REVISTA CHILENA DE PEDIATRÍA
www.revistachilenadepediatria.cl
www.scielo.cl

Rev Chil Pediatr. 2019;90(4):411-421
DOI: 10.32641/rchped.v90i4.901

ORIGINAL ARTICLE

Impact of a community program for child malnutrition

Impacto de un programa comunitario para la malnutrición infantil

Clara Denisse Perdomo[a], Elizabeth Raquel Rodríguez[b], Héctor Carrasco Magallanes[c], Hugo Ernesto Flores Navarro[d], Saira Elvira Matul Pérez[e], Daniela Moyano[f]

[a]Bachelor of Nutrition. National University of Formosa. National Council of Scientific and Technical Research (CONICET)
[b]Bachelor of Nutrition. School of Nutrition, Faculty of Medical Sciences, National University of Córdoba
[c]Doctor, Master in Public Health Partners in Health. Harvard T.H Chan, School of Public Health
[d]Doctor. Partners in Health
[e]Bachelor of Nursing.Secretary of Health of Mexico
[f]Bachelor of Nutrition Master in Public Health School of Nutrition, Faculty of Medical Sciences, National University of Córdoba

Received: 8-10-2018; Approved: 1-04-2019

Abstract

Objective: To evaluate the impact of a community program aimed at improving the children malnutrition in a rural community of the State of Chiapas, Mexico, 2013. **Material and Method:** Descriptive study of the evaluation program from a secondary database of nutritional data registry of 113 children under five years of age in a rural area of Mexico. The intervention and the survey were carried out during 2013. Baseline and 4-month measurements were recorded. The World Health Organization (WHO) Anthro software was used to calculate nutritional status indicators. According to WHO guidelines, the following data were estimated: weight for age (W/A), height for age (H/A), weight for height (W/H), and Body mass index for age (BMI/A). Position and dispersion measures were calculated; Student's T-test, Kruskal-Wallis, and MacNemar test were used for paired data and linear regression. **Results:** Between the beginning and the end, the median of the Z W/H went from -0.7 (p25 -1.24, p75 -0.01) to -0.62 (p25 -1.09, p75 -0.15). The prevalence of low weight decreased from 5.31% (CI 2.38-11.44) to 4.42% (CI 1.83-10.32) (Z BMI/A). The appropriate weight according to Z score W/H increased from 78.76% (CI 70.12-85.43) to 84.96% (76.98-90.51). In the subgroup with low initial weight, the mean of Z BMI/A and Z W/H increased 0.4 ($p = 0.003$). The change in the mean of Z W/H was 0.02 points in the subgroup that received the direct transfer program and of -0.3 in which it did not ($p = 0.020$). **Conclusions:** It is concluded that the community program during the four months of implementation contributed to improve some anthropometric indicators, although no apparent effects were found in indicators related to chronic malnutrition.

Keywords:
Children;
Community Health Services;
Malnutrition;
Nutrition Programs and Policies

Correspondence:
Daniela Moyano
moyanodaniela12@gmail.com

How to cite this article: Rev Chil Pediatr. 2019;90(4):411-421. DOI: 10.32641/rchped.v90i4.901

Introduction

In recent decades, Latin America has seen improvements in some aspects related to the protection of children's rights[1]. However, the evidence highlights several problems that negatively affect their health and have an impact on healthy and harmonious development[2,3].

In Mexico in 2014, it was observed that 55.2% of children between the ages of 2 and 5 were below the poverty line and 13.1% were extremely poor[3], which is one of the main social determinants of health and nutrition[4] especially undernutrition during the first years of life that is a cause and effect of poverty[5].

Child malnutrition is a serious problem in Latin America and the Caribbean that violates the right to life and constitutes a multi-causal pathological state with significant effects on child development[6]. It includes socially determined biological processes[7,8] related to social and environmental conditions[9].

Malnutrition includes undernutrition (wasting, stunting, and underweight), vitamin or mineral imbalances, overweight, obesity, and diet-related non-communicable diseases[10].

According to World Health Organization (WHO) data, fifty-two million children under five years of age are wasted, 17 million present severe wasting and 155 million are stunted, while 41 million are overweight or obese[10].

In Mexico, based on the National Survey of Health and Nutrition Mid-way 2016 (ESANUT) was estimated that the prevalence of overweight was 17.9% and 15.3% of obesity in children between 5 and 11 years[11]. However, both acute and chronic malnutrition is still a major problem in the country[12-14], where it was observed that during the period from 1990 to 2009 there have been nearly 35,000 deaths of children under the age of five due to undernutrition[12].

As some authors suggest, malnutrition in its multiple forms is currently a public health challenge[15,16] with significant impacts on the physical, psychological, and social spheres[17] of children.

There are significant gaps in the nutritional status of children from urban areas compared to those from rural areas. In Mexico, the chronic malnutrition prevalence in the rural population is twice as high as in the urban area[14].

A recently published systematic review showed that factors associated with stunting and low weight in children could be derived from the social and environmental spheres, including low education, inadequate nutrition and health status of the mother, household poverty, and rural residence[18].

