Malnutrition among children under 60 months of age in two cities of the state of Acre, Brazil: prevalence and associated factors

Desnutrição em crianças menores de 60 meses em dois municípios no Estado do Acre: prevalência e fatores associados

Orivaldo Florencio de Souza[I,II]
Maria Helena D'Aquino Benício[I]
Teresa Gontijo de Castro[III]
Pascoal Torres Muniz[II]
Marly Augusto Cardoso[I]

[I] Departamento de Nutrição da Faculdade de Saúde Pública da Universidade de São Paulo (USP), São Paulo.

[II] Centro de Ciências da Saúde da Universidade Federal do Acre, Rio Branco, Acre.

[III] Departamento de Enfermagem Materno Infantil e Saúde Pública da Escola de Enfermagem, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais.

Abstract

Objective: To investigate the prevalence of malnutrition and associated factors in children under the age of 60 months in two cities in the state of Acre, Brazil. **Methods:** A population-based cross-sectional study was carried out with 667 children living in urban areas of the cities of Acrelândia and Assis Brasil. The prevalence of malnutrition was calculated by height for age (stunting) and weight for height (W/H) indexes, which were calculated with a cutoff point of -2 for Z scores as determined by the 2006 World Health Organization child growth standards. A structured questionnaire was used to gather information on socioeconomic conditions, access to services and child care, birth weight and morbidity. Poisson regression was used to identify the factors associated with child malnutrition. **Results:** The prevalence of height-for-age and weight-for-height deficit was 9.9% and 4.1%, respectively. The factors associated with height-for-age deficit were low household wealth index (prevalence ratio [PR]: 1.74; 95% confidence interval [95% CI]: 0.95 – 3.18); having an illiterate father or stepfather (PR: 1.82; 95% CI: 1.01 – 3.27); having 2 or more younger siblings (PR: 2.88; 95% CI: 1.45 – 5.72); biological mother not living in the home (PR: 2.63; 95% CI: 1.32 – 5.24); and exposure to open wastewater near the home environment (PR: 2.46; 95% CI: 1.51 – 4.00). "Low weight at birth" was the only factor associated with weight-for-height deficit (PR: 2.91; CI95%: 1.16-7.24). **Conclusions:** In the cities studied, malnutrition in children under 60 months is an important public health problem, and is associated with indicators of social inequality, access to health services and biological mother not living in the home.

Keywords: Malnutrition. Child health. Nutritional status. Cross-sectional survey. Anthropometry. Nutritional epidemiology.

Resumo

Objetivo: Investigar a prevalência da desnutrição e fatores associados em crianças menores de 60 meses em dois municípios do Estado do Acre. **Métodos:** Estudo transversal de base populacional realizado com 667 crianças da área urbana dos municípios de Acrelândia e Assis Brasil. A prevalência da desnutrição foi calculada pelo padrão de crescimento da Organização Mundial da Saúde de 2006, com o ponto de corte -2 escores Z. Informações sobre condições socioeconômicas, acesso aos serviços e cuidado da criança, peso ao nascer e morbidade foram obtidas por questionário estruturado. A regressão de Poisson foi utilizada para identificar os fatores associados à desnutrição de crianças. **Resultados:** A prevalência do déficit estatura para idade e déficit peso para estatura foi de 9,9% e 4,1%, respectivamente. Os fatores associados ao déficit estatura para idade foram o baixo índice de riqueza (razão de prevalência [RP]: 1,74; intervalo de confiança em 95% [IC95%]: 0,95 - 3,18), analfabetismo do pai ou padrasto (RP: 1,82; IC95%: 1,01 - 3,27), ter 2 ou mais irmãos menores (RP: 2,88; IC95%: 1,45 - 5,72), ausência da mãe biológica no domicílio (RP: 2,63; IC95%: 1,32 - 5,24) e exposição ao esgoto a céu aberto no âmbito domiciliar (RP: 2,46; IC95%: 1,51 - 4,00). Somente o baixo peso ao nascer mostrou-se como fator associado ao déficit peso para estatura (RP: 2,91; IC95%: 1,16 - 7,24). **Conclusões:** Nos municípios estudados, a desnutrição em crianças menores de 60 meses apresenta-se como um importante problema de saúde pública, associado aos indicadores de iniquidades sociais, acesso aos serviços de saúde e ausência da mãe no domicílio.

