





An analysis of policy interventions regarding school lunch programs and their role in the healthy nutrition of children in Córdoba, Argentina


Análisis de la intervención de la política de comedores escolares y el rol en la nutrición saludable de niños y niñas de Córdoba, Argentina

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ABSTRACT The aim of this article is to analyze school lunch programs and their role in the healthy nutrition of children in Córdoba, Argentina from 2013 to 2018. A descriptive, cross-sectional study was conducted that included a sample of 10 schools in 2013 and 10 different schools in 2018. A survey of school lunch programs and 24-hour nutrition reminders was carried out with 341 children. The nutritional value of school lunch programs decreased over the study period, particularly among schools in contexts of greater social vulnerability. Significant reductions in average calcium and energy intake were also observed. Indicators of chronic malnutrition, overweight, and excess calcium and vitamin A and C intakes worsened among children attending school lunch programs. Regarding the association between school lunch program attendance and low height for age/risk of low height for age, the odds ratio was not statistically significant. We argue for the necessity of promoting policies that seek urgent improvements in child nutritional indicators from a rights-based perspective.

KEY WORDS School Lunches; Child Nutrition; Food Services; Argentina.

RESUMEN El objetivo fue analizar la intervención de la política de comedores escolares y el rol en la nutrición saludable de niños y niñas de Córdoba, Argentina en los años 2013 y 2018. Estudio descriptivo y trasversal. La muestra incluyó diez escuelas en 2013 y diez diferentes en 2018. Se realizó un relevamiento de comedores escolares y recordatorios alimentarios 24 hs a 341 niñas y niños. Los aportes nutricionales de los comedores escolares descendieron entre ambos periodos, en especial, en las escuelas insertas en contexto de mayor vulnerabilidad. También se observó una reducción significativa de la ingesta media de calcio y energía total. En las niñas y los niños asistentes a los comedores escolares se encontraron indicadores de desnutrición crónica, exceso de peso e ingestas de calcio, vitamina A y C deficitarios. En la asociación entre la asistencia al comedor escolar y el indicador baja talla/riesgo de baja talla, el *odds ratio* no fue estadísticamente significativa. Resulta necesario impulsar una política que busque de manera urgente mejoras de los indicadores de nutrición infantil, considerando un enfoque de derechos.

PALABRAS CLAVES Alimentación Escolar; Nutrición del Niño; Servicios de Alimentación; Argentina.

INTRODUCTION

In Latin America and the Caribbean, overweight in children is an alarming health concern. Overweight continues to rise, affecting 7.3% of the population under 5 years of age, a figure that exceeds the world average of 5.6%.⁽¹⁾ In Argentina, based on recent data provided by the Second National Health and Nutrition Survey (ENNyS 2, for its Spanish acronym), 41.1% of the population between 5 and 17 years of age was overweight.⁽²⁾

Moreover, short stature is another health concern, being closely related to inequalities and poverty.⁽¹⁾ In Argentina, in the period 2018-2019, short stature affected 7.9% of the population under 5 years of age.⁽²⁾ As several authors argued, malnutrition in its multiple forms is currently a public health challenge.⁽³⁾

The Third Global School-Based Student Health Survey of 2018, which assesses the risk factors in adolescents between 13 and 15 years of age in Argentina, showed that 19% of them were overweight while 2.6% were obese, a figure that has been increasing since 2012.⁽⁴⁾

In Argentina, in the last decades, there has been an important process of recognition of the rights of children and adolescents, such as the 1990 International Convention on the Rights of the Child, and the enactment in 2005 of Law 26061 on the Comprehensive Protection of the Rights of Children and Adolescents. With regard to the right to food, Argentina has the legal protection of Law 25724, which gave rise to the National Food and Nutrition Program and later on, to the National Food Security Plan (PNSA, for its Spanish acronym), implemented in 2003 with the aim of facilitating access of the socially vulnerable population to adequate, sufficient food that best suits the customs and particular characteristics of each region of Argentina. In Article 13 of the Law, reference is made to the express guarantees of regular execution of the funds destined to school feeding programs for each jurisdiction.

Furthermore, Law 26396, in its Article 8, focuses on the coordination between the

Ministry of Health and the Ministry of Social Development to ensure that school feeding programs comply with nutritional requirements, placing special emphasis on the correction of nutrient deficiencies or excesses, and taking into account the particular features of the local food culture.

Today, the nutritional policies promoted by the State play a central role in achieving healthy eating in children. One of the oldest and far-reaching food policies in Argentina are the school feeding programs. Since the 1990 decentralization, the provinces and/or the municipalities have been in charge of their implementation, and based on evidence, there have been significant changes at their different levels of implementation.⁽⁵⁾ Although these policies have been in the limelight in the last decades, the oldest experiences date back to the beginning of the 20th century, as is the case of the School Feeding Program in Uruguay. Other programs were created in the 1950s and 1960s, such as the National School Feeding Program in Brazil, the School Feeding Program in Argentina and the School Feeding Program in Chile.⁽⁶⁾

In recent years, the analysis of the literature on school feeding at the global, regional and national levels has evidenced the barriers that exist when trying to implement healthy school meals in line with the state policy.⁽⁷⁾ The difficulties in complying with the regulations^(8,9) and the factors that affect the menu planning are highlighted.⁽¹⁰⁾ The studies found consistently show a less than optimal quality in the food services provided, evidencing remarkable deficiencies in the provision of micronutrients and energy.^(9,11,12,13,14) Several authors suggest that in Latin America, the nutritional scenarios with a double burden of malnutrition are reflected in school meals.^(15,16,17)

However, there is background information that shows that healthy interventions in the context of the school feeding programs could positively impact on food selection,⁽¹⁸⁾ would be effective in reducing the risk of obesity,^(8,19) and favorably influence in decreasing unhealthy food consumption and increasing fruit consumption⁽¹⁹⁾ that can be sustainable over time.⁽²⁰⁾ Nevertheless, in the

local context, during 2013 and 2018, when this work was developed, there were no apparent government initiatives regarding the school feeding programs beyond the provision of food.