Another study found that stunting in boys and girls was associated with lower schooling, reduced school performance and increased likelihood of living in poverty during adulthood[19], making child malnutrition a priority issue on the public health agenda that will require complex interventions at the community level with a holistic and participatory approach[18,20,21].

This study emerges as part of a community program carried out by the international non-profit organization Partners in Health (PIH) and its main objective was to evaluate the impact of a community program aimed at improving malnutrition on children in a rural community in Chiapas, Mexico, 2013.

Material and Method

Study type

Descriptive, analytical and longitudinal study of a program evaluation based on a secondary database from the records of individual nutritional data of children under five years of age belonging to the international organization Partners in Health in the rural community of La Soledad, Chiapas, Mexico, during 2013.

Partners in Health is actively working in the Sierra Madre de Chiapas, Mexico's poorest state, along with the Ministry of Health. Data from the organization indicated that in 2016 more than 28,000 medical consultations were provided to the population, 142 communities are currently covered and more than 300 patients were accompanied to receive specialized care[22].

Participants

The inclusion criteria during the program were to present at least one of the following diagnoses at the start of the program: acute malnutrition (low weight measured by BMI-for-age Z-score or weight-for-height Z-score), chronic malnutrition (very low height; low height measured by Height-for-age Z-score), and/or to be of normal weight, but at risk of acute or chronic malnutrition (defined by the following criteria: low weight-for-age alert diagnosis, low height-for-age alert, or low weight-for-height alert). In addition, belong to the community covered by the program, proximity to the health clinic, to be up to five years old, and present written or verbal authorization from the mother/father or guardian.

Since it was a community program, no sample size was applied and all children of both sexes who met the inclusion criteria in the program were included in the intervention group (IG).

For the data collection on nutritional status diagnosis and sociodemographic data of the child, a collection instrument was implemented that consisted of an observation guide and recording of anthropometric measurements that was carried out by the staff of the community of La Soledad health clinic.

Before the program implementation, the clinic's health team was trained in anthropometric measurement techniques following the guidelines of the training manual for health personnel "Child Nutrition and Growth Surveillance" of the Mexican Ministry of Health in order to standardize measurements. To estimate weight, we used a baby scale in children under two years and a platform scale for children over two years with an accuracy of 100 g and for height, we used an infantometer for children under two years and a stadiometer for children over two years.

During the data collection at the beginning of the program, the mother (self-report) was asked if her child was born at term to correct age in cases of premature infants.

In this analysis, the World Health Organization's (WHO) Anthro software was used to calculate nutritional status indicators of children. The following were estimated: Weight-for-age (W/A), Height-for-age (H/A), Weight-for-height (W/H), and Body mass index-for-age (BMI/A) according to WHO guidelines[23].

Activities carried out in the program

Before starting the program, mothers of children were invited to participate with inclusion criteria captured through spontaneous consultation, by the health clinic doctor or nurse referral, through advertisements (with megaphones), and/or home visits.

It took four months to perform this analysis (baseline measurements and at four months) as this is the time in which the community program was implemented and whose recorded data are available.

The methodology for planning and carrying out program activities was based on the approach levels of the Ecological Model[24] which had the child as the main focus, considering the interrelation of individual, family, social and community elements.

1. *Microsystem:* related to the closest environment of the malnourished child, is the place where the person can interact face-to-face easily, such as at home and in the health system.

Health System

- Advice, education, and screening of nutritional status by health professionals in an outpatient clinic.
- Individual monthly medical and nutritional follow-up consultations with implementation of a 24-hour food reminder, personalized nutritional advice, implementation of the ad hoc undernutrition risk factor survey, evaluation and follow-up of the nutritional status and implementation of ELCSA (Latin American and Caribbean Food Security Scale).
- Nutritional supplementation (multivitamins, iron), and probiotics with Lactobacillus rhamnosus GG (for diarrhea management).
- Deworming program control and implementation.
- Biochemical hemoglobin measurement.
- Counseling and awareness-raising opportunities among mothers and caregivers in the waiting room of the health clinic.

Home

- Planned monthly home visits to children at higher social risk.

2. *Mesosystem:* comprises the interrelationships of two or more environments in which the developing child is actively involved.
- Community kitchen run by mothers: with the main focus on the organization and empowerment of mothers to carry out fundraising activities, purchase and food processing.

3. *Exosystem:* refers to one or more environments that do not include the developing child as an active participant, but in which occur the events affecting the child.
- Community education workshops: monthly theoretical-practical workshops planned and carried out by health professionals. The topics were healthy eating, food and culture, healthy cooking, and hygiene. Tools and teaching materials were available.
- Microenterprises by obtaining microcredits for women: through a government program.
- Obtaining farm animals for self-consumption: selection of families, training, and delivery of farm animals with subsequent follow-up.
- Homemade egg incubator development: design and production of a homemade egg incubator.
- Training and implementation of community vegetable gardens: in community spaces with the aim of becoming a socio-pedagogical and awareness-raising tool to progress towards the family vegetable garden.

4. *Macrosystem:* comprised of the culture and subculture in which the person and all the individuals of their society develop. It is the broadest context and refers to forms of social organization.
- Intersectoral agreements: between the education area at the local level, community leaders, governmental and non-governmental organizations. Activities were coordinated with the *Diconsa* (food assistance) and *Oportunidades* (direct transfer) programs.

