

NUTRITION AND EDUCATION
II. EDUCATIONAL ACHIEVEMENT AND NUTRIENT
INTAKE OF CHILEAN ELEMENTARY AND
HIGH SCHOOL GRADUATES^{1,2}

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SUMMARY

The interrelationships between educational achievement (EA) and nutrient intake were investigated in 550 Chilean adolescent schoolers graduating from elementary and high school. The random sample included schoolers from both educational levels (1:1), from public and private schools (1:1), and from high, medium, and low socioeconomic status (SES) (1:1:1). Standard procedures for 24-hour dietary recall interviews were used to collect data, and adequacy of intake was assessed by the FAO/WHO Pattern. EA was measured by means of the Achievement Evaluation Program (AEP) and Academic Aptitude Test (AAT) in elementary and high school, respectively. In elementary school graduates, results showed a significant and positive correlation

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between EA (AEP) and energy, protein, riboflavin, ascorbic acid, calcium and vitamin A intake (Multiple $r = 0.456$ $p < 0.01$; $r^2 = 0.208$). The School Feeding Program beneficiaries who belonged to the low SES presented the lowest EA (AEP) together with a deficient nutrient intake, especially for energy, riboflavin, niacin, vitamin A and calcium, at the same time that they registered the lowest values for those anthropometric parameters, indicators of past nutrition, that is to say height-for-age, weight-for-age, head circumference-for-age and a higher upper-to-lower segment ratio, as compared with non-beneficiaries from the same SES and with those from the higher strata. In high-school graduates, EA (AAT) was found to be significantly and positively correlated with protein, calcium, riboflavin and iron intake (Multiple $r = 0.438$ $p < 0.001$; $r^2 = 0.192$). Nevertheless, these interrelationships are strongly related to SES and sex.

Results showed that educational achievement (EA) is significantly and positively associated with nutrient intake, this fact being important for educational planning related to the School Feeding Program.

INTRODUCTION

It is well known that children need a balanced diet to express all their genetic potential, since a deficient nutrient intake might be responsible for a delay in the growth and maturation process, both physical and psychological. Therefore, the effects of malnutrition particularly upon behaviour, are related to functional alterations in the attention, response, motivation and sensibility degrees, rather than with structural alterations in the central nervous system (1). On the other hand, malnourished schoolers whose diet is unable to satisfy their basic physiological needs, probably will have a low educational performance (2).

In this context, nutrition appears as an educational achievement determinant factor, since it affects the development aptitudes and attitudes that schooling requires (2). That is how several authors have determined the effect of fasting on speed and accuracy of problem solving tasks. While some of them found a positive effect of breakfast on school performance, others did not confirm such interrelation (3, 4). On the other side, a significant inverse association between anemia and educational achievement has been described (5, 6). In Chilean infants, the adverse effects that mild iron deficiency has on their mental development have also been reported (7, 8).

Thus literature regarding the possible consequences of malnutrition on educational achievement reveals that children suffering from nutritional problems will probably have serious learning difficulties, whereby food and nutritional variables would have a significant impact on school performance. Furthermore, some authors have emphasized the importance of the modality of feeding in early infancy on school performance; breast-fed infants presented statistically higher scores than bottle-fed infants in later tests of intelligence, and in reading and mathematical tests (9, 10).

In Chile, as in other countries, the interrelationship between nutrient intake and educational achievement has been insufficiently investigated. For this reason, the purpose of the present study was to correlate nutrient intake with educational achievement of Chilean elementary and high school graduates from different socioeconomic status.

MATERIAL AND METHODS

Sample

A random sample of 550 Chilean adolescent schoolers graduating from elementary and high school (1:1) was selected in the Metropolitan Area of Santiago, Chile. The sample included schoolers from public and private schools (1:1), of both sexes (1:1), and from high, medium and low socioeconomic status (SES) (1:1:1). Only elementary school graduates pertaining to the lowest poverty grades were beneficiaries from the School Feeding Program. Schoolers aged between 13 and 19 years (13 and 16 years and 16 and 19 years in elementary and high school, respectively), and from the low SES, were significantly older in relation to other strata. The field study was carried out in the second semester of 1982.