Earlier international and national research works show that the meals served to children attending school feeding programs do not meet the nutritional goals required to satisfy the nutritional needs in childhood,^(12,21,22) and exhibit a deficit in vegetable, fruit and legume intake⁽²⁴⁾, although the theoretical food offer of the school feeding programs may be adequate.⁽²³⁾

In Argentina, the provinces and/or municipalities⁽²⁵⁾ are in charge of the implementation of the school feeding programs, and specific data indicate that approximately 4.5 million children, most of them from vulnerable sectors, eat at school.⁽²⁵⁾ The few evaluated experiences regarding the school feeding programs at the regional level, and especially in South America, make it difficult to assess the actual impact of this policy on the nutrition of the target population. In Argentina, there are few published studies on the topic; one of them is an analysis conducted in 1990⁽²⁶⁾, almost three decades ago. Without evaluative research, there is little chance of achieving sustained improvement in managing this situation and of verifying the compliance of objectives and goals.⁽²⁷⁾

This study is framed in the doctoral thesis of the first author of this work, entitled "*La política pública alimentaria y nutricional destinada a la población infantil: un análisis de la implementación y del impacto de los Comedores Escolares de Córdoba, Argentina*" ["Food and nutrition public policy directed to children: an analysis of the implementation and impact of school feeding programs in Córdoba, Argentina"]. The aim of this study was to analyze the intervention of the school lunch program policy and its role in the healthy nutrition of children of Córdoba, Argentina in the periods 2013 and 2018.

METHODS

Study design

A descriptive and cross-sectional study was carried out, based on a primary data source collected during the year 2018, and a secondary database with data collected in 2013.⁽²⁸⁾ A comparison of the nutritional quality variables of school feeding programs and the food intake of children was sought during two survey periods over a 5 year-period. During the year 2018, the comparison between school lunch program attendees and non-attendees was deepened with the incorporation of nutritional status indicators.

The data obtained at two different times enabled to make comparisons in a period in which important changes were observed in the Argentine social and political situation, being a useful and important analysis for public health monitoring and surveillance as well as for State interventions.

Sampling and units of analysis

The universe consisted of 37 municipal schools in Córdoba, Argentina, their respective school feeding programs and the services provided on two non-consecutive days during the same survey year. A convenience sample of 20 schools was selected from this universe: ten of these schools were surveyed in 2013,⁽²⁸⁾ and ten different units in 2018. In order to ensure the feasibility of the study during the two survey periods, non-probability sampling was implemented, in which school quotas were established according to socioeconomic level, taking household crowding as a proxy variable, in accordance with the National Population, Households and Dwellings Census, 2010.⁽²⁹⁾ Considering the feasibility of the study and the possibility of obtaining a minimum sample size that would enable to conduct the proposed analyses, children from each school were randomly selected, with the aim of reaching minimum quotas composed of at least 15 schoolchildren of both sexes. During the 2013 sample collection⁽²⁸⁾ only

those schoolchildren who attended the school feeding programs were selected, whereas in 2018, in view of the social, economic and political context in Argentina, both school feeding program attendees and non-attendees were included with the purpose of being able to compare both scenarios.

Inclusion Criteria

Schools, their school feeding programs and urban location services that had provided at least two of the frequent feeding services (breakfast, lunch and/or snacks) during the survey days were included in the study. Children of both sexes aged 8 years or older in 4th, 5th and 6th grade of the schools under study, attending the morning or afternoon school shift were recruited.

To determine the inclusion of the children who attended the school feeding program, the self-report of attendance, the day before the survey, to at least one of the meals provided by the feeding program was defined as an inclusion criterion. Exclusion criteria included children of both sexes exhibiting a degree of cognitive dysfunction, language barriers or any other situation that would not enable to implement the 24-hour dietary recall. However, during the field stage, no situations were detected that hindered the progress of the interviews. All participating children had their informed consent forms signed by their father, mother or responsible person.

Main Variables

School feeding program

- Critical nutrients due to deficiency: daily average of vitamin A (μg), calcium (mg), zinc (mg), vitamin C (mg), fiber (g), iron (mg), vitamin D (μg) and folic acid (μg) provided by the school feeding program services.
- Critical nutrients due to excess: daily average of total energy (kcal), saturated fats (g), simple sugars (g) and sodium (mg) provided by the school feeding program services.

Dietary intake in children

- Intake in accordance with the food groups proposed in the 2016 Dietary Guidelines for the Argentine Population (GAPA, for its Spanish acronym).⁽³⁰⁾ Categories: Oils, dried fruits and seeds; vegetables and fruits; legumes, cereals, potatoes, bread and pasta; milk, yogurt and cheeses; meats and eggs; optional group: sweets and fats; water.⁽³⁰⁾
- Intake of critical nutrients due to deficiency through different routes (food and beverages): average daily intake of vitamin A (μg), calcium (mg), zinc (mg), vitamin C (mg), fiber (g), iron (mg), vitamin D (μg) and folic acid (μg).
- Intake of critical nutrients due to excess through different routes (food and beverages): average daily intake of total energy (kcal), saturated fats (g), simple sugars (g) and sodium (mg).
- Achievement (%) of the mean total consumption of energy and critical nutrients due to deficiency, of the healthy nutritional goals: vitamin A (μg), calcium (mg), zinc (mg), vitamin C (mg), fiber (g), iron (mg), vitamin D (μg) and folic acid (μg). Categories: achievement /non-achievement.
- Achievement (%) of the mean total energy intake and critical nutrients due to excess, of the healthy nutritional goals: total energy (kcal), saturated fats (g), simple sugars (g) and sodium (mg). Categories: achievement/non-achievement.
- Nutrient coverage of the school feeding program policy: quantity (absolute values and percentages (%) of coverage) of critical nutrients due to deficiencies and to excess provided by the food services of school feeding programs (food and beverages offered) representing the total nutrient intake in children.

Nutritional status: Categories and indicators

- Height-for-age Z-score, BMI-for-age Z-score and weight for-height Z-score.

- Nutritional status according to BMI-for-age Z-score (very low weight; low weight risk, adequate weight; high weight and very high weight).
- Nutritional status according to weight-for-age Z-score (severe acute malnutrition; moderate acute malnutrition; risk of acute malnutrition; adequate weight; overweight risk or overweight; obesity).
- Nutritional status according to height-for-age Z-score (very short height, short height, short height risk; adequate height and tall height).

