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Nutrition and Education IV. Clinical signs of malnutrition and its relationship with socioeconomic, anthropometric, dietetic and educational achievement parameters [1]

Daniza Ivanovic Marincovich[2]

University of Chile, Institute of Nutrition and Food Technology (INTA), Nutrition and Educational Achievement Unit
Santiago, Chile

SUMMARY The objective of this study was to determine the prevalence of clinical signs of malnutrition, and to measure the interrelationship with socioeconomic, anthropometric, dietetic and educational achievement parameters. A random sample of 550 Chilean elementary and high school graduates (1:1), of both sexes (1:1), from public and private schools (1:1) and from high, medium and low socioeconomic status (SES) (1:1:1), was chosen in the Metropolitan Area of Santiago, Chile. SES was measured through the Graffar Modified Scale. Clinical signs of malnutrition were assessed according to Jelliffe. Nutritional status was determined by means of anthropometric measurements: percentages of weight/age (W/A), height/age (H/A) and weight for height (W/H) were compared with the WHO Tables; head circumference/age (HC/A) with the Tanner Tables, and branchial anthropometric parameters by applying the Frisancho norms. Standard procedures for the 24hour dietary recall interviews were used to collect data, and adequacy of intake was assessed by the FAO/WHO pattern. Educational achievement (EA) was measured through the Achievement Evaluation Program, (AEP) and Academic Aptitude Test (AAT) in elementary and high school graduates, respectively. Results showed that apart from caries (87.5%), most prevalent clinical signs of malnutrition were dermatosis (13.4%), follicular hyperkeratosis type I (13.2%), nasolabial dyssebacea (7.9%), lustreless hair (7.7%), angular stomatitis (4.4%) and cheilosis (2.7%). The number of clinical signs of malnutrition was found inversely and significantly associated with SES, H/A, vitamin A and calcium intake, as well as with EA, besides registering a lower nutrient intake, specially for energy, riboflavin and niacin.

In spite of the fact that few researches have been carried out on the matter, based on the results of the present study, it can be concluded that the examination of clinical signs of malnutrition is, in general, a practical method for assessing nutritional status. SES appears to be conditioning both, nutritional status-assessed through clinical parameters (clinical signs of malnutrition). Further researches, evidently, are needed to quantify the explanatory power of schoolers' food and nutritional status over educational achievement (EA).

RESUMEN. Nutrición y Educación. IV. Signos clínicos de malnutrición y su asociación con indicadores socioeconómicos, antropométricos, dietéticos y rendimiento escolar. El objetivo de este estudio fue establecer la prevalencia de signos clínicos de malnutrición y medir su interrelación con indicadores socioeconómicos, antropométricos, dietéticos y de rendimiento escolar (RE). Para tal efecto, se seleccionó una muestra aleatoria de 550 escolares chilenos que egresaban de Educación Básica y Media (1:1), de ambos sexos (1:1), de colegios publicos y privados (1:1) y de nivel socioeconómicos (NSE) alto, medio y bajo (1:1:1), medido a través de la escala de Graffar modificada. Los signos clínicos de malnutrición se determinaron de acuerdo a los estándares de Jelliffe. El estado nutricional se evaluó por medio de mediciones antropométricas, estableciéndose los porcentajes de adecuación peso/edad (P/E), talla/edad (T/E) y peso/talla (P/T) de acuerdo a las Tablas de la OMS; circunferencia craneana/edad (CC/E) en relación a las Tablas de Tanner, y los parámetros antropométricos braquiales se compararon con las Tablas de Frisancho. La ingesta dietaria se evaluó mediante la encuesta Recordatorio de 24 horas del dia anterior, y su adecuación se estableció en relación al Patrón FAO/OMS. El RE se determinó según el Programa de Evaluación del Rendimiento (PER) y por la Prueba de Aptitud Académica (PAA), en los egresados de Educación Básica y Media, respectivamente. Los resultados revelaron que aparte de las caries (87.5%), los signos clinicos de malnutrición más prevalentes en esta muestra fueron dermatosis (13.4%), hiperqueratosis folicular tipo I (13.2%), disebácea nasolabial (7.9%), pelo opaco (7.7%), estomatitis angular (4.4%) y queilosis (2.7%). El número de signos clínicos de malnutrición se asoció inversa y significativamente con el NSE, T/E, ingesta de vitamina A, ingesta de calcio y RE, además de registrarse una baja ingesta de nutrientes, sobre todo de energía, riboflavina y niacina. A pesar del hecho de que se han efectuado pocas investi-

1 Supported by Grant S 1505853F of Departamento Técnico de Investigación (DTI), University of Chile.

2 Assistant Professor and Chief, Nutrition and Educational Achievement Unit, University of Chile, Institute of Nutrition and Food Technology (INTA), P.O. Box 138, Santiago 11, Chile.

gaciones sobre estas materias, a partir de los resultados del presente estudio es factible concluir que la evaluación de los signos clínicos de malnutrición es, en general, un método práctico de evaluar el estado nutricional. El NSE aparece condicionando tanto el estado nutricional evaluado a través de parámetros clínicos (signos clínicos de malnutrición)así como el RE. Por lo tanto, es imprescindible realizar nuevas investigaciones al respecto, con el objeto de cuantificar el poder explicatorio de la situación alimentaria y nutricional del escolar en su rendimiento escolar (RE).

