Original Article

Consumption of dairy products in adolescents in Tehran

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Abstract

Background: Dairy products are required for bone metabolism; however, the majority of adolescent do not consume the products adequately. This study was performed to assess the prevalence of dairy products consumption, daily calcium, vitamin D intake, and vitamin D deficiency.

Methods: In this cross-sectional study, 444 females and males' students in middle and secondary school were recruited by using mixed sampling method. Food Frequency Questionnaire (FFQ) was used to estimate dietary calcium and vitamin D consumption. Serum calcium, and 25 (OH) vitamin D were measured. The data was analyzed by IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp. T-test, Chi^2 and Spearman correlations tests were used as well.

Results: Out of all participants, 214 (48.2%) were females. The average age of the participants was 14.34 years and 206 (46.6%) of the students were in middle and 238 (53.6%) were in high school. 409 (92.1%) of the students consumed at least one glass of milk per week. Calcium intake from milk and yoghurt was more than calcium intake from other dairy products. The amount of calcium lower than 700 mg/day was consumed in 176 (39.6%) of adolescents. There was a significant positive correlation between weekly calcium intake and serum vitamin D level (P=0.001). The prevalence of vitamin D deficiency was higher in females rather than males (151 (71.2%) vs. 40 (17.5 %)).

Conclusion: Adolescents in Tehran do not consume dairy products enough. Indeed, encouraging teenagers to consume dairy products and alter in dietary patterns that improve calcium intake, should be taken in to consideration.

Keywords: adolescent; calcium; Dairy Products; vitamin D; Vitamin D Deficiency

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Introduction

Calcium and vitamin D are necessary for optimal bone mineral accrual in adolescence (1). Apparently, Inadequate calcium intake and vitamin D deficiency could occur at the same time, vitamin D deficiency leads to a decrease in dietary calcium absorption, changed formation of the growth plate, and defective mineralization of skeleton and result rickets. The odds ratio for developing rickets with a daily calcium intake below 300 mg was 4.8 (2-4).

Milk and dairy products are known as the principal sources for calcium and if fortified with vitamin D, could be desirable sources of edible vitamin D.

Nonetheless, in these last decades, dairy products consumption in adolescents decreased dramatically and the majority of juveniles and young adult have not meet daily recommended intake of milk and the other dairy products (1, 5, 6).

Although, accurate evidence regarding the amount for the consumption is needed, the amount of daily calcium and vitamin D intake is not available in Iranian adolescence. It appears, calcium and vitamin D nutritional intake is not enough in the mentioned groups.

Since, there are not sufficient data available, the present study was performed to assess the amount of dairy products consumption, daily calcium, and vitamin D intake and eventually the prevalence of vitamin D deficiency in adolescents in Tehran.

Methods

This cross sectional study was done on 15-19-year old females and high school students in both genders from different districts of Tehran, Iran. The study took place in wintertime (from February 1st 2012 to March 30th 2012). In this study a mixed sampling method including stratified random sampling and two-stage cluster sampling was applied.

Initially, the districts in Tehran were divided into 3 strata (high, middle, and low) based on the socioeconomic status (SES), by using the Urban Health Equity Assessment and Response Tool Study (Urban HEART) carried out by Tehran municipality. Districts 16 and 17 were from 'low SES; additionally, the 10^{th}, 11^{th}, and 13^{th} districts were from 'middle SES; moreover, 3 districts were from 'high SES' in this study design.

Then, by using Block Balanced Randomization Method, 12 schools from each strata were selected. Hence, 36 schools were entered into the study. Promptly, 3 middle schools and 3 male high schools were randomly chosen from the list, provided by the education ministry for each district. A similar strategy was used to select females' schools. The entire students in these schools were recruited. Also, the study design and method for sampling were published in the previous article (7).

This research was carried out in compliance with the Helsinki Declaration and approved by the ethical committee of the Institute of Endocrinology and Metabolism, Tehran University of Medical Sciences. The ethical code is the Ethical Board Committee of the Endocrinology and Metabolism Research Institute and Clinical Trials Gov (NCT02035423). The entire parents signed an informed consent.

