Fatores associados à recuperação nutricional de crianças em programa de suplementação alimentar

Factors associated to child nutritional recovery in a supplemental feeding program

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Resumo

Objetivos: Identificar os fatores associados à recuperação nutricional de crianças inscritas no Programa de Incentivo ao Combate às Carências Nutricionais (ICCN) no Município de Mogi das Cruzes. **Métodos:** Foi realizado um ensaio institucional não controlado com 570 crianças inscritas no ICCN, que foram seguidas de julho de 1999 a julho de 2001. O estado nutricional foi avaliado segundo índice altura/idade, sendo consideradas eutróficas as crianças com escore z ≥ - 1; de risco as que apresentaram z ≥ - 2 e < - 1; desnutridas moderadas aquelas com z < - 2 e > - 3; e desnutridas graves as que apresentavam z ≤ - 3. O impacto do ICCN foi analisado através de modelo multivariado com o uso de equações de estimação (GEE – Generalized Estimating Equations), sendo considerado significativo p<0,05. **Resultados/Conclusão:** Ao final do seguimento, houve a melhora nutricional das crianças, com um gradiente, sendo maior a recuperação quanto maior a deficiência nutricional inicial. Observaram-se ganhos em altura de 1,12, 0,82, 0,57 e 0,45 desvios-padrão para as desnutridas graves, moderadas, em risco nutricional e eutróficas, respectivamente. Os fatores associados à evolução nutricional das crianças desnutridas foram a idade de 12 a 24 meses ao ingressar no ICCN, o peso ao nascer igual ou superior a 3 kg e o aleitamento materno. Os fatores associados negativamente à evolução nutricional neste grupo foram idade da mãe entre 20 a 40 anos e a ausência de trabalho remunerado materno. Para as crianças em risco, a renda familiar também se mostrou associada à melhor evolução nutricional. A experiência do ICCN em Mogi das Cruzes sugere que os programas de suplementação alimentar têm papel relevante na recuperação nutricional de desnutridos.

Palavras-chave: Suplementação alimentar. Desnutrição e avaliação.

Abstract

Objectives: To identify the factors associated with the nutritional recovery of children enrolled in the Incentive Program to Combat Malnutrition (ICCN) in the city of Mogi das Cruzes. **Methods:** An institutional trial without a concomitant control group was conducted with 570 children enrolled in the ICCN, who were observed from July 1999 to July 2001. The nutritional status was evaluated by weight/age scores, considering children with Z score ≥ - 1 as well-nourished children; those with Z score ≥ - 2 and < - 1 as children at risk; those with Z score < - 2 and > - 3 as moderately malnourished, and, finally, those with Z score ≤ - 3 as severely malnourished. The impact of ICCN was analyzed in a multivariate model with the use of estimating equations (GEE - Generalized Estimating Equations) considering $p<0.05$ as significant. **Results/Conclusion:** Children's nutritional improvement at the end of the segment shows that the higher the initial nutritional deficiency, the greater the recovery. There were gains in height of 1.12, 0.82, 0.57 and 0.45 standard deviations for severely malnourished, moderately malnourished, at risk for malnutrition, and well-nourished children, respectively. The factors that showed association with the nutritional evolution of malnourished children were 12 to 24 months of age when joining ICCN, birth-weight equal to or greater than 3 kg, and breast-feeding. Factors negatively associated to nutritional recovery were mother's age between 20 to 40 years old and absence of maternal work outside the home. For children at risk, family income was also associated to better nutritional evolution. The ICCN experience in Mogi das Cruzes city suggests that dietary supplementation programs have a relevant role in the nutritional recovery of malnourished individuals.

Keywords: Supplementary feeding. Malnutrition and evaluation.

INTRODUCTION

The macro scenario of child malnutrition in Brazil, evidenced by three population-based cross-sectional studies – National Study on Household Spending (ENDEF) 1974-1975, National Survey on Health and Nutrition (PNSN) 1989, and the National Demographic and Health Survey (PNDS) 1996 – is characterized by a descending trend in the prevalence of the event[1]. In 1974, prevalence of low weight for the age was 18.4%; it went down to 7.0% in 1989, and reached the percentage of 5.7% in 1996 [2].