INTRODUCTION

Nutritional assessment of schoolers through the recognition of some physical signs related to inadequate nutrition has been defined as an important method for learning their actual nutritional status. Notwithstanding, most clinical signs of malnutrition are not specific to the lack of one nutrient and, sometimes, can be produced by nonnutritional environmental factors (1).

In Chile, some investigations have been carried out to assess clinical signs of malnutrition in children (2-4). These studies have demonstrated that it would seem that the prevalence of clinical signs has decreased in the Chilean population during the last years. From these findings, follicular hyperkeratosis has been described as the most outstanding clinical sign, although of low occurence, since it has been found only in 13.2% of children (3).

Taking into account all of the above considerations, the purpose of this study was to determine the prevalence of clinical signs of malnutrition, and to measure their interrelationship with socioeconomic, anthropometric, dietetic and educational achievement parameters.

MATERIAL AND METHODS

Sample Selection

A random sample of 550 schoolers graduating from elementary and highschool (1:1), was selected from the Metropolitan Area of Santiago, Chile. The sample included schoolers of both sexes (1:1), from public and private schools and from high, medium and low socioeconomic status (SES)

1). Age ranged between 13-19 years (13-16 years and 16-19 years in elementary and high school, respectively) and mean age of low SES schoolers was significantly higher, as compared to those belonging to other strata. The field study was carried out during the second semester of 1982.

Socioeconomic Status

SES was measured through a socioeconomic scale that has been repeatedly tested by the Institute of Nutrition and Food Technology (INTA) of the University of Chile, based on the Graffar modified method. This scale includes schooling, occupation of the household head, and housing (conditions, property, water supply, sanitation and goods (5).

Clinical Signs Assessment

Clinical signs of malnutrition were assessed according to the definition, classification and standardization suggested by Jelliffe (1). Therefore, all clinical signs used in nutrition surveys, especially those belonging to group 1, were examinated in hair, face, eyes, lips, tongue, teeth, gums, glands, skin, nails, subcutaneous tissue, muscular and skeletal systems and internal systems.

Nutritional Status

The nutritional status was determined through anthropometric measurements. Percentages of adequacy of weight for age (W/A), height for age (H/A) and weight for height (W/H) were assessed according to the US National Center for Health Statistics (NCHS) Tables adopted by WHO (6); head circumference for age (HC/A) was determined in relation to the Tanner Tables (7); and arm circumference for age (AC/A), triceps skinfold for age (TS/A), arm muscle area for age (AMA/A) as well as arm fat area for age (AFA/A) were calculated using Frisancho norms (8). Upper segment (US) was measured to determine upper to lower segment ratio (US/LS).

Dietary Intake

Standard procedures for the 24hour dietary recall interviews were used to collect data. Chemical Composition of Chilean Foods Tables were used to calculate nutrient intakes (9) and adequacy on intake was assessed by the FAO/WHO Pattern (10-13).

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 8th grade. In the present study, results are expressed as percentage of achievement of both, language and mathematics test in three categories: high (> 40%), medium (30-40%) and low (< 30%). On the other hand, in highschool graduates, EA was measured through the Academic Aptitude Test (AAT), a national verbal and mathematics test administered by the university system prior to admission. Results are expressed as the mean between both scores, verbal and mathematics part. Scores range between 0-900 and, in the present study, three categories were established: high ($\geq$ 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 covering and have been submitted to adequate processes of validity and reliability.

Statistical Analysis

Statistical procedures included analysis of variance, Student's "t" test and chi square test (14).

RESULTS AND DISCUSSION

Figure 1 depicts the clinical signs of malnutrition by body area, most outstanding being those affecting teeth (caries 87.5%), skin (20.1%), nasolabial area (12.5%) and hair (9.2%). The specific clinical signs found in each body area are related in detail in Figure 2. Apart from caries, the most prevalent clinical signs detected in the adolescent schoolers under study were dermatosis (13.4%), follicular hyperkeratosis type I (13.2%), nasolabial dyssebacea (7.9%), lustreless hair (7.7%), angular stomatitis (4.4%) and cheilosis (2.7%). Prevalence observed for beading of ribs, subcutaneous tissue oedema, thin hair and follicular hyperkeratosis (type 1) was similar to those reported by the