Dependent Variables

- 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 (Low weight; Low weight warning, Adequate weight; High weight, and Very high weight).
- Nutritional Status according to Weight-for-Height Z-score (Severe Acute Malnutrition; Moderate Acute Malnutrition; at Risk of Acute Malnutrition; Adequate weight-for-height; at Risk of overweight or overweight; Obesity).
- Nutritional status according to Height-for-Age Z-score (Very low height; Low height; Low height warning; Appropriate height, and High height).

Independent variables

- Social protection program: defined as self-report at the time of entering the intervention of receiving social protection through the *Diconsa* food assistance program and/or direct money transfer through the *Oportunidades* program.
- Child's age (in months).
- Child's sex (male/female).

Statistical analysis

A descriptive analysis of the variables of interest was performed using position and dispersion measures (mean, median, standard error and 25th and 75th percentiles) according to the data distribution in the case of continuous variables, as well as absolute and relative frequency for categorical data.

Diagnostic prevalence of nutritional status and its 95% confidence interval were estimated.

The normal distribution of continuous data (body weight, height, and Z-score) was assessed using graphical methods (histogram), the Shapiro-Wilk test and Bartlett's test were used for variances analysis.

Subjects who did not have baseline data on all variables under analysis were removed from the database. The Z-scores and nutritional status diagnostics calculations were performed following WHO guidelines by two independent researchers. In all cases, standardized data were used through the Z-score.

Analysis of changes in nutritional status at the beginning and the end of the program at the individual level were carried out using the Student's T-test, Kruskal-Wallis nonparametric test, MacNemar test for paired data and simple linear regression. Statistical significance in all cases was $p < 0.05$ and 95% confidence level. The statistical software used for all analyses was Stata 14.

Ethical aspects

This study was carried out based on the analysis of a secondary database of data produced by Partners in Health during its work in the territory as part of a program implemented during 2013.

At the beginning of the program, mothers, fathers and/or guardians of children were asked for written and/or verbal consent for their child's participation.

The research team requested in writing to use the database and before analyzing it, it was previously de-identified by the responsible body.

The protocol was evaluated and approved by an ethics committee and is exempt from informed consent signature as it worked with secondary data from a public health registry.

Results

The sample at the beginning of the program was 113 children represented by 46% male and 54% female, and at the end of the program was 112 subjects (1% loss rate).

The mean age at baseline was 31 months (CI 27.9-34.0), which was lower in boys (mean 28.2 months with CI 24.0-32.4) than in girls (mean 33.3 months with CI 29.0-37.7).

The initial body weight was slightly higher in girls than in boys (10.9 kg vs. 10.6 kg), where height followed the same trend (85.1 cm vs. 82.5 cm). 62% of the sample were receiving direct cash transfer program and 33.6% were receiving food assistance (Table 1).

Table 2 shows the comparison of the anthropometric indicators at the beginning and at the end of the community program. In the BMI-for-age and Height-for-age Z-score indicators, the median was similar in both stages, while the median of weight-for-height Z-score went from -0.7 (p25 -1.2; p75 -0.0) to -0.6 (p25 -1.1; p75 -0.1).

The nutritional diagnosis estimated by the BMI-for-age Z-score showed that the low weight prevalence went from 5.3% (CI 2.4-11.4) to 4.42% (CI 1.8-10.3) between the start and end of the program, where the appropriate weight category was from 83.2% (CI 75.9-89.1) to 86.7 (CI 79.0-91.9) between these stages (Table 2).

Regarding the Height-for-Age Z-score, it was observed that the diagnostic category of very low height went from 10.6% (CI 6.1-17.9) to 6.2% (CI 2.9-12.5), while the low height category remained unchanged with 30.1% of prevalence (CI 22.2-39.3) between the beginning and the end of the intervention (Table 2).

When analyzing nutritional status according to weight-for-height Z-score, it was observed that moderate acute malnutrition went from 5.3% (CI 2.4-11.4) to 4.4% (CI 1.8-10.3), adequate weight-for-height had an increase from 78.8% (CI 70.1-85.4) to 84.9% (76.9-90.5), where reductions in prevalence were also obser-

Table 1. Anthropometric baseline characteristics of the diagnosis of nutritional and sociodemographic status of children according to sex