Socioeconomic Study

SES was determined through a socioeconomic scale which includes schooling, occupation of the household head and housing conditions (property, water supply, sanitation and goods) (11).

Dietary Intake

Standard procedures for the 24-hour dietary recall interviews were used to collect data. The Chemical Composition Table of Chilean Foods was used to calculate nutrient intake (12), while adequacy of intake was assessed through the FAO/WHO pattern (13-16).

Anthropometric Measurements

The nutritional status was assessed through anthropometric measurements. Percentages of adequacy of weight for age (W/A), height for age (H/A) and weight for height (W/H) were established according to the National Center for Health Statistics (NCHS) Tables adopted by WHO (17); head circumference for age (HC/A) was determined in relation to Tanner tables (18); arm circumference for age (AC/A), triceps skinfold for age (TS/A), arm muscle area for age (AMA/A) and arm fat area for age (AFA/A) were calculated using Frisancho's norms (19). Upper segment (US) was measured to determine the upper to lower segment ratio (US/LS).

Educational Achievement

Educational achievement (EA) was measured by means of the Achievement Evaluation Program (AEP) in schoolers graduating from elementary school, national achievement test of language and mathematics, administered by the Ministry of Education at the end of grade 8. In the present study, results are expressed as percentages of achievement of both language and mathematics test in three categories: high (> 40%), medium (30-40%) and low (≤ 30%). On the other hand, in high-school graduates, EA was measured through the Academic Aptitude Test (AAT), a national verbal and mathemat-

ics test administered by the University system at the entrance of prospective students. Results are expressed as the mean between both scores, verbal and mathematics part. Scores range from 0 to 900, and in this study three categories were established: high (≥ 600), medium (450-600) and low (< 450). Scores < 450 prevent schoolers to postulate for university entrance. Both instruments, AEP and AAT are of wide national scoring and have been submitted to adequate processes of validity and reliability.

Statistical Analysis

Statistical methods included analysis of variance, Student's "t" test, Pearson's correlation coefficients and step-wise multiple regression (20).

RESULTS AND DISCUSSION

In the sample of the present study, approximately 49.0% and 62.0% showed a low and excessive intake of energy and protein, respectively, at the same time that deficiencies in vitamin A, riboflavin, niacin, calcium and iron intake were detected, this last one specially in females. On the other hand, nutrients were found to be significantly and positively associated with SES (21, 22).

Food consumption of Chilean elementary school graduates by the percentage of achievement in EA (AEP) is shown in Table 1. Milk consumption was significantly higher in schoolers that obtained a high percentage of achievement compared with the lower categories of EA. This same fact was observed for carbonated beverages and juices. On the other hand, yogurt, meat, vegetables and fruits, miscellaneous, and fats and oils consumption was higher in the upper categories of EA, but differences were not significant. In the same way, consumption of fish and shellfish, legumes and cereals was higher in the lower categories of EA. Sugar intake was significantly higher in the low to medium EA groups than for the higher EA groups. Likewise, potatoes and bread consumption was significantly higher in schoolers who obtained a medium percentage of achievement as compared with the upper category of EA.

Table 2 presents the nutrient intake values expressed as percentages of adequacy of the FAO/WHO Pattern by percentage of achievement in AEP. Schoolers who registered the lowest percentages of achievement in AEP had a significantly lower nutrient intake, especially for energy, protein, riboflavin, vitamin C and calcium, in comparison to those belonging to the medium and high categories of EA. On the other hand, it is necessary to underline the high percentage of adequacy observed for protein, thiamine, vitamin C and iron intake in all categories of EA. A multiple regression analysis between EA (AEP, dependent variable) and nutrient intake, expressed as percentage of adequacy of the FAO/WHO Pattern (independent variables) is shown in Table 3. EA (AEP) was found significantly and positively correlated with energy, protein, riboflavin, vitamin C, calcium and vitamin A intake (Multiple $r = 0.456$; $p < 0.01$; $r^2 = 0.208$). The independent variables with the greatest explanatory power in EA variance were in decreasing order, calcium, vitamin C, energy, protein, riboflavin and vitamin A, explaining 7.22%, 3.21%, 2.19%,