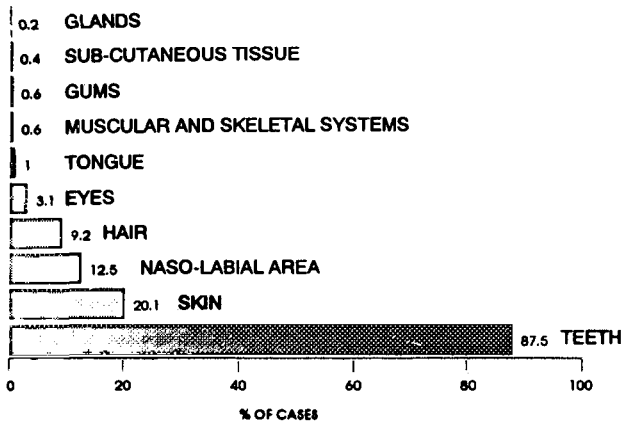

FIGURE 1
Prevalence of clinical signs of malnutrition by body area in Chilean elementary and highschool graduates

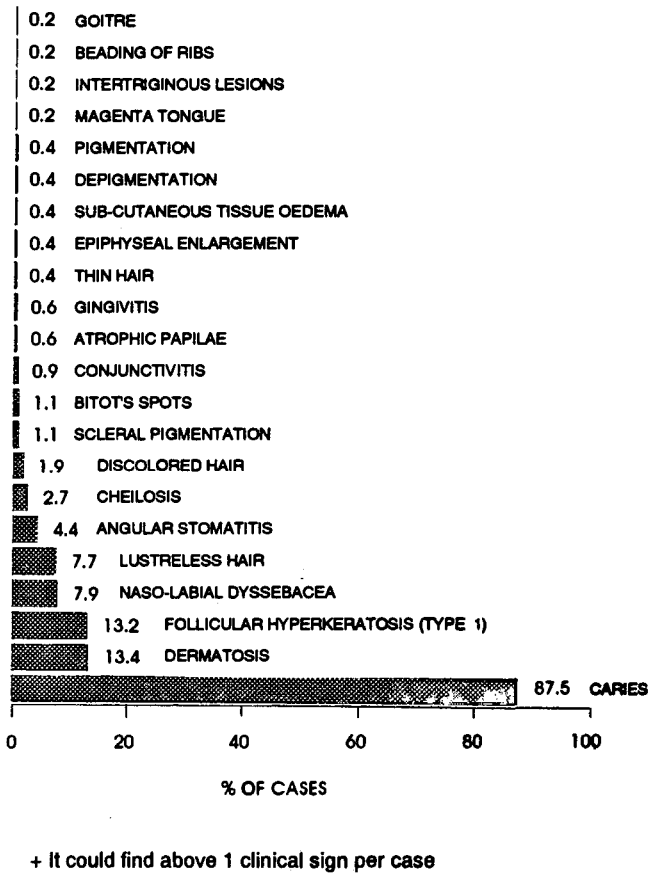

FIGURE 2
Prevalence of clinical signs of malnutrition in Chilean elementary and highschool graduates

TABLE 1
PREVALENCE OF CLINICAL SIGNS OF MALNUTRITION OF CHILEAN SCHOOLERS GRADUATING FROM ELEMENTARY AND HIGHSCHOOL, BY SOCIOECONOMIC STATUS (SES)

Clinical signs area[a]	Socioeconomic status: High (N = 173) N	%	Medium (N = 174) N	%	Low (N = 175) N	%	x^2 (2 g.l.)[b]	P
Hair	6	3.5	16	9.2	26	14.9	13.510	< 0.01
Eyes	0	0	8	4.6	8	4.6	8.180	< 0.02
Nasolabial	9	5.2	22	12.6	34	19.4	16.160	< 0.001
Teeth (caries)	157	90.8	149	85.6	15 1	86.3	2.470	NS
Skin	17	9.8	24	13.8	64	36.6	42.217	< 0.001

a.- In some cases more than one clinical sign was found.
b.- Chi square test was calculated comparing schoolers with and without the specific clinical sign .

TABLE 2
PREVALENCE OF CLINICAL SIGNS OF MALNUTRITION OF CHILEAN ELEMENTARY AND HIGH SCHOOL GRADUATES

Clinical signs area[a]	Elementary school graduates (N = 250)		High school graduates (N = 272)		x^2 (1 g.l.)[b]	p
	N	%	N	%		
Hair	30	12.0	18	6.6	4.520	< 0.05
Eyes	5	2.0	11	4.0	1.832	NS
Nasolabial	29	11.6	36	13.2	0.319	NS
Teeth (caries)	211	84.4	246	90.4	4.361	< 0.05
Skin	60	24.0	45	16.5	4.507	< 0.05

a.- In some cases more than one clinical sign was found.
b.- Chi square test was calculated comparing schoolers with and without the specific clinical sign.

TABLE 3
NUMBER OF CLINICAL SIGNS OF MALNUTRITION BY SOCIOECONOMIC STATUS (SES) OF CHILEAN ELEMENTARY AND HIGH SCHOOL GRADUATES

Number of clinical signs of malnutrition	Socioeconomic level						Total	
	High		Medium		Low			
	N	%	N	%	N	%	N	%
0	12	6.9	20	11 .5	18	1 0.3	50	9.6
1	134	77.4	97	55.7	63	36.0	294	56.3
2	20	11.6	37	21.3	47	26.8	104	19.9
3	5	2.9	12	6.9	2 1	1 2.0	3 8	7.3
4	1	0 .6	4	2.3	15	8.6	2 0	3 .8
≥5	1	0.6	4	2.3	11	6.3	16	3.1
Total	173	100	174	100	175	100	522	100

x^2 = 75.192. 10 g.l. P < 0.001. C = 0.35.

