



## Child health: risk factors applied in programs of primary health care\*

*Saúde da criança: fatores de risco aplicados em programas de atenção básica à saúde*

*Salud del niño: factores de riesgo aplicados en programas de atención básica a la salud*

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### ABSTRACT

**Objective:** To compare the frequency of risk factors in children attending basic health units (UBS) in two periods (1988-1989 and 2005-2006) and to analyze the association of these factors with malnutrition, hospitalization and death. **Methods:** A retrospective study using a quantitative approach with a random cohort sample (n = 414) of children under one year of age, enrolled in two UBS of Embu (SP) in 2005-2006. Independent variables: high risk and presence of risk factors. Outcomes: unfavorable weight gain, malnutrition, hospitalization and death. Statistics: Chi-square and Odds Ratio. **Results:** In 2005-2006, we found: a higher frequency of neonatal complications and adolescent mothers; lower rates of malnutrition or death of a sibling <5 years; unfavorable weight gain (1.6%); nutritional deficit (2.9%); BMI  $\geq 2z$  (17.9%); hospitalizations (21.8%); no deaths. Low birth weight was associated with hospitalization (OR = 4.04, 95% : 1,35-12, 04). **Conclusions:** Low birth weight remains an important risk factor and the proportion of overweight / obesity indicates a need for redirection of child health activities.

**Keywords:** Child health (Public health); Epidemiology; Primary health care; Risk factors

### RESUMO

**Objetivo:** comparar as frequências dos fatores de risco em crianças matriculadas em unidades básicas de saúde (UBS) em dois períodos (1988-1989 e 2005-2006) e analisar a associação desses fatores com desnutrição, internação e óbito. **Métodos:** Estudo de abordagem quantitativa, tipo coorte retrospectiva com amostra probabilística (n=414) de crianças menores de um ano matriculadas em duas UBSs do Embu (SP), em 2005-2006. Variáveis independentes: alto risco e presença de fatores de risco. Desfechos: evolução ponderal desfavorável, déficit nutricional, internação, óbito. Estatística: Qui-Quadrado e Odds Ratio. **Resultados:** em 2005-2006, verificou-se: maior frequência de intercorrências neonatais e mães adolescentes; menor frequência de desnutrição ou óbito de irmão < 5 anos; evolução ponderal desfavorável (1,6%); déficit nutricional (2,9%); IMC  $\geq 2z$  (17,9%); internações (21,8%); nenhum óbito. Baixo peso ao nascer associou-se à internação (OR=4,04;IC95%:1,35-12,04). **Conclusões:** Baixo peso ao nascer permanece, como importante fator de risco e a proporção de sobrepeso/obesidade indica necessidade de redirecionamento das ações de saúde da criança.

**Descritores:** Saúde da criança; Epidemiologia; Atenção primária à saúde; Fatores de risco

### RESUMEN

**Objetivo:** comparar las frecuencias de los factores de riesgo en niños matriculados en unidades básicas de salud (UBS) en dos períodos (1988-1989 y 2005-2006) y analizar la asociación de esos factores con desnutrición, internamiento y óbito. **Métodos:** Estudio de abordaje cuantitativo, tipo cohorte retrospectivo con muestra probabilística (n=414) de niños menores de un año matriculados en dos UBSs de Embu (SP), en 2005-2006. Las variables independientes: alto riesgo y presencia de factores de riesgo. Desenlace: evolución ponderal desfavorable, déficit nutricional, internamiento, óbito. Estadística: Chi-Cuadrado y Odds Ratio. **Resultados:** en 2005-2006, se verificó: mayor frecuencia de variaciones neonatales y madres adolescentes; menor frecuencia de desnutrición u óbito de hermano < 5 años; evolución ponderal desfavorable (1,6%); déficit nutricional (2,9%); IMC  $\geq 2z$  (17,9%); internamientos (21,8%); ningún óbito. Bajo peso al nacer se asoció al internamiento (OR=4,04;IC95%:1,35-12,04). **Conclusiones:** Bajo peso al nacer permanece, como un importante factor de riesgo y la proporción de sobrepeso/obesidad indica la necesidad de redireccionamiento de las acciones de salud del niño.