Covariates

- Observation (time of the survey). Categories: first survey (2013); second survey (2018).
- Sex (male/female).
- Age (in completed years) and for specific analyses was defined in completed months, grades (4th, 5th and 6th).
- School shift attended (morning/afternoon).
- School feeding program attendance (Yes/No).
- Household crowding⁽²⁹⁾ (Number of households with more than three people per room, corresponding to the neighborhood in which the school is located). The low/medium/high crowding categories were defined according to the maximum values of each tercile for the crowding continuous variable. Categories: Low crowding: up to 34 households; medium crowding: up to 106 households; high crowding: up to 639 households.

Data collection techniques and instruments: Food and nutritional quality of school feeding programs

A survey of primary and secondary data was conducted.⁽²⁸⁾ The same methodology was used for the variables collected in both periods. This instrument consisted of a direct observation guide and a record of all food and beverages in all the food services provided

on two non-consecutive days. The weights of randomly selected food rations were included, using a portable electronic scale with a capacity of up to 3 kg; accuracy ± 1 g. Based on the food data obtained, estimates of the amount of nutrients were calculated using the food composition databases of Latinfoods, Argenfoods, the Food Analysis and Registration System (SARA, for its Spanish acronym), nutritional labeling of food industries in Argentina published on web pages and the United States Department of Agriculture (Release 28).

For food and nutritional intake and the achievement of healthy nutritional goals, the 24-hour food recall method^(31,32) was used, validated for children older than 8-years of age. In order to minimize possible biases, the Gibson's four-step technique⁽³²⁾ as well as validated visual food models, standardized recipes and household utensils (spoons, cups and others) were used. Two non-consecutive observations to a 15% subsample per school were conducted, using the "multiple source method" to statistically adjust the intake.

The amount of energy and critical nutrients due to deficiency and excess was estimated, and the abovementioned nutritional composition databases were used. The achievement of healthy nutritional goals was determined taking as reference the dietary reference intakes recommended by the United States Institute of Medicine⁽³³⁾, and the WHO/FAO 2001^(34,35) and 2003.⁽³⁶⁾ The age ranges of energy proposed by the WHO/FAO 2001⁽³⁴⁾ and, for its application, the 50th percentile by age and sex was taken as reference weight for the children, according to the *Guide for the evaluation of growth*, published by the Argentine Society of Pediatrics in 2013⁽³⁷⁾. The activity factor considered for the calculation was that for moderate physical activity. In the case of the micronutrients for which there were no available data on recommendations, the adequate intake values were used.

To define the nutritional status of the children, the guidelines of the WHO and the *Guide for the evaluation of physical growth*, of the Argentine Society of Pediatrics⁽³⁷⁾, were followed to implement an instrument for the collection of anthropometric measurements.

Prior to the implementation of the survey, the team of researchers were trained in order to standardize the measurements. To estimate the weight, a platform scale with 100 mg accuracy was used as well as a stadiometer to measure the height. The WHO *Anthro* software was used to calculate the children's nutritional status indicators.

Data analysis

A descriptive analysis of the main variables and covariates of interest was performed, using measures of central tendency and dispersion (mean); standard deviation, median and 25th and 75th percentiles for the continuous variables and the absolute and relative frequencies for categorical data.

The distribution of continuous data (nutritional) was evaluated by using graphic methods (histogram) and the Shapiro-Wilk test to contrast the normality of the distribution of data; the Bartlett test was used for the analysis of variances. In all the anthropometric indicators, standardized data through the Z-score were always used,

To explore possible associations between dichotomous variables of achievement of healthy nutritional goals and the school feeding program attendance, a multivariate analysis through logistic regression methods (melogit), taking the schools as variable effect and the variables from the children as fixed effects. The outcomes are expressed in crude odds ratios and adjusted for potential confounders. The multicollinearity of the independent variables was verified using the variance inflation factor. Possible interactions that were not statistically significant ($p > 0.05$) were explored. For the goodness-of-fit, the ROC curve and the Hosmer-Lemeshow test were used as discrimination and calibration parameters of the model. In all cases with 95% confidence intervals and a statistical significance value of $p < 0.05$. Statistical software Stata version 14.0 was used for all the analyses.

Ethical aspects

All ethical requirements at the national level were followed in this study. The informed consent of the mother/father/guardian of the participating children was requested in accordance with the current national regulations of the 2016 Argentine Civil and Commercial Code – with respect to the age scale for signing the informed consent – and the requirements of the local ethics committees. The secondary base protocol (2013) was evaluated by the Research Ethics Committee of Hospital Nacional de Clínicas, Universidad Buenos Aires and, in 2018, by the Institutional Ethics Committee of Health Research of Hospital Nacional de Clínicas, Universidad Nacional de Córdoba (RHNC No. 3575/2018).

RESULTS

The food service sample of the school feeding programs in the first survey was $n = 58$ and in the second survey was $n = 57$. The total sample of children of both sexes during the two data collection periods was $n = 341$, consisting of 150 children of both sexes in the first survey and 191 in the second survey. As shown in Table 1, the sociodemographic indicators in the two periods under analysis, followed a similar structure, with a predominance of the girl subgroup, with ages equal to and/or older than 10 years, attending grades below 6th grade and the morning shift.

In the global sample, and taking as a reference the food groups proposed by the 2016 *Dietary Guidelines for the Argentine population*, it was found that, of the total sample, the most consumed foods were those in the group of optional foods (33%) and to the group of legumes, cereals, potatoes, bread and pasta (21%); 17% of the foods under analysis belonged to the group of vegetables and fruits, 8% to the group of milk, yogurt and cheeses, 8% to meats and eggs, 6% was water, 7% belonged to the group of oils, dried fruits and seeds.

Table 1. Sociodemographic characteristics of the sample of children from municipal schools of Córdoba, Argentina. Years 2013 and 2018.

Characteristics	First survey 2013 (n=150)		Second survey 2018 (n=191)	
	n	%	n	%
Sex				
Female	88	58.6	118	61.8
Male	62	41.3	73	38.2
Age				
Under 10 years of age	59	34.7	101	44.5
Older or equal to 10 years of age	111	65.3	126	55.5
Grade				
Up to 5th grade	92	54.1	127	66.5
Above 5th grade	78	45.9	64	33.5
School shift				
Morning	130	76.5	101	52.9
Afternoon	40	23.5	90	47.1

Source: Own elaboration.