National Nutrition Survey carried out in 1974 with respect to the Metropolitan Region. Nevertheless, in the present study, the prevalence of Bitot's spots, discolored hair, cheilosis, angular stomatitis, naso labial dyssebacea and dermatosis, was higher (3).

Clinical signs of malnutrition were found significantly and inversely associated with SES, as indicated in Table 1. Except for teeth (caries), prevalence of clinical signs increased significantly in the medium and low SES schoolers, as compared to those belonging to the high SES. These results are not in agreement with those reported by other investigators who have not found a significant association between SES and the prevalence of clinical signs of malnutrition. Taking into account these findings, caries is a community nutritional problem that affects all socioeconomic strata, but it could be due to nonnutritional factors.

Hair clinical signs prevalence was significantly higher in females (12.4%) compared with males (6.1%) (Xo^2 = 6.286 1 g.l. p < 0.02). However nonnutritional factors could be explaining more properly this fact. Likewise, in this sample, only the prevalence of skin clinical signs presented significant differences by type of school (28.5% and 11.6% in public and private schools, respectively) (Xo^2= 23.288 1 g.l. p < 0.001).

Table 2 shows the prevalence of clinical signs of malnutrition in elementary and highschool Chilean graduates. Hair and skin clinical signs significantly

TABLE 4
ANTHROPOMETRIC PARAMETERS BY NUMBER OF CLINICAL SIGNS OF MALNUTRITION OF CHILEAN ELEMENTARY AND HIGH SCHOOL GRADUATES

Anthropometric parameters	Number of clinical signs of malnutrition						
	0 (50)a	1 (296)	2 (103)	3 (37)	4 (20)	≥ 5 (16)	F[b]
	% of standard						
Weight/age	98.92 ± 17.34c	98.88 ± 16.49	96.03 ± 14.21	92.23 ± 14.10	91.26 ± 14.87	94.74 ± 18.13	2.17 NS
Height/age	97.04 ± 3.93	97.70 ± 4.23	96.62 ± 3.66	95.65 ± 4.36	95.21 ± 4.04	93.70 ± 3.32	5.57
Weight/height	110.75 ± 17.43	109.38 ± 14.63	110.52 ± 16.32	108.13 ± 12.67	109.47 ± 14.42	119.72 ± 24.00	1.49NS
Upper to lower segment ratio	106.11 ± 5.34	105.90 ± 7.46	106.57 ± 6.02	106.67 ± 6.60	104.13 ± 6.88	107.90 ± 5.85	0.74NS
Head circumference	101.42 ± 2.68	101.92 ± 3.22	101.81 ± 2.78	100.10 ± 2.99	100.40 ± 2.33	101.03 ± 3.11	3.32
Arm circumference	98.41 ± 12.72	97.68 ± 10.97	96.63 ± 10.67	94.98 ± 10.76	94.07 ± 9.36	98.40 ± 14.42	0.92NS
Triceps skinfold	150.57 ± 56.72	149.45 ± 56.03	138.80 ± 48.22	125.59 ± 42.36	131.58 ± 47.73	136.55 ± 56.52	2.10NS
Arm muscle area	80.88 ± 13.53	82.37 ± 16.78	82.91 ± 14.68	81.58 ± 11.73	78.90 ± 13.31	83.27 ± 13.13	0.33NS
Arm fat area	134.67 ± 61.27	129.58 ± 53.92	120.46 ± 51.29	110.16 ± 49.54	113.82 ± 46.61	124.33 ± 61.84	1.58NS

a: number of cases
b**: $p < 0.01$ NS = non significant
c: mean ± standard deviation
Student's "t" test:
Height/age: 0/≥ 5 = $p < 0.01$; 1/2 = $p < 0.05$; 1/3 and 1/4 = $p < 0.01$; 1/≥ 5 = $p < 0.001$; 2/≥ 5 = $p < 0.01$.
Head circumference/age: 0/3 = $p < 0.05$; 1/3 = $p < 0.001$; 1/4 = $p < 0.01$; 2/3 = $p < 0.01$; 2/4 = $p < 0.05$.