TABLE 1

EDUCATIONAL ACHIEVEMENT (ACHIEVEMENT EVALUATION PROGRAM, AEP) AND FOOD CONSUMPTION OF CHILEAN ELEMENTARY SCHOOL GRADUATES

Food	AEP			F	Student's "t" test		
	% of achievement				L/M	M/H	L/H
	Low (L) ≤ 30 (75) ^a	Medium (M) 30-40 (75)	High (H) > 40 (101)				
Milk (cc)	194.27 ± 216.80 ^b	295.13 ± 252.92	417.92 ± 450.78	9.43**	**	*	***
Cheese (g)	6.77 ± 17.73	16.20 ± 34.71	13.08 ± 28.37	2.21NS			
Fresh cheese (g)	0.00 ± 0.00	1.60 ± 13.86	1.88 ± 8.57	0.95NS			
Yogurt (g)	9.87 ± 51.73	18.11 ± 60.86	33.21 ± 75.32	2.93NS			
Meat (g)	68.80 ± 71.14	95.79 ± 136.02	107.16 ± 105.80	2.77NS			
Fish and shellfish (g)	22.88 ± 131.31	24.53 ± 102.22	7.86 ± 29.83	0.87NS			
Eggs (g)	19.05 ± 31.74	28.93 ± 41.04	22.45 ± 34.77	1.46NS			
Legumes (g)	23.61 ± 55.32	15.27 ± 40.71	15.99 ± 45.59	0.73NS			
Cereals (g)	77.07 ± 92.19	69.39 ± 67.20	65.49 ± 65.48	0.51NS			
Potatoes (g)	118.43 ± 178.55	172.12 ± 196.30	100.52 ± 154.53	3.69*	NS	**	NS
Bread (g)	265.80 ± 150.97	296.36 ± 142.01	226.25 ± 140.92	5.14**	NS	**	NS
Vegetables & fruits (g)	255.07 ± 221.96	298.53 ± 246.02	306.11 ± 239.44	1.09NS			
Almonds, nuts & peanuts (g)	1.39 ± 7.40	3.53 ± 17.04	4.62 ± 18.33	0.92 NS			
Sugar (g)	28.89 ± 19.40	23.23 ± 19.26	19.75 ± 17.87	5.06**	NS	NS	**
Miscellaneous (g)	100.49 ± 142.08	92.85 ± 126.15	128.25 ± 140.50	1.65NS			
Beverage & juices (cc)	7.07 ± 35.10	6.07 ± 32.63	35.30 ± 106.65	4.68*	NS	**	*
Fats and oils (g)	24.88 ± 20.88	32.35 ± 28.47	32.55 ± 27.33	2.22NS			

a Number of cases in each group * p < 0.05; ** p < 0.01; *** p < 0.001 NS = Not significant.

b Mean ± Standard deviation.

TABLE 2

EDUCATIONAL ACHIEVEMENT (ACHIEVEMENT EVALUATION PROGRAM, AEP) AND NUTRIENT INTAKE OF CHILEAN ELEMENTARY SCHOOL GRADUATES

Nutrient	AEP			F	Student's "t" test		
	% of achievement				L/M	M/H	L/H
	Low (L) ≤ 30 (75) ^a	Medium (M) 30-40 (75)	High (H) > 40 (101)				
	----- % FAO/OMS Pattern -----						
Energy	82.65 ± 32.32 ^b	96.63 ± 39.56	94.39 ± 35.17	3.36*	*	NS	*
Protein	127.18 ± 72.94	166.08 ± 115.14	175.82 ± 96.22	5.76**	*	NS	***
Thiamine	153.45 ± 63.63	177.08 ± 72.41	155.82 ± 63.92	2.94NS			
Riboflavin	84.00 ± 39.94	97.29 ± 42.10	99.75 ± 36.27	3.74*	*	NS	NS
Niacin	67.09 ± 34.84	79.66 ± 43.30	76.73 ± 42.78	1.97NS			
Vitamin A	54.42 ± 47.53	79.16 ± 68.68	81.10 ± 121.73	2.17NS			
Vitamin C	267.95 ± 266.09	437.39 ± 473.95	416.72 ± 332.16	4.93**	**	NS	**
Calcium	87.25 ± 54.24	130.72 ± 80.58	142.26 ± 64.19	15.20**	***	NS	***
Iron	148.74 ± 115.28	153.25 ± 111.12	131.18 ± 74.38	1.22NS			

a Number of cases in each group. * p < 0.05; ** p < 0.01; *** p < 0.001 NS = Not significant.

b Mean ± Standard deviation.

