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Differences in food intake and nutritional habits between Spanish adolescents who engage in ski activity and those who do not

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Abstract

Background: **Increasing obesity among adolescents in the industrialized world may result from poor nutritional habits and inadequate exercise.**

Aim: **To determine differences in food intake, nutritional habits, and body mass index between Spanish adolescents who engage in ski activity and those who do not.**

Methods: **A socio-demographic survey, food frequency questionnaire, 24-hr dietary recall, and physical activity questionnaire were completed by 300 Spanish schoolchildren aged 10 to 18 yrs. Results were compared (Student's t, chi-square and Fisher's exact test) between adolescents engaged (SP) and not engaged (N-SP) in skiing according to their sex.**

Results: **SP adolescents devoted > 4 h/day to physical activity versus < 1 h for N-SP adolescents. No significant differences were found in nutrient intake or nutritional habits between SP and N-SP adolescents. Protein and fat intakes of both groups were above recommended levels. A higher proportion of N-SP than SP males were overweight. Logistic regression analysis showed that the maintenance of a normal weight was favored by the practice of skiing, the consumption of sugar-free drinks, and supplementation with vitamins/mineral salts and was negatively associated with body weight dissatisfaction, intake of nutritional supplements other than vitamins or minerals, and the consumption of snacks.**

Conclusions: **The diet of this adolescent population was poorly balanced. Engagement in physical activity appears to be a key factor in maintaining a healthy body mass index.**

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Key words: *Food intake. Nutritional habits. Adolescents. Physical activity. Sport.*

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INGESTA DE ALIMENTOS Y HÁBITOS NUTRICIONALES ENTRE ADOLESCENTES ESPAÑOLES QUE PRACTICAN Y NO PRACTICAN ESQUÍ

Resumen

Antecedentes: **El aumento de la obesidad entre los adolescentes en países desarrollados puede ser consecuencia de malos hábitos alimentarios y falta de actividad.**

Objetivo: **Determinar las diferencias en la ingesta de alimentos, hábitos nutricionales e índice de masa corporal entre adolescentes españoles que practican esquí y los que no lo hacen.**

Métodos: **Una muestra de 300 adolescentes españoles de 10 a 18 años completó una encuesta que incluyó variables sociodemográficas, un cuestionario de frecuencia de consumo de alimentos, recordatorio de 24h y un cuestionario de actividad física. Se utilizaron test de comparación paramétricos y no paramétricos para comparar los resultados entre adolescentes que practican (SP) y no practican (N-SP) esquí, en función al sexo.**

Resultados: **Los adolescentes SP dedicaron más de 4h diarias a la realización de actividad física mientras que los adolescentes N-SP dedicaron menos de 1 hora diaria a la actividad física. No se encontraron diferencias significativas en la ingesta de nutrientes o los hábitos nutricionales entre adolescentes SP y N-SP. La ingesta de proteínas y lípidos de ambos grupos estuvo por encima de los niveles recomendados. El sobrepeso fue más frecuente entre adolescentes N-SP. El análisis de regresión logística mostró que el mantenimiento de un peso normal se ve favorecido por la práctica del esquí, el consumo de bebidas sin azúcar y la suplementación con vitaminas/minerales y se asoció negativamente con la insatisfacción con el peso corporal, el consumo de suplementos nutricionales distintos a vitaminas o minerales y el consumo de aperitivos.**

Conclusiones: **La dieta de esta población adolescente fue desequilibrada. La participación en la actividad física parece ser un factor clave en el mantenimiento de un índice de masa corporal saludable.**

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Palabras clave: *Ingesta de alimentos. Hábitos nutricionales. Adolescentes. Actividad física. Deporte.*

Introduction

The diet of a population is determined by its life habits and environment, and numerous factors must be taken into account in evaluating the nutritional behavior of children and adolescents[1]. In Europe, depending on the country, 53-98% of children aged 6 to 11 yrs engage in sports activity, at least occasionally[2], and similar percentages are reported for adolescents aged 12 to 16 yrs. In Spain, this proportion declines to 40% in the 15-19 yr age range[3]. This appears to be a low percentage, especially given current worldwide reports of an increase in childhood and adolescent obesity[4,5], because the nutritional habits of adolescent athletes have been shown to be healthier than those of their non-athletic peers[6]. In fact, nutrition is a major component of their training, aimed at optimizing performance and avoiding injuries or conditions related to nutritional deficiencies.