Inclusion criteria indicated that all the participants who got their educations in these selected schools, their parents signed informed consent form and the students as well tended to participate in the present study. If parents did not agree with their child giving serum samples, the other student on the list could be selected through the same procedure.

Exclusion criteria included, students who took vitamin D supplements (different forms of Calcium and Vitamin D supplements or multivitamins containing Calcium and Vitamin D) during the past three months, suffering from underlying conditions (liver, kidney, gastrointestinal, cancer, endocrine, bone, and biliary disease) or consumed medication affected bone metabolism (anti-convulsions, anti-tuberculosis medication, HMG-CoA inhibitors, cimetidine, theophylline, and cholestyramine), as well as those who were following special diets; such as vegetarian diet or consumed fortified products regularly could not participate.

A team expert including 2 skilled technicians, 1 physician and a fully equipped ambulance were sent to each school. Approximately, 10cc of blood was drawn between 7:00 am and 9:30 am after the students had fasted for at least eight hours, if the students were non fasting, sampling was done the following day. Serum serum samples were used to determine calcium and 25 (OH) D.

Serum samples were taken in a sitting position according to the standard protocol. Participants rested in the seated position for 15 minutes prior to the blood collection. This waiting period allowed the calibration of the concentrations of blood components. The vacuum tubes were immediately placed on wet ice and transferred to the Endocrinology and Metabolism Research Institute (EMRI) laboratory. For serum separation, we allowed the blood to clot and separated it by centrifugation at 3000 revolutions per minute for 10 min.

Serum samples were aliquoted into four vials for freezing at -70 °C until assayed. Serum calcium levels was determined by colorimetric method of 3.9%. Vitamin D was measured by Enzyme Immunoassay by CV% of 9%. All the samples with high concentration of analytes (more than reportable ranges) were diluted according to the kit protocol and assessed again.

The normal ranges of blood vitamin D for adolescents considered >30 ng/ml. Serum 25-hydroxyvitamin $20 \leq D \leq 30$ ng/ml considered as vitamin D insufficiency and serum 25-hydroxy vitamin D <20 ng/ml as vitamin D deficiency. The normal ranges of blood calcium for adolescents considered 6.7-10.7 mmol/L. Recommended Dietary Allowance was defined as the average daily dietary nutrient intake level that was sufficient to meet the nutrient requirements of nearly 97 to 98 % of healthy individuals in a particular life stage and gender group. This value was 1300 mg/day for calcium and 200 IU/day for vitamin D in 9 through 13 years (8).

The students then asked to fill a questionnaire on their demographic data, possible underlying diseases, and bone health-related lifestyle habits. They also asked to fill out a weekly questionnaire on their compliance with milk consumption and possible reasons for not consuming milk regularly. The questionnaire in the subgroup also contained a section for assessing Ca and vitamin D food intake in the past three months.

Eventually, the data were analyzed by using Windows, Version 19.0. Armonk, NY: IBM Corp. T-test, Chi square and Spearman correlations tests were used. *P* value less than 0.05 was statistically significant.

Results

The total number of participations was 444 individuals and the number of females and males participants were 214 (48 .2%) vs. 230 (51.8%). The average age was 14.3±1.92 years. Approximately, 206 (46.4%) of students were in middle school and 238 (53.6%) were in high school. The serum calcium was 9.9±0.54 mg/dl in these participants. The serum 25 OH vitamin D was analyzed separately according to the gender; additionally, it was significantly ($t=8.242$, $P<0.001$) higher in males (31.3±14.72 ng/ml) rather than females (19.8±14.37 ng/ml).

We analyzed the dairy consumption in detail in adolescents according to their responses to Food Frequency Questionnaire (FFQ) (Table 1). The most dietary sources for calcium which was used among adolescents in both gender were milk, plain yogurt, cheese, dough (yogurt drink), and ice cream, respectively. About, 92.1% (409) of students consumed at least one unit of milk per week with higher consumption among boys rather than girls.