TABLE 3

MULTIPLE REGRESSION TABLE OF EDUCATIONAL ACHIEVEMENT (ACHIEVEMENT EVALUATION PROGRAM, AEP) (DEPENDENT VARIABLE) AND NUTRIENT INTAKE (INDEPENDENT VARIABLE) OF CHILEAN ELEMENTARY SCHOOL GRADUATES

Nutrient ^a	Multiple r	r ²	r ² change	simple r	B	Beta
Energy	.14813	.02194	.02194	.14813*	.2103523D-01	.07503
Protein	.19017	.03616	.01422	.19014***	.3072078D-02	.02332
Thiamine	.29412	.08651	.05035	-.02285	-.5292075D-01	-.36003
Riboflavin	.31378	.09846	.01195	.17642***	-.4233440D-01	-.22898
Niacin	.31383	.09849	.00003	.08144	.4232477D-01	.16929
Vitamin C	.36138	.13059	.03210	.17660***	.2920073D-02	.11031
Calcium	.45038	.20285	.07225	.32838***	.5955603D-01	.54467
Iron	.45091	.20332	.00048	.08133	-.3318421D-02	-.04144
Vitamin A	.45578***	.20773***	.00441	.20728***	.7768895D-02	.07525
Constant					34.58983	

a Percentage of adequacy to 1973 FAO/WHO Pattern. * p < 0.05; *** p < 0.01.

TABLE 4

NUTRIENT INTAKE, ANTHROPOMETRIC MEASUREMENTS AND EDUCATIONAL ACHIEVEMENT (ACHIEVEMENT EVALUATION PROGRAM, AEP) OF ELEMENTARY SCHOOL GRADUATES. BENEFICIARIES AND NON BENEFICIARIES OF THE SCHOOL FEEDING PROGRAM

	Beneficiaries low SES	Non-Beneficiaries		F
		Low SES	High and medium SES	
Nutrient intake	% FAO/OMS Pattern			
n	(24)	(56)	(163)	
Energy	80.26 ^a ± 34.42	79.93 ^a ± 27.74	97.03 ^b ± 36.84	6.355**
Protein	111.46 ^a ± 70.30	113.09 ^a ± 62.26	179.14 ^b ± 100.03	14.496**
Thiamine	141.12 ± 56.52	155.41 ± 55.76	166.88 ± 70.68	1.885 NS
Riboflavin	70.78 ^a ± 23.18	78.13 ^a ± 34.84	102.70 ^b ± 39.38	14.167**
Niacin	55.03 ^a ± 33.22	66.18 ^a ± 36.28	80.24 ^b ± 40.59	5.968**
Vitamin A	42.67 ^a ± 47.76	49.48 ^a ± 33.62	80.84 ^b ± 80.38	6.216**
Vitamin C	166.12 ^a ± 166.77	283.36 ^b ± 256.93	444.68 ^c ± 404.72	8.896**
Calcium	66.04 ^a ± 35.54	83.11 ^a ± 51.16	143.48 ^b ± 70.59	28.518**
Iron	133.16 ± 83.08	135.42 ± 99.91	142.62 ± 82.85	.222 NS
Energy source	% of total energy			
Protein	10.92 ^a ± 2.20	11.98 ^a ± 3.77	13.44 ^b ± 3.27	8.474**
Fat	21.94 ^a ± 9.38	22.12 ^a ± 6.46	29.39 ^b ± 8.86	20.001**
Carbohydrate	67.13 ^a ± 8.79	65.90 ^a ± 6.90	57.17 ^b ± 9.52	27.775**

Protein source

% animal protein	27.69 ^a ± 17.92	36.71 ^b ± 17.37	51.27 ^c ± 16.54	30.136**
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Iron source

