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Milk and dairy products intake in child-juvenile population in Navarre, Spain

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Abstract

Objective: **To make a descriptive study of milk and dairy products intake in a population of school-children and adolescents and to analyze its nutritional contribution in the diet of this population.**

Methods: **A nutrition survey was carried out in the form of personal interview (food intake registration of 3 consecutive school days) in a sample of 353 school-children, aged 9 to 12 years, and 406 adolescents, aged 13 to 16 years, in Pamplona, Spain.**

Results: **Dairy products intake was referred by 94% of the respondents in breakfast, 69.3% in supper, 42.1% in lunch, 23.3% in the afternoon snack and 16.4% in the mid-morning snack (there were no statistically significant differences among the groups of age).**

The mean number of diary products servings was 2.0, being higher ($p<0.05$) among adolescents (2.22) as compared to school-children (1.75). Milk and dairy products constitute the main source of calcium, iodine, magnesium and phosphorous, as well as riboflavin, vitamin B12 and vitamin A, and also contribute substantially to the daily intake of calories, proteins, potassium and zinc; although they provide significant amounts of saturated fat and cholesterol.

Conclusions: **The intake of milk and derivatives in child-juvenile population is inappropriate. The need to undertake a massive public enlightenment campaign involving families regarding the nutritional importance of this food group should be considered.**

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CONSUMO DE LECHE Y DERIVADOS EN LA POBLACIÓN INFANTO-JUVENIL DE NAVARRA (ESPAÑA)

Resumen

Objetivo: **Realizar un estudio descriptivo del consumo de leche y derivados lácteos en una población de escolares y adolescentes y analizar su contribución nutricional en la dieta de estos jóvenes.**

Material y Métodos: **Registro de consumo de alimentos de tres días lectivos consecutivos en una muestra de 353 alumnos que cursaban Educación Primaria, entre 9 y 12 años de edad; y a 406 alumnos que cursaban Educación Secundaria Obligatoria, entre 13 y 16 años, en la ciudad de Pamplona (Navarra, España).**

Resultados: **El 94% de los encuestados referían haber tomado lácteos en el desayuno y, en menor proporción, en la cena (69,3%), comida del mediodía (42,1%), merienda (23,3%) y almuerzo (16,4%). No existían diferencias estadísticamente significativas entre los grupos de edad. El valor medio del número de raciones de lácteos consumidas por la totalidad de los encuestados era de 2 diarias, siendo significativamente superior ($p<0,05$) en el grupo de adolescentes. La leche y derivados constituyen la principal fuente dietética de calcio, yodo magnesio y fósforo; así como de riboflavina, vitamina B12 y vitamina A y, además, contribuyen sustancialmente al aporte diario de calorías, proteínas, potasio, magnesio y zinc; aunque también contribuyen sustancialmente al aporte de lípidos totales, ácidos grasos saturados y colesterol.**

Conclusión: **En la población infantojuvenil el consumo de leche y derivados es inadecuado y, en consecuencia, cabría contemplar la necesidad de una divulgación masiva de información entre las familias acerca de la importancia nutricional de este grupo de alimentos.**

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Palabras clave: *Adolescentes. Escolares. Ingesta de lácteos. Leche.*

Introduction

Ninety per cent of body calcium is stored in bone tissue and the remaining 1% is distributed among soft tissue and extra cellular fluid. The acquisition of an optimal bone mass is basically conditioned by the dietary intake of calcium and physical activity. A positive mineral balance for calcium during childhood and adolescence is mandatory, and it should be extended up to 24-25 years of age, the time when skeleton maturation is reached.

The peak bone mass attained by the time of skeleton maturation is the most determining factor in bone mass in older ages, and, therefore, a deficient calcium intake during the period of active growth not only could condition the predicted final height, but also would be a risk factor for osteoporosis and osteoporotic fractures in adult life[1-4].

The recommended daily intake for calcium in ages 9-18 years is 1300 mg per day. In addition, at least 60% of daily dietary calcium should be supplied by means of milk and derivatives, given its higher bioavailability[5,6]. Therefore, dairy products should provide at least 780 mg of calcium on a daily basis during this period (9-18 years) of age, which would correspond with the intake of the three servings of dairy products (equivalent dairy products whit an estimated 250-300 mg calcium contribution) which are recommended in the food pyramid[7].