Recently, the National Survey on Women's and Children's Demographics and Health (PNDS, 2006) showed the same trend of previous studies. The frequency of weight-for-age deficits estimated for Brazilian children less than 5 years of age was 1.7%, therefore, not above expectations based on the reference distribution of healthy, well-nourished children. However, a distribution of the weight-for-age rate close to that expected in well-nourished populations does not necessarily indicate absence of nutritional problems in the population. Indeed, considering the deviation from normality shown for the height-to-age distribution (7.0%) we can conclude that the observation of the weight-for-age rate distribution alone gives us little information about the nutritional status of the Brazilian child population [3].

Decrease of malnutrition in Brazil along recent years was influenced by the improvement of several conditions such as: moderate progresses in family income, expansion of public sanitation, health and education services, reduction in fertility and birth rates, with less numerous families and, finally, growing population movement to the country's urban areas where, as a whole, there are better job and income opportunities [4].

Despite this improvement in children's nutritional condition, child malnutrition continues to be a public health problem, due to its magnitude and negative consequences [5,6], which have kept it as a priority in the government agenda.

Among governmental actions, supplemental feeding is one of the leading strategies to fight nutritional deficiencies, particularly child malnutrition. Brazil has been conducting supplemental feeding programs to malnourished children since the 1940's. However, few assessments have been conducted on the results of these programs among the beneficiary population, since there is not a continuous assessment process of supplemental feeding programs. The few assessments available are conducted by researchers that are interested in the theme but they are neither connected nor systematized in program planning and execution [7].

Assessments are rare elsewhere as well. An analysis of 140 nutritional intervention programs conducted in several countries showed that only 23% had information regarding nutritional impact [8].

Along the past years, some researchers have focused on result assessments and shown the positive effects of supplemental feeding programs developed in different regions of the country [9,10,11,12,13].

However, discussion about the effectiveness of supplemental feeding programs is far from reaching consensus,[14] with criticism that goes from aspects of implementation and logistics difficulties in operation to the results reached as the strategy to fight malnutrition.

We understand that assessing programs and policies, when done with technical and technological rigor, enable greater technical and managerial rationality and expand the chances of providing more benefits to population health [15.16].

According to Barreto (2004),[15] the construction of a culture to assess public policies may turn the State into a growing consumer of the results of this scientific activity, enabling adjustment and review of the strategies adopted, thus making policies more effective.

In 1999, the Ministry of Health (MS), by means of the ICCN, proposed a set of actions that included supplemental feeding. The initiatives designed to prevent and recover malnourished children combined feeding and nutrition actions and basic health actions. In addition to being assured food distribution, children should be followed up, with monitoring of growth and assessment of nutritional status.[17]

To follow up program performance, the Ministry of Health established that assessment of nutritional status should be monthly entered in its Food and Nutritional Surveillance System (SISVAN). The city of Mogi das Cruzes joined ICCN and implemented, as of July 1999, the Incentive Program to Combat Malnutrition.

The objective of this study was to identify the factors associated to nutritional recovery among children, in different categories of nutritional status, in the city of Mogi das Cruzes.

METHODS

The city of Mogi das Cruzes is located 53 km away from the capital. Its population in 2000 was 372,419 inhabitants, with 79,399 permanent private homes and an average of 3.9 members per household. Compared to the national average, Mogi das Cruzes showed high HDI, with 0.81 score [18]. However, child mortality was above (21.5) average in the State of São Paulo (17.0)[19]. With regard to health services, the city had, when the study started, 20 Basic Health Units (UBS) in addition to 2 public hospitals, 3 private hospitals and 1 philanthropic hospital with 503 beds and 4 ICUs.

The intervention assessed was ICCN. The population studied comprised the universe of children seen in UBS (20 units) and enrolled in ICCN between July 1999 to July 2001.

Program enrollment complied with the enrollment criteria defined by the Ministry of Health: from 6 to 24 months of age, in that malnourished children were considered those with weight-for-age below the 3rd percentile and children at nutritional risk were considered those with weight-for-age between the 10th and 3rd percentiles (inclusive). The program also provided for the enrollment of

children who in three successive follow-up visits showed weight loss or no weight gain. According to the ICCN, all children should remain in the program for 12 months[17].

At a central location, children were weighed and measured again following standardized procedures[20].

The supplemental feeding provided included 3.5 kg of whole powdered milk a month (7 cans) and one can of soybean oil per child/month. The energy intake value, in calories, of the powdered milk and oil, reached 580 Kcal/day and protein content was 28.8 g/day, if fully consumed by children at the recommended dilution and quantity.