**Descriptores:** Salud del niño; Epidemiología; Atención primaria de salud; Factores de riesgo

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## INTRODUCTION

The application of risk factors to healthcare programs might contribute to the identification of more patently vulnerable population groups and segments to increase the effectiveness of assistance by considering inequalities and differentiated needs<sup>(1)</sup>. Risk is defined as higher odds for an individual or a group of people suffering from some alteration in their state of health in the future, whereas risk factors are the personal, environmental, and social traits or circumstances associated with such increased odds<sup>(2)</sup>. However, it must be emphasized that risk factors do not imply causality. In regard to children's health in particular, their socioeconomic level, basic sanitation conditions, level of schooling of the parents, birth weight, gestational age, neonatal problems, breastfeeding, and access to healthcare services, among other factors, have been widely studied, and their associations with child morbidity and mortality have been well established<sup>(3-5)</sup>.

The establishment of risk factors in healthcare programs depends on the previous definitions of the problems that such programs will address. The criteria used to select risk factors include: their capacity to distinguish among population groups, the level of understanding of the professionals who will apply them, clarity and objectivity, and feasibility in the identification and recording of such factors so as not to interfere with healthcare service routines.

Based on the notions described above, after long debates among healthcare providers and managers, in 1988, the Program for Children's Integral Health Care (Programa de Atenção Integral à Saúde da Criança) in the Embu Municipality (São Paulo, Brazil) included risk factors in the definitions of two assistance models for high- (HR) and low-risk (LR) children that schedule medical and nursing appointments for children younger than two years old. In 1991, a study<sup>(6)</sup> was performed to analyze the frequencies of and the associations between such risk factors and the occurrence of malnutrition, hospitalizations, and deaths among the children included in the Program. The results of this study and the features related to the human and infrastructure resources available at the local healthcare services were used to redefine the risk factors to be considered, the schedule of visits for LR and HR children, and novel activities aimed at offering integral health care. It is worth noting that at the time of the initial study, the municipality did not have a hospital or a maternity facility; thus, births occurred in several other municipalities in the São Paulo metropolitan area.

Due to changes in the country as a whole and also in Embu Municipality regarding epidemiological profiles, access to and qualification of healthcare services, and,

more particularly, the establishment of a hospital and the expansion of the basic healthcare network, this study sought to describe the current incidence frequencies of the abovementioned risk factors in children registered with the Basic Healthcare Units (Unidades Básicas de Saúde – BHUs) and to analyze the associations of such risk factors with malnutrition in children younger than 16 months old, in addition to rates of hospitalization and mortality in the first year of life, to contribute to updating and optimizing the Program for Children's Integral Healthcare.

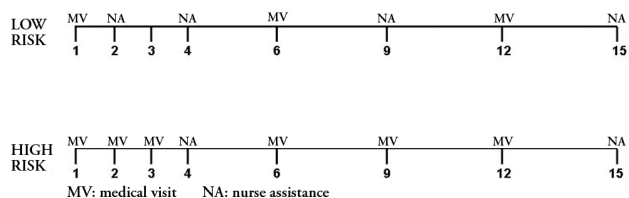
## METHODS

Embu Municipality is located in the Southwestern area of the São Paulo metropolitan area and is 27 km away from the downtown area of the state capital. In 2007, when this study was performed, the population of Embu consisted of 249,777 inhabitants, its Human Development Index (HDI) was 0.772 (lower than the average 0.814 in the State of São Paulo), and the child mortality rate was 12.0/1,000 live births, which was mainly due to perinatal infections, followed by congenital malformations and respiratory disorders<sup>(7)</sup>. That year, the municipal healthcare network consisted of 13 UBSs, two emergency rooms, one maternity facility (low- and medium-risk pregnancies/deliveries), medical specialties and mental health outpatient clinics, and one 250-bed regional hospital where high-risk pregnancies/deliveries were assisted. In addition, since the 1960s, the Federal University of São Paulo (Universidade Federal de São Paulo - Unifesp) has performed various assistance, teaching, research, and continued education activities and has participated in the planning of healthcare actions together with the municipal managers<sup>(8)</sup>.

### The Program for Children's Integral Health Care and the 1991 study

The 1991 study analyzed a random sample consisting of 25% of the children registered at six UBSs (1,094 children) between July 1988 and July 1989; out of a total of eight units, the six investigated UBSs covered a geographical area encompassing approximately 95% of the population. The main results of this study showed that 40% of children were classified as HR, the most frequent birth weight range was under 2,750 g (Table 1), and malnutrition and/or hospitalization was associated with the following risk factors: prematurity, severe neonatal problems, death of a sibling before five years of age, birth weight between 2,500 and 2,750 g, and maternal age equal to or younger than 18 years old<sup>(9)</sup>. These data were used to reformulate the Program enacted until the time when this study was performed, and the results are described below.