Food consumption surveys show how milk and derivatives intake displays a decreasing trend along with age, and this could condition maximum bone mineral content that is presumably reached within the third decade of life[8-13]. This potential nutritional impairment justifies the interest in evaluating milk and derivatives intake in those sectors of population whose bone mineralization is still in a critical situation, as it occurs in school children and adolescents.

The aim of the present work is to make a descriptive study of milk and derivatives intake in a population of school children and adolescents and to analyze its nutritional contribution in the diet of this population.

Material and methods

A nutritional survey was carried out in a sample of 353 primary education students (school children group), aged 9 to 12 years, and 406 secondary education students (adolescents group) aged 13 to 16 years, from four public school centers in the city of Pamplona (Navarre, Spain) in the January-June, 2013 period.

Surveys were conducted by means of face-to-face interview by students of the last course of the degree in human nutrition and dietetics of the University of Navarre. The method they used is the registration of food intake during three consecutive academic days. Every student was asked about the food intake within the previous three consecutive days in every meal (breakfast, mid-morning snack, lunch, afternoon snack and supper).

With respect to dairy products intake, a serving of dairy were defined as the following amounts of dairy products: a glass of milk (250 ml), two yogurts (250 g), semi-mature cheese (60 g), fresh cheese (120 g), milkshake (250 ml), junket (150 g), custard-pudding (250 ml) and ice-cream (200 ml). The calculation of the size of the portions corresponding to the different food groups was made using a photograph notebook for estimation of portion sizes from the *Institut Scientifique et Technique de la Nutrition et de l´Alimentation* (París, 2002)[14].

Calorie and macronutrients (proteins, carbohydrates, total fat, saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA), total fibre and cholesterol), minerals (calcium, iron, iodine, magnesium, zinc, selenium and phosphorus) and vitamins (thiamine, riboflavin, niacin, vitamin B6, folates, vitamin B12, vitamin C, vitamin A, vitamin D and vitamin E) intake was calculated individually using the Nutrition Calculation Program CESNID 1.0® (Centro de Enseñanza Superior de Nutrición y Dietética. Universidad de Barcelona)[15]. The updated charts of the National Academy of Sciences[16] were used as reference values for the daily recommended intake (dietary reference intake) for minerals and vitamins.

Results are displayed as means (m) and percentages (%) with corresponding standard deviation (SD) or confidence intervals (95% CI). Statistical analysis (Student's T, comparison of proportions) was made using the program SPSS version 20.0 (Chicago, Illinois, USA). Statistical significance was assumed when p value was below 0.05.

Results

Characteristics of the sample

The group of primary education students was made up of 188 males (53.3%) and 165 females (46.7%); the average age was 10.51 years (CI 95%: 10.3-10.7). The group of secondary education was made up of 194 males (47.8%) and 212 females (52.2%); the average age was 14.6 years (CI 95%: 14.5-14.7).

Consumption frequencies

Table I shows consumption frequencies of milk and derivatives in the different daily meals in the entire sample. There were no statistically significant differences among the groups of age. Dairy products intake was referred by 94% of the respondents in breakfast, 69.3% in supper, 42.1% in lunch, 23.3% in the afternoon snack and 16.4% in the mid-morning snack. Milk intake was mainly associated to breakfast (88.3%),

Table I
Consumption frequencies (%) for milk and other dairy products from different meals

Meals	*Milk (%)*	*Yogurt (%)*	*Cheese (%)*	*Other Dairy (%)*
Breakfast	88,3	3,5	2,2	0,1
Mid-morning snack	5,3	4,0	8,3	0,2
Lunch	4,4	28,4	4,4	5,2
Mid-afternoon snack	9,4	8,7	3,4	2,0
Supper	16,0	29,8	18,3	5,5

yogurt consumption in lunch (28.4%) and/or dinner (29.8%) and, finally, cheese intake was frequent in supper (18.3%).