Between the two cut-off points, most of the means of the critical nutrients due to deficiency, especially zinc, vitamin C, iron and folic acid, exhibited a reduction in the contribution of food services of the school feeding programs. For example, the mean of iron of the portion offered by the school feeding programs went from 3.06 [95%CI (1.96-4.16)] in 2013 to 2.16 in 2018 [95% CI (1.57-2.76)]; of folic acid from 142.09 [95%CI (91.97-192.21)] to 117.17 [95%CI (95.13-139.21)] and of vitamin C from 20.08 [95% CI (4.92-35.24)] to 8.03 [95% CI (2.48-13.57)] in the high crowding stratum (greater vulnerability). This was similarly reflected in the means of nutrients considered to be critical due to excess such as simple sugars and energy. In the case of energy, it went from a mean of 371.5 [95%CI (264.02-479.05)] in 2013 to a mean of 305.12 [95%CI (241.68-368.55)] in the stratum of highest crowding (Table 2).

Another interesting fact is that in the school feeding program subgroup in the context of high level of crowding, both in 2013 and 2018, the median of calcium and vitamin D was lower compared to the subgroup with a medium and/or low level of crowding (Table 2).

Table 3 shows a comparison analysis between the intakes of the children that partici-

pated in the first survey (n=150) and those in the second survey (n=191) (Table 3). It was observed that almost all the means of the critical nutrients under analysis were higher in the subgroup that participated in the 2013 survey compared to 2018; however, the statistically significant differences were found in the mean total calcium intake, where the mean in 2013 was 573.49 [95% CI (524.61-622.38)] and in 2018 was 493.99 [95%CI (463.81-524.17)] and in total energy with a mean of 2480.59 [95%CI (2333.38-2627.79)] and 2243.68 [95%CI (2146.99-2340.38)], respectively. Only in the case of fiber, a slightly higher intake was observed in the second survey [mean 9.83; 95% CI (9.19-10.46)] with respect to the first survey [mean 11.39; 95% CI (10.62-12.15)] (Table 3). A relevant fact is that taking the median of nutrients provided by the school feeding programs, this value would be covering 23% or less of the median global intake (depending on the nutrient), with the exception of vitamin D, which reached 48.3% of coverage (Table 3).

From the analysis of the coverage of the healthy nutritional goals recommended by international organizations, it was observed that an important part of the nutrients under study in both periods of analysis did not

Table 2. Median and 25th and 75th percentiles of critical nutrients in food and beverages of food services of school feeding programs according to crowding conditions and survey year. Municipal schools in Córdoba, 2013 y 2018.

Nutritional intake	First survey 2013 (n=58)						Second survey 2018 (n=57)					
	Low crowding		Medium crowding		High crowding		Low crowding		Medium crowding		High crowding	
	Median	25th-75th p	Median	25th-75th p	Median	25th-75th p	Median	25th-75th p	Median	25th-75th p	Median	25th-75th p
Critical nutrients due to deficiency												
Vitamin A (µg)	31.4	23.2-137.0	49.5	22.4-164.5	48.5	23.2-140.4	41.7	19.3-101.1	33.6	23.0-100.7	42.0	24.9-67.5
Calcium (mg)	119.9	108.7-137.6	134.0	100.5-189.5	114.9	94.6-134.4	134.4	92.6-191.0	151.9	97.4-191.6	126.7	80.5-214.2
Zinc (mg)	1.0	1.0-2.3	1.6	0.9-3.7	1.6	0.9-3.8	1.1	0.8-1.3	1.1	1.0-3.6	1.2	0.9-2.8
Vitamin C (mg)	0.0	0.0-18.5	0.0	0.0-37.5	0.0	0.0-47.0	0.0	0.0-5.5	0.0	0.0-22.0	0.0	0.0-6.4
Fiber (g)	1.2	1.1-3.4	1.1	0.4-5.1	1.1	0.4-4.3	1.1	0.7-1.1	1.3	1.1-2.4	1.1	1.0-2.6
Iron (mg)	1.4	1.4-3.4	1.4	1.1-5.4	3.3	1.4-5.1	1.4	1.3-3.5	1.4	1.4-4.3	1.5	1.4-3.1
Vitamin D (µg)	1.0	0.2-1.1	0.9	0.2-1.1	0.9	0.1-1.1	0.23	0.1-1.3	0.6	0.1-1.4	1.2	0.2-2.0
Folic acid (µg)	131.6	92.9-183.6	131.3	70.0-184.0	131.6	40.2-183.7	132.6	21.60-135.99	132.9	100.8-146.3	133.4	83.5-153.2
Critical nutrients due to excess												
Simple sugars (g)	22.4	16.2-26.4	27.0	20.0-32.2	18.6	14.4-30.6	15.9	13.61-20.49	14.6	9.5-18.5	17.4	9.4-22.9
Sodium (mg)	110.5	101.7-318.8	160.8	95.6-397.2	199.5	101.7-303.8	139.3	93.73-212.01	130.0	106.2-282.7	150.4	105.1-221.8
Saturated fats (g)	2.6	1.6-6.0	2.9	1.4-5.2	2.4	1.4-5.7	2.8	1.22-4.97	2.3	1.6-6.4	2.8	1.7-3.9
Total energy (kcal)	267.0	221.7-466.5	322.9	214.9-518.4	307.9	189.7-583.4	239.3	181.77-334.79	222.8	169.0-607.7	261.0	169.2-385.8

Source: Own elaboration.

95% CI= 95 % confidence interval; 25th-75th p= 25th and 75th percentiles; Crowding (No. of households with more than three individuals per room corresponding to the neighborhood where the school is located.) This variable was used in the analysis as tertiles of the number of crowded households. Categories: Low (tertile 1): up to 34 households. Medium (tertile 2): more than 34 up to 106 households. High (tertile 3): more than 106 households.

Table 3. Median and 25th and 75th percentiles of critical nutrients of the nutritional intake of children and nutritional coverage by the school feeding programs and survey year. Municipal schools of Córdoba, 2013 and 2018.