Approximately 80% of deliveries performed within the Unified Health System (Sistema Único de Saúde - SUS) now occur in the municipality at a regional hospital and a maternity facility that opened in 1999 and 2004, respectively. Upon the discharge of infants, their first medical visit is scheduled at the UBS closest to their home; approximately 80% of children younger than one year old are registered at UBSs. Upon their first medical visit (MV), children exhibiting any of the following are classified as HR: birth weight less than 2,750 g, maternal age less than 18 years old, one sibling death before five years of age, one sibling younger than five years old diagnosed with malnutrition, and severe neonatal problems. The interval between the scheduled visits is shorter for such children compared to LR children (Figure 1), and the HR qualification is considered each time such children visit the UBS for any reason. After age 15 months, the mothers are instructed to make routine appointments every six months or whenever they are judged necessary (later, the Program was extended to 18 months). This basic schedule is complemented by several other activities performed at UBSs: medical assistance at non-scheduled visits<sup>(9)</sup>, assistance programs for children with bronchial asthma and/or recurrent wheezing<sup>(10)</sup>, outpatient assistance for children with learning disabilities, and Project Development (Projeto Desenvolver) for children at risk of or with established developmental delays<sup>(11)</sup>.



**Figure 1.** Schedule of visits. Surveillance of growth and development. Health Secretary of Embu.

### The present study

This was a retrospective cohort study to assess the association between risk factors and weight progression, hospitalizations, and mortality in the first year of life. This was also a cross-sectional analytic study to compare the frequencies of risk factors between 1988-1989 and 2005-2006 and to analyze the associations between risk factors and nutritional status at ages 12-16 months old.

The study population and sample consisted of children younger than one year old registered between July 1, 2005, and June 30, 2006, at Santo Eduardo and Santa Emília UBSs. These two UBSs were chosen among the six investigated in the previous study because they kept the same areas of coverage that included approximately 40,000 residents each. During the investigated

period, 588 and 508 children younger than one year old registered at Santo Eduardo and Santa Emília UBSs, respectively. To calculate the sample size, Epi-info software (version 6.01)<sup>(12)</sup> was used, considering the lowest frequency of each risk factor identified in the previous study (7.2%) and a 95% confidence interval. The samples were calculated as consisting of 238 and 224 children from each UBS, respectively; 250 children were established in both. Simple random sampling was performed based on the filing numbers from clinical records. A group of 21 (4.2%) children were excluded because the clinical records could not be located, and a further 65 (13.0%) children were excluded because the first visit form (which defined the risk factors) had not been completed. Thus, the final sample consisted of 414 (82.8%) children: 205 (82.0%) from Santo Eduardo UBS and 209 (83.6%) from Santa Emília UBS.

#### Independent variables

- Risk classification: high risk (HR), low risk (LR).
- Risk factors: birth weight less than 2,750 g, gestational age less than 38 weeks, maternal age < 18 years old, death of a sibling aged less than five years old, malnourished sibling, and neonatal problems.

#### Dependent variables

- Malnutrition/nutritional state: two criteria were used. 1) Favorable or unfavorable weight progression was assessed by means of a graphic curve during the first year of life for children attending three or more visits. For favorable progression, the curve for the child fell above the 2.5 percentile, steadily ascending and parallel to the median. For unfavorable progression, the child had a descending curve diverging from the median or steadily below the 2.5 percentile. 2) Nutritional status at age 12-16 months old (this age range encompassed the last scheduled medical and nursing visits) was assessed by means of anthropometric indices: weight-for-age (W/A), height-for-age (H/A), weight-for-height (W/H), and Body Mass Index (BMI) according to the charts provided by the World Health Organization (WHO) (WHO, 2006)<sup>(13)</sup>. These measures were expressed as z-scores; measures less than two standard deviations from the mean were considered to be anthropometric deficits<sup>(14)</sup>.
- Morbidity: number of hospitalizations during the first year of life registered in each child's clinical records and complemented by information supplied by mothers or caretakers in up to three attempts at telephone contact or domiciliary visits to families without a telephone line. For the purposes of this study, only hospital admissions after the post-neonatal period were

considered to be hospitalizations; thus, admissions to the neonatal unit for more than six hours during the first year of life were excluded.

- Mortality: data were collected at the County's Committee for Child Mortality in the case of children who left the Program before age one year old.

Statistical analysis: Excel and Epi-Info 6 (version 6.01)<sup>6</sup> software were used. The chi-squared test and odds ratios (ORs) were used to compare categorical variables (EPINFO 6.01 Epi-Info) at a 5% level of significance ( $\mu = 0.05$ ).