Only 2.6% (6) of males consumed milk in a week; while this was 13.6% (29) in females. In addition, the percentage of males that consumed milk was more than 5 units per week which was significantly ($P<0.001$) greater rather than females (60.9% (140) vs. 46. 7% (100)). There was a significant ($P=0.021$) difference in milk consumption between middle and high school students with higher consumption in middle school students (mean: 10.62 units per week vs. 7.98).

Apparently, the mean weekly yoghurt consumption in Tehran adolescents was near the mean of milk consumption (9.06 unit per week vs. 9.20) and it worth to mention the percent of

Table 1. Dairy products consumption measurement according participants´ responses to Food Frequency Questionnaire (FFQ)

Parameter	Boys n=230 N(%)	Grils n=214 N(%)	Total n=444 N(%)	*P** Chi ^{2}
How many glasses do you consume milk per week?				
No consume per week	6(2.6)	29(13.6)	35(7.9)	<0.001
One to two units per week	39(17)	40(18.7)	79(17.8)	
Three to five units per week	45(19.6)	45(21)	90(20.3)	
More than five units per week	140(60.8)	100(46.7)	240(54)	
How many bowls do you consume yoghurt per week?				
No consume per week	16(7)	11(5.1)	27(6.1)	0.431
One to two units per week	29(12.6)	38(17.8)	67(15.1)	
Three to five units per week	57(24.8)	49(22.9)	106(23.9)	
More than five units per week	128(55.6)	116(54.2)	244(49.9)	
How many match boxes do you consume cheese per week?(%)				
No consume per week	25(10.9)	31(14.5)	56(12.6)	0.661
One to two units per week	34(14.8)	28(13.1)	62(14.0)	
Three to five units per week	35(15.2)	29(13.6)	64(14.4)	
More than five units per week	136(59.1)	126(58.8)	262(59.0)	
How many glasses do you consume Dough (yoghurt drink) per week?(%)				
No consume per week	33(14.3)	47(22)	80(18.1)	0.174
One to two units per week	60(26.1)	55(25.7)	115(25.9)	
Three to five units per week	49(21.3)	36(16.8)	85(19.1)	
More than five units per week	88(38.3)	76(35.5)	164(36.9)	
How many spoons do you consume cream per week?(%)				
No consume per week	72(31.3)	95(44.4)	167(37.6)	0.009
One to two units per week	51(22.2)	36(16.8)	87(19.6)	
Three to five units per week	45(19.6)	24(11.2)	69(15.5)	
More than five units per week	62(26.9)	59(27.6)	121(27.3)	
How many ice creams do you consume per week?(%)				
No consume per week	26(11.3)	38(17.8)	64(14.4)	0.222
One to two units per week	77(33.5)	63(29.4)	140(31.5)	
Three to five units per week	54(23.5)	43(20.1)	97(21.8)	
More than five units per week	73(31.7)	70(32.7)	143(32.3)	
How many spoons do you consume butter per week?(%)				
No consume per week	82(35.7)	86(40.2)	168(37.8)	0.615
One to two units per week	41(17.8)	30(14)	71(16.0)	
Three to five units per week	32(13.9)	32(15)	64(14.4)	
More than five units per week	75(32.6)	66(30.8)	141(31.8)	

*The consumption level of each dairy products, which has a 4-part answer, was considered as a multivariate qualitative variable and its relationship with the gender variable was evaluated by Chi ^{2} test.

students that consumed at least one unit of yoghurt in a week were more than those who consumed at least one unit of milk (93.9% (417) vs. 92.1% (409)). More information regarding the dairy consumption is presented in Table 1.

Fluid milk and plain yogurt provided the largest mean percentile of calcium (5634.6 gram per week) intake for both girls and boys. The mean amount of intake calcium from milk was 2735.2 gram per week; however, it was lower than the amount of calcium intake from yoghurt (2899.4 vs 2735.2 gram per week). The amount of calcium intake from other dairy products including cheese, dough (yogurt drink), cream, ice cream, and butter measured in these students also. Calcium intake from any kind of dairy products was higher in males than females; although these data were not significant (P>0.05) (Fig 1).