Palavras-chave: Desnutrição. Saúde da criança. Estado nutricional. Estudos transversais. Antropometria. Epidemiologia nutricional.

Introduction

A substantial decrease in malnutrition was observed in recent decades in Brazilian children younger than five years[1,2]. However, regional inequalities still exist. The 2006 *Pesquisa Nacional de Demografia e Saúde* (PNDS – National Demographic and Health Survey) revealed that the Northern region of Brazil maintained double the prevalence of height and weight deficit, compared to the Brazilian average[3]. This situation in Northern Brazil is an indication of the vulnerability of children to conditions of poverty, household food insecurity and poor access to health services[4,5,6]. In this sense, these indicators suggest an unsatisfactory situation that does not enable child malnutrition to decrease. Due to the lack of population-based studies in the Northern region, little is known about the determinants of child health profile in different contexts, which can be different from those observed in other Brazilian regions.

Public policies to prevent and reduce child malnutrition must be developed considering regional characteristics. However, in the state of Acre, there are few population-based studies on factors associated with child malnutrition that can help to design and adapt public policies aimed at improving child nutritional status. This information is key to develop and implement programs aimed at family empowerment, thus promoting health in the family context with an impact on child malnutrition prevention.

As a result, the present study aimed to investigate the prevalence of malnutrition in children younger than 60 months and associated factors, in two cities of the state of Acre.

Methods

A population-based cross-sectional study was conducted. The study population was comprised of children younger than 60 months, living in urban areas of the cities of Acrelândia and Assis Brasil, in the state of Acre, Brazil. According to the census

based on records of the *Programa de Saúde da Família* (PSF – Family Health Program), conducted in December 2002 and with a full coverage of all families living in the urban area of both cities, there were 334 homes in Acrelândia and 157 homes in Assis Brasil, totaling 724 children. These children were located using the PSF census records of both cities studied. In 2002, there were only PSF clinics in urban areas and, due to difficulties in logistics and access, the rural areas were not included in the present survey. The exclusion criterion was the presence of any diseases that prevented anthropometric measurement.

Data collection occurred during January 2003. The field team was comprised of community health agents, undergraduate nursing students of the *Universidade Federal do Acre* and postgraduate students of the *Universidade de São Paulo*, trained and supervised locally by project team researchers. During home visits, interviewers introduced themselves, explained the objectives and benefits of the study and requested that an informed consent form be signed by the parents or those responsible for the children, guaranteeing anonymity of information.

The present study was approved by the Human Research Ethics Committee of the *Faculdade de Saúde Pública da Universidade de São Paulo* (Research Protocol 810). Children diagnosed with parasite infection and anemia in this study received adequate drug treatments, prescribed by the project's medical team.

The following information was obtained from the structured questionnaire, applied to parents or those responsible for the children in the home interviews: demographic characteristics (sex and age of children), household goods, number of younger siblings, biological parents' residence status in the home, father's or stepfather's level of literacy, presence of open sewage in the home environment, type of water supply in the home, weight at birth (obtained from the child health report card), maternal reproductive history, characteristics at birth, maternal breastfeeding and previous morbidities. Diarrhea was defined as the frequent passage or loss of liquid feces in the 15 days prior to interview. The household wealth index was calculated (in Z-scores) to evaluate the socioeconomic level of families, based on the presence of household goods and appliances in the homes (television, sound system, VCR, stove, fridge, radio, telephone, bicycle, electric iron, blender, car, couch, washing machine and satellite dish antenna), according to what had been described in previous studies[7,8]. In brief, scores originated from main component analysis were added, using household goods as the basis for the calculation and estimating the household wealth index, as recommended by Filmer & Pritchett[9].

Peripheral blood samples of children aged between 6 and 60 months were collected with a portable hemoglobinometer (Hemocue®, Ängelhom, Sweden) to quantify hemoglobin concentration. Anemia cases were defined by values lower than 11.0g/100ml, as established by the World Health Organization (WHO)[10].