Milk and other dairy products intake

Table II shows and compares the average values of daily milk and derivatives intake by groups of age and sex. The consumption of milk, yogurt, other dairy products and total dairy products was significantly higher ($p< 0.05$) in the adolescent group. The consumption of yogurts was significantly higher ($p< 0.05$) in males within the school children group. The intake of total dairy products was significantly higher ($p<0.05$) in males within both groups.

All respondents within the school children group referred to drink whole milk whereas 21.7% of adolescents consumed skim or semi-skim milk ($p<0.05$). In the same way, 82.8% and 85.3% of the intake of yogurts in school children and adolescents was as flavored whole milk yogurts, respectively (n.s.). Within the school children group, 82.2% of cheese intake was as mature cheese and 17.8% as fresh cheese, whereas within the adolescents group, cheese intake was 59.7% as mature cheese and 40.3% as fresh cheese, respectively ($p<0.05$). With regard to the consumption of other dairy products, within the school children 50.5% of the intake was as custard, whereas within adolescents 44.3% of the intake was as pudding. From the total dairy products intake, those made with skim milk represented 1% and 14.8% ($p<0.05$) in school children and adolescents, respectively.

Table III exposes and compares the percentage contribution of milk and derivatives to the total dairy products intake, as well as the average values for the number of dairy servings by groups of age. From the total amount of dairy products intake, milk and yogurts

Table II
Average daily intake of milk (ml) and other daily products (g) by groups of age and sex

Age groups (years)	*Milk (ml)*	*Yogurt (g)*	*Cheese (g)*	*Other Dairy (g)*	*Total Dairy (g)*
9 to 12					
Boys	277,2	97,5	15,4	23,7	413,8
Girls	264,3	62,5	18,4	20,4	365,6
Total	266,5*	80,1*	16,9	20,8*	384,3*
13 to 16					
Boys	308,5	103,2	29,5	47,2	488,4
Girls	294,7	91,9	22,8	43,6	453,0
Total	305,1*	96,4*	26,8	45,4*	473,7*

(*) $p<0.05$ among groups of age.

Table III
Percentage contribution (%) to the total dairy products intake from milk and derivatives and average values for the number of portions by groups of age

Age groups (years)	*Milk (%)*	*Yogurt (%)*	*Cheese (%)*	*Other Dairy (%)*	*Portions (number)*
9 to 12	69,3	20,8	4,4	5,5	1,75
13 to 16	64,4	20,4	5,7	9,5	2,22*
Total	66,6	20,5	5,2	7,8	2,00

(*) $p<0.05$ among groups of age.

represented 87.1%, showing no statistically significant differences among groups and sexes. The mean value for the number of servings consumed by the entire group of surveyed students was 2 servings per day, being significantly higher ($p<0.05$) in the adolescents group.

Calorie and nutrients intake

Table IV displays and compares the average values for calorie, macronutrients, cholesterol, minerals and vitamins intake provided by milk and derivatives by groups of age. The contribution of calories as well as some macronutrients (proteins and carbohydrates), minerals (calcium, iodine, magnesium, sodium and potassium) and vitamins (folates and vitamin A) were significantly higher ($p<0.05$) in the adolescent group.

Table IV
Average calorie and nutrient intake per day from milk and dairy products in different groups of age