Children and adolescents need an adequate energy intake to ensure their proper growth, development, and maturation. The athletic or very active child or adolescent will generally need a greater intake to match their higher energy expenditure from physical activity. Energy intakes recommended by[7] are based on equations that consider age, height, body weight, and physical activity, classified as sedentary, moderately active, active, and very active.

Although an adequate protein intake is important to provide essential amino acids to support growth, especially to maintain and develop lean body mass, an adequate energy intake is also critical. Inadequate energy will cause protein to be used as an energy substrate rather than for synthesizing lean tissues. It is generally recommended that adults obtain at least 12-15% of their dietary energy from protein[8], and this recommendation also appears reasonable for the child and adolescent athlete. The combination of heavy training and increased protein intake may also influence protein turnover and perpetuate the need for greater protein intake[9]. Grain-based foods, vegetables, and fruit supply significant amounts of carbohydrate, fiber, minerals, and vitamins and contribute to restoring the muscle glycogen needed for training and competition. Because of the importance of carbohydrates as substrate for high-intensity training, it is recommended that young athletes consume at least 50% of their total daily energy intake as carbohydrates[9]

Dietary fat provides energy for the growth needs of children and adolescents and contributes essential fatty acids to their diet. In addition, a slightly higher fat intake might be recommended to young athletes in comparison with their sedentary counterparts, because of their increased energy expenditure during training[10].

Minerals play key roles in the formation of body tissues (e.g., calcium in bone), in the maintenance of fluid balance within specific compartments (sodium for extracellular fluid space and potassium for intracellular fluid space), and in the excitation of tissues (action potentials and signal transmission in nerve and muscle tissue)[11,12]. Research in adults has shown that elevated metabolism from exercise does not increase mineral requirements except when large amounts are lost in sweat[13].

Likewise, the need of children for minerals is not thought to be changed by sports.[11,12] However, iron and calcium are two frequently deficient minerals in the diet of children and teenagers, which could affect health and physical performance, especially in female athletes[9]. Inadequate intake of energy, protein, vitamin D, and calcium may influence other factors (e.g., estrogen hormone levels) that negatively affect bone health. Increasing the consumption of iron in the diet could be assumed to alleviate iron deficit, although interactions with other nutrients should not be ignored. It was reported that plasma ferritin levels in athletes were not influenced by total iron or meat intake and that the best predictor of iron status was the proportion (not absolute intake) of total protein in the diet[14]. Carbohydrate and fat ingestion have been negatively correlated with plasma ferritin, and their high ingestion may inhibit iron absorption, whereas protein facilitates iron absorption[15].

At all stages of childhood and adolescence, it is necessary to promote not only a healthy diet that supplies all nutrients but also healthy life habits, primarily an appropriate level of physical activity.[16] A good diet and physical activity are known to be related to weight control and a correct body composition in each age group. Intense physical activity is associated with maintenance of a stable weight[17], and examples include running, fast cycling, aerobic exercises, and competitive team sports such as football, hockey and volleyball, etc. Lower body fat levels have been observed in children and adolescents who perform more intense physical activity[18,19]. One European study showed that body fat levels in children aged 9-10 yrs were lower in those performing an intense physical activity for more than 40 min/day than in those performing intense activity for 10-18 min/day. A physical activity level (PAL) of ~1.8, as defined by FAO[7], is necessary to minimize weight gain[17] and corresponds to moderate physical activity. The WHO recommends physical activity for 30 min on almost all days of the week[20]

Methods

Description of Sample and Study Design

This study included 300 adolescents recruited from middle and high schools in Granada city (Southern Spain). Mean age (±SD) of the series was 12.8 (2.7) yrs (range: 10-18 yrs). All participants completed a socio-demographic survey, food frequency questionnaire (FFQ), 24-hr x 3 times dietary recall, and physical activity questionnaire (PAQ) during a physical education class or training session. The whole survey took 60-90 min. Anthropometric data were collected by trained research staff. Study procedures were approved by the Ethics Committee of Granada University, and informed consent was obtained from the participants or, when aged below 18 yrs, by their parent or guardian. The final study group comprised 288 students (93% of original enrolment).