	Male (n = 52)				Female (n = 61)				Total (n = 113)			
Variables	Mean	CI	Median	p25-p75	Mean	CI	Median	p25-p75	Mean	CI	Median	p25-p75
Child's age (in months)	28.2	24.0; 32.4	30.1	13.6; 40.1	33.3	29.0; 37.7	33.6	21.2; 48.5	31.0	27.9; 34.0	31.5	17.1; 45.7
Weight(kg)	10.6	10.0; 11.2	10.8	8.9; 12.3	10.9	10.2; 11.6	11.1	9.9; 13.0	10.8	10.3; 11.3	10.9	9.3; 12.5
Height (cm)	82.5	79.0; 86.1	84.5	69.5; 91.5	85.1	81.5; 88.7	87.0	71.0; 93.0	83.9	81.4; 86.4	86.0	70.0; 92.0
BMI	15.8	15.2 ;16.4	15.3	14.2; 17.2	15.0	14.6; 15.4	14.9	13.9; 15.6	15.0	14.6; 15.4	14.9	13.9; 15.6
Height-for-Age Z-score	-2.1	-2.4; -1.8	-1.9	-2.5; -1.3	-1.6	-1.9; -1.4	-1.7	-2.3; -1.1	-1.8	-2.0; -1.7	-1.8	-2.4; -1.1
BMI-for-Age Z-score	-0.3	-0.7; 0.0	-0.4	-1.1; 0.5	-0.5	-0.7; -0.2	-0.6	-1.2; 0.1	-0.4	-0.6; -0.2	-0.5	-1.2; 0.2
Weight-for-Height Z-score	-0.45	-0.9; -0.1	-0.7	-1.3; -0.2	-0.5	-0.7; -0.2	-0.6	-1.2; -0.1	-0.5	-0.7; -0.3	-0.7	-1.2; -0.0
Diagnosis of nutritional status	N	%	CI		N	%	CI		N	%	CI	
BMI-for-Age Z-score												
Low weight	5	9.6	3.9-21.4		1	1.6	0.2-11.1		6	5.3	0.2-11.4	
Low weight warning	3	5.8	1.8-16.7		6	9.8	4.4-20.5		9	7.9	4.1-14.7	
Adequate weight	41	78.8	65.4-88.0		53	86.9	75.6-93.4		94	83.2	74.9-89.1	
High weight	3	5.8	1.8-16.7		1	1.6	0.2-11.1		4	3.5	1.3-9.2	
Height-for-Age Z-score												
Very low height	9	17.3	9.1-30.3		3	4.9	1.6-14.4		12	10.6	6.1-17.9	
Low height	16	30.8	19.6-44.8		18	29.5	19.3-42.3		34	30.1	22.2-39.3	
Low height warning	11	21.1	11.9-34.6		15	24.6	15.3-37.1		26	23.0	16.1-31.8	
Appropriate height	16	30.8	19.6-44.8		25	40.9	29.2-53.9		41	36.3	27.8-45.7	
Weight-for-Height Z-score												
Severe Acute Malnutrition	1	1.9	0.3-12.9		0	0	0		1	0.9	0.1-6.2	
Moderate Acute Malnutrition	5	9.6	3.9-21.4		1	1.6	0.2-11.1		6	5.3	2.4-11.4	
Risk of Acute Malnutrition	3	5.8	1.8-16.7		8	13.1	6.6-24.4		11	9.7	5.4-16.9	
Adequate weight-for-height	40	76.9	63.3-86.6		49	80.3	68.2-88.6		89	78.8	70.1-85.4	
Risk of overweight	1	1.9	0.3-12.9		3	4.9	1.6-14.4		4	3.5	1.3-9.2	
Obesity	2	3.8	0.9-14.5		0	0	0		2	1.8	0.4-6.9	
Receive social protection	N	%	CI		N	%	CI		N	%	CI	
Food assistance	20	38.5	26.1-52.5		18	29.5	19.3-42.3		38	33.6	25.4-42.9	
Direct transfer	32	61.5	47.5-73.9		38	62.3	49.4-73.7		70	61.9	52.5-70.5	

Age is defined as decimal years completed at the time of data collection. Coporal weight expressed in Kg. Height expressed in cm. BMI: Body mass index. Z score is defined as: reference lines of growth curves, also known as standard deviation score (SD) according to WHO guidelines. Receive social protection is defined as: receiving the Diconsa Program and / or Program Oprotunidades at the moment of entering the intervention. CI: 95% confidence interval. p25-p75: Percentiles 25 and 75.

Table 2. Comparison of the anthropometric variables and the diagnosis of children's nutritional status at the beginning and end of the program (N = 113)

	Star		Final	
Nutritional variables	Mean (CI)	Median (p25-p75)	Mean (CI)	Median (p25-p75)
Height-for-Age Z-score	-1.8 (-2.0;1.7)	-1.8 (-2.4; -1.1)	-1.9 (-2.1; -1.1)	-1.8 (-2.4; -1.3)
BMI-for-Age Z-score	-0.4 (-0.6;-0.2)	-0.5 (-1.2; -0.2)	-0.4 (-0.6; -0.3)	-0.5 (-1.0; 0.1)
Weight-for-Height Z-score	-0.5 (-0.7;-0.3)	-0.7 (-1.2; -0.0)	-0.6 (-0.8; -0.4)	-0.6 (-1.1; -0.1)
Diagnosis of nutritional status	n/N	% (CI)	n/N	% (CI)
BMI-for-Age Z-score				
Low weight	6/113	5.3 (2.4; 11.4)	5/113	4.4 (1.8; 10.3)
Low weight warning	9/113	7.9 (4.1; 14.7)	8/113	7.1 (3.5;13.6)
Adequate weight	94/113	83.2 (75.9; 89.1)	98/113	86.7 (79.0; 91.9)
High weight	4/113	3.5 (1.3; 9.2)	1/113	0.9 (0.1; 0.6)
Very high weight	NA	NA	1/113	0.9 (0.1; 0.6)
Height-for-Age Z-score				
Very low height	12/113	10.6 (6.1; 17.9)	7/113	6.2 (2.9; 12.6)
Low height	34/113	30.1 (22.2; 39.3)	34/113	30.1 (22.2; 39.3)
Low height warning	26/113	23.0 (16.1; 31.8)	31/113	27.4 (19.9; 36.5)
Appropriate height	41/113	36.3 (27.8; 45.7)	40/113	35.4 (27.0; 44.8)
High height	NA	NA	1/113	0.9 (0.1; 0.6.2)
Weight-for-Height Z-score				
Severe acute malnutrition	1/113	0.9 (0.1; 6.2)	1/113	0.9 (0.1; 6.2)
Moderate Acute Malnutrition	6/113	5.3 (2.4; 11.4)	5/113	4.4 (1.8; 10.3)
Risk of Acute Malnutrition	11/113	9.7 (5.4; 16.9)	8/113	7.1 (3.5; 13.6)
Adequate weight-for-height	89/113	78.8 (70.1; 85.4)	96/113	84.9 (76.9; 90.5)
Risk of overweight or overweight	4/113	3.5 (1.3; 9.2)	2/113	1.8 (0.4; 6.9)
Obesity	2/113	1.8 (0.4; 6.9)	1/113	0.9 (0.1; 6.2)