Nutritional intake of children	First survey 2013 (n=150)				Second survey 2018 (n=191)			
	Median	25th-75th p	Goal achievement (%)*	School feeding program coverage (%)**	Median	25th-75th p	Goal achievement (%)*	School feeding program coverage (%)**
Critical nutrients due to deficiency								
Vitamin A (µg)	375.8	228.9-559.5	68.3	12.9	308.6	(199.5-464.4)	56.1	13.5
Calcium (mg)	523.2	319.7-735.1	52.3	23.0	444.7	329.2-636.9	44.5	30.3
Zinc (mg)	11.0	8.3-13.9	157.0	9.5	11.5	8.4-14.9	164.7	10.2
Vitamin C (mg)	96.7	36.4-493.4	257.9	0.0	34.5	14.6-63.6	91.9	0.0
Fiber (g)	10.6	7.6-13.8	37.2	10.6	9.2	6.6-12.1	32.2	12.2
Iron (mg)	15.8	12.4-21.0	126.7	13.4	16.1	12.0-22.1	129.1	9.0
Vitamin D (µg)	2.0	0.6-3.8	40.6	48.3	2.0	1.0-3.1	40.6	44.9
Folic acid (µg)	670.8	449.9-919.5	191.6	19.7	719.5	445.8-1064.3	205.6	18.7
Critical nutrients due to excess								
Simple sugars (g)	92.3	67.4-130.2	174.2	23.4	107.5	(79.8-135.1)	202.7	13.8
Sodium (mg)	1344.4	846.5-2049.0	67.2	9.1	1423.2	891.2-2110.5	71.2	9.8
Saturated fats (g)	21.5	15.3-30.8	92.4	13.2	21.9	15.1-30.9	93.8	12.9
Total energy (kcal)	2233.9	1762.8-3080.4	107.4	14.4	2168.8	1715.5-2680.4	104.3	11.9

Source: Own elaboration

95% CI= 95% Confidence interval; 25th-75th p= 25th and 75th percentiles.

*For the definition of goal achievement: the median value was taken as a parameter in all the analyses. The nutritional goals were established in accordance with the guidelines of international organizations.

**For school feeding program coverage (%): the median value was taken as a parameter in all the analyses. The contribution of school feeding programs obtained by the survey was considered and the percentage that this contribution represents in the total intake was estimated.

Table 4. Median and 25th and 75th percentiles of critical nutrients of the nutritional intake of children attending or not attending the school feeding programs. Municipal schools of Córdoba, Argentina, 2018.

Nutritional intake	School feeding program attendees (N=140)			School feeding program non-attendees (N=51)		
	Median	25th-75th p	Goal achievement (%)*	Median	25th-75th p	Goal achievement (%)*
Critical nutrients due to deficiency						
Vitamin A (µg)	308.1	209.0-452.0	56.0	308.6	178.3-547.6	56.1
Calcium (mg)	438.8	323.5-629.4	43.9	512.4	380.6-670.8	51.2
Zinc (mg)	11.9	8.5-15.1	170.7	11.0	8.2-14.0	156.7
Vitamin C (mg)	32.2	14.0-64.4	85.9	37.0	18.2-63.5	98.6
Fiber (g)	9.2	6.7-12.0	32.1	9.2	6.5-12.6	32.3
Iron (mg)	16.2	12.0-22.1	130.0	15.4	11.9-22.1	123.4
Vitamin D (µg)	2.0	1.0-3.1	40.2	2.2	1.0-3.4	43.8
Folic acid (µg)	725.3	452.5-1099.0	207.2	671.5	393.9-940.6	191.9
Critical nutrients due to excess						
Simple sugars (g)	102.3	78.7-129.8	192.9	115.7	87.1-139.1	218.3
Sodium (mg)	1446.3	895.4-2048.6	72.3	1370.7	891.2-2308.5	68.5
Saturated fats (g)	21.5	14.8-29.5	92.3	22.6	17.4-34.2	96.8
Total energy (kcal)	2154.5	1708.3-2639.1	103.6	2302.2	1757.3-2777.4	110.7

Source: Own elaboration.

*For the definition of goal achievement: the median value was taken as a parameter in all the analyses. The nutritional goals were established in accordance with the guidelines of international organizations.

95%CI= 95% confidence Interval; 25th-75th p= 25th and 75th percentiles.

achieve the proposed goal (taking the median value), this being more evident in 2018. The most critical cases of insufficient achievement of the goal were observed in relation to calcium, vitamin A, fiber and vitamin D, as well as to simple sugars (Table 3).

When conducting the subgroup analysis comparing the nutritional intake of children attending and non-attending the school feeding programs (Table 4) during the 2018 survey, it could be observed that part of the nutritional indicators were lower in the group covered by school feeding programs compared to those who were not covered by the programs, especially regarding calcium, in which the median in the group of attendees was 438.8 and in that of non-attendees was 512.4, while in relation to vitamin C a median of 32.2 and 37.0 was observed and regarding vitamin D the median was 2.0 y 2.2 between attendees and non-attendees, respectively. In the critical nutrients due to excess, an intake according to the highest median of total sodium was observed in the subgroup of attendees compared to the non-attendee subgroup. However, total energy was lower in the group of attendees compared to the group of non-attendees (Table 4).

With regard to the achievement of healthy nutritional goals, it was observed that an important part of the nutrients under analysis, especially calcium, vitamin C and vitamin D, both in the group of attendees and non-attendees was inadequate. Nevertheless, this latter scenario was more evident in the subgroup that attended the school feeding programs.

In Table 5, a column is included that represents the proportion of children with "adequate diagnosis" both in the subgroup of school feeding program attendees and non-attendees in each of the Z-scores under analysis (BMI-for-age, height-for-age and weight-for-age) following the WHO guidelines. With regard to the nutritional status, differences were observed in the percentiles in the subgroup of school feeding program attendees compared to those in non-attendees, for example in the case of the weight-for-age Z-score. The first group had a median of 1.0 and the second a median of 0.4. The height-for-age percentile in the group of attendees had a sample proportion with "adequate diagnosis" of 90.8% and 95.8% in the non-attendee group, while the BMI-for-age percentile was higher in the first group compared to the second group (Table 5).

Table 5. Z-score of the nutritional status of children attending or not attending the school feeding programs. Municipal schools of Córdoba, Argentina. 2018.