Our study indicated that the mean intake of calcium in daily diet from dairy products, as the essential source of calcium, was less than recommended dietary allowance value which would be appropriate for these critical ages (1176.5±48.12 mg/day) and in 39.6% (176) of adolescents were lower than 700 mg/day, nearly equal to the proportion in both genders; nevertheless, the mean calcium intake was in male adolescents higher than female adolescents (1240.20 mg/day vs. 1108.05 mg/day); although, it was not significant. (P>0.05).

The mean±SD for daily vitamin D intake from dairy products in males was 56.8±3.36 IU/day and in females was 51.6±3.27 IU/day and none of the participants meet the recommended dietary allowance for vitamin D.

The average for serum calcium level was 9.89±0.03 mg/dl in males and 9.99±0.03 mg/dl in females with a significant (P=0.012) higher range in females and The average of 25 OH vitamin D was in males 31.32±0.97 ng/ml and in females 19.89±0.98 ng/ml that was statistically significant (P<0.001) higher in males than females.

There was a significant positive correlation (Pearson Correlation=0.154) between weekly calcium intake and serum vitamin D level (P=0.001). As it is showed in figure 2, the prevalence of normal range for serum vitamin D was higher in adolescents that consumed calcium more than 5000 mg per week rather than the others (26.3% vs. 16.8%). Indeed, the prevalence of vitamin D deficiency in females was higher compared to males (71.2% vs. 17.5 %). (Figure 2)

Discussion

Dairy products are one the most indispensable source of calcium which should be used in daily regime to protect bone health. It is essential to consume in adolescence age, especially in female adolescents, since the influence in later generation has been proven (1, 5, 6).

Our results showed dairy products are not consumed in recommended measure in Tehran's adolescents; as a consequence, calcium and vitamin D could not provide sufficiently for physiological functions, including bone formation.

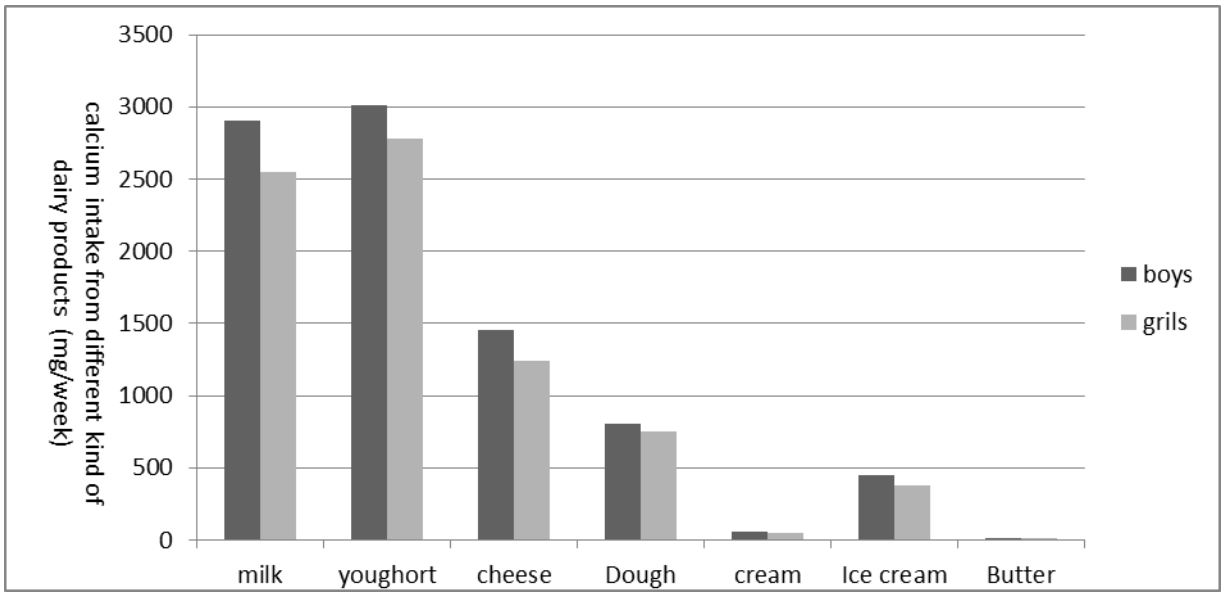

Figure 1. Calcium intake (according to average weekly consumption) from different kind of dairy products in boys and girls separately