Groups of age (years)	*9 to12 Mean (SD)*	*13 to 16 Mean (SD)*
Energy (Kcal)	349 (105.9)	410 (124.4)*
Proteins (g)	18.3 (3.8)	22.6 (4.9)*
Carbohydrates (g)	28.2 (5.4)	37.4 (7.1)*
Fat (g)	18.1 (4.9)	18.9 (4.8)
SFA (g)	10.6 (2.5)	11.0 (2.7)
MUFA(g)	5.0 (1.6)	5.2 (1.7)
PUFA (g)	1.3 (0.2)	1.4 (0.3)
Cholesterol(mg)	58.2 (17.4)	60.8 (18,0)
Calcium (mg)	574 (109.6)	675 (128.2)*
Iron (mg)	0.44 (0.13)	0.51 (0.16)
Iodine (mg)	35.7 (9.7)	47.6 (13,0)*
Magnesium (mg)	49.9 (13.1)	70.3 (18,6)*
Zinc (mg)	2.0 (0,4)	2.4 (0.5)
Selenium (μg)	5.5 (1.5)	7.0 (2.1)
Sodium (mg)	291 (51.2)	346 (65.6)*
Potassium (mg)	670 (117.2)	797 (141.1)*
Phosphorous (mg)	462 (84.5)	555 (101.6)*
Thiamin (mg)	0.15 (0.05)	0.17 (0.05)
Riboflavin (mg)	0.74 (0.2)	0.86 (0.23)
Niacin (mg)	3.5 (0,6)	4.5 (0.87)
Pyridoxine (mg)	0.19 (0.06)	0.22 (0.07)
Folates (μg)	28.3 (12.5)	34.4 (15.2)*
B12 (mg)	1.2 (0,5)	1.5 (0,6)
Vit. C (mg)	4.6 (2.8)	5.5 (3.4)
Vit. A (μg)	186 (81,9)	194 (85.4)*
Vit. D (UI)	88.5 (56,0)	95.0 (61.2)
Vit. E (mg)	0.43 (0,19)	0.46 (0.2)

Percentage contribution of food groups

Table V shows and compares the percentage values for nutrients provided by milk and derivatives in relation to the total daily intake (%TI) as well as in relation to the established recommendation (%DRI). In both groups, milk and derivatives contributed mainly to the total daily intake of calories (18.1%), proteins (21.5%), total fat (26.4%), SFA (36.7%) and cholesterol (20%) and, specially, minerals: calcium (72,1%), iodine (51,2%), phosphorous (36,4%), potassium (28,5%), magnesium (23,36%) and zinc (17,7%) and vitamins: vitamin A (47,8%), riboflavin (40%) and vitamin B12 (42%). In the same way, milk and derivatives contributed largely to the dietary reference intake of proteins (21.5%) and carbohydrates (25%), as well as minerals: calcium (48,1%), phosphorous (40,7%), iodine (30,9%), zinc (24,7%), magnesium (19,6%) and sodium (21,3%) and vitamins: riboflavin (78,8%), vitamin B12 (65%), vitamin A (27,8%), niacin (29,9%) and pyridoxine (18,3%).

Discussion

Nutrition surveys based on recall are an optimal and quite used method in cross-sectional studies for descriptive purposes, as it occurs in this study[17]. In this case, it is remarkable how interviews were carried out by sufficiently qualified personal; in addition, a photograph notebook with portions and servings was used to facilitate the respondents to specify the quantity and/or size of the corresponding servings for the previous 3 days as accurately as possible. In this way, respondents were able to identify portions and/or serving sizes and interviewers could estimate the intake [14]. However, this study has several methodological limitations, since sociological variables, such as socioeconomic status and/or level of educational attainment, life style, etc. were not registered, and they could condition, to some extent, the dietary intake.

When analyzing the consumption frequencies for the different types of dairy products registered, it is worth highlighting that almost every respondent consumed dairy products along the day, being whole milk a basic food for breakfast, and plain or flavored yogurt –also full-fat yogurt– a relatively frequent food for lunch and/or supper. The intake of other dairy products, including the different kind of cheese, was, in comparison, less frequent. These registered consumption frequencies could explain how the total number of dairy servings in both age groups –even though it was significantly higher in adolescents– did not reach

Table V
Contribution (%) of milk and derivatives to total intake of energy and nutrients (%TI) and in relation to the dietary reference intakes (%DRI)