Some highlights of the education activities conducted in the program included reinforcing medical follow-up and vaccination at UBS, providing guidance on the use of the child card, holding discussions of themes related to child care and breastfeeding with groups of mothers, as described in a previous article [21].

Of the total children enrolled in the period studied (742), 02 children were excluded because they had been referred to the ICCN before six months of age, because their mothers were HIV+; and 16 children were excluded (2.5%) due to consecutive absences, thus totaling 724 children assessed at baseline. Later, 154 children quit the program before completing 12 months. Thus, assessment included the nutritional progress of 570 children, which accounted for a loss of 21.2%.

Assessment of children's nutritional status and progress was conducted based on Z score values.[20] The reference standard used was from the National Center for Health Statistics (NCHS). For nutritional diagnosis, z score values defined were: Well-nourished ≥ -1; Risk of malnutrition ≥ -2 and < -1; Moderate malnutrition < -2 and > -3 and Severe malnutrition ≤ -3.

To assess children evolution during intervention, the height-for-age rate was selected due to the fact that linear growth, measured by this rate, is the most affected among Brazilian children [22]. The dependent variable was the difference between Z score of height-for-age at start and at the completion of the 12-month program. The explanatory variables related to children were: birth weight, age at program inclusion, maternal breastfeeding, and hospitalization in the period. Whenever possible, birth weight was verified in the birth certificate brought by the mother. Total time of maternal breastfeeding (offer of maternal milk and no other foods concomitantly) and history of hospitalization in the period children stayed with the program were informed by mothers. Gestational age was not collected.

Family-related variables were: mother's nutritional status [Body Mass Index - BMI (FAO/OMS, 1997)], years of education of mother and father, family income, mother's age, mother's job, number of children, family setting, housing conditions, attendance to pre-natal care and if there was any episode of unemployment of a family member during the study period.

Data analysis

Assessment of nutritional status was entered in EPINUT[23] program. Data analysis used STATA 7.0 [24] program.

Z score averages for height-for-age were described as per the selected explanatory variables comparing the first and last height-for-age measurements.

To assess whether the positive change in nutritional status could be attributed to ICCN, a time-series multivariate analysis model was built with the use of equations to estimate normal distribution (correlation structure – exchangeable) [25]. This type of model enables both assessing the effect of each adjusted variable considering time in the program—controlling confounding variables—and, at the same time, controlling data self-correlation. The dependent variable was the initial and final measurement (at 12 months) of the Z score of height-for-age for each child group: malnourished, at nutritional risk and well-nourished. Intervention was assessed based on the number of visits to the program. The number of months in the program was adjusted as a time

variable necessary to conduct the model.

At the end of the analysis, model residues were analyzed to assess adjustments.

Three different multivariate models were built: malnourished, at nutritional risk and well-nourished children, to identify the specific factors of each category, since it had already been perceived that recovery presented different intensity and rhythm[21]. Malnourished children were taken as a single group, since the number of severely malnourished was not enough to support an isolated model.

The variables adjusted in the model were selected by the p value of Wald test [24], calculated in the univariate analysis. A step-by-step strategy was used, starting with a model with all variables adjusted, and removing the variables that scored in Wald test a p value equal or below 0.25. [26]

To estimate the importance of a variable in the model, the difference used was deviance from the model with the variable analyzed and without it. With this value, the asymptotic value of Qui square and corresponding probability (p) were estimated.[24]

The coefficients whose p value in Wald test was below 0.05 were evaluated as a significant trend of Z score, as well as due to the precision of coefficient estimates (95% confidence interval), calculated for each category of variables present in the model.

A variable was considered a confounding variable when, after adjustment to the multivariate model, the coefficient value decreased or increased by 15% of the value attained in the univariate analysis[20].

For ethical reasons, a control group was not adopted, because that would imply keeping malnourished children without any intervention. The project was approved by the Ethics Committee of the School of Public Health. Children's legal representatives were invited to take part in the study and sign the consent form.

RESULTS

In the period studied, 724 children were enrolled at the ICCN; along follow-up, 154 children (21.2%) abandoned the study, totaling in the final nutritional status assessment 570 children. However, it seems there has not been a selective loss of follow-up since, when assessing the number of children that joined the program in the different nutritional status categories, the abandonment rate was similar, as can be seen in Table 1.