Nutritional status	School feeding program attendees (N=140)				School feeding program non-attendees (N=51)			
	Median	25th-75th p	Adequate diagnosis*	95% CI	Median	25th-75th p	Adequate diagnosis*	95% CI
BMI-for-age Z-score	1.0	0.2-1.9	77.5	69.77-83.66	0.5	-0.1-1.6	77.1	62.59-87.11
Height-for-age Z-score	-0.2	-0.9-0.6	90.8	84.78-94.64	-0.2	-0.8-0.5	95.8	84.11-99.01
Weight-for-age Z-score	1.0	-0.5-2.0	79.3	59.58-90.88	0.4	-0.4-1.9	76.9	42.83-93.68

Source: Own elaboration.

*The criterion chosen to establish the "adequate diagnosis" in the BMI-for-age Z-score was the adequate weight category, in the height-for-age Z-score was adequate height and in the weight-for-age Z-score was adequate weight.

95% CI= 95% confidence interval; 25th-75th p= 25th and 75th percentiles.

As shown in Table 6, in the simple and multiple logistic regression models adjusted for potential confounders on the relationship between the category of failure to achieving the healthy nutritional goals and attendance to school feeding programs, an OR of 1.37 [95%CI (0.47-3.98); $p=0.566$] in saturated fats and an OR of 1.42 [95% CI (0.62-3.28);

$p=0.406$] in total energy, although these associations were not statistically significant. Increased ORs were observed, although not significant, in the category of failure to achieve vitamin C and folic acid goals in those attending school feeding programs.

When the *odds ratio* between the indicators of the nutritional status of children and

Tabla 6. Odds ratio between the achievement of nutritional goals and nutritional status, according to the Z-score of children and school feeding program attendance. Municipal schools of Córdoba, Argentina, 2018. (n=191).

Nutritional intake (n=190)	Model 1			Model 2		
	OR*	95% CI	p-value	OR*	95% CI	p-value
Critical nutrients due to deficiency						
Vitamin A (µg)	1.19	0.33-4.29	0.789	0.80	0.12-5.12	0.812
Calcium (mg)	1.00	-	-	1.00	-	-
Zinc (mg)	0.90	0.30-2.67	0.846	0.53	0.10-2.92	0.470
Vitamin C (mg)	1.15	0.59-2.24	0.674	1.23	0.48-3.12	0.669
Fiber (g)	3.50	0.20-60.84	0.390	1.00	-	-
Iron (mg)	0.80	0.36-1.74	0.570	0.53	0.24-1.16	0.112
Vitamin D (µg)	0.21	0.03-1.56	0.128	1.00	-	-
Folic acid (µg)	1.19	0.54-2.59	0.663	1.27	0.48-3.37	0.627
Critical nutrients due to excess						
Simple sugars (g)	0.58	0.23-1.50	0.263	0.80	0.29-2.23	0.674
Sodium (mg)	0.75	0.48-1.17	0.208	0.65	0.33-1.27	0.207
Saturated fats (g)	0.90	0.56-1.47	0.684	1.37	0.47-3.98	0.566
Total energy (kcal)	1.05	0.49-2.21	0.906	1.42	0.62-3.28	0.406
Nutritional status (Z-score)	OR**	95% CI	p-value	OR**	95% CI	p-value
BMI-for-age Z-score (n=190)	0.98	0.50-1.91	0.949	0.94	0.45-1.96	0.869
Height-for-age Z-score (n=190)	2.32	0.49-10.99	0.290	2.59	0.53-12.80	0.241
Weight-for-age Z-score (n=42)	0.87	0.14-5.47	0.882	1.24	0.18-8.54	0.829

*OR= odds ratio obtained by a logistic regression model, where the dependent variables were the achievement of the nutritional goal (categories: achieves/does not achieve) of all the nutrients due to deficiency or excess under analysis. The independent variable was school feeding program attendance. p-value= level of statistical significance <0.05. 95%CI= 95% confidence interval. Model 1: crude bivariate model. Model 2: model 1 + adjustment for sex (female/male), age (dichotomous: up to 10 years/more than 10 years), school attendance shift (morning/afternoon) and total energy (except in the model of achievement of the energy goal).

**OR= odds ratio obtained by a logistic regression model, where the dependent variables were the BMI /age Z-score (categories: adequate weight/ high weight or more) Z-score height/age Z-score. (categories: adequate height or more/ short stature and short stature risk) and weight/age Z-score y Z-score (categories: adequate weight /high weight or more). The independent variable was school feeding program attendance. p-value = level of statistical significance <0.05. 95%CI: 95% confidence interval. Model 1: crude bivariate model. Model 2: model 1 + adjustment for the number of the children's family members (continuous variable) and school attendance shift (morning/ afternoon).

school feeding program attendance were analyzed, both in crude and adjusted models, no statistically significant differences were observed in any scenario. Although an OR of 2.59 [95%CI (0.53-12.80)] was found in the category of short stature/ short stature risk in children attending the school feeding programs in the adjusted model, which was not statistically significant ($p=0.241$) (Table 6).

DISCUSSION

Based on the results obtained, it is concluded that it would be useful to promote a policy of school feeding programs urgently seeking improvements in the quality indicators of food services, as well as in the intervention indicators in child food and nutrition. Although the school feeding programs provide part of the critical nutrients (both due to deficiency and excess) of the global average intake of children attending the school feeding programs, more aggravated indicators of excess weight and short stature were found in this group with respect to those not attending the programs, with a deterioration in the nutritional contributions of the school feeding programs, as well as in the intakes between 2013 and 2018.

The generalized micronutrient deficiency and, consequently, a low presence of food sources such as fruits and vegetables, was alarmingly reflected both in this work and in a previous study.⁽³⁸⁾

The context of inequalities in which the school feeding programs are inserted, would be apparently conditioning the nutritional contributions. Incorporating this approach into the analysis is relevant when thinking about child nutrition from a comprehensive perspective and within a human rights-based perspective. In this sense, it was observed that in the subgroup of school feeding programs inserted in contexts with a level of critical crowding – both in the surveys conducted in 2013 and 2018 – most of the critical nutrients and total energy provided were lower. This finding calls attention to the importance of protecting the right to healthy

food from a public policy perspective in all social groups, especially those with greater social vulnerability and even more so in a scenario of crisis and increased poverty indicators, leaving an open door for future studies addressing inequality variables, especially taking into account that the most vulnerable groups are the direct targets of these policies. In line with our findings, and based on 2019 data from the *Childhood Social Debt Barometer* of the Argentine Catholic University, extreme poverty due to financial indigence and/or severe deprivation affected 24.7% of children between 0 and 17 years of age in 2018.⁽³⁹⁾

The abovementioned differences regarding the impoverishment of the school feeding programs between 2013 and 2018 may be related to the economic and social context of Argentina, with the increase in poverty indicators in 2018.⁽³⁹⁾ Although the menu offered by the school feeding programs surveyed in both mentioned periods, apparently remained unchanged in the period under study, the decrease in the global provision of the analyzed nutrients could have been due to the policy decision to reduce food portion sizes, replace ingredients or increase the number of attendees at food service time, which impacted on global nutrient provision. Understanding the public intervention from the perspective of the territory and the local reality in a national context and the potential role within the nutritional food processes of children in a context of deprivation and from a multidimensional approach will be key in fully achieving the right to food.