CI: 95% confidence interval. p25-p75: Percentiles 25 and 75. NA: not applicable.

ved in the indicators of overweight risk, overweight, and obesity (Table 2).

When analyzing the change in anthropometric indicators according to initial nutritional status, it was observed that there was an increase in the mean BMI-for-age and Weight-for-height Z-scores of approximately 0.4 points in the initial low weight diagnostic subgroup, which was statistically significant (p = 0.0), although this was not reflected in the Height-for-age Z-score (Table 3).

The BMI-for-age Z-score difference was 0.2 in the group older than two years while it was -0.5 in the group younger than that age (p = 0.0) (Table 4).

Regarding the changes in the mean height-for-age Z-score, significant differences were found according to sex, which was -0.1 points in girls and 0.3 in boys (p = 0.0). In children under two years of age, it was 0.5, and in children older than that age it was -0.1 (p = 0.0) (Table 4).

In the mean weight-for-height Z-score, it increased statistically significantly in the subgroup older than two years compared to the one younger than or equal to two years (p = 0.0). In this indicator, a 0.0 coefficient was found in the group that received direct money transfer program while the coefficient was -0.3 in the group that did not. These are statistically significant differences (p = 0.1) (Table 4).

97% of children maintained their adequate or better nutritional status from the beginning to the end of the program, while only 3% of children with low

Table 3. Change of anthropometric indicators of children between the start and end of the program according to the initial nutritional diagnosis (N = 112)

	BMI-for-Age Z-score											
Initial diagnosis	Low weight			Risk of low weight			Adequate weight			High weight		
Change in anthropometric indicators	Coef.	CI	p	Coef.	CI	p	Coef.	CI	p	Coef.	CI	p
Height-for-Age Z-score	-0.3	-0.6; 0.1	0.1	-0.2	-0.3; -0.0	0.0	0.1	-0.1; 0.3	0.3	0.6	-1.1; 2.3	0.3
BMI-for-Age Z-score	0.5	0.2; 0.7	0.0	0.3	0.1; 0.6	0.1	-0.1	-0.2; 0.1	0.2	-0.8	-2.4; 0.8	0.2
Weight-for-Height Z-score	0.4	0.2; -0.6	0.0	0.3	0.5; 0.6	0.0	-0.1	-0.3; 0.0	0.1	-1.4	-3.6; 0.7	0.1

Coef .: coefficient obtained by a simple linear regression model (bivariate), where the dependent variables were: difference in the Z score of BMI / age, size / age (only in children with acute malnutrition in the basal stage) and Weight / height between the initial stage and at 4 months of follow-up. The independent variable was the initial diagnosis obtained by the Z Score BMI / age. p: level of statistical significance < 0.05. CI: 95% confidence interval. Z score: reference lines of growth curves also known as standard deviation (SD) score according to WHO guidelines.

Table 4. Mean difference of the anthropometric indicators in children between the start and end of the program according to sociodemographic variables (N = 112)

	BMI-for-Age Z-score					Height-for-Age Z-score				Weight-for-Height Z-score			
Demographics	N	Mean*	SE	CI	P	Mean*	SE	CI	P	Mean*	SE	CI	P
Sex													
Female	60	0.0	0.1	-0.2; 0.2		-0.1	0.1	-0.3; 0.1		-0.0	0.1	-0.3; 0.1	
Male	52	-0.1	0.1	-0.3; 0;1	0.3	0.3	0.1	0.0; 0.5	0.0	-0.2	0.1	-0.4; 0.0	0.4
Child's age													
Less than or equal to 2 years	39	-0.5	0.2	-0.8; -0.2		0.5	0.2	0.0; 0.9		-0.7	0.2	-1.0; 0.3	
Older than 2 years	73	0.2	0.0	0.1; 0.3	0.0	-0.1	0.0	-0.2; -0.1	0.0	0.2	0.0	0.1; 0.3	0.0
Receive direct transfer													
Do not	42	-0.2	0.1	-0.5; 0.1		0.1	0.2	-0.2; 0.5		-0.3	0.2	-0.7; 0.0	
Yes	70	0.0	0.1	-0.1; 0.2	0.1	0.0	0.1	-0.1; 0.2	0.4	0.0	0.1	-0.1; 0.1	0.0
Receive food assistance													
Do not	74	-0.1	0.1	-0.3; 0.1		0.1	0.1	-0.1; 0.3		-0.1	0.1	-0.4; 0.0	
Yes	38	-0.0	0.1	-0.2; 0.2	0.6	0.1	0.1	-0.2; 0.3	1.0	-0.0	0.1	-02; 0.2	0.4