% animal iron	8.56 ^a ± 8.74	14.82 ^b ± 16.40	22.02 ^c ± 14.24	12.193**
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Anthropometric measurements

% of standard

Weight/age	89.42 ^a ± 16.63	93.82 ^a ± 16.91	102.82 ^b ± 16.72	10.154**
Height/age	93.05 ^a ± 4.44	95.60 ^b ± 4.19	97.99 ^c ± 4.30	16.273**
Weight/height	111.98 ± 20.97	108.60 ± 15.12	108.98 ± 14.68	.407 NS
Upper to lower segment ratio	1.15 ^a ± 0.09	1.12 ^a ± 0.06	1.09 ^b ± 0.08	6.186**
Head circumfe- rence/age	99.30 ^a ± 2.06	100.70 ^b ± 2.86	101.44 ^b ± 2.92	6.071**
Arm circumfe- rence/age	92.98 ^a ± 12.47	94.76 ^a ± 11.59	99.82 ^b ± 11.62	5.991**
Triceps skin- fold/age	118.31 ^a ± 40.42	132.89 ^{ab} ± 57.83	149.09 ^b ± 54.02	4.232*
Arm muscle area/age	79.44 ^{ab} ± 16.08	77.74 ^a ± 12.68	84.30 ^b ± 15.18	4.507*
Arm fat area/age	103.77 ^a ± 46.11	118.36 ^a ± 60.47	138.17 ^b ± 58.17	4.917**

Educational
achievement
(AEP)

% of achievement

23.92 ^a ± 6.66	29.28 ^b ± 8.20	40.38 ^c ± 8.06	70.889**
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Note: Results are expressed as the mean ± standard deviation. Means with the same superscript are not significantly different at the 0.05 level of probability, based on Student's "t" test.

*p < 0.05 **p < 0.01

1.42%, 1.20% and 0.4%, respectively, and all of them 75.3% of the explained variance. Controlling for SES, the interrelationships found between EA (AEP) and nutrient intake are affected by this variable, by which SES appears as an important determinant of EA (AEP) as well as nutrient intake. In this respect, in this sample of elementary school graduates under study, a significant association between nutrient intake and SES and differences according to sex, were described previously (21).

The School Feeding Program in Chile focuses on elementary school students belonging to the lowest poverty grades, and covers 33% of the FAO/WHO Recommended Dietary Allowances for energy and protein; in other words, 800 kcal and 15 g of protein, the last one being at least 7.5 g of animal source (300 kcal and 500 kcal in breakfast and lunch, respectively). Table 4 shows the nutrient intake, anthropometric measurements and EA (AEP) of elementary school graduates, beneficiaries and non beneficiaries of the School Feeding Program. All beneficiaries had breakfast during the first recess, this meaning that they engaged in the first lesson period under fasting conditions; 50% of them had lunch at 13:00. Although in general no significant difference was found between nutrient intake of beneficiaries and non beneficiaries from low SES, beneficiaries showed a lower nutrient intake, particularly for riboflavin, niacin, vitamin A and calcium. The same fact was observed for energy sources. Likewise, beneficiaries registered a significantly lower percentage of protein and iron from animal source, compared with the other groups. Even more, in this sample it can be concluded that the School Feeding Program benefits were well focused because the target group presented a significantly lower percentage of height for age and head circumference for age, compared with non beneficiaries from the same and higher SES, at the same time that they registered lower and higher values for the percentage of weight for age and upper to lower segment ratio, respectively. All the anthropometric parameters mentioned are indicators of past nutrition whose low values are characterizing these beneficiaries really as a deprived group, in which a significantly lower percentage of achievement in AEP was found, compared with non beneficiaries whether from low or higher SES.