Questionnaires

A 56-item socio-demographic questionnaire was used to explore socio-environmental, personal, and behavioral factors of relevance to adolescent food choices, weight status, and overall health. The self-administered FFQ included 92 food items classified by food group. The 3x 24-h recall used an open format and served to validate the nutritional questionnaires.. The validity and reliability of the FFQ were previously established by our research group[21,22]. The PAQ gathered data on their physical activities during the previous year and on the time devoted to each activity.

Nutrient Intake

Dietary intake of energy (kcal) and nutrients was assessed from responses to the 3x24 hour-recall. The 24-h recall was completed by all study subjects at the beginning of the ski season (December) and again at the end of the season (April/May). Questionnaires were excluded as unreliable following the criteria established by Goldberg et al[23], taking account of the energy intake (EI) results, daily energy expenditure (from 3x 24-h recall), and basal metabolism rate (BMR) FAO[7]. The food composition tables in the NOVARTIS software program[24] used in this study were reviewed, checking the nutrient composition of each food against the data in the program and ensuring the inclusion of all nutrients of interest or in the usual diet of the study population[25] The reference data were based on dietary recommendations for this population in Spain[26] and those published by the FAO[7]

Division of population by physical activity level

The study population was divided between skiing participants (SP) and non-ski participants (N-SP). Inclusion criteria for SP were membership of a Sports Training Center and participation in competitive ski training two or more days/week. Inclusion criterion for N-SP was participation in physical activities for less than two hours/ week.

Anthropometrics

Height, weight, and skin-fold measurements were always performed in a private room at the education centers by the same group of three trained researchers using the same equipment and procedure, following recommendations of the Anthropometry Procedures Manual (NHANES)[27] Body mass index (BMI, Kg/m^2) was categorized as follows: <15^{th} percentile, underweight; 15^{th}-85^{th} percentile, normal weight; and >85^{th} percentile, overweight[7,28]

Data Analysis

Analyses were stratified by sex across the two groups (SP and N-SP). Continuous variables were expressed as mean, maximum, minimum and standard deviation (SD), and categorical variables as frequencies and analyzed with the chi-square and Fisher's exact tests. The Student's t-test was used to compare means of variables. Logistic regression analysis was used to establish the likelihood of being normal- *versus* over-weight as a function of the study variables. $P<0.05$ was regarded as significant. SPSS version 19.0 statistical software was used for all statistical analyses.

Results

Eighty-six students (33 females and 53 males) were classified as SP; all participated in ski training at the Club Monachil de Sierra Nevada and High Performance Centre (CAR) in Sierra Nevada. The remaining 202 students (87 females and 115 males) were considered as N-SP; only 15 students in this group performed some type of physical activity for up to 2 or 3 hrs weekly.

Table I lists the demographic characteristics of the two groups. The age of the study population (range: 10-18 yrs) showed a non-normal distribution (p=0.0001). There was no significant age difference between the groups (SP and N-SP) in either sex. The weight of the population showed a normal distribution (p=0.200), whereas their height, BMI, and % fat values did not. Mean BMI and BMR values were significantly lower in SP females than in N-SP females. There were no differences in BMI or BMR between SP males and N-SP males. The physical activity was estimated as the number of hours dedicated to sports training (mean of 4.2 h/day for SP groups versus 0.95-1.05 h/day for N-SP groups), which significantly differed (p=0.001) between the SP and N-SP groups in both sexes.

There was a significant difference (p=0.019) in weight classification (underweight, normal weight, overweight) between SP males and N-SP males, with 26% of N-SP males and 10.1% of SP males being categorized as overweight (Table I).

Eating Behaviors

The frequency of meals and other aspects of eating behavior were gathered from 15 questions in the FFQ survey. No difference in the number of daily meals on week days or at the weekend was observed among any of the four subgroups (N-SP males and females, NP males and females), being around four in all ca-

Table I
Demographic characteristics of Sporting (SP) and Non-Sporting (N-SP) groups