Child malnutrition in frequent users of school feeding programs should be a priority in the public agenda of the countries in Latin America and the Caribbean, and at the country level in a current context of alarming malnutrition indicators.⁽⁴⁰⁾

The findings of this research would be indicating that the foods most consumed by schoolchildren were, in more than one third, those in the group of optional foods (according to the GAPA),⁽³⁰⁾ being those that most provide critical nutrients due to excess and which need to be reduced within the framework of

healthy nutrition policies. These results are similar to those reported by ENNyS, 2018-2019⁽²⁾, as well as to those recently published by Dunford and Popkin⁽⁴¹⁾ in children aged 2 to 18 years in the United States. When specifically analyzing the nutrient intake in Dunford and Popkin's work, multiple nutritional inadequacies were observed in the children's intake, with calcium, fiber, vitamin A and simple sugars being the most alarming in both survey periods. Similarly, these inadequacies were reported in national data.⁽²⁾

A worsening of the indicators was observed in an important part of the nutrients under analysis between 2013 and 2018. However, statistically significant differences were found in the mean intake of calcium and total energy, which were higher in the first survey compared to the second survey. As mentioned in the section on the analysis of the nutritional quality of food services in school feeding programs, these results may be due to the context of increased child poverty indicators⁽³⁹⁾ that directly affects the access to healthy and sufficient nutrition.

Relating situations of deprivation to the social context is essential to understand nutritional outcomes, as was shown by Monteiro *et al.*'s study in Brazil⁽⁴²⁾ during the period 1974-2007, the socioeconomic development along with equity-oriented public policies have been accompanied by remarkable improvements in living conditions and a substantial decrease in child malnutrition, as well as by a reduction in the gap in the nutritional status of children in the highest and lowest socioeconomic quintiles.

Along this same line, a study that analyzed malnutrition and nutrition disparities showed that overweight is more prevalent in low and middle-income countries, where children are among the most affected⁽⁴³⁾ and also the weight of social and economic inequalities is blamed for growth stunting over time.⁽⁴⁴⁾ Furthermore, according to a longitudinal study conducted in 2009, growth stunting in children was associated with poor school attendance, lower school performance and an increased likelihood of living in poverty in adult life.⁽⁴⁵⁾ This indicates how child

malnutrition may be the cause and effect of situations of vulnerability, in which public policies are crucial to intervene in these complex scenarios.

As was observed in this study, a significant number of children, both in the group of school feeding program attendees and non-attendees, did not achieve the healthy nutritional goals for their age. Although in the subgroup of school feeding program attendees it was found that the average intakes of some critical nutrients such as vitamin A and calcium and total energy were lower than in the group of non-attendees. A deterioration in nutritional status indicators was also observed, especially those of overweight and short stature/short stature risk, although, broadly speaking, the nutritional profiles in both groups were less than optimal. This finding enables to account for and verify that both in the school feeding programs and in the households children eat the same kind of food; therefore, the policy that intends to be "compensatory" becomes "conservative", in terms of quantity and not quality, as several authors have already argued in a similar manner,^(15,17,27) highlighting the urgent need to improve the food policy in school settings.

With regard to the relationship explored between the children's intake and school feeding program attendance (models adjusted for potential confounders), despite the fact that no statistically significant associations were found, it was observed that in the critical nutrients due to excess, in the group of school feeding program attendees, the OR for saturated fats was 1.37 and for total energy was 1.42. Moreover, an increased OR was also observed in the category of failure to achieve the goals of other critical nutrients due to deficiency, such as vitamin C and folic acid in school feeding program attendees.

This outcome is relevant as it leaves the door open to use longitudinal studies to go deeper into the weight that the school feeding program policy has in the excess of critical nutrients in the intake. As the WHO suggests, these nutrients have been associated with various non-communicable diseases,⁽⁴⁶⁾ leading to greater risks for the future development

of chronic diseases in children who have had part of their diet covered by the school feeding programs. There are scant track records published in this line of research. An earlier study stated that the intake of energy, carbohydrates and fats in the group of school feeding program attendees was significantly higher than in those that did not attend the school feeding programs,⁽¹⁹⁾ although it was based on a bivariate analysis.

A study conducted by Ongan *et al.* found no statistically significant differences in body weight, height and body mass index in the group of school feeding program attendees compared to non-attendees,⁽²²⁾ although no confounding variables were reported in this study.

In Argentina, we found some isolated studies analyzing aspects of school feeding programs in public schools and describe the characteristics of the services,^(12,13,14,28) although more robust analyses on child nutrition intervention are limited. Unfortunately, this limitation also extends to several Latin American countries.⁽⁴⁷⁾

The study published by Rausch Herscovici *et al.*,⁽⁴⁸⁾ could be an exception to this situation. This study, among several interventions, focused on providing food with better nutritional value to be offered in the school feeding programs, within the framework of other educational and physical activity interventions. Although the authors found significant changes in some indicators of healthy food consumption, the limitation of the study was that the intervention was short-term (six months), as mentioned by the authors themselves,⁽⁴⁸⁾ and no aspects related to school feeding program exposure in outcome variables, such as the achievement of nutritional goals in children, were explored.

Another outcome that should be explored deeper in future studies is the association between the exposure to school feeding programs and nutritional status indicators. Along this line, we found an OR of 2.59 in the category of short stature/ short stature risk in the subgroup that was exposed to school feeding programs compared to those that were not exposed, although this was not statistically

significant. Failure to find significant differences in the multivariate analysis could have been due to the fact that the sample size of the subgroup of school feeding program non-attendees was small with large confidence intervals. In addition, as stated by Galván *et al.*⁽⁴⁹⁾ the impacts on chronic malnutrition indicators need to be analyzed in the long term.