It is necessary to underline that EA problems are multicausal; therefore, it cannot be concluded that the low percentage of achievement observed in low SES schoolers, especially in School Feeding Program beneficiaries, is due only to a deficient nutrient intake or to malnutrition conditions in the past and present life. In other words, nutrient intake-EA relation is not one of cause and effect, since a strong interaction between SES and nutritional status has been described, making SES an important determinant of educational achievement as well as nutritional status measured through direct or indirect indicators. Even more, in this sample of elementary school graduates the percentage of height for age was the most important nutritional parameter in explaining approximately 6% of EA variance, but SES was the variable with the greatest explanatory power, 31.4% of EA variance (approximately 77% of the explained variance) (23, 24). Consequently, in Table 3, it is verified that calcium intake was the variable with the greatest explanatory power in EA variance (7.2%), but it is significantly and positively correlated with the percentage of height for age ($r = 0.164$, $p < 0.02$) and SES ($r = -0.332$, $p < 0.01$); the negative sign is due to the fact that more lower grades in the SES scale belong to higher levels in SES).

Table 5 shows the food consumption of Chilean high school graduates by EA (AAT) categories. Schoolers that scored ≥ 600 presented a significantly higher consumption of milk, cheese and meat compared with the other categories of EA and of yogurt, compared with schoolers of the lowest category of EA. Likewise, this last one registered a significantly higher bread consumption in comparison to the upper categories of EA. Nutrient intake, expressed as percentage of adequacy to FAO/WHO Pattern by EA (AAT) categories, is indicated in Table 6. Schoolers obtaining the highest scores presented a riboflavin and calcium intake, significantly higher as compared with the other categories. Furthermore, they registered a protein, niacin, vitamin A, vitamin C and iron intake higher than schoolers in the lower categories of EA, but differences were not significant. Table 7 illustrates a multiple regression analysis between EA (AAT, dependent variable) and nutrient intake expressed as percentage of adequacy to FAO/WHO Pattern (independent variables). A significant and positive correlation was found between EA and protein, riboflavin, calcium and iron intake (Multiple $r = 0.438$, $p < 0.01$; $r^2 = 0.192$), being protein, calcium, iron and riboflavin intake the independent variables with the greatest explanatory power in EA variance (8.22%, 2.04%, 0.51% and 0.31%, respectively), explaining 57.7% of the explained variance. Controlling for SES such as observed in elementary school graduates, these interrelationships are affected by SES and sex. Therefore, in high-school graduates a significant and positive association between nutrient intake and SES was observed at the same time that differences according to sex were informed in a previous report (22). Thus females presented a more deficient nutrient intake, a specially outstanding fact for iron intake, since adolescent females are, in Chile, a vulnerable group with respect to nutritional anemia, although of low prevalence. In this context, sample behavior related to the significant and positive correlation found between EA and iron intake occurred at the expense of females. On the other hand, in this sample of high-school graduates, the percentage of height for age was the nutritional parameter of main impact in EA (AAT), variance explaining 3.2%, but SES was the variable with the greatest explanatory power, 30.2%, that is 88% of the explained variance (23, 24). In this respect, a similar situation in elementary and high school was observed. In high-school graduates as Table 7 depicts, protein intake was the variable with the greatest explanatory power in EA (AAT) variance (8.2), but it is significantly and positively correlated with the percentage of height for age ($r = 0.261$, $p < 0.01$) and SES ($r = -0.270$, $p < 0.01$).

The greatest impact of calcium and protein intake in EA variance of elementary and high-school graduates could be explained because at the onset of adolescence, calcium is very important for the growth processes and at the end, when final stature is almost attained, the biological structure support would appear to be a great priority, in spite of the fact that calcium intake is also important. Nevertheless, as informed previously, when a multiple regression between EA (dependent variable) and the most significant parameters (independent variables) in elementary and high school graduates was carried out, the explanatory power of calcium and protein intake in EA variance was very low because SES is a codeterminant of both EA and nutrient intake (24).