Additionally, an analysis was performed to detect the leading characteristics presented by the set of children and their families that started follow-up in the program and compared them to those that abandoned the program before completing twelve months. Results indicate that the losses occurred during the follow-up period neither over nor underestimated the results attained in nutritional evolution, once the children that left the program (losses) are similar, in relation to the variables studied, to those that remained in the study, except with regard to the loss of children whose parents had less years of education (1-4 years), which was

TABELA 1 – Distribuição de crianças segundo percentual de abandono e estado nutricional pelo índice altura/idade ao ingressar no ICCN. Mogi das Cruzes, 2002.
TABLE 1 *– Distribution of children under percentage of abandonment and nutritional status through height-for-age ratio when joining ICCN. Mogi das Cruzes, 2003.*

Nutritional status Initial	ICCN start n	ICCN end n	% of abandonment
Well-nourished	209	169	19.1
Nutritional risk	321	250	22.1
Malnourished children	194	151	22.1*
Total	724	570	21.2

*Severely malnourished children: 13,6% and Moderately malnourished children: 24,6; p = 0,954

TABELA 2 - Distribuição das características de crianças que iniciaram e que abandonaram o ICCN. Mogi das Cruzes, 2002.
TABLE 2 – Distribution of the characteristics of children who joined and quit ICCN. Mogi das Cruzes, 2002.

Variables	Children that quit		Children that started		*p*
	n	%	***n***	%	
Age range (months)					0,073
6 – 12	17	12.1	202	27.9	
12 – 24	113	80.7	482	66.6	
>24	10	7.2	40	5.5	
Birth weight (g)					0.747
< 2500	21	15.0	70	12.4	
2500 – 2999	48	34.3	187	33.0	
≥ 3000	61	43.6	271	47.9	
W/o information	10	7.1	38	6.7	
Maternal breastfeeding					0.526
Yes	120	85.7	605	83.5	
No	20	14.3	119	16.5	
Family income (s.m.)					0.995
< 1	40	28.6	197	27.2	
1 – 3	74	52.8	367	50.7	
> 3	25	17.8	121	16.7	
W/o information	1	0.8	39	5.4	
Mother's schooling					0.160
No schooling	11	7.8	37	5.1	
1 – 4 yo	53	37.9	235	32.4	
> 4 yo	75	53.6	433	59.8	
W/o information	1	0.7	19	2.7	
Father's schooling					0.000
No schooling	9	6.4	48	7.7	
1 – 4	74	52.8	181	28.8	
> 4	46	32.8	398	63.5	
W/o information	11	7.8	110	15.5	
Mother's work outside home					0.492
No	108	77.1	579	80.0	
Yes	32	22.9	145	20.0	
Mother's age (yo)					0.472
< 20	19	13.5	98	13.5	
20 – 40	113	81.5	604	83.1	
> 40	7	5.0	22	3.4	
Number of siblings					0.650
0 a 1	72	51.4	402	55.5	
2 – 3	59	42.1	280	38.7	
> 3	9	6,5	42	5,8	

higher among those that did not remain in the study (Table 2).

A high percentage of severely (6.1%) and moderately malnourished children (20.7%) can be observed, totaling 26.8% (Table 3). Children with Z score above +2 were not identified.

Nutritional recovery, assessed by height-for-age rate according to initial nutritional status and Z score variation, can be seen in Table 4.

The results found in children evolution based on height-for-age rates were positive in all child groups. Groups of moderately malnourished, at nutritional risk, and well-nourished, showed significant differences between the first and last visits (paired t, $p<0.001$). It is important to highlight that evolution is directly proportional to the severity of nutritional deficit, that is, higher gain for children with higher deficits.

Because of the reduced number of children with severe malnutrition (Z score ≤-3), these were grouped with children with moderate malnutrition (Z score < -2 and > -3) to investigate the association of nutritional evolution and the selected independent variables.The sample totalled 194 children who, hereinafter, will be called malnourished. The results attained in univariate and multivariate models are shown for the set of children per category of initial nutritional status, in Tables 5 and 6.

After adjusting variables, time of exposure to the program (number of visits) was associated to better nutritional recovery of malnourished children. At each visit, children gained 0.07 Z score of height-for-age.

Also positively associated to nutritional recovery were children's age when they enrolled in the ICCN (12-24 months), birth weight ≥ 3000g and maternal breastfeeding, which showed borderline value ($p=0.05$); however, the lower limit of the confidence interval of the adjusted average score was above zero.