	Female skiers	*Female non- skiers*	*p*	*Male skiers*	*Male non-skiers*	*p*
Age (yrs)	13.4 (1.8)	13.7 (1.4)	0.399	14.20 (2.4)	13.8 (1.5)	0.454
Weight (Kg)	48.92 (10.62)	57.68 (11.89)	0.140	53.52 (16.48)	54.93 (14.85)	0.039
Height (cm)	154.75 (8.95)	160.04 (6.99)		160.00 (14.65)	162.07 (10.98)	
Waist/Hip ratio	0.77 (0.05)	0.74 (03)		0.81 (0.03)	0.79 (0.10)	
BMI (Kg/m^2)	19.92 (3.01)	22.36 (3.54)	0.030	20.61 (3.41)	20.65 (3.84	0.487
BMR (Kcal/day)	1332.91 (123.84)	1429.06 (124.91)	0.007	1577.40 (258.91)	1626.39 (251.56)	0.155
TEE (Kcal/day)	2322.43 (223.32)	2457.58 (147.51)		2875.10 (572.44)	2936.83 (447.22)	
PAL	1.74 (.04)	1.72 (0.06)		1.81 (0.08)	1.80 (0.04)	
% Body fat	22.4 (4.3)	23.73 (4.00)	0.090	16.49 (2.72)	18.14 (4.31)	0.046
Body fat weight	12.99 (3.70)	14.04 (4.98)	0.155	8.77 (3.68)	10.20 (4.93	0.064
Training (hours/day)	4.0 (2.0)	0.9 (1.4)	0.001	4.2 (2.1)	1.0 (1.0)	0.001
	Frequency (%)		*p^b*	*Frequency (%)*		*p^b*
Underweight	4.3	4.0		8.1	2.0	
Normal weight	78.3	70.7	0.478	81.1	72.0	0.019
Overweight	17.4	25.3		10.1	26.0	

([a]) T-Test. ([b]) Chi-square test. * (SP): Ski People. ** (N-SP): Non-Ski People
BMR: Basal metabolic rate; PAL: physical activity level (TEE/BMR)
TEE Total energy expenditure[7]. Male TEE = 310.2 + 63.3 weight - 0.263 weight^2 ; Female TEE = 263.4 + 65.3 weight - 0.454 weight^2
Male % Body fat = 18.70 (LG10 (Biceps+Triceps+Subscapula+Suprailiac)) -11.91
Female % Body fat = 23.94 (LG10 (Bíceps+Triceps+Subscapula+Suprailiac))-18.89

ses (Table II). The SP group more frequently had lunch at their educational centre in comparison to the N-SP group (p<0.001). A very small percentage of both groups considered breakfast to be important, but 90% of all participants had breakfast, at a mean time of 07.45 h during the week and between 09.00 h and 10.30 h at weekends. Around half of the females spent 10-20 min on breakfast, with no difference between SP and N-SP females (p=0.116). Between 30 and 36% of males spent 10-20 min on breakfast, with no significant difference between SP and N-SP males (p=0.130). At the weekend, the percentage of males spending 10-20 min on breakfast increased from 44.2 to 54.3%, with no significant difference between SP and N-SP males (p=0.381). Between 48.7 and 58.3% of all participants considered that they had good knowledge of nutrition, although there was a significant difference in this assessment between the two female sub-groups (Table II).

The percentage of each group that was satisfied with their weight ranged from 48.7% (SP males) to 66.7% (SP females), with no significant differences among sub-groups. More than 80% of participants had never been on a diet to modify their weight.

There was no significant difference in the consumption of sweets with sugar or artificial sweeteners between SP and N-SP groups. The consumption of snacks was slightly higher in N-SP groups but did not significantly difference among sub-groups (p<0.05).

Nutrient Intake

The equation proposed by Goldberg et al.[23] was used to exclude questionnaires that deviated by more than double the mean for a study variable. We specifically applied this equation to the estimation of energy as a multiple of the BMR from 24h-recall questionnaires. As a result, 15 questionnaires were excluded from the analysis and their data are not included in table III.

No significant differences in macronutrient or energy intake were found between the SP and non-SP groups. Comparison between the two male groups showed no significant difference in their nutrient intake, regardless of their physical activity level (Table III). The mean energy intake of the males was significantly (p=0.003) lower than Spanish recommendations while their protein intake was significantly (p=0.006) higher, with a range of 74.7-75.8 g/day *versus* the recommended 43-56 g/day.