Within the framework of the region's progress in promoting efforts in school setting interventions and that these are evaluated, different international organizations have been establishing the issue of healthy school settings in the global, regional and national agenda, as a starting point in the fight against childhood overweight, obesity and malnutrition.⁽⁵⁰⁾ However, there are no apparent and updated data on actions at the provincial and municipal levels in Argentina in relation to this topic. Moreover, there is a lack of impact assessments that can give an account of the efforts made in this connection. All this has already been highlighted in a previous study.⁽²⁷⁾

The world literature is highlighting the potential of school feeding programs in improving nutritional indicators in the infant-juvenile population. A review published in 2016 by Meiklejohn *et al.*, which evaluated the impact of nutritional interventions in adolescents, showed that the changes in school feeding programs were associated with significant changes in food intake.⁽⁵¹⁾ Furthermore, the contributions to school permanence, school performance, the implications of social protection and individual and family food and nutritional security, the positive effects on healthy habits and on children's socialization processes are also underlined.^(52,53)

However, there is scant published information in the region regarding the actual contribution of school feeding programs and all the more, from healthy interventions. In recent years, there are other alternative proposals for school feeding programs in Latin America.^(52,53) Brazil is one of the most remarkable cases, given that despite having a long-standing school feeding program, several actions are currently being performed that transcend the welfare nature that these programs historically had.⁽⁵⁴⁾

Today it has its respective legal framework and seeks to favorably contribute to children's growth, biopsychosocial development, nutritional status, learning and school performance, as well as to promote healthy eating habits, act on adverse environmental factors, incorporate food nutritional educational instances (EAN, for its acronym in Spanish) and strengthen the participation of the local community in the control and management of the program.⁽⁵⁴⁾

Among the limitations of this work, the biases from cross-sectional studies can be mentioned, such as the selection that could have occurred at the time of excluding schoolchildren with a cognitive and/or intellectual impairment, although the official data⁽⁵⁵⁾ may be indicating that the percentage of children with disabilities currently included in mainstream schools is low. It was also possible to report the presence of information bias and social complacency (information) that is frequently observed in population studies that survey food data; nevertheless, the data were collected through a questionnaire with open-ended questions, guided by trained researchers, which could reduce the influence of this bias.

In the evaluated relationships, a common confounding and reverse causality bias could have existed in epidemiological cross-sectional studies, although we had a comparison group that enabled to make comparisons, and models adjusted for potential confounders were performed. In addition, the small sample size could have been a limitation at the time of analyzing the relationships; therefore, future more robust studies need to be conducted, with larger samples that will enable to improve the estimates. However, the fact of having data from two time periods (2013 y 2018), and different socio-political contexts of Argentina, and including a comparative analysis from an approach of inequalities, is key when defining the public intervention aimed at achieving the right to food and other fundamental rights, such as health and education

This study has multiple and important strengths in the field of public health and public policies. The sample is representative of the municipal schools under analysis with

a sufficient number of children that enabled to make population estimates. In addition, this proposal provides evidence for an issue that is now controversial and with multiple knowledge gaps in our region.

Below are several recommendations related to the issue addressed in this study and to future lines of work in the national and local context.

At the level of management and implementation of the school feeding program policy

- To evaluate the design and implementation of the program, considering the variable of a minimum standard of nutritional quality of the food services provided, as multiple nutritional inadequacies were observed.
- To conduct new surveys that would help to improve the records and analyze the monitoring indicators longitudinally.
- To provide continuous training for the school feeding program staff, based on an approach centered on improvement processes, mainly in the preparation of breakfasts and snacks, where the deficit of micronutrients, especially of calcium, was critically detected, and on the analysis of the sufficient and quality supply of rations for the entire population that attends daily.
- To review the possibility of including in the program other aspects related to school health and the articulation among public programs, mainly, for the follow-up of children at nutritional risk.
- To provide analysis and educational workshops on healthy eating among different actors, including children, teachers and families, as it was verified that both school and out-of-school feeding urgently need to be improved.
- To evaluate the possibility of increasing the intake of fruits and vegetables, these foods being the most deficient in the school feeding program menu according to this survey, and mainly to ensure that these foods come from local producers. As stated by the FAO report, local purchases for the school feed-

ing programs come from family farming and small farmers, in countries such as Guatemala, Jamaica, Peru, Ecuador, Nicaragua, Uruguay, Brazil, Barbados, Colombia, Guyana, Bolivia, Paraguay, Grenada, Belize, Trinidad and Tobago,⁽⁵⁶⁾ therefore, there would already be earlier experiences on this aspect and it would be feasible to implement them in the future.

At the level of the impact of the school feeding policy

- To develop future impact studies from quantitative-qualitative approaches of the school feeding program policy in different groups and in greater depth on the relationships explored, as well as their binding mechanisms and their psychosocial and health benefits, based on more robust designs
- To consider the possibility of collecting data on the attendance to school feeding programs and the characteristics of the recipients within the framework of national health surveys, for example: the World School Health Survey and the National Nutrition and Health Survey that are implemented in Argentina.

At the level of regulations, local, subnational and national public policies of school feeding programs

- To develop a legislation process and regulatory frameworks at the local level specifically for the school feeding programs, which will consider a periodic review of the quality standards of the services and the

multidimensional indices of achievement of the policy.

- To evaluate the possibility of developing a national reference framework guide for good nutritional practices in school feeding programs, as is the case in the Grenada and Brazil experience, which already have a reference guide, and where the people in charge of preparing food are trained on how to use it, in order to ensure that the requirements are met.⁽⁵⁶⁾
- The analysis of the current legal-regulatory frameworks that guarantee the right to food was not among the objectives of this work, although an in-depth analysis of Law 25724 that creates the National Nutrition and Food Program and a review of –among various aspects–the level of compliance in the line of school feeding programs are recommended; after almost 18 years of its enactment, to reflect on the potential redefinitions that best suit the current context and analyze the implementation of Article 4, which creates the National Commission on Nutrition and Food and the regulation of Articles 7 and 8, which address the creation of commissions of the provincial governments and the functions of the municipalities, being fundamental aspects in the framework of a federal country.

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