Tabela 3 – Distribuição em número e percentual de crianças segundo estado nutricional inicial pelo índice altura/idade. Mogi das Cruzes, 2002.
Table 3 – *Distribution by number and percentage of children according to nutritional status by baseline height/age ratio. Mogi das Cruzes, 2002.*

Nutritional status	n	%
Well-nourished	169	29,6
Nutritional risk	250	43,8
Moderately malnourished	117	20,6
Severely malnourished	34	6,0
Total	570	100,0

Table 4 – Variação do índice altura/idade em 12 meses de programa segundo estado nutricional inicial. Mogi das Cruzes, 2002.
Table 4 – *Change in height/age ratio at 12 months of program from baseline nutritional status. Mogi das Cruzes, 2002.*

Baseline nutritional status	initial Z Average (sd)	final Z Average (sd)	Variation Average (95% CI)
Severely malnourished children	-3,67 (0,60)	-2.55 (0,72)	1,12 (0,80 – 1,44)
Moderately malnourished children	-2,46 (0,28)	-1,64 (0,66)	0,82 (0,67 – 0,97)
Nutritional risk	-1,48 (0,27)	-0.91 (0,63)	0,57 (0,47 – 0,66)
Well-nourished	- 0,38 (0,54)	0,07 (0,73)	0,45 (0,30 – 0,60)

Children whose mothers did not work evolved worse when compared to the children whose mothers worked. It is interesting to observe that, after adjustment of any possible confounding variables, absence of maternal employment increased negative association with nutritional recovery by 35.6% (- 0.18 to – 0.24).

TABELA 5 – Associação entre fatores relacionados à recuperação de crianças desnutridas - Análise Multivariada. Mogi das Cruzes, 2002.
TABLE 5 – Association between factors related to the recovery of malnourished children - Multivariate Analysis. Mogi das Cruzes, 2002.

Variables / Categories	Average non-adjusted Z score height-for-age variation* (CI)	Average adjusted Z score height-for-age variation* (CI)	p
Number of visits	**0.09 (0.08 – 0.09)**	**0,07 (0,06 – 0,08)**	**0,00**
Child age at start in the ICCN (months):			
6 – 11 [a]	-	-	-
12 – 23	**0.36 (0.15 – 0.56)**	**0.40 (0.19 – 0.61)**	**0.00**
≥ 24	0.42 (-0.27 – 1.10)	0.60 (-0.01 – 1.20)	0.06
Birth weight (g):			
< 2500 [a]	-	-	-
2500 – 2999	0.15 (-0.09 – 0.39)	0.05 (-0.18 – 0.28)	0.68
≥ 3000	**0.38 (0.11 – 0.64)**	**0.30 (0.03 – 0.56)**	**0.03**
Maternal breastfeeding:			
No [a]	-	-	-
Yes	**0.29 (0.05 – 0.52)**	**0.24 (0.01 – 0.48)**	**0.05**
Number of people in family:			
< 3 [a]	-	-	-
≥ 3	-0.25 (-0.53 – 0.02)	-0.28 (-0.60 – 0.04)	0.08
Number of siblings:			
0 – 1 [a]	-	-	-
2 – 3	-0.20 (-0.40 – 0.01)	0.10 (-0.14 – 0.34)	0.41
> 3	-0.61 (-1.00 – 0.23)	-0.38 (-0.83 – 0.06)	0.09
Mother's age (completed years):			
< 20 [a]	-	-	-
20 – 40	**-0.33 (-0.63 – -0.03)**	**-0.47 (-0.80 – -0.13)**	**0.00**
> 40	-0.91(-1.52 – -0.30)	-0.51 (-1.11 – 0.08)	0.09
Mother working outside the home:			
Yes [a]	-	-	-
No	**-0.18 (-0.42 – 0.06)**	**-0.24 (-0.47 – -0.01)**	**0.04**
New job during the ICCN:			
Yes [a]	-	-	-
No	-0.32 (-0.61 – -0.03)	-0.20 (-0.41 – 0.02)	0.07
Degree of malnutrition:			
Moderate [a]	-	-	-
Severe	**0.10 (0.09 – 0.11)**	**0.52 (0.45 – 0.59)**	**0.00**

* Os valores foram arredondados para duas casas decimais./ values were rounded to two decimal houses
a = categoria de referência / reference category

TABELA 6 – Associação entre fatores relacionados à recuperação de crianças em risco nutricional e eutróficas – Análise Multivariada. Mogi das Cruzes, 2002

TABLE 6 – Association between factors related to the recovery of children at nutritional risk and well-nourished children - Multivariate Analysis. Mogi das Cruzes, 2002.