This study was approved by the Research Ethics Committee of the Federal University of São Paulo (Ruling 1.287/07) and the Health Secretary of Embu Municipality.

## RESULTS

A total of 586 (53.9%) children younger than three months old were registered at the two investigated UBSs in 1988-1989, and 381 (92.0%) were registered in 2005-2006, from which 316 (82.9%) were younger than one month old; these results reflect the current integration between the maternity service and the primary health care network.

Table 1 describes the distribution of children according to classification of risk and the corresponding data from the same UBSs collected in the 1991 study. The frequency of risk factors was compared to the full set of six units investigated in 1991 (there are no data available for each individual UBS). The comparison reveals remarkable increases in the numbers of children,

mothers younger than 18 years old, and neonatal problems, and significant decreases in the factors deceased sibling younger than five years old and malnourished sibling; it is worth noting that no instance of the latter factor was reported in any clinical record. Birth weight less than 2,750 g did not exhibit a statistically significant difference; however, the number of children with low birth weight (< 2,500 g) decreased from 13.6% to 8.7% ( $p = 0.03$ ) among the registered population.

The weight progression was favorable in 306 (73.9%) children in 98.4%; only five children exhibited unfavorable progression. From the 207 (50.0%) children who remained in the Program until age 12-16 months old, only six (2.9%) exhibited any nutritional deficit (H/A or W/A indices). No child exhibited a deficit in the W/A index. Therefore, it was not possible to analyze the associations of such variables with the risk factors. It is worth noting that 17.9% of children exhibited BMI z-scores > 2 for age and gender.

Regarding hospital admissions, information was collected from 197 (47.6%) children (via clinical records, telephone contacts, and domiciliary visits). Of these, 42 (21.8%) children had been hospitalized during the first year of life, excluding the neonatal period; 34 (81%) had one hospital admission, five (11.9%) had two, and three (7.1%) had three or more; 50% of admissions were due to acute respiratory disorders – pneumonia/bronchopneumonia (40.0%), bronchiolitis (6.7%), and bronchitis (3.3%) – followed by surgical procedures (10%). Except for four children who were diagnosed

**Table 1.** Distribution of children according to risk level (HR and LR) and factors. Embu (SP), 1988-1989 and 2005-2006.

	1988/1989 - n <sup>o</sup> = 329		2005/2006 - n <sup>o</sup> = 414		P value
	n <sup>o</sup>	(%)	n <sup>o</sup>	(%)	
<b>Risk classification*</b>					0.99
High Risk	114	(34.6)	142	(34.3)	
Low Risk	211	(64.1)	263	(63.5)	
Disease	4	(1.2)	9	(2.2)	
<b>Risk factors**</b>					
Birth weight < 2,750 g	214	(49.6)	66	(46.5)	0.47
Maternal age < 18 years old	90	(20.8)	46	(32.4)	0.006
Death of sibling < 5 years old	78	(18.1)	13	(4.8)	0.01
Loss of family structure #	72	(16.7)	-	(-)	
Prematurity #	35	(8.1)	-	(-)	
Other	32	(7.4)	7	(2.6)	0.30
Neonatal problems	31	(7.2)	65	(45.8)	<0.001
Twins #	18	(4.2)	-	(-)	
Malnourished sibling	16	(3.7)	0	(0.0)	<0.001

\* comparison between Santo Eduardo and Santa Emília UBSs in 1988-9 and 2005-6

\*\* comparison between Santo Eduardo and Santa Emília UBSs in 2005-6 and six UBSs in 1988-9

# factors not included in this study



as ill at the first medical visit, although hospitalizations were more frequent among the HR population (26.6%), the difference was not statistically significant (Table 2). Table 2 also describes the analysis of each risk factor; an association was only detected for birth weight < 2,500 g (low birth weight). According to the data supplied by the County's Committee of Child Mortality, no child included in this study died during the first year of life.

**Table 2.** Hospital admissions during the 1<sup>st</sup> year of life according to risk level and factors. Embu, 2005-2006, n= 42.