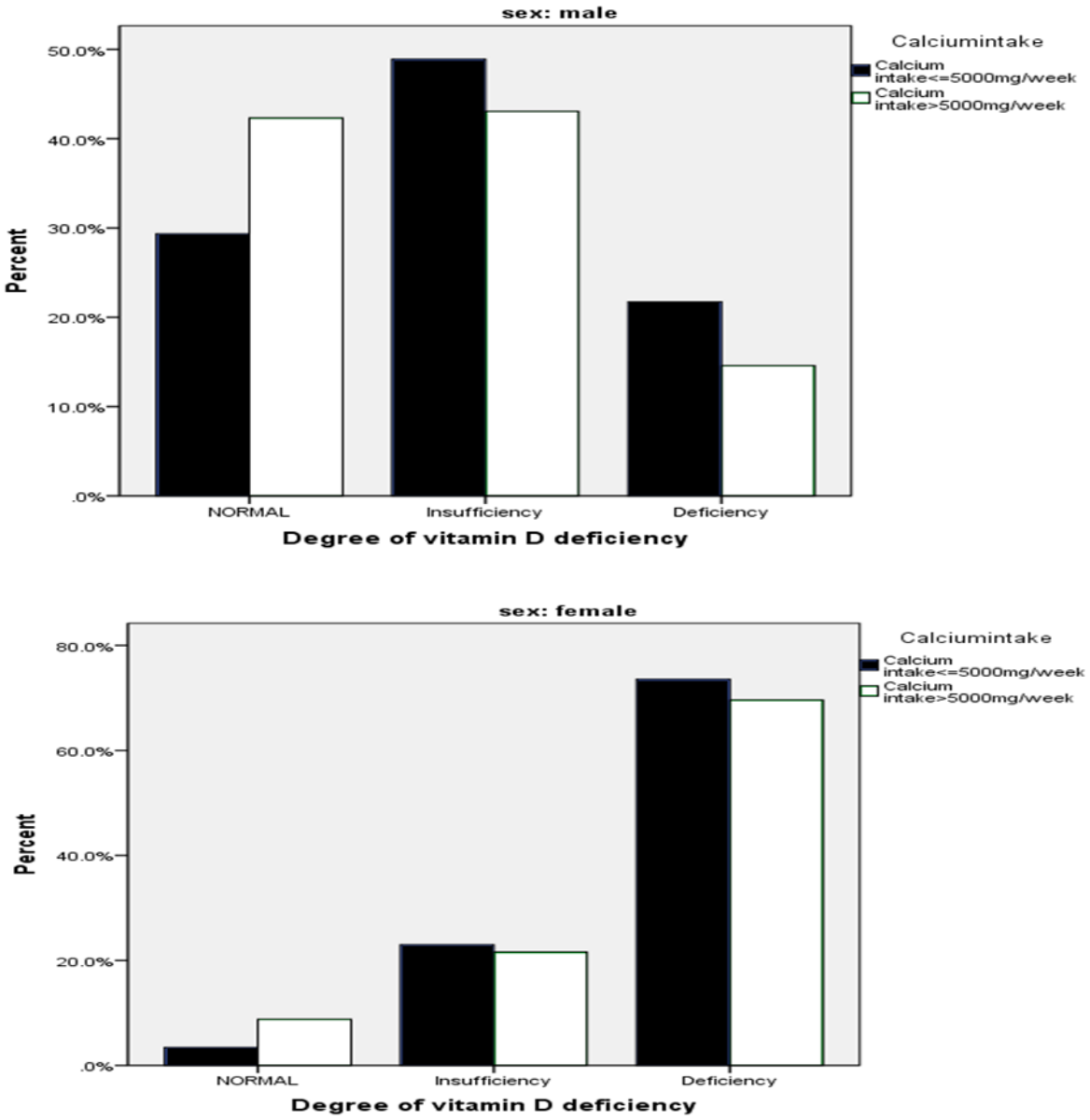

Figure 2. Degree of vitamin D deficiency in different calcium intake in both genders