Variables / Categories	Average non-adjusted Z score height-for-age variation* (CI)	Average adjusted Z score height-for-age variation* (CI)	p
CHILDREN AT NUTRITIONAL RISK			
Number of visits:	0.06 (0.05 – 0.06)	0.06 (0.05 – 0.06)	0.00
Maternal breastfeeding:			
No [a]	-	-	-
Yes	**0.19 (0.04 – 0.34)**	**0.32 (0.13 – 0.51)**	**0.00**
Family income (minimum wages):			
< 1 [a]	-	-	-
1 – 3	0.03 (-0.08 – 0.16)	0.10 (-0.04 – 0.23)	0.16
> 3	**0.16 (0.00 – 0.32)**	**0.24 (0.05 – 0.42)**	**0.02**
Mother's schooling (years of education):			
0 [a]	-	-	-
1 – 4	-0.15 (-0.40 – 0.11)	-0.22 (-0.54 – 0.08)	0.15
> 4	-0.04 (-0.29 – 0.21)	-0.14 (-0.48 – 0.17)	0.38
Mother working outside the home:			
Yes [a]	-	-	-
No	-0.12 (-0.25 – 0.01)	**-0.18 (-0.33 – -0.02)**	**0.02**
Mother's perception (Thin child):			
Yes [a]	-	-	-
No	0.08 (-0.04 – 0.21)	0.07 (-0.06 – 0.20)	0.32
WELL-NOURISHED CHILDREN			
Number of visits:	0.05 (0.05 –0.06)	0.04 (0.04 – 0.05)	0.00
Child age at start in the ICCN (months):			
6 – 11 [a]	-	-	-
12 – 24	**0.21 (0.03 – 0.40)**	**0.28 (0.05 – 0.51)**	**0.02**
≥ 24	-0.06 (-0.42 – 0.30)	0.35 (-0.15 – 0.84)	0.17
Birth weight (g):			
< 2500 [a]	-	-	-
2500 – 2999	0.30 (-0.02 – 0.62)	0.20 (-0.17 – 0.57)	0.30
≥ 3000	-0.28 (-0.01 – 0.57)	0.24 (-0.09 – 0.57)	0.16
Number of people in family:			
< 3 [a]	-	-	-
≥ 3	-0.13 (-0.06 – 0.34)	-0.17 (-0.40 – 0.06)	0.15
Mother's schooling (years of education):			
0 [a]	-	-	-
> 4	0.12 (-0.03 – 0.27)	0.37 (-0.22 – 0.97)	0.22

* Os valores foram arredondados para duas casas decimais./ values were rounded to two decimal houses
a = categoria de referência / reference category

The degree of malnutrition presented at enrollment in the ICCN (severe and moderate) was also associated. Results show that the recovery of those children who joined the program with higher nutritional deficits (Z score=0.52) was significantly higher.

Such results show that, for malnourished children, attending ICCN was favorable to recovery, regardless of other factors assessed in this study.

When analyzing association between birth weight and initial malnutrition, we can observe that 64.1% of severely malnourished children were born with weight <2500g. Although not adjusted in the model, weight > 3000g kept a significant association with the nutritional improvement of a child exposed to ICCN.

For children at nutritional risk, after adjustment for possible confounding variables, maternal breastfeeding, family income and time of exposure to the program were associated to nutritional improvement.

Absence of maternal employment kept negatively associated to nutritional recovery, with increasing association after multivariate adjustment. The other variables selected for adjustment in the multivariate model, that is, age and number of siblings, did not remain in the model.

For well-nourished children, time of exposure to the program and age (12-24 months) showed association to higher height-for-age gain, regardless of other factors.

DISCUSSION

Along time of exposure to ICCN, nutritional condition was significantly better for all categories assessed, with higher impact the more intense the initial nutritional deficiency. These results coincide with studies that show that the best responses to supplemental feeding programs are recorded among those children with the highest nutritional deficits[9,10,11].