TABLE 5

FOOD CONSUMPTION BY NUMBER OF CLINICAL SIGNS OF MALNUTRITION OF CHILEAN ELEMENTARY AND HIGH SCHOOL GRADUATES

	Number of clinical signs of malnutrition						
FOOD	0 (50)a	1 (288)	2 (103)	3 (38)	4 (20)	≥5 (16)	F[b]
Milk (cc)	330.20 ± 653.53c	296.72 ± 294.57	220.32 ± 219.58	197.97 ± 246.08	216.50 ± 266.58	196.25 ± 230.42	1.79
Cheese (g)	7.14 ± 16.66	16.05 ± 30.80	14.79 ± 34.19	5.66 ± 13.36	7.00 ± 12.61	3.63 ± 9.91	2.14
Fresh cheese (g)	0.00 ± 0.00	2.91 ± 16.92	1.65 ± 11.81	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.78
Yogurt (g)	40.69 ± 92.30	32.04 ± 83.71	10.24 ± 49.08	21.24 ± 57.95	18.50 ± 56.94	0.00 ± 0.00	2.12
Meat (g)	108.24 ± 162.30	113.03 ± 99.05	86.20 ± 73.86	99.05 ± 88.17	55.85 ± 47.92	65.25 ± 71.43	2.52
Fish and shellfish (g)	16.26 ± 52.71	14.21 ± 76.82	13.41 ± 49.54	15.66 ± 53.35	40.20 ± 178.89	16.25 ± 57.49	0.46
Eggs (g)	33.66 ± 45.65	24.57 ± 39.11	29.36 ± 46.74	21.58 ± 36.19	21.50 ± 30.60	4.38 ± 13.15	1.59
Legumes (g)	13.36 ± 32.13	18.90 ± 46.26	22.24 ± 54.42	20.63 ± 45.6g	5.65 ± 20.51	22.63 ± 41.29	0.61
Cereal (g)	93.62 ± 86.23	70.02 ± 74.81	74.51 ± 95.87	73.24 ± 88.98	80.65 ± 72.14	52.50 ± 46.79	0.96
Bread (g)	241.92 ± 149.30	273.70 ± 189.87	297.28 ± 186.06	278.03 ± 153.67	295.40 ± 134.86	280.94 ± 155.46	0.70
Potatoes (g)	113.54 ± 190.74	131.26 ± 171.40	104.62 ± 149.04	123.08 ± 142.20	197.15 ± 254.40	76.94 ± 105.24	1.39
Vegetables & Fruits (g)	296.56 ± 1 92.56	325.58 ± 282.54	321 .05 ± 275.39	331 .24 ± 252.40	31 5.45 ± 276.60	329.94 ± 521 .38	0. 10
Almond, nuts & peanuts (g)	1.30 ± 6.61	3.98 ± 16.63	1.99 ± 12.38	3.45 ± 16.61	0.00 ± 0.00	0.00 ± 0.00	0.81
Sugar (g)	25.40 ± 21.72	24.27 ± 18.91	26.14 ± 18.77	29.11 ± 23.48	22.40 ± 12.77	22.44 ± 13.07	0.63
Miscellaneous (g)	100.02 ± 121.58	103.66 ± 116.81	101.79 ± 119.32	106.61 ± 141.93	62.45 ± 111.92	74.56 ± 129.87	0.61
Juices & beverages (cc)	20.10 ± 74.04	25.43 ± 83.50	12.52 ± 44.50	10.00 ± 61.64	28.00 ± 111.90	9.06 ± 31.32	0.74
Oils & fats (g)	40.46 ± 33.94	28.38 ± 23.45	32.19 ± 27.95	29.00 ± 19.02	29.35 ± 17.35	22.50 ± 19.91	2.41

a: number of cases

b*: $p < 0.05$.

c: mean ± standard deviation

Meat: 0/4 = $p < 0.05$; 1/2 = $p < 0.01$; 1/4 = $p < 0.001$; 1/≥5, 2/4 and 3/4 = $p < 0.05$.

Oils and fats = 0/1, 0/3 and 0/≥ 5 = $p < 0.05$.

decreased in highschool graduates. Thus, these clinical signs of malnutrition decreased with age at the same time that caries significantly increased with age ($p < 0.05$).

The number of clinical signs of malnutrition by SES is presented in Table 3. It can be observed that these variables are inversely and significantly associated ($X^2 = 75.192$ 10 g.l. $p < 0.001$).

Table 4 indicates the anthropometric parameters values, according to the number of clinical signs of malnutrition. Schoolers with five or more signs registered a significantly lower H/A, and most part of them presented growth failure. This same group registered the highest values for upper to lower segment ratio and W/H, consequently, the high prevalence of obesity and overweight registered in this sample is more properly explained by growth failure, as informed previously (15-17). Thus, clinical signs of malnutrition are strongly related to socioeconomic and sociocultural conditions the same as anthropometric parameters. Therefore, growth failure was significantly higher in low SES schoolers (15). It can be concluded that more deprived schoolers present malnutrition conditions which can be detected by the clinical signs of malnutrition. HC/A values presented significant differences by the number of clinical signs of malnutrition, but there is not a clear tendency in this respect. On the other hand, the low AMA/A values observed in all socioeconomic strata, can be due to the low physical activity (18).