SP females reported significantly higher intakes, above recommended values, of vitamin C (p=0.011) and riboflavin (p=0.029) intakes in comparison to non-SP females (Table III). The mean energy intake of the females in both groups was lower than Spanish recommendations, significantly (p=0.036) in the 10- to 15-yr age group and non-significantly in the 16-to 18-yr age group (p=0.593) (Table IV). As in the males, protein intake was significantly (p<0.05) above recommendations in both female groups.

table II
Eating Behaviors

	Females *Mean(SD)*			**Males** *Mean(SD)*		
	*SP**	*N-SP***	*[a]P*	*SP**	*N-SP***	*[a]P*
How many times a day do you eat on weekdays?	4.3 (0.6)	4.3 (0.7)	0.761	3.9 (2.6)	4.1 (0.8)	0.354
How many times a day do you eat at the weekend?	3.8 (0.9)	4.0 (0.6)	0.299	3.7 (0.7)	3.9 (0.9)	0.188
	Frequency (%)		*[b]P*	*Frequency (%)*		*[b]P*
Have lunch at school/college during term-time	40.0	1.8	0.001	46.2	2.0	0.001
Watch TV and talk while eating lunch	28.0	53.2	0.308	46.2	37.6	0.002
Believe breakfast to be important	4.0	3.3	0.626	2.6	4.4	0.306
Consider yourself to have good knowledge of nutrition	58.3	51.6	0.186	48.7	54.5	0.025
Appetite for food: eat everything presented without repeating	75.0	61.3	0.328	59.0	60.4	0.154
Consumed supplements (vitamins, minerals) in past year	32.0	16.1	0.298	20.5	16.8	0.526
Habitually consume specific sports preparations	8.7	1.3	0.040	2.6	5.0	0.351
Habitually consume sweets, chewing gum, etc.	72.7	79.3	0.441	73.6	75.7	0.774
Habitually consume sugar-free sweets and chewing gum, etc.	78.8	81.6	0.726	64.2	73.0	0.241
Habitually consume snacks (crisps, popcorn, etc.)	81.8	81.6	0.979	77.4	84.3	0.272
Are satisfied with your weight	66.7	53.3	0.294	48.7	64.4	0.101
Have been on some type of low-calorie (slimming) diet in past year	8.3	8.2	0.543	2.6	4.0	0.067

([a]) T-Test. ([b]) Chi-square test. *(SP): Ski People. **(N-SP): Non-Skiing People

Analysis of the influence of the different study variables on normal-weight/overweight showed that the maintenance of a normal weight was favored (with statistically significant ORs) by the practice of skiing, the consumption of sugar-free drinks, supplementation with vitamins and mineral salts, and a restrictive diet designed to lose weight. Conversely, maintenance of normal weight was negatively associated with dissatisfaction with current body weight, intake in the previous year of nutritional supplements other than vitamins or minerals, and the consumption of snacks (Table IV).

Discussion

This study compared eating habits and nutrient adequacy between adolescents who were engaged in sports training and those who were not. They all came from a single city, limiting extrapolation of the results to other populations. Moreover, being a cross-sectional study, it was only possible to examine associations between involvement in sports and nutritional adequacy.

There was no significant age difference among the study groups, but a significantly higher proportion of the parents of SP groups had a university education in comparison to the parents of N-SP groups. In agreement with other reports[29], the BMI of SP females was significantly lower than that of N-SP females. Although the percentage with normal weight did not differ between the female groups, 17.4% of SP females were overweight *versus* 25.3% of N-SP females, using the classification of Cole et al,[28] corrected for the % fat of subjects. The BMI was also lower in SP *versus* N-SP males, but the difference was not significant, while 26.0% of N-SP males were overweight *versus* 10.1% of the SP males, a significant difference ($p = 0.019$). The time devoted to sports practice significantly ($p<0.001$) differed between SP and N-SP groups (4.03h/day for SP females versus <1 h for N-SP females; 4.21 h/day for SP males versus 1.05 h/day ($p<0.001$).

There were few significant differences in eating behaviors between sport-involved youths and their non-sport involved peers. Sport-involved youths more frequently ate at school and a higher percentage considered that they had a good knowledge of nutrition compared with N-SP males. The female groups did not differ in the percentage that had been on a diet to lose weight. More than 56% of study participants were satisfied with their weight, and more than 59% ate everything on the plate at each meal, with no significant differences among sub-groups.