In relation to malnourished children, attending ICCN was associated to nutritional progress in an independent manner, since the coefficient of height-for-age gain was not reduced, even after inclusion of other variables in the statistical model deployed.

Similar results were found by Aitchison et al [28], who studied the effects of a supplemental feeding program in the growth of malnourished children in Indonesia where, after a multivariate analysis, they found a positive effect in the growth of supplemented children when compared to non-supplemented children.

A study conducted with 90 children, 60 of whom malnourished (30 with supplementation and 30 without supplementation) and 30 well-nourished (without supplementation) in Nigeria, found that, at the end of the intervention, supplemented children reached the same weight average as well-nourished children, while malnourished children not supplemented kept the weight disadvantage initially diagnosed, showing that supplemental feeding improves the nutritional status of children with nutritional deficits[29].

Despite ethically controversial procedures, such as having malnourished children not receiving nutritional intervention and being merely used for research, supplemental feeding programs conducted in different parts of the world seem to converge to a positive response in this kind of intervention to recover children that show nutritional deficits.

Also identified as variables positively associated to the recovery of malnourished children are child age at the time of enrollment in the program, birth weight, and total maternal breastfeeding offer.

Findings related to better recovery of children between 12 and 24 months of age [30] are consistent with the literature.

According to Schroeder et al.[31], few publications have analyzed supplementation response at specific ages. Additionally, more precise understanding of the ages in which children can benefit the most from nutritional supplementation may help to improve the effectiveness of such programs.

In relation to birth weight, although many studies evidence a direct relationship with the child's nutritional future, there are

very few publications assessing its influence in the nutritional recovery of children who join supplemental feeding programs. Santos[32] refers to the importance of including birth weight in studies that analyze the impact of nutritional interventions in childhood as a possible intervenient variable in the nutritional recovery process.

With regard to maternal breastfeeding, several studies indicate that children that are breastfed have lower risk of malnutrition. However, the influence of maternal breastfeeding in the recovery of children in supplemental feeding programs has been little explored.

The findings in this study, that show positive association of maternal breastfeeding in the nutritional evolution of malnourished children and children at nutritional risk, is more difficult to explain, since what was assessed was the offer of maternal breastfeeding in the past and not the presence of breastfeeding in the period of intervention. Such findings suggest that children that were breastfed are different than those that were not. Perhaps such difference can be explained by the establishment of better attachment between mother and child among those children that were breastfed, or by the fact that maternal breastfeeding can produce long-lasting impact in children's nutritional and health status that enables them to respond better in recovery. This result shows that maternal breastfeeding is a variable that should be explored in studies on the impact of supplemental feeding programs.

Still in the group of malnourished children, children whose mothers did not work had worse evolution when compared to those whose mothers worked. Studies have evidenced that, quite often, mothers of malnourished children do not perform paid jobs. However, when women do have jobs, they improve family income, which reflects in better nutritional status of children [29].

Studies compiled by Carvalhaes and Benício [33] did not find conclusive evidences about the association between maternal work and children's nutritional status. Other researchers say that, depending on the income generated, type of job, suitability of substitute care, and child age—in addition to mother's autonomy to use the resources generated from her job—effects on children's nutritional status may vary from risk to protection.

The findings of this study consistently show association between unemployment and malnutrition, with worse child recovery in the absence of maternal work. A possible explanation may be the less availability of resources for childcare, before and after supplementation, suggesting that the impact of maternal unemployment adversely affects nutritional recovery. This result points to healthcare limits in controlling malnutrition, showing the need to change public policies directed to societal structure, for example, increasing the offer of jobs for women with malnourished children.

For children at nutritional risk, frequency of attendance to ICCN, maternal breastfeeding and family income >3 minimum wages stand out as significantly associated to recovery; negative outcomes are associated to absence of maternal work.

Likewise, for well-nourished children, program participation was associated to nutritional evolution, in that, for these children, enrolling in the ICCN between 12 and 24 months of age was also positively associated. It is important to highlight that well-nourished children had lower response than children with nutritional deficits—a trend observed in other studies conducted with supplemental feeding program populations that included children with light or nonexistent nutritional deficits [30, 12].

Based on result analysis, we can verify that frequency of attendance to the program, which implicated in receiving supplemental feeding, and participation in educational activities, was associated to the nutritional improvement of all children, regardless of other factors.