In relation to these results, however, we suggest caution, because al-

TABLE 5
EDUCATIONAL ACHIEVEMENT (ACADEMIC APTITUDE TEST, AAT) AND FOOD CONSUMPTION
OF HIGH-SCHOOL CHILEAN GRADUATES

Food	AAT			F	Student's "t" test		
	Low (L) < 450 (105) ^a	Medium (M) 450-600 (93)	High (H) ≥ 600 (69)		L/M	M/H	L/H
Milk (cc)	173.95 ± 219.35 ^b	195.48 ± 264.64	389.17 ± 399.48	12.72**	NS	***	***
Cheese (g)	12.09 ± 29.97	9.62 ± 23.90	24.20 ± 32.57	5.57**	NS	**	*
Fresh cheese (g)	2.74 ± 21.15	1.94 ± 11.91	3.77 ± 15.45	0.23NS			
Yogurt (g)	14.19 ± 66.99	33.65 ± 87.22	47.12 ± 96.12	3.46*	NS	NS	*
Meat (g)	95.15 ± 86.23	99.91 ± 85.47	153.84 ± 97.31	10.25**	NS	***	***
Fish and shellfish (g)	17.62 ± 68.17	12.26 ± 41.28	7.19 ± 32.23	0.85NS			
Eggs (g)	27.73 ± 45.81	25.07 ± 42.94	23.73 ± 36.50	0.20NS			
Legumes (g)	21.54 ± 51.80	29.77 ± 55.28	16.52 ± 42.94	1.41NS			
Cereals (g)	73.27 ± 99.48	80.20 ± 87.92	76.44 ± 71.44	0.16NS			
Potatoes (g)	132.52 ± 160.14	102.51 ± 127.76	124.74 ± 209.64	0.85NS			
Bread (g)	329.91 ± 208.19	266.80 ± 210.85	247.26 ± 186.65	4.05*	*	NS	**
Vegetables & fruits (g)	360.14 ± 368.00	304.46 ± 233.72	362.46 ± 282.93	1.03NS			
Almonds, nuts & peanuts (g)	2.05 ± 11.13	2.25 ± 9.76	4.45 ± 19.14	0.77NS			
Sugar (g)	29.15 ± 21.81	27.08 ± 20.06	21.90 ± 20.67	2.52NS			
Miscellaneous (g)	86.80 ± 96.72	89.29 ± 105.42	117.13 ± 106.82	2.06NS			
Beverage & juices (cc)	18.91 ± 63.59	18.28 ± 72.27	39.42 ± 98.08	1.86NS			
Fats and oils (g)	31.78 ± 23.64	27.30 ± 20.58	27.55 ± 25.54	1.13NS			

a Number of cases.

* p < 0.05; ** p < 0.01; *** p < 0.001 NS = Not significant.

b Mean ± Standard deviation.

TABLE 6

EDUCATIONAL ACHIEVEMENT (ACADEMIC APTITUDE TEST, AAT) AND NUTRIENT INTAKE OF HIGH-SCHOOL CHILEAN GRADUATES

Nutrient	AAT			F	Student's "t" test		
	score				L/M	M/H	L/H
	Low (L) < 450 (105) ^a	Medium (M) 450-600 (93)	High (H) ≥ 600 (69)				
	% FAO/WHO Pattern						
Energy	100.74 ± 41.85 ^b	95.48 ± 35.27	99.47 ± 39.83	0.47NS			
Protein	160.95 ± 94.70	158.98 ± 88.12	178.35 ± 88.42	1.04NS			
Thiamine	192.61 ± 85.53	170.72 ± 75.76	173.90 ± 84.40	2.01NS			
Riboflavin	96.35 ± 47.29	95.50 ± 40.76	112.94 ± 42.39	3.81*	NS	**	*
Niacin	80.09 ± 39.63	79.19 ± 42.31	86.59 ± 41.98	0.73NS			
Vitamin A	76.35 ± 69.57	77.00 ± 178.47	90.31 ± 98.82	0.31NS			
Vitamin C	404.67 ± 470.73	367.42 ± 375.62	537.32 ± 537.01	2.87NS			
Calcium	131.34 ± 81.72	123.27 ± 77.97	192.03 ± 107.36	13.83**	NS	***	***
Iron	244.60 ± 204.53	205.23 ± 170.03	278.85 ± 198.07	2.95NS			

a Number of cases in each group

b Mean ± Standard deviation.

* p < 0.05; ** p < 0.01; *** p < 0.001 NS = Not significant.