It was demonstrated that consuming ≥2 servings/day of dairy (versus less) was associated with a significant higher mean bone mineral content (BMC) and area (BA) and children who avoided milk, suffer from more fractures than children who consumed milk (9, 10).

As our results showed, the data was in accordance to the previous studies. Apparently, adolescents who did not use dairy products in adequately and used other drinks instead had some problems specially in female adolescents (1).

In our study the lack of milk intake increased with increasing in age, that is in concordant with The CSFII (Continuing Survey of Food Intakes by Individuals) study; it showed that between ages 12 and 19 years, the intakes of fruit juice, soda, tea, fruit drinks, and alcoholic beverages either increased or remained relatively steady, whereas milk intakes decreased with an increase in age (11).

In a cross sectional study on 1047 Iranian students (42.2% were males and 57.8% were females); the median of milk consumption was only 3 glasses per week, ranging from 0 to 7 (12). Although, the median for the usage of milk was the same in our study, the range was different from 0 to 3 glasses per week.

Apparently, the calcium intake among adolescents is inadequate globally; for example, from the National Health and Nutrition Examination Survey (NHANES; 1999–2000), detected that mean calcium intake for females 12–19 years was 793 mg/day (13).

In addition to the calcium intake, the intake of vitamin D from food sources and dietary supplements did not meet the recommended criteria especially in females who were teenagers and female adults. Distinctly, only 50% of girls (age 9–13 years) and 32% of girls (age 14–18 years) a meet the dietary reference intake recommendation for vitamin D (14); unfortunately, no one full filled the criteria for the dietary reference intakes for vitamin D in our study. The reason could be due to the fact that dietary sources of vitamin D are low and only few products such as milk, orange juice, and breakfast cereals fortified with vitamin D in some countries (1, 15).

The mineralization time for bon occurs in adolescence. Approximately, 26% of adults' calcium mineralization takes place during the adolescent years and it has been confirmed that the increase in dietary calcium to the optimal levels of 1200–1600 mg/d has a positive effect on bone in adolescents; therefore, foods that provide adequate dietary calcium intake; such as, dairy products should be encouraged (16-20).

As mentioned, 25 (OH) vitamin D deficiency status can have adverse effects on bone health and prolonged 25 (OH) vitamin D deficiency could cause rickets in children and osteomalacia in adults (21). Our finding showed that the prevalence of 25 (OH) vitamin D deficiency in Tehran adolescents is high similar to many regions including middle-east and southeast Asia; in addition, The high prevalence of 25 (OH) vitamin D deficiency in Iran is similar to the results attained from other studies in middle east area, 75.1% of women and 72.1% of men in Iran have different levels of 25 (OH) vitamin D deficiency (22, 23); nonetheless, in our study vitamin D deficiency in female adolescents was more prevalent than male adolescents (71.2% vs. 17.5 %).

The present study contained some limitations. In our study, only adolescents lived in Tehran providence included in the study. Moreover, due to the small sample size in our study, we cannot distinctly conclude the result for the whole population. Indeed, further research is needed to assess the amount of dairy products consumption, daily calcium, and vitamin D intake in adolescents living in other cities and rural areas.

It was ultimately attained that there is an insufficient calcium and vitamin D intake in adolescents, hence specific strategies to increase the intake of nutritional sources are needed. Also, vitamin D deficiency is common among healthy adolescents in Tehran. The usage of foods with high calcium sources and changing the dietary patterns could affect calcium intake among adolescents. Additionally, increasing vitamin D fortification of dairy products can be considered as a population-wide public health strategy in Iran.

Conflict of interest

Authors declare no conflict of interests.

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