Food consumption by the number of clinical signs of malnutrition is showed in Table 5. A significantly lower consumption of meat, fats and oils was detected when clinical signs of malnutrition increased. This fact was linked to a lower consumption of dairy products, eggs, potatoes, miscellaneous products, juices and carbonated beverages. Table 6 indicates the percentage of adequacy of nutrient intake by the number of clinical signs of malnutrition. As observed vitamin A and calcium intake significantly decreased insofar as clinical signs of malnutrition increased. In relation to this fact, nutrient intake decreased when clinical signs increased. Therefore, schoolers that presented five or more clinical signs of malnutrition, registered a lower nutrient intake, especially of energy, riboflavin and niacin, besides nutrients before mentioned. It is necessary to underline the fact that in this sample, a significant association between nutrient intake and SES was described previously, at the same time that 49.0% and 62.0% registgered a low and excessive intake for energy and protein, respectively; deficiencies in vitamin A, riboflavin, niacin, calcium and iron intake were also detected (19, 20).

The percentage of adequacy of nutrient intake by clinical signs of malnutrition is presented in Table 7. In decreasing order, it is possible to appreciate deficiencies, especially for riboflavin, niacin, and vitamin A, besides energy and calcium intake, as it said previously. On the other hand, it is necessary to show the fact that nutrient intake from the different groups was heterogeneous, a situation that shows the examination of means $\pm$ standard deviation. This fact must be considered in analyzing these data. Thus, for example, the clinical picture of Bitot's spots considered pathognomonic of vitamin A deficiency, could be due to other factors as chronic conjuntival trauma from smoke, dust, glare and eye infections (21). In this sample, the cases that registered Bitot's spots presented a percentage of adequacy of vitamin A intake of 129.11 $\pm$ 113.11, thus making it possible that other non nutritional variables could also be explaning this pathology. This same explanation is valid when analyzing the nutrient intake of those cases that registered other signs, such as nasolabial dyssebacea, angular stomatitis, cheilosis and other signs found in the tongue. Based on these results, it can be concluded that most clinical signs of malnutrition are not specific to lack of one nutrient and could be produced by simultaneous deficiency of many nutrients in diets. So, Table 7 illustrates deficiences in riboflavin, niacin and vitamin A intake were detected in the most part of cases, in spite of the the fact that the mean intake of the main nutritional deficiency responsible for the specific sign, indicated between parenthesis, was adequate. In this respect, biochemical tests can be useful although of many of them are costly and timeconsuming to carry out. Therefore, results of biochemical tests could be correlated with clinical, anthropometric, dietetic and socioeconomic parameters.

Tables 8 and 9 indicate the associations found between EA and a number of clinical signs of malnutrition in elementary and highschool Chilean graduates, respectively. In both educational levels, an inverse and significant interrelationship was observed. Nevertheless, as reported previously, socioeconomic factors are conditionning EA in a more outstanding form, both elementary and high school, at the same time that they affect nutritional status (22). In both education levels, EA was found to be positively and significantly correlated with H/A, the frequency of consumption of dairy products, and SES and in relation to dietary intake, with calcium and protein intake, respectively, but SES was the independent variable with the greatest explanatory power in EA variance (approximately 80% of the explained variance) (22). Thus, in the present study the interrelationship found between EA and clinical signs of malnutrition is strongly related to SES, because this last one appears conditioning both EA and nutritional status measured through anthropometric, dietetic and clinical parameters (23-25). Even more, in spite of the fact that few investigations have been carried out on the matter, from the results of the present study it can be concluded that the examination of clinical signs of malnutrition is in general a practical method for assessing the nutritional status of school population, since these signs have been found to be significantly correlated with socioeconomic,

TABLE 6
NUTRIENT INTAKE BY NUMBER OF CLINICAL SIGNS OF MALNUTRITION OF CHILEAN ELEMENTARY AND HIGH SCHOOL GRADUATES

Nutrient	Number of clinical signs of malnutrition						F[b]
	0 (50)a	1 (288)	2 (103)	3 (38)	4 (20)	≥5 (16)	
	% FAO/WHO Pattern						
Energy	97.30 ± 45.29c	96.09 ± 37.46	95.80 ± 38.71	90.16 ± 33.40	92.38 ± 30.61	78.67 ± 32.32	0.82NS
Protein	177.25 ± 130.54	164.90 ± 91.68	163.25 ± 95.74	138.89 ± 77.65	137.68 ± 68.46	115.60 ± 59.12	1.78NS
Thiamin	164.23 ± 69.16	173.38 ± 79.42	173.15 ± 76.47	164.08 ± 55.24	185.53 ± 80.38	161.11 ± 73.22	0.40NS
Riboflavin	101.55 ± 49.48	101.42 ± 43.67	91.03 ± 38.22	89.57 ± 32.06	96.65 ± 39.85	77.01 ± 36.30	2.08NS
Niacin	79.12 ± 44.98	80.84 ± 41.52	70.03 ± 34.90	80.32 ± 39.07	80.81 ± 31.49	61.88 ± 27.29	1.68NS
Vitamin A	127.19 ± 251.80	76.50 ± 90.26	68.92 ± 61.17	75.85 ± 73.30	74.23 ± 53.30	34.20 ± 22.11	2.66*
Vitamin C	389.08 ± 330.65	459.90 ± 475.95	321.82 ± 355.40	412.47 ± 450.80	417.91 ± 359.45	282.76 ± 311.78	1.91NS
Calcium	119.73 ± 77.48	145.87 ± 86.32	128.43 ± 82.18	105.20 ± 63.44	106.44 ± 72.46	93.72 ± 66.42	3.71**
Iron	185.92 ± 171.78	201.81 ± 162.16	202.39 ± 167.23	188.85 ± 164.44	141.56 ± 94.62	140.23 ± 128.76	0.98NS