It is difficult to establish the energy requirements of this adolescent population, because of the large inter-individual variability and the unpredictability of the onset of the growth spurt, a major impetus for increased energy requirements. It has been reported that children require more energy per kilogram of body weight during physical activity compared with adults[9] .The combination of inadequate energy intake and high energy expenditure can create a negative energy balance that may lead to a delay in puberty onset and nutrient deficiencies[30]. Energy intake values did not

Table III
Comparison of nutrient and energy intakes (Kcal/day) among skiing (SP) and non-skiing (N-SP)** groups*

Nutrient	Sport	Female			Male		
		Mean (SD)	%DRI	P^a	Mean (SD)	%DRI	P^a
Energy (Kcal/day)	SP	2096.7 (771.4)	90.4	0.383	2117.6 (689.8)	77.1	0.630
	N-SP	1963.7 (683.5)	78.5		2060.1 (664.5)	75.1	
Protein (g)	SP	75.8 (29.5)	135.5	0.377	80.2 (30.0)	146.7	0.402
	N-SP	70.5 (27.4)	126.0		76.0 (27.1)	139.0	
Fats (g)	SP	99.6 (47.8)	-	0.413	98.2 (41.3)	-	0.833
	N-SP	92.5 (40.6)	-		96.8 (35.6)	-	
Carbohydrate (g)	SP	224.0 (78.4)	-	0.495	228.0 (85.3)	-	0.737
	N-SP	212.6 (77.9)	-		222.9 (84.7)	-	
Phosphorus (mg)	SP	1105.4 (488.4)	92.1	0.786	1233.6 (459.7)	102.7	0.199
	N-SP	1079.1 (438.5)	89.9		1137.3 (400.5)	94.7	
Magnesium (mg)	SP	197.0 (72.7)	56.3	0.656	217.2 (78.8)	62.5	0.337
	N-SP	190.4 (68.5)	54.4		204.3 (74.7)	58.4	
Calcium (mg)	SP	1048.1 (550.4)	104.8	0.220	1031.8 (461.0)	103.2	0.625
	N-SP	917.2 (471.4)	91.7		996.9 (370.8)	99.7	
Iron (mg)	SP	11.7 (4.6)	61.1	0.194	10.7 (4.8)	71.3	0.601
	N-SP	10.5 (3.9)	58.3		11.2 (4.0)	74.6	
Zinc (mg)	SP	11.4 (5.0)	76.0	0.627	12.1 (5.7)	80.6	0.740
	N-SP	10.9 (5.9)	72.6		11.8 (5.8)	78.6	
Selenium (μg)	SP	63.76 (39.10)	123.1	0.143	73.12 (31.87)	144.3	0.465
	N-SP	67.63 (51.4)	133.2		71.90 (35.36)	143.8	
Ascorbic acid (mg)	SP	130.7 (92.1)	217.8	0.011	107.6 (81.2)	179.3	0.16
	N-SP	82.6 (70.5)	137.6		88.4 (74.4)	147.3	
Thiamin (mg)	SP	1.5 (0.6)	150.0	0.535	1.5 (0.8)	125.0	0.434
	N-SP	1.6 (1.5)	160.0		1.6 (0.8)	133.3	
Riboflavin (mg)	SP	1.4 (0.5)	100.0	0.029	1.4 (0.6)	100.0	0.292
	N-SP	1.1 (0.5)	78.5		1.3 (0.5)	92.8	
Nicotinic acid (mg)	SP	17.4 (8.3)	102.3	0.178	17.0 (9.8)	100.0	0.151
	N-SP	14.8 (9.3)	87.0		14.8 (7.7)	87.0	
Pyridoxine (mg)	SP	1.3 (0.6)	61.9	0.540	1.4 (0.8)	66.6	0.027
	N-SP	1.2 (0.7)	57.2		1.1 (0.6)	52.4	
Vit. A (μg)	SP	1750.1 (1597.1)	218.7	0.821	2017.3 (1811.3)	201.7	0.152
	N-SP	1824.0 (1497.0)	228.0		1600.8 (1200.8)	160.0	
Vit. D (μg)	SP	4.9 (9.7)	98.0	0.766	5.6 (10.6)	112.0	0.292
	N-SP	5.5 (10.4)	110.0		3.8 (6.6)	76.0	
Vit. E (mg)	SP	7.4 (5.4)	61.6	0.795	7.3 (5.1)	60.1	0.334
	N-SP	7.1 (4.7)	59.2		6.5 (4.8)	54.2	
Folic acid (μg)	SP	166.2 (76.9)	41.5	0.172	155.9 (72.6)	38.9	0.289
	N-SP	143.4 (78.0)	35.8		143.0 (66.5)	35.7	
Cholesterol (mg)	SP	365.7 (245.8)	121.9	0.435	338.7 (192.8)	112.9	0.433
	N-SP	328.6 (210.4)	109.0		367.5 (214.5)	122.5	
Fiber (g)	SP	11.2 (4.7)	44.8	0.553	12.0 (5.2)	48.0	0.603
	N-SP	11.9 (5.5)	47.6		11.5 (5.0)	46.0	

([a]) T-Test. *(SP): Ski People. **(N-SP): Non-Ski People.