Age groups (years)	*9 to 12*		*13 to 16*	
	(%TI)	*(%RDI)*	*(%TI)*	*(%RDI)*
Calories	18.5	ND	17.7	ND
Proteins	19.7	54.3	23.2	45.5
Carbohydrates	9.0	21.8	15.6	28.2
Total fat	36.9	ND	15.8	ND
SFA	47.5	ND	25.8	ND
MUFA	32.4	ND	10.9	ND
PUFA	23.8	ND	5.3	ND
Cholesterol	20.2	ND	19.8	ND
Calcium (mg)	71.8	44.7	72.3	51.4
Iron (mg)	2.7	5.6	8.3	4.0
Iodine (mg)	43.7	30.2	58.7	31.5
Magnesium (mg)	20.9	21.0	25.6	18.1
Zinc (mg)	19.8	25.1	15.5	24.2
Selenium (μg)	5.1	14.1	8.3	12.5
Sodium (mg)	11.7	19.6	22.0	22.9
Potassium (mg)	22.8	15.0	34.2	16.7
Phosphorous (mg)	35.0	37.4	37.7	43.9
Thiamin (mg)	11.2	16.7	16.9	15.5
Riboflavin (mg)	41.3	82.8	37.8	74.8
Niacin (mg)	10.3	30.0	11.9	29.7
Pyridoxine (mg)	9.9	19.0	16.0	17.6
Folates (μg)	9.4	9.5	18.0	8.5
B12 (mg)	38.3	69.5	45.6	60.4
Vit. C (mg)	9.4	10.4	15.3	7.8
Vit. A (μg)	47.6	31.4	48.0	24.1
Vit. D (UI)	7.2	3.2	8.0	3.8
Vit. E (mg)	11.4	4.0	7.5	3.1

the recommended three daily servings. Moreover, as a consequence of the deficient ingestion of dairy products, the intake of dietary calcium from milk and derivatives barely reached 48% of dietary reference intake for the age groups that have been analyzed, even though it represented 72% of the daily dietary calcium. It should be mentioned how a maintained dairy product intake below recommendations implies the need to provide with dietary and/or pharmacological calcium supplements, since there would not be adequate assurance of a normal bone apposition.

The variety of dairy products consumed by these young students has a number of peculiarities which should be analyzed. When studying the contribution of milk and derivatives to the daily nutrients intake within the referred population, we confirm how, despite the deficient intake of dairy servings with respect to the established recommendations, this food group still constitutes the main dietary source of calcium, iodine, magnesium and phosphorous, as well as riboflavin, vitamin B12 and vitamin A; they also contribute substantially to the daily intake of calories, proteins, potassium and zinc. In the same way, the recorded dairy products consumption contributed largely to fulfill the recommended dietary allowances of proteins, carbohydrates, as well as different minerals (calcium, phosphorous, iodine, zinc, magnesium y sodium) and vitamins (riboflavin, vitamin B12, vitamin A, niacin

and pyridoxine)[18-21]. Nevertheless, it should be emphasized that dietary milk calcium in both groups barely reached 48% of daily dietary reference intake of these groups of age, as had been reported by authors in our cultural-geographic environmental[19-24], being long below the percentage of daily dietary calcium that should be provided by milk and derivatives in order to obtain an adequate bone mass.

However, even when the daily intake of dairy products should be increased so as to make up of the deficient calcium intake that has been observed in school children and adolescents, milk and derivatives intake also contributed substantially to the intake of total fat, SFA and cholesterol. These could be noticeably reduced by the consumption of low fat and/or modified fatty acid composition dairy products[23]. The consumption of low-fat products in school children is virtually non-existent and represents scarcely 15% of total dairy product ingestion. Therefore, it should be required to recommend these students the daily consumption of skim or low fat dairy products (milk and yogurts), as well as the different varieties of fresh cheese available in the market (Burgos cheese, petit Suisse, cottage, mozzarella, etc.). In this way, the content of minerals and vitamins would increase without growing calorie, SFA and cholesterol intake. Likewise, the avoidance of milk derivatives with a high content of carbohydrates and cholesterol (custard, pudding, etc.) should be promoted.

As a conclusion, the intake of milk and derivatives in child-juvenile population is inappropriate. Consequently, the need to undertake a massive public enlightenment campaign involving families regarding the nutritional importance of this food group should be considered. Moreover, they should be advised on dietary alternatives available in current markets such as low fat and high nutrition value (minerals and vitamins) dairy products, which could noticeably contribute to the dietary calcium intake required to get an optimal peak of bone mass, as well as other nutrients with beneficial effects on health.

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