a: number of cases
b*: $p < 0.05$; ** $p < 0.01$.
c: mean ± standard deviation
Vitamin A: 0/> 5 = $p < 0.05$; 1/ > 5 = $p < 0.001$; 2/> 5 = $p < 0.001$; 3/> 5 = $p < 0.01$.
Calcium = 0/1 = $p < 0.05$; 1/3 = $p < 0.001$; 1/4 = $p < 0.05$; 1/> 5 = $p < 0.001$.

TABLE 7
CLINICAL SIGNS OF MALNUTRITION AND NUTRIENT INTAKE OF CHILEAN ELEMENTARY AND HIGH SCHOOL GRADUATES

Clinical signs	Nº of[a] cases	NUTRIENT INTAKE								
		Energy	Protein	Thiamine	Riboflavin	Niacin	Vitamin A	Vitamin C	Calcium	Iron
		% FAO/OMS, 1973, RDA								
HAIR	(48)	(91.6 ± 36.2)b	143.7 ± 81.5	173.1 ± 76.7	86.5 ± 36.3	70.7 ± 28.2	61.3 ±57.7	312.3 ± 298.g	90.0 ± 58.7	154.2 ± 132.5
EYES	(16)	88.4 ± 25.7	130.4 ± 74.4	177.6 ± 57.0	92.4 ± 43.3	69.2 ± 27.0	(5B.6 ± 83.1)	388.5 ± 384.0	116.6 ± 88.0	214.1 ±141.6
Bitot's spots	(6)	86.9 ± 29.5	106.0 ± 54.8	179.2 ±78.6	86.0 ± 44.9	65.2 ± 22.7	(129.1 ±113.1)	297.2 ± 177.3	120.3 ± 100.7	214.0 ±183.1
Conjunctival xeroxis	(5)	89.2 ± 26.3	167.8 ± 102.9	167.6 ± 22.6	99.1 ± 41.1	77.3 ± 35.0	(81.7 ±60.5)	555.5 ± 522.7	115.2 ± 81.8	275.2 ±103.6
Scleral Pigmentation	(6)	88.0 ± 23.7	125.8 ± 55.1	182.7 ± 55.2	93.2 ± 46.4	68.8 ± 25.6	(74.3 ±57.7f	275.8 ± 411.5	111.7 ± 88.1	171.3 ± 112.2
NASOLABIAL AREA	(65)	91.3 ± 33.9	143.0 ± 83.9	175.8 ±70.4	(95.1 ± 41.1)	73.8 ± 31.0	0.65 ± 54.8	401.5 ± 391.1	116.7 ± 75.6	179.9 ±138.7
Nasolabial Dyssebacea	(41)	90.9 ± 38.1	144.8 ± 91.4	168.7 ± 77.4	(95.4 ± 45.3)	69.3 ± 33.7	69.8 ± 60.5	364.4 ± 394.4	120.6 ± 82.2	173.7 ± 155.4
Angular estomatitis	(23)	90.8 ± 23.7	136.6 ± 60.0	186.4 ± 60.0	(92.9 ± 36.9)	79.4 ± 27.8	51.4 ± 38.6	422.1 ± 328.8	100.8 ± 58.6	179.4 ± 107.9
Cheilosis	(14)	99.8 ± 32.9	149.9 ± 83.1	202.2 ± 76.6	(95.2 ± 37.9)	85.2 ± 26.3	63.3 ± 45.0	451.2 ± 377.9	135.7 ± 82.8	228.9 ± 159.6
TONGUE	(5)	64.2 ± 45.1	102.8 ± 69.9	126.1 ± 123.7	(84.1 ± 64.3)	44.2 ± 30.2)	40.3 ± 32.2	185.7 ± 221.0	140.7 ± 134.8	196.4 ± 224.6
TEETH: Caries	(450)	94.7 ± 37.5	159.7 ± 90.8	172.2 ± 77.5	96.4 ± 41.4	78.0 ± 39.5	72.4 ± 81.0	418.4 ± 445.1	134.8 ± 83.6	195.0 ± 161.6
SKIN	(104)	90.6 ± 35.7	144.5 ± 83.8	169.5 ± 70.8	88.4 ± 37.2	(74.2 ± 37.2)	(75.9 ± 69.2)	402.9 ± 414.7	119.6 ± 81.7	185.7 ± 158.0
Dermatosis	(70)	86.45 ± 30.4	134.2 ± 72.5	166.9 ± 66.0	86.1 + 33.4	(71.5 ± 28.8)	75.2 ± 71.2	372.3 ± 404.0	114.1 ± 77.0	157.6 ± 105.9
Follicular Hyperkeratosis	(68)	93.0 ± 37.2	149.9 ± 89.5	171.0 ± 67.1	90.3 ± 38.1	75.2 ± 40.9	(66.5 ± 55.2)	411.2 ± 452.7	120.8 ± 81.3	200.3 ± 180.2
Pigmentation	(2)	98.8 ± 13.6	148.6 ± 17.3	154.8 ± 17.2	82.1 ± 5.4	58.4 ± 20.7	62.5 ± 30.3	140.2 ± 123.7	106.8 ± 15.1	168.8 ± 3.4
Depigmentation	(2)	98.9 ± 25.2	142.6 ± 57.6	208.6 ± 106.0	91.4 ± 32.8	75.1 ± 41.2	68.1 ± 54.4	448.1 ± 20.0	121.2 ± 47.0	275.4 ± 291.1
Intertinginous lesions	(1)	87.0	192.3	132.2	61.1	45.0	76.2	271.8	52.3	77.1
GUMS (Gingivitis)	(3)	147.6 ± 49.9	229.0 ± 76.7	290.1 ± 61.0	119.7 ± 25.04	161.2 ± 74.7	32.7 ± 25.4	349.3 ± 319.9	178.9 ± 114.1	581.4 ± 236.3
GLANS (Goitre)	(1)	60.7	112.2	78.3	48.2	22.6	50.3	58.8	48.3	55.8
SUBCUTANEOUS TISSUE(Oedema)	(2)	(67.6 ± 20.5)	(111.1 ± 0.4)	121.5 ± 82.5	96.9 ± 53.6	30.9 ± 20.2	11.7 ± 6.6	31.9 ± 40.1	122.0 ± 13A	56.2 ± 47.8
MUSCULAR AND SKELETAL SYSTEMS	(3)	94.9 ± 17.9	174.6 ± 31.2	169.2 ± 57.2	82.8 ± 41.6	62.3 ± 24.6	68.7 ± 36.8	490.3 ± 220.6	91.4 ± 50.2	257.0 ± 156.5
Spyphyseal enlargement	(2)	90.6 ± 23.3	171.3 ± 43.3	157.g ± 76.0	59.4 ± 13.6	55.5 ± 30.6	47.5 ± 2.1	(415.4 ± 252.2)	64.8 ± 28.7	174.4 ± 89.9
Beading of ribs (1)	102.9	181.2	191.9	129.5	76.0	111.2	640.2	144.5	422.2	