Table IV
Logistic regression analysis of influence of study variables on normal-weight/overweight

	B	*p*	*OR*	*95.0% C I*	
				Lower	*Upper*
Skiing	1.222	0.006	3.393	1.411	8.161
Sugar-free soft drinks	0.745	0.052	2.107	0.995	4.462
Vit.-mineral supplements*	1.467	0.025	4.334	1.201	15.643
Other supplements*	-1.420	0.078	0.242	0.050	1.175
Satisfied with weight	-0.828	0.044	0.437	0.196	0.976
Tried to lose weight*	0.635	0.140	1.887	0.812	4.386
Snack	-1.416	0.001	0.243	0.111	0.531
Constant	-3.175	0.084	0.042		

*In the previous 12 months

differ between ski and non-ski groups, either between SP and N-SP females or between SP and N-SP males. For all study groups, the energy intake was highly significantly below Spanish recommendations[26] for these age groups.

The degree to which protein requirements are increased in children undertaking endurance training is not yet established. Based on research conducted on endurance and strength in adult athletes, many sports nutritionists and exercise physiologists recommend protein intakes for these groups that exceed recommended values (1.2-1.6 g/Kg/day and 1.2-1.7 g/Kg/day) respectively[9]. They also recommend 1.5 g/Kg/day of protein for adolescents undergoing growth spurt, which was around the mean intake found for the present study population, significantly higher than Spanish recommendations and also considered adequate for situations of high physical activity.

In adults performing prolonged or repeated high-intensity exercise, carbohydrate is considered the limiting fuel for maintaining the work rate[13]. Children are thought to lack the full development of glycolytic capacity[11]; therefore, fats may play a role as important as that of carbohydrates in supporting performance. The difference between childhood and adulthood in muscle enzymatic capacity for glycogenolysis may disappear during the adolescent period, given that little or no difference from adult values has been observed in muscle glycolytic enzymes among adolescents aged 13 to 15 yrs[31]. When glycogen stores are depleted during exercise, athletes can obtain as much as 5% to 10% of energy needs from the oxidation of body protein. This is an undesirable response in growing young athletes, supporting the recommendation for an adequate carbohydrate intake to maintain adequate muscle and liver glycogen concentrations[32]. A deficit in the daily energy from carbohydrates is commonly observed in contemporary populations, and these adolescents only received 43% of their energy from carbohydrates comparison to the recommended 60%[33]. This low daily contribution of carbohydrates is compensated with an excess of energy from fats, which represented 42% of the energy intake of the present study population, in comparison to the recommended 25% to 30%[9]. Dietary fat also facilitates absorption of essential fat-soluble vitamins and carotenoids, which are all required in a healthy diet.

A chronic inadequate intake of iron-rich food can reduce body iron stores, impairing muscle metabolism and affecting cognitive function[34,35], and iron intake appeared to be low in the present study population. Calcium is well known to interfere with the absorption of heme and non-heme forms of iron[11], but the intake of the present sports and non-sports groups remained within Spanish recommendations (1000mg/day), with no significant differences among the study groups.

Results of the logistic regression analysis showed that the maintenance of a normal weight was favored by the practice of skiing, the consumption of sugar-free drinks, and supplementation with vitamins/mineral salts and was negatively associated with body weight dissatisfaction, intake of nutritional supplements other than vitamins or minerals, and the consumption of snacks.

To summarize, no significant differences were found in nutrient intake or eating behavior between ski and non-ski groups. However, the sports-involved adolescent group showed lower BMI values and a smaller percentage of overweight individuals in comparison to their non-sporting peers, reflecting the significantly higher number of hours per day that the former devoted to physical activity. These findings confirm the major impact of physical activity on the control of obesity in young people. Finally, the information gathered on supplement consumption was limited. A more detailed exploration of supplement use could yield important information on its impact on overall nutrient adequacy.

Competing interests

All authors revised and approved the manuscript. None of the authors had a conflict of interest. This

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