Weight and height measurements of children aged two years or more were taken. Weight was measured with a portable electronic scale (Plenna, USA) with a 150kg capacity and 100g accuracy. Height was measured using a stadiometer with a 0.1cm accuracy. Children younger than two years had their weight and height measured with a digital pediatric scale, with a 16kg capacity and 10g accuracy (Soehnle, Germany) and a child anthropometer (0.1cm accuracy), respectively. anthropometric measurements were obtained in duplicate by research team nutritionists (TGC and PTM), using the mean between two measurements, observed according to the procedures recommended by the WHO[11]. With the help of the WHO Anthro 2005 software, Z-scores of the height-for-age and weight-for-height indices were obtained from the WHO's 2006 child growth standard[12]. A cut-off point equal to or lower than a Z-score of –2 was used to determine nutritional deficits[11]. Extreme values below a Z-score of -6 and above +6 for anthropometric indices were

Malnutrition among children under 60 months of age in two cities of the state of Acre, Brazil
Souza, O.F. et al.

213

Rev Bras Epidemiol
2012; 15(1): 211-21

excluded from data analysis, as recommended by the WHO[12].

Data were typed into the Epi-Info software program, version 6.01, following the double-entry procedure. After this process, data were transferred to the Stata™ statistical software program, version 9.2, for statistical analysis. Chi-square test for homogeneity was used to compare proportions (p<0.05).

Factors associated with child malnutrition were identified in two stages. In the initial analysis, independent variables associated with nutritional deficits with a p value<0.20 (chi-square test for homogeneity and linear trend) were selected to comprise the multiple models. In the second stage, the factors associated with height-for-age and weight-for-height deficits were identified with hierarchical and multiple Poisson regression analysis (robust standard error), using a conceptual model and procedures adapted from previous publications[13,14, 15]:

- 1st block: city of residence and demographic characteristics ("city", "child sex", and "child age" variables);
- 2nd block: socioeconomic characteristics ("household wealth index", "father's or stepfather's level of literacy" variables);
- 3rd block: access to child care and services ("living with biological parents", "having younger siblings", "open sewage" and "water supply" variables);
- 4th block: birth characteristics ("weight at birth" variable);
- 5th block: morbidities ("anemia" and "diarrhea in the 15 days prior to interview" variables).

Multiple model analysis began from the distal block to the proximal block. Child sex and age were included into the first block and remained in the subsequent stages. All variables selected in the first stage were included inside each block. Variables with a p value<0.05 using the Wald test or linear trend were selected as a factor associated with nutritional deficits, remaining in the multiple models in the analyses of subsequent blocks. Variables with a p value>0.05 were excluded from the model and chan-

ges higher than 10% in the magnitude of prevalence ratios of variables remaining in the model were evaluated. In cases of occurrence of changes in prevalence ratio higher than 10% in the variables remaining in the model, the variable was reinserted and maintained in the multiple models of subsequent blocks.

Results

Of all 720 children younger than 60 months, whose parents agreed to participate in the study (99.4% of those eligible), 677 completed the physical exam. Of these, 10 children were excluded because they had Z-score values lower than -6 or higher than +6 for the anthropometric indices evaluated. Thus, 667 children were considered in this analysis, corresponding to 92.2% of all eligible children in this study. Of all 667 children, 329 (49.3%) were males and 338 (50.7%) were females. With regard to age, 246 (36.9%) were aged between 0 and 23 months and 421 (63.1%), between 24 and 60 months.

The magnitudes of prevalence were 9.9% (CI95%: 7.6-12.1) for the height-for-age deficit and 4.1% (CI95%: 2.5-5.5) for the weight-for-height deficit. Maternal breastfeeding began for the majority of children studied (97.5%), although the prevalence of exclusive breastfeeding until the sixth month was 33.6%, including a median of total duration of breastfeeding of 180 days, without significant statistical differences between cities. The distributions of children younger than 60 months, according to city of residence, socioeconomic conditions, access to child care and services, weight at birth and morbidities are shown in Table 1. "Living with the biological parents" and "weight at birth" were selected to comprise the multiple models of height-for-age and weight-for-height deficits. In contrast, "household wealth index", "father's or stepfather's level of literacy", "having younger siblings", "open sewage", "anemia" and "diarrhea in the 15 days prior to interview" were selected to comprise the multiple model for height-

Rev Bras Epidemiol
2012; 15(1): 211-21
214
Malnutrition among children under 60 months of age in two cities of the state of Acre, Brazil
Souza, O.F. et al.