*Average difference in the Z score of BMI / age, height / age and weight / height between the initial stage and at 4 months of follow-up. p: level of statistical significance < 0.05. CI: 95% confidence interval. SE: standard error.

weight or at risk of low weight had diagnostic improvements measured by the BMI-for-age Z-score moving to a higher category.

56.1% of children with an initial diagnosis of low height or at risk of low height achieved a height appropriate to their age (height-for-age Z-score) and according to the weight-for-height Z-score, 33% who presented some type of malnutrition or was at risk improved their initial diagnosis. However, in all analyses, these differences were not statistically significant (Table 5).

Discussion

In conclusion, the community program carried out on children under five years of age in a rural area of Chiapas, Mexico during the four months of its implementation has contributed to improving the anthropometric indicators BMI-for-age and weight-for-height Z-scores, mainly in groups with an initial low weight diagnosis. However, no apparent effects were observed in indicators related to chronic malnutrition in the studied population.

Table 5. Maintenance of the diagnostic category of children's nutritional status between the start and end of the program (n = 113)

	BMI-for-Age Z-score			
Final diagnosis	Low weight and risk of low weight	Adequate weight or more	Total	p
Initial Diagnosis	n (%)	n (%)	n (%)	
Low weight and low weight risk	10 (100)	0 (0)	10 (100)	0.1
Adequate or superior weight	3 (2.9)	100 (97.1)	103 (100)	
	Height-for-Age Z-score			
Final diagnosis	Low height and low height warning	Appropriate height or more	Total	p
Initial Diagnosis	n (%)	n (%)	n (%)	
Low height and low height warning	61 (43.9)	11 (56.1)	72 (100)	1.0
Appropriate height or more	11 (4.5)	30 (95.5)	41 (100)	
	Z Score Peso/talla			
Final diagnosis	Severe Acute Malnutrition, Moderate Acute Malnutrition and Risk of Acute Malnutrition	Adequate or superior weight	Total	p
Initial Diagnosis	n (%)	n (%)	n (%)	
Severe Acute Malnutrition, Moderate Acute Malnutrition and Risk of Acute Malnutrition	12 (66.7)	6 (33.3)	18 (100)	0.2
Adequate or superior weight	2 (2.1)	93 (97.9)	95 (100)	

p: level of statistical significance < 0.05

Child malnutrition in rural contexts has been a priority issue on the public agenda of the countries of Latin America and the Caribbean for decades. The first relevant studies on the subject date from 1975[25].

In the region, there are some published data on interventions focused on improving child malnutrition in children under five years of age[25,26-28] however, there are few publications on community interventions with holistic approaches addressing both individual and socio-environmental aspects where the children's biographies of rural areas are developed.

At the beginning of the intervention, a high chronic malnutrition prevalence was observed, in accordance with the study carried out by Rivera et al.[14] in children in Mexico.

An interesting result of our study was the increase in the BMI-for-age and weight-for-height Z-scores, mainly in subgroups with low weight and at risk of low weight between the beginning and the end of the program. This result was similar to what was published by another study carried out in Chile[29].

Nearly one-third of the studied children who entered the intervention with low weight or at risk of low weight developed positively their diagnosis of weight-for-height. However, 4% of those who entered with the right height-for-age, their nutritional status worsened. This could be explained by the short intervention period or by potential inaccuracies in anthropometric measurements, although this last aspect could be controlled from the training of health personnel before beginning the program implementation.

Although it was observed that the very low height prevalence slightly decreased between the beginning and the end of the program, no effects of the program were found on indicators related to chronic malnutrition (height-for-age Z-score) in the studied population. We are aware that the short implementation period of the program (four months) invalidates the ability to achieve effects on height. As proposed by Galván et al.[30], even when there are gains in height, the reduction of chronic malnutrition prevalence would occur in the long term.

Improvements in height-for-age were also found in the subgroup of children under two years of age. This could be related to the so-called "1,000 days of opportunities for nutrition interventions"[31], where there is compensatory growth capacity after a stunting period. Our results are consistent with other studies conducted in Latin America[32-34].

In our study, there were improvements in the indicators Weight-for-height and Height-for-age Z-scores (which was statistically significant only in the first

case) in the subgroup that received social protection program through direct money transfer. This would indicate the potential of these programs to contribute to improving child nutrition[30].