TABLE 7

**MULTIPLE REGRESSION TABLE OF EDUCATIONAL ACHIEVEMENT (ACADEMIC APTITUDE TEST, AAT)
(DEPENDENT VARIABLE) AND NUTRIENT INTAKE (INDEPENDENT VARIABLE)
OF HIGH-SCHOOL CHILEAN GRADUATES**

Nutrient ^a	Multiple r	r ²	r ² change	simple r	B	Beta
Energy	.01818	.00033	.00033	.01818	-.1326097	-.04107
Protein	.28731	.08255	.08222	.19121***	.6196224	.37812
Thiamine	.38670	.14954	.06699	-.10754	-.6731923	-.44778
Riboflavin	.39063	.15259	.00305	.15658**	-.1377992	-.06124
Niacin	.39806	.15845	.00586	.02434	-.9556675D-01	-.03110
Vitamin C	.40650	.16529	.00684	.11914	.1612149D-01	.06091
Calcium	.43091	.18569	.02039	.26920***	.2385700	.21931
Iron	.43684	.19083	.00514	.12815*	.5137162D-01	.09824
Vitamin A	.43800***	.19185***	.00102	.11047	.2705744D-01	.03259
Constant					492.2797	

a Percentage of adequacy to the 1973 FAO/WHO Pattern.

* p < 0.05; ** p < 0.02 *** p < 0.01.

though the 24-hour dietary recall method is widely used, additional work is needed to determine their sensitivity in diverse children population groups, the extent of variability in children and the factors that affect the accuracy of a person's self-reported dietary intake (25-27).

Results of the present study confirm the fact that EA is significantly and positively correlated with nutrient intake, but these interrelationships are strongly related to socioeconomic-sociocultural conditions, making it very difficult to establish, in a conclusive way, the explanatory power of these variables in EA because they are interdependent. As a final thought, it is necessary to allude to the fact that EA problems are multicausal, determined by the schooler, the family and educational system factors. Among the schooler's factors, their food and nutritional situation—measured through anthropometric parameters and nutrient intake—is significant in school performance. Likewise, schoolers's food habits play an important role in EA, the results of which study will be communicated in a forthcoming article.

RESUMEN

NUTRICION Y EDUCACION. II. RENDIMIENTO ESCOLAR E INGESTA DE NUTRIENTES DE ESCOLARES CHILENOS QUE EGRESAN DE EDUCACION BASICA Y MEDIA

El propósito de este estudio fue investigar las interrelaciones existentes entre rendimiento escolar (RE) e ingesta dietaria de escolares chilenos que egresan de educación básica y media. Se seleccionó una muestra aleatoria de 550 escolares de ambos niveles educacionales (1:1) y de ambos sexos (1:1), de colegios fiscales y particulares (1:1) y de nivel socioeconómico (NSE) alto, medio y bajo (1:1:1). La ingesta dietaria se determinó mediante la encuesta de recordatorio de 24 horas, del día anterior, y la adecuación de la ingesta se evaluó en relación al Patrón FAO/OMS. El RE se midió mediante el Programa de Evaluación del Rendimiento (PER) y por la Prueba de Aptitud Académica (PAA), en los egresados de educación básica y media, respectivamente. En los egresados de educación básica, el RE (PER) correlacionó positiva y significativamente con la ingesta de energía, proteínas, riboflavina, ácido ascórbico, calcio y vitamina A (r múltiple = 0.456 $P < 0.01$; $r^2 = 0.208$). Los beneficiarios del Programa de Alimentación Escolar presentaron los niveles más bajos de RE (PER) unido a una deficiente ingesta de energía, riboflavina, niacina, vitamina A y calcio, así como los más bajos valores para aquellos parámetros antropométricos que son indicadores de la historia nutricional, o sea porcentaje de talla para la edad, circunferencia craneana para la edad y una mayor relación de segmentos, comparado con los no-beneficiarios del mismo NSE (bajo) y de NSE alto y medio. En los egresados de educación media, el RE (PAA) correlacionó positiva y significativamente con la ingesta de proteínas, calcio, riboflavina y hierro (r múltiple = 0.438 $P < 0.01$; $r^2 = 0.192$). Sin embargo, estas interrelaciones están estrechamente ligadas al NSE y al sexo.

Los resultados muestran que el rendimiento escolar (RE) está asociado positiva y significativamente con la ingesta de nutrientes, siendo importantes para la planificación educacional en relación al Programa de Alimentación Escolar en Chile.

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