-for-age deficit. In the multiple model for weight-for-height deficit, "water supply" was also selected (Table 2).

Table 3 shows the factors associated with height-for-age deficit in the final multiple models. In the socioeconomic block, chil-

Table 1 - Distribution of children under 60 months by municipality of residence, socioeconomic conditions, access to services and child care, birth weight and morbidity. Assis Brasil and Acrelândia, AC, 2003.

Tabela 1 – Distribuição das crianças menores de 60 meses segundo município de residência, condições socioeconômicas, acesso aos serviços e cuidado da criança, peso ao nascer e morbidades. Assis Brasil e Acrelândia, AC, 2003.

	n	%
City		
Assis Brasil	197	29.5
Acrelândia	470	70.5
Household wealth index		
3rd third (high)	226	34.2
2nd third	213	32.3
1st third (low)	221	33.5
Father's or stepfather's level of literacy		
Literate	552	89.5
Illiterate	65	10.5
Living with the biological parents		
Living with the biological mother and father	465	69.7
Living only with the biological mother	151	22.6
Biological mother not living in the home	51	7.7
Younger siblings		
No younger sibling	300	45.4
1 younger sibling	273	41.4
2 or more younger siblings	87	13.2
Open sewage		
Absent	507	77.3
Present	149	22.7
Water supply		
Public network	402	60.9
Other sources (water well, river or dam)	258	39.1
Weight at birth		
Higher than 2,500 g	566	91.3
Equal to or lower than 2,500 g	54	8.7
Anemia		
Absent	433	71.0
Present	177	29.0
Diarrhea in the 15 days prior to interview		
Absent	466	70.2
Present	198	29.8

Malnutrition among children under 60 months of age in two cities of the state of Acre, Brazil
Souza, O.F. et al.
215
Rev Bras Epidemiol
2012; 15(1): 211-21

Table 2 - Prevalence (%) and prevalence ratio (PR) of malnutrition among children under 60 months by municipality of residence, socioeconomic conditions, access to services and child care, birth weight and morbidity. Assis Brasil and Acrelândia, AC, 2003.

Tabela 2 – Prevalência (%) e razão de prevalência (RP) da desnutrição em crianças menores de 60 meses segundo município de residência, condições socioeconômicas, acesso aos serviços e cuidado da criança, peso ao nascer e morbidades. Assis Brasil e Acrelândia, AC, 2003.

Variables / Categories	Height-for-age deficit			Weight-for-height deficit		
	%	Crude PR	p	%	Crude PR	p
City						
Assis Brasil	7.6	1	0.202	5.0	1	0.383
Acrelândia	10.8	1.42		3.6	0.71	
Household wealth index						
3rd third (high)	7.0	1	0.017	3.5	1	
2nd third	7.9	1.12		4.2	1.19	
1st third (low)	14.4	2.04		4.0	1.15	0.927
Linear trend p			0.013			0.767
Father's or stepfather's level of literacy						
Literate	8.8	1	0.014	4.3	1	0.630
Illiterate	18.4	2.07		3.0	0.70	
Living with the biological parents						
Living with the biological mother and father	9.4	1	0.047	4.0	1	0.050
Living only with the biological mother	7.9	0.83		1.9	0.48	
Biological mother not living in the home	19.6	2.07		9.8	2.39	
Younger siblings						
No younger sibling	5.6	1	0.000	3.0	1	0.449
1 younger sibling	10.9	1.93		4.4	1.46	
2 or more siblings	20.6	3.65		5.7	1.91	
Linear trend p			0.000			0.202
Open sewage						
Absent	7.3	1	0.000	4.1	1	0.414
Present	18.7	2.57		2.6	0.64	
Water supply						
Public network	9.2	1	0.488	4.7	1	0.195
Other sources (water well, river or dam)	10.8	1.17		2.7	0.57	
Weight at birth						
Higher than 2,500 g	9.1	1	0.078	3.1	1	0.024
Equal to or lower than 2,500 g	16.6	1.81		9.2	2.91	
Anemia						
Absent	8.5	1	0.038	4.6	1	0.495
Present	14.1	1.65		3.3	0.73	
Diarrhea in the 15 days prior to interview						
Absent	11.5	1	0.029	3.8	1	0.684
Present	6.0	0.52		4.5	1.17	