This study also demonstrated gender differences in the mean change in the height-for-age Z-score before and after the intervention, with better results in the subgroup of boys compare to girls. It is important to note that at the beginning of the intervention, boys had a higher prevalence of chronic malnutrition than girls, a result consistent with other studies conducted in Latin America[34,35]. Possibly during the intervention, there could have been a greater growth acceleration and a rapid compensatory recovery in the children as Victora C suggest[31].

One of the main strengths of the study lies in the importance of evaluating the impact of community programs promoted by third sector entities and the State. Evidence indicates that there are significant socioeconomic inequities in undernutrition in both urban and rural areas[36] and local community programs need to be implemented and evaluated to improve malnutrition and reduce these inequity gaps.

The main limitation of the study is the short intervention period, which invalidates the possibility of seeing global changes and specific improvements in the diagnosis of short stature and impacts on longitudinal growth in the studied group.

Another limitation is the absence of a control group. However, it is important to consider that there is a dissociation between the obtained evidence in experimental studies in the field of health and application in the real world[37], where such flexible designs could be considered acceptable and realistic.

This study provides scientific evidence in the evaluative research field on community nutrition programs with an integrated approach aimed at children from rural areas, a subject with a little-documented background in the region.

Conclusions

Although the community nutrition program had a positive impact on anthropometric indicators linked to acute malnutrition in early childhood, no changes were observed in the nutritional indicators related to chronic malnutrition, which could be due to the short time period of the nutritional intervention.

Ethical Responsibilities

Human Beings and animals protection: Disclosure the authors state that the procedures were followed according to the Declaration of Helsinki and the World Medical Association regarding human experimentation developed for the medical community.

Data confidentiality: The authors state that they have followed the protocols of their Center and Local regulations on the publication of patient data.

Rights to privacy and informed consent: The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the correspondence author.

Financial Disclosure

Authors state that no economic support has been associated with the present study.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

Aknowledgments

To children and their families belonging to the community of La Soledad of the State of Chiapas who were part of the program and to the health team of Partners in Health, a subsidiary in Mexico that worked in the territory.