Historically, supplemental feeding programs have been developed in the basic healthcare network, where other preventive actions are developed too. When supplemental feeding is regarded as a mere distri-

bution of food, without the development of any educational action amongst the population, results can be inexpressive[34]. However, when accompanied by other health and education actions, supplemental feeding has shown to be effective to recover malnutrition [35,36].

In the case of the ICCN in Mogi das Cruzes, when mothers went to the supplement distribution site, they took part in nutritional education actions. Perhaps this differential can explain part of the recovery attained by children.

A study conducted in Vietnam with malnourished children that used nutritional education interventions, found significant association of non-deterioration of child growth in the families that received educational actions, when compared to the children in control families [37]. Income has been related to children's health and nutrition conditions, which, in turn, is related to mother's level of education and maternal work. In this study, income did not show any association, probably because it was a homogenous population, where 85.2% of children's families received up to 3 minimum wages.

Possible selection, measurement and confounding biases sometimes present in studies like this seem not to have occurred or, if so, to have been small. In relation to selection, the number of children that enrolled in the ICCN in Mogi das Cruzes in the period assessed coincides with the estimate of malnourished children and children at nutritional risk of NUPENS (Center of Epidemiological Research in Nutrition and Health) for the municipality.

With regard to measurement bias, before program start, 4th year interns of Nutrition from a private university in the same city were trained to measure children's height, with direct supervision along the program. Additionally, children's height measurements were verified by sampling, which provided greater reliability to results.

With regard to confounding biases, a multivariate model was used and the independence of effects was measured for the variables that remained in the final model. We could not identify seasonal influence on child nutritional evolution, since admission was along all months of the year and evolution was followed monthly for twelve months. In relation to economic changes, we tried to identify them by asking the child's legal representative at the end of the 12 months' period, if during intervention someone in the family had got a job and, therefore, increased family income. Any occurrence of child hospitalization was also verified.

A problem found in studies with repeated samples is data self-correlation. Effects of self-correlation were controlled by using the model applied in data analysis. Considering the validity of this study due to the little presence of biases and suitability of the statistical tool employed, we can say that the children the benefited from the ICCN in the city of Mogi das Cruzes showed improvement in nutritional status, assessed by the average variation of Z score along 12 months. The best results were attained by children with the highest nutritional deficits, corroborating studies that assessed supplementation programs developed in different parts of the world.

In a positive manner, higher birth weight, maternal breastfeeding and age at enrollment in the ICCN (12 to 24 months) were associated to children recovery. Special attention should be given, therefore, to pre-natal care with regard to encouraging maternal breastfeeding, following pregnant women's nutritional status and including children in supplemental feeding programs at the age there is better possibility of response.

It was also possible to verify that absence of maternal employment was associated to worse child recovery, as well as non attainment of work by some family member configured as a possible association to worse nutritional recovery. These factors should be studied in greater samples since, in this study, they showed borderline values.

Also, it is important to make some considerations about the limitations described

in literature with regard to assessments of supplemental feeding programs without a control group. According to Taddei[27], associations found between supplementation and evolution in nutritional status in the group studied cannot be inferred as causal relations, since such modifications may occur due to other factors not addressed in this study. In such case, possible associations found may be undue.

However, this study sought, by means of the statistical model employed, to adjust the variables described in literature as associated to malnutrition, which made the results attained more powerful.

Another limitation refers to possible presence of prematurity, which was not assessed in the present study. It is possible that recovery is overestimated among malnourished children and that some factors identified could be adjusted by the variable of prematurity.

It is also pertinent to discuss the methodological option made in this study, separating children according to baseline nutritional status. Another alternative would be to consider the program's global effectiveness and consider the initial nutritional status as another exposure. Our option may have reduced the statistic power to identify a greater number of variables by expanding confidence intervals; however, it enabled understanding that children's age at enrollment, birth weight and mother's age are specific factors of malnourished children.

CONCLUSION

The ICCN experience in Mogi das Cruzes suggests that supplemental feeding has a relevant role in nutritional recovery, particularly for more severe cases. It should be started as soon as possible, and reinforcing the protective role of maternal breastfeeding.

In addition to offering food, our results showed absence of maternal employment as a risk factor for worse child nutritional recovery, which points to the need of increasing the offer of employment and education to women, particularly to those in more vulnerable families.

We can also conclude that the policies that positively affect pre-natal care aiming to reduce low birth weight may equally accelerate nutritional recovery.

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