Rev Bras Epidemiol
2012; 15(1): 211-21　216　Malnutrition among children under 60 months of age in two cities of the state of Acre, Brazil
Souza, O.F. et al.

Table 3 - Factors associated with malnutrition in children under 60 months, using hierarchical multiple regression analysis. Assis Brasil and Acrelândia, AC, 2003.

Tabela 3 – Fatores associados à desnutrição em crianças menores de 60 meses obtidos mediante análise múltipla hierarquizada. Assis Brasil and Acrelândia, AC, 2003.

Indicator / Variables / Categories	Adjusted prevalence ratio	(CI95%)	p
Height-for-age deficit			
Household wealth index*			
3rd third (high)	1		
2nd third	1.18	(0.61 ; 2.31)	0.608
1st third (low)	1.74	(0.95 ; 3.18)	0.071
Linear trend p			0.067
Father's or stepfather's level of literacy *			
Literate	1		
Illiterate	1.82	(1.01 ; 3.27)	0.046
Living with the biological parents †			
Living with the biological mother and father	1		
Living only with the biological mother	0.56	(0.24 ; 1.26)	0.165
Biological mother not living in the home	2.63	(1.32 ; 5.24)	0.006
Younger siblings †			
No younger sibling	1		
1 younger sibling	1.69	(0.91 ; 3.12)	0.094
2 or more younger siblings	2.88	(1.45 ; 5.72)	0.003
Linear trend p			0.004
Open sewage †			
Absent	1		
Present	2.46	(1.51 ; 4.00)	0.000
Weight-for-height deficit			
Weight at birth *			
Higher than 2,500 g	1		
Equal to or lower than 2,500 g	2.91	(1.16 ; 7.24)	0.022

* Adjusted for sex and age / *Ajustado para sexo e idade*
† Adjusted for sex, age, wealth index and literacy of the father or stepfather / *Ajustado para sexo, idade, índice de riqueza e alfabetização do pai ou padrasto*

dren whose father or stepfather was illiterate showed a greater magnitude of association with height-for-age deficit, when compared to others whose father or stepfather was literate. The exclusion of "household wealth index" from the multiple model reduced the prevalence ratio of "having a literate father or stepfather" by more than 10%. Thus, "household wealth index" remained in the multiple model as a factor associated with height-for-age deficit. In the block of access to child care and services, the fact of a child living without the biological mother showed double the magnitude of association with the height-for-age deficit. A linear relationship was found between a higher number of younger siblings and height-for-age deficit (linear trend p=0.004). In addition, "home environment being exposed to open sewage" doubled the magnitude of association with height-for-age deficit.

In the hierarchical multiple analysis of

Malnutrition among children under 60 months of age in two cities of the state of Acre, Brazil
Souza, O.F. et al.
217
Rev Bras Epidemiol
2012; 15(1): 211-21

weight-for-height deficit, only the "weight at birth" variable was found to be an associated factor. Low weight at birth was associated with an increase in the prevalence of weight-for-height deficit by approximately three times. After adjustment for sex and age, the prevalence ratio of low weight at birth remained similar to that identified in the crude analysis. "Diarrhea in the 15 days prior to interview" and "anemia" did not remain in the final multiple model for height-for-age deficit, after adjustment of variables from previous blocks, because they did not show statistical significance (p<0.05). In the analysis of weight-for-height deficit, after adjustment for sex and age, "living with the biological parents" and "water supply" did not show statistical significance (p<0.05) and were excluded from the multiple model.