References

1. Organización de las Naciones Unidas. Convención sobre los Derechos del Niño. ONU; 1989. Disponible en http://www.un.org/es/events/childrenday/pdf/derechos.pdf
2. Mieles MD Acosta A. Calidad de vida y derechos de la infancia: un desafío presente. Revista Latinoamericana de Ciencias Sociales, Niñez y Juventud. 2012;10(1):205-17.
3. Fondo de las Naciones Unidas para la infancia. La infancia. [Internet]. Unicef; 2017. Disponible en https://www.unicef.org/mexico/spanish/ninos.html
4. Organización Mundial de la Salud. Subsanar las desigualdades en una generación. Alcanzar la equidad sanitaria actuando sobre los determinantes sociales de la salud. Ginebra, Suiza: OMS; 2008. Disponible en http://apps.who.int/iris/bitstream/handle/10665/69830/WHO_IER_CSDH_08.1_spa.pdf;jsessionid=12E74A49D8719F2BAA9689EF80F7AF42?sequence=1.
5. Martorell R. Efectos de la desnutrición en la salud y desarrollo humano y estrategias efectivas para su prevención. Salud Pública Méx. 2007;49 (Ed Esp 1):151.
6. Fondo de las Naciones Unidas para la Infancia. Desnutrición infantil en América Latina y el Caribe. CEPAL, Unicef: Santiago, Chile; 2006. Disponible en http://www.oda-alc.org/documentos/1367000434.pdf.
7. Breilh J. La epidemiología crítica: una nueva forma de mirar la salud en el espacio urbano. Salud Colectiva. 2010; 6(1):83-101.
8. Ortiz-Andrellucchi, L. Peña Quintana y col. Desnutrición infantil, salud y pobreza: intervención desde un programa integral. Argentina. Nutr Hosp. 2006; 21(4):533-41.
9. De Castro J. El Hambre problema universal. Buenos Aires: Editorial Leviatán; 1983.
10. Organización Mundial de la Salud. Malnutrición: OMS; 2017. Disponible en http://www.who.int/mediacentre/factsheets/malnutrition/es/.
11. Secretaría de Salud de México. Encuesta Nacional de Salud y Nutrición de Medio Camino; 2016. Disponible en http://transparencia.insp.mx/2017/auditorias-insp/12701_Resultados_Encuesta_ENSANUT_MC2016.pdf.
12. Fernández Cantón SB, Viguri Uribe R. La mortalidad por desnutrición en México en menores de cinco años, 1990-2009. Boletín médico del Hospital Infantil de México. 2010; 67:(5)471-3.
13. Ayala-Gaytán EA, Díaz Durán-Hernández A. Infraestructura, ingreso y desnutrición infantil en México. Salud Pública Méx. 2015; 57:22-8.
14. Rivera-Dommarco JÁ, Cuevas-Nasu L, González de Cosío T, Shamah-Levy T, García-Feregrino R. Desnutrición crónica en México en el último cuarto de siglo: análisis de cuatro encuestas nacionales. Salud Pública Méx. 2013; 55(2):S161-S9.
15. Kac G, García Alvear JL. Epidemiología de la desnutrición en Latinoamérica: situación actual. Nutr Hosp. 2010; 25(3):50-6.
16. Organización de las Naciones Unidas para la Alimentación y la Agricultura. Organización Panamericana de la Salud. Panorama de la Seguridad Alimentaria y Nutricional en América Latina y el Caribe. Santiago de Chile: FAO/OPS; 2017. Disponible en http://www.fao.org/3/a-i7914s.pdf.
17. Fondo de las Naciones Unidas para la Infancia. El estado mundial de la infancia 2016. Una oportunidad para cada niño. New York: Unicef; 2016. Disponible en https://www.unicef.org/spanish/publications/files/UNICEF_SOWC_2016_Spanish.pdf
18. Akombi BJ, Agho KE, Hall JJ, Wali N, Renzaho AMN, Merom D. Stunting, Wasting and Underweight in Sub-Saharan Africa: A Systematic Review. Int J Environ Res Public Health. 2017;14(8):863.
19. Maluccio JA, Hoddinott J, Behrman JR, Martorell R, Quisumbing AR, Stein AD. The impact of improving nutrition during early childhood on education among Guatemalan adults. The Economic Journal. 2009;119(537):734-63.
20. Rodríguez-Martín A, Novalbos-Ruiz JP, Jiménez-Rodríguez A, Baglietto Ramos M, Romero Sánchez JM. Implicaciones de la desnutrición en atención primaria. Nutr Hosp. 2010; 25(3):67-79.
21. Jiménez-Benítez D, Rodríguez-Martín A, Jiménez-Rodríguez R. Análisis de determinantes sociales de la desnutrición en Latinoamérica. Nutr Hosp. 2010; 25(3):18-25.
22. Compañeros en Salud. Nuestro impacto; 2017. Disponible en https://companerosensalud.mx/impacto/
23. Word Health Organitation. Child Growth Standards: Methods and development. Geneva: WHO; 2006. Available in http://www.who.int/childgrowth/standards/Technical_report.pdf
24. Bronfenbrenner U. The Ecology of Human Development. Cambridge: Harvard University Press; 1979.
25. Instituto de Nutrición de Centroamérica y Panamá. Nutricion, crecimiento y desarrollo. INCAP; 1975. Disponible en http://iris.paho.org/xmlui/bitstream/handle/123456789/17627/v78n1p38.pdf?sequence=1
26. Bonilla Catherine, Híjar Gisely, Márquez Delia, Aramburú Adolfo, Aparco Juan Pablo, Gutiérrez Ericson L. Intervenciones para prevenir la aparición de sobrepeso y obesidad en niños menores de cinco años. Rev. Perú. Med. Exp. Salud Publica. 2017; 34(4):682-9.
27. Rodríguez O Lorena, Pizarro Q Tito, Benavides M Xenia, Atalah S Eduardo. Evaluación del impacto de una intervención alimentario nutricional en niños chilenos con malnutrición por déficit. Rev. Chil. pediatr. 2007; 78(4):376-83.
28. Vitolo MR, Bortolini GA, Campagnolo PD, Hoffman DJ. Maternal dietary counseling reduces consumption of energy-dense foods among infants: a randomized controlled trial. J Nutr Educ Behav. 2012; 44(2):140-7.
29. Ratner RG, Durán SA, Garrido MJL, Balmaceda SH., Jadue LH, Atalah ES. Impacto de una intervención en alimentación y actividad física sobre la prevalencia de obesidad en escolares. Nutr. Hosp. 2013; 28(5):1508-14.
30. Galván M, Amigo H. Programas destinados a disminuir la desnutrición crónica. Una revisión en América Latina. ALAN. 2007; 57(4):316-26.
31. Victora C. Los mil días de oportunidad para intervenciones nutricionales. De la concepción a los dos años de vida. Arch Argent Pediatr 2012; 110(4):311-7.
32. Buitrón D, Hurtig A, San Sebastián M. Estado Nutricional en niños naporunas menores de cinco años en la Amazonia ecuatoriana. Rev. Panam Salud Pública. 2004; 15(3):151-9.
33. Calvo E, et al. Estudios sobre Nutrición en menores de 3 años (Alimentación y Riesgo de desnutrición infantil). Estudio Colaborativo Multicéntrico. Ministerio de Salud y Ambiente de la Nación, Comisión Nacional de Programas de Investigación Sanitaria CONAPRIS; 2003. Disponible en http://www.fmed.uba.ar/depto/edunutri/Calvo_desnutricion_infantil.pdf
34. Sobrino M, Gutiérrez C, Cunha AJ, Dávila M, Alarcón J. Desnutrición infantil en menores de cinco años en Perú: tendencias y factores determinantes. Rev Panam Salud Publica. 2014;35(2):104-12.
35. Lafuente YKV, Rodriguez S, Fontaine V, Yañez VR. Prevalencia de la desnutrición crónica en niños menores de 5 años atendidos en el Centro de Salud Tacopaya, primer semestre gestión 2014. Gac Med Bol. 2016;39(1):26-29.
36. Fotso. JC.Child health inequities in developing countries: differences across urban and rural areas. Int J Equity Health. 2006;5:(9).
37. Gagliardino JJ, Costa Gil JE, Faingold MC, Litwak L, Funte GV. Insulina y control de la diabetes en la argentina. medicina (Buenos Aires). 2013; 73: 520-8.