a In some cases more than 1 clinical sign was found. The percentage of adequacy of nutrient intake that appears between parentheses indicates the main nutritional deficiency responsible of the specific signs according to D.B. Jelliffe (1).

b Mean ± standard deviation

TABLE 8
EDUCATIONAL ACHIEVEMENT (ACHIEVEMENT EVALUATION PROGRAM AEP) AND NUMBER OF CLINICAL SIGNS OF MALNUTRITION OF CHILEAN ELEMENTARY SCHOOL GRADUATES

Number of clinical signs of malnutrition	AEP						Total	
	% of achievement							
	≤ 30		30 - 40		> 40			
	N	%	N	%	N	%	n	%
0	11	15.1	6	8.5	11	11.1	28	11.5
1	22	30.1	41	57.8	70	70.7	133	54.7
2	18	24.6	14	19.7	11	11.1	43	17.7
3	11	1 5.1	5	7.0	4	4.0	20	8.2
>4	1 1	15.1	5	7.0	3	3.0	19	7.8
Total	73	100	71	100	99	100	243	100

$x^2 = 33.030$ 8 g.l. $p < 0.001$. $C = 0.35$

TABLE 9
EDUCATIONAL ACHIEVEMENT (ACADEMIC APTITUDE TEST, AAT) AND NUMBER OF CLINICAL SIGNS OF MALNUTRITION OF CHILEAN HIGHSCHOOL GRADUATES

Number of clinical signs of malnutrition	AAT						Total	
	Score							
	< 450		450 - 600		≥ 600			
	N	%	N	%	N	%	n	%
0	5	5.0	7	7.9	4	6.1	16	6.2
	49	48.5	55	61.7	49	74.2	153	59.8
2	30	29.7	13	14.6	13	19.7	56	21.9
3	9	8.9	7	7.9	0	0	16	6.2
≥4	8	7.9	7	7.9	0	0	15	5.9
Total	101	100	89	100	66	100	256	100

$x^2 = 21.136$. 8 g.l. $P < 0.01$. $C = 0.28$.

anthropometric, dietetic and educational achievement parameters. In other context, EA problems are multicausal, so that, in summary, further research is needed on the matter, in order to quantify the explanatory power of schoolers' food and nutritional situation over EA.

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