There were no statistically significant differences between cities for the variables investigated, except for "number of younger siblings" (proportion of two or more younger siblings: Acrelândia 16% and Assis Brasil 6.1%, p=0.016) and "water supply" (proportion of homes with public water supply: Acrelândia 54% and Assis Brasil 77%, p=0.000). The inclusion of a city as an adjustment/control variable in all blocks did not change the variables selected in the final model (data not shown).

Discussion

In the present study, the prevalence of height-for-age deficit was an important public health problem in the cities studied, with a general prevalence of 9.9%. Factors associated with height-for-age deficit were as follows: low household wealth index, having an illiterate father or stepfather, biological mother not living in the home, having two or more younger siblings, and being exposed to open sewage in the home environment. With regard to the weight-for-height deficit, with a general prevalence of 4.1%, the only associated factor was "low weight at birth". This is the first investigation conducted in Northern Brazil that estimated nutritional deficits, using the new bench-mark of the WHO's 2006 growth standard. The height-for-age deficit was found to be an important nutritional problem in the cities studied.

Compared to recent information from the 2006 PNDS, the prevalences of nutritional deficits found in the present study were higher than the general Brazilian prevalence of height-for-age deficit (7.0%) and weight-for-height deficit (1.98%) in children younger than 60 months[3]. Vulnerability of children to socioeconomic inequalities and the characteristics inherent in the family structure are important factors associated with child malnutrition in the cities studied.

On the distal level, having an illiterate father or stepfather was associated with height-for-age deficit in the cities studied, corroborating findings from a previous study conducted in Southern Brazil[16]. This association could be the result of the father's or stepfather's limited ability to help the mother with their children's adequate health and food habits, due to the difficulty in understanding the information provided by health services or originated from other sources[17]. Thus, the father's or stepfather's reduced length of time of study can also influence the acquisition of household goods or allocation of income aimed at child care.

The great difference between high-income and low-income families in the cities analyzed, with regard to the prevalence of height-for-age deficit of children, was consistent with national studies[1,18]. Monteiro et al.[1], while analyzing data from the 1996 and 2006-2007 PNDS, observed that the strata with lower per capita household income had a higher prevalence of height-for-age deficit and that an increase in maternal level of education ("proportion of mothers with complete primary education" indicator) and in the purchasing power of poorer families explained 25.7% and 21.7% of the decrease in the prevalence of height-for-age deficit in the country, respectively. Thus, as income is a key aspect for the acquisition of goods and access to services, the high proportion of poverty in the state of Acre can be considered the main determinant of high prevalence of

Rev Bras Epidemiol
2012; 15(1): 211-21 218 Malnutrition among children under 60 months of age in two cities of the state of Acre, Brazil
Souza, O.F. et al.

malnutrition observed in the present study.

With regard to child care, Thomas[19] analyzed data from the 1989 national survey, suggesting that income controlled by mothers had a greater positive effect on the child's height-for-age index, compared to income controlled by fathers. In addition, this author evidenced that mothers allocated more resources to buy foods than fathers. Likewise, couples living in the Northeast region of Brazil also indicated that fathers are responsible for the family's economic issues, whereas food care is attributed to mothers[20]. Considering these circumstances, the fact that the biological mother does not live in the home, as observed in the present study, indicates a vulnerable situation involving the child's inadequate nutritional status.

On the other hand, children from Assis Brasil and Acrelândia who only live with the biological mother did not show statistically different prevalences of nutritional deficits, when compared to children who lived with the biological mother and father. However, the fact of a child only living with the biological mother did not exclude the possibility of their living with the stepfather or other family members. Likewise, Carvalhaes & Benício[21] observed that, in the city of Botucatu, state of São Paulo, 90% of mothers living without a partner resided with other family members. In this sense, living with family members strengthens the social support network for child care[22,23], enabling emotional support and helping with this child care. Moreover, the presence of the mother's partner in the home increases access to household goods and essential services for adequate child nutritional status[21,24,25,26].

