences, and availability are stronger influences. Overall, the results emphasize the importance of promoting balanced dairy consumption as part of a healthy diet, while also encouraging appropriate food choices, physical activity, and weight management strategies among school-aged children. Future studies with larger sample sizes and longitudinal designs are recommended to clarify the causal relationship among dairy intake, growth indicators, and BMI status across different ethnic and socioeconomic groups. Future studies are recommended to assess the association between dairy consumption and anthropometric outcomes using energy-adjusted regression models.

Limitation and Research Recommendations

A limitation of this study is the reduced sample size. Although the results offer valuable preliminary insights into dairy consumption and nutritional status among elementary school children, the limited sample may affect the precision of proportion estimates and the detection of subtle correlations. Further research employing larger samples is warranted to validate and build upon these initial observations. Parental height, although indicative of genetic growth potential, was not included in the analysis due to the lack of reliable and systematically collected data. Furthermore, the present study focused on modifiable nutritional factors, particularly dairy consumption, rather than non-modifiable genetic determinants.

Declarations

Acknowledgment

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Conflicts of Interest

The authors declare have no conflicts of interest to disclose.

Code of Ethics

IR.SHOUSHTAR.REC.1400.025

Artificial Intelligence (AI)

The authors enhanced the text's language and readability using Sider AI.

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