Evidence of a higher number of younger siblings being associated with height-for-age deficit suggests an increase in household spending and reduction in time and resources allocated for child care. In this sense, Eastwood & Lipton[27] reported that high fertility has a great impact on household income, especially in families living below the poverty line.

With regard to access to services, the present study revealed that child malnutrition was associated with the presence of open sewage. In 2000, it was estimated that only 34% of homes in the state of Acre were connected to the general water supply network and that 17.6% of homes were connected to the general sanitary sewage network[6]. National data also showed an association between inadequate basic sanitation conditions and child malnutrition[28,29]. On the proximal level, the association between low weight at birth and weight-for-height deficit could reflect the precariousness of health care services for pregnant women in the cities studied. In this sense, according to an observation made during the study in 2003, pregnant women of the cities of Assis Brasil and Acrelândia were treated by only one *Unidade Básica de Saúde* (UBS – Primary Health Unit) in each city studied. Moreover, in this same year, a UNICEF report stated that 20.2% of pregnant women did not have prenatal consultations in the state of Acre[30].

The cross-sectional design of the present study prevented the identification of temporality between independent variables and nutritional deficits. However, information was collected from direct observation and report of a recent occurrence. Thus, it could be inferred that the occurrence of memory bias for the main variables analyzed is unlikely.

In conclusion, results of the present study are expected to contribute to the implementation of public policies aimed at the reduction in malnutrition of children younger than 60 months, in the cities of Acrelândia and Assis Brasil, in the state of Acre.

Malnutrition among children under 60 months of age in two cities of the state of Acre, Brazil
Souza, O.F. et al.

219

Rev Bras Epidemiol
2012; 15(1): 211-21

References

1. Monteiro CA, Benicio MHA, Konno SC, Silva ACF, Lima ALL, Conde WL. Causes for the decline in child under-nutrition in Brazil, 1996-2007. *Rev Saúde Pública* 2009; 43: 35-43.

2. Monteiro CA, Conde WL, Popkin BM. Is obesity replacing or adding to under-nutrition? Evidence from different social classes in Brazil. *Public Health Nutr* 2002; 5: 105-12.

3. Ministério da Saúde. *Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher: 2006*. Brasília; 2008. Disponível em http://www.saude.gov.br/pnds2006 (Acessado em 12 de dezembro de 2008).

4. Instituto de Pesquisa Econômica Aplicada. *Radar Social*. Brasília: Instituto de Pesquisa Econômica Aplicada; 2005.

5. Instituto Brasileiro de Geografia e Estatística. *Pesquisa Nacional por Amostras de Domicílios. Segurança alimentar 2004*. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 2006.

6. Ministério da Saúde. *Saúde Brasil 2004: uma análise da situação de saúde*. Brasília: Ministério da Saúde; 2004.

7. Muniz PT, Castro TG, Araujo TS, Nunes NB, Silva-Nunes M, Hoffmann EH et al. Child health and nutrition in the Western Brazilian Amazon: population-based surveys in two counties in Acre State. *Cad Saúde Pública* 2007; 23: 1283-93.

8. Castro TG, Silva-Nunes M, Conde WL, Muniz PT, Cardoso MA. Anemia e deficiência de ferro em pré-escolares da Amazônia Ocidental brasileira: prevalência e fatores associados. *Cad Saúde Pública* 2011; 27: 131-42.

9. Filmer D, Pritchett LH. Estimating wealth effects without expenditure data-or tear: an application to educational enrolments in states of India. *Demography* 2001; 38: 115-32.

10. World Health Organization. *Iron Deficiency Anaemia: Assessment, Prevention and Control*. Geneva: World Health Organization; 2001.

11. World Health Organization. *Physical Status: The Use and Interpretation of Anthropometric Indicators of Nutritional Status*. Geneva: World Health Organization; 1995. (WHO - Technical Report Series 854).

12. World Health Organization. WHO Multicentre Growth Reference Study Group. *WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age*. Geneva: World Health Organization; 2006.

13. Barros AJD, Hirakata VN. Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. *BMC Med Res Methodol* 2003; 3: 21. Disponível em http://www.biomedcentral.com/1471-2288/3/21 [Acessado em 5 de dezembro de 2008]

14. Victora C, Huttly S, Fuchs S, Olinto M. The role of conceptual frameworks in epidemiological analysis: a hierarchical approach. *Int J Epidemiol* 1997; 26: 224-7.

15. UNICEF. *Situação mundial da criança 1998*. Brasília: UNICEF; 1998.

16. Olinto MT, Victora CG, Barros F, Tomasi E. Determinantes da desnutrição infantil em uma população de baixa renda: um modelo de análise hierarquizado. *Cad Saúde Pública* 1993; 9: 14-27.

17. Mascarenhas MLW, Albernaz EP, Silva MB, Silveira RB. Prevalência de aleitamento materno exclusivo nos 3 primeiros meses de vida e seus determinantes no Sul do Brasil. *J Pediatr* 2006; 82: 289-94.

18. Oliveira VA, Assis AM, Pinheiro SM, Barreto ML. Determinantes dos déficits ponderal e de crescimento linear de crianças menores de dois anos. *Rev Saúde Pública* 2006; 40: 874-82.

19. Thomas D. Incomes, expenditures, and health outcomes: evidence on intrahousehold resourse allocation. In: Haddad L, Hoddinott J, Alderman H, eds. *Intrahousehold resourse allocation in developing countries: models, methods, and policy*. Baltimore, USA: IFPRI; 1997. p. 142-64.

20. Pontes CM, Alexandrino AC, Osório MM. Participação do pai no processo da amamentação: vivências, conhecimentos, comportamentos e sentimentos. *J Pediatr* 2008; 84: 357-64.

21. Carvalhaes MA, Benício MH. Capacidade materna de cuidar e desnutrição infantil. *Rev Saúde Pública* 2002; 36: 188-97.

22. Carvalhaes MA, Benício MH, Barros AJ. Social support and infant malnutrition: a case–control study in an urban area of Southeastern Brazil. *Br J Nutr* 2005; 94: 383–9.

23. Marques ES, Cotta RMM, Magalhães KA, Sant'Ana LFR, Gomes AP, Siqueira-Batista R. A influência da rede social da nutriz no aleitamento materno: o papel estratégico dos familiares e dos profissionais de saúde. *Ciênc Saúde Coletiva* 2010; 15 (S1): 1391-400.

24. Silveira FJF, Lamounier JA. Fatores associados à duração do aleitamento materno em três municípios na região do Alto Jequitinhonha, Minas Gerais, Brasil. *Cad Saúde Pública* 2006; 22: 69-77.

25. Santos Neto ET, Faria CP, Barbosa ML, Oliveira AE, Zandonade E. Association between food consumption in the first months of life and socioeconomic status: a longitudinal study. *Rev Nutr* 2009; 22: 675-85.

26. Molina MCB, Lopéz PM, Faria CP, Cade NV, Zandonade E. Preditores socioeconômicos da qualidade da alimentação de crianças. *Rev Saúde Pública* 2010; 44: 785-32.

Rev Bras Epidemiol
2012; 15(1): 211-21 | 220 | Malnutrition among children under 60 months of age in two cities of the state of Acre, Brazil
Souza, O.F. et al.

27. Eastwood R, Lipton M. The impact of changes in human fertility on poverty. *J Dev Stud* 1999; 36: 1-30.

28. Monteiro CA, Conde WL. Tendência secular da desnutrição e da obesidade na infância na cidade de São Paulo (1974-1996). *Rev Saúde Pública* 2000; 34: 52-61.

29. Rissin A, Batista-Filho M, Benício MH, Figueiroa JN. Condições de moradia como preditores de riscos nutricionais em crianças de Pernambuco, Brasil. *Rev Bras Saúde Matern Infant* 2006; 6: 59-67.

30. UNICEF. Ser criança na Amazônia. Belém; 2004. Disponível em http://www.unicef.org/ brazil/pt/ser_crianca_amazonia.pdf (Acessado em 12 de dezembro de 2008).

Malnutrition among children under 60 months of age in two cities of the state of Acre, Brazil
Souza, O.F. et al.
221
Rev Bras Epidemiol
2012; 15(1): 211-21