Risk Classification	n <sup>a</sup>	(%)	OR	95% CI	P value
High Risk	17	(26.6)	1.74	0.78-3.85	0.132
Risk Criteria	n <sup>a</sup>	(%)	OR	95% CI	P value
Birth weight < 2,750 g	10	(32.6)	1.77	0.96 – 3.27	0.07
Birth weight < 2,500 g	09	(47.4)	4.04	1.35-12.04	0.003
Adolescent mother	07	(35.0)	1.86	0.95 – 3.66	0.09
Death of sibling < 5 years old	01	(25.0)	1.22	0.22 – 6.84	0.82
Neonatal problems	08	(25.0)	1.28	0.65 – 2.53	0.48
Other	00	(0.0)	0.00	0.00-16.57	0.47

## DISCUSSION

Although this study had some limitations because its geographical scope was not the same as in the 1991 study and because of its losses to follow-up typical of healthcare service cohorts, its results are relevant and might serve to optimize healthcare actions in the investigated municipality. It is worth noting that in 1991, no differences were identified in the frequencies of risk factors among all six of the investigated UBSs.

The results of this study show that the frequencies of children classified as HR and LR did not change between the two investigated timepoints; however, neonatal problems exhibited an important increase, likely due to modifications in perinatal assistance conditions and increased survival of premature and/or severely ill newborns. This hypothesis is strengthened by the fact that birth weight < 2,750 g remained the most frequent factor. Conversely, analysis of the low birth weight frequency reveals a decrease among the children registered at the two investigated UBSs. Nevertheless, it is worth noting that in 1995, Project Development was launched<sup>(11)</sup>, and children exhibiting risk factors for developmental delays, including birth weight < 1,500 g, are referred to this Program straight from maternity. This fact might have interfered with the frequency of low birth weight children registered at the investigated UBSs because the Municipality data for this same period were 9.9% and 9.0% greater in 2005 and 2006, respectively<sup>(7)</sup>. Stagnation and even increase in the rate of low birth weight in areas with a satisfactory socioeconomic

level<sup>(15-16)</sup> are attributed to countless factors, particularly: better prenatal control and diagnosis of risk situations, with a consequent increase in the rate of premature births; better technological support in neonatology services, with increased survival of premature infants; older average age of mothers, especially among population segments with higher incomes and better schooling, and a consequent increase in complications during pregnancy. In Brazil and other developing countries<sup>(16)</sup>, the use of technology may partially explain such increased rates; in fact, low birth weight is rated a complex indicator comprising a heterogeneous group of newborn infants that exhibits no linear associations with income and/or access to and quality of healthcare services. The persistence of the association between hospitalizations and low birth weight identified in this study shows that this indicator remains a warning signal in children's healthcare.

The increase in the frequency of adolescent mothers in the investigated period (from 20.8% to 32.4%) is also relevant; in fact, this increase is even more significant when one considers that the 1991 study defined this variable as age equal to or lower than 18 years old, whereas in this study, it was exclusively defined as lower than 18 years old. In Brazil, the rate of births in this age range (< 18 years old) increased from 13.3% to 17.3% between 1980 and 1992; the progression then slowed until 2001 (22.5%) and remains at this level with small variations (21.0% in 2004)<sup>(7)</sup>. According to the SEADE Foundation (State System of Data Analysis/Sistema Estadual de Análise de Dados) (2010)<sup>(7)</sup>, in 2005 and 2006, the percentages of mothers younger than 18 years old in Embu Municipality were 8.3% and 7.1%, respectively. This difference regarding the data collected in this study is possibly due to the social characteristics of the areas covered by the two investigated UBSs. In 1988-1989, the maternal age risk factor did not exhibit associations with malnutrition or hospitalizations; nevertheless, it was maintained in the Program as a warning signal for healthcare providers to pay special attention to adolescent mothers. This indicator also did not exhibit an association with hospitalizations in 2005-2006. The studies on adolescent pregnancy present conflicting results, and most authors believe that it is difficult to attribute biological risk to age alone because other factors associated with age are determinants of risk<sup>(17,18)</sup>.

The death of a sibling younger than five years old and malnourished sibling risk factors were significantly reduced; this finding was expected as a function of the known progression of these indicators in Brazil as a whole and in Embu. In 1988 and 1989, the mortality rates in Embu were 56.3 and 43.8/1,000 live births, respectively; in 2005 and 2006, the rates were 15.2 and 11.2/1,000 live births, respectively<sup>(7)</sup>. Regarding malnutrition in this municipality, population-based surveys of

schoolchildren revealed a reduction in malnutrition and increases in overweight and obesity<sup>(19,20)</sup>. The results of this study on weight progression (more than 98% of children exhibited favorable progression, and 17.9% exhibited overweight/obesity) confirmed this tendency. This phenomenon, known as nutritional transition<sup>(21)</sup>, has been well documented in Brazil and was further confirmed in this study; this finding shows that malnutrition and growth deficit during childhood, especially in urban areas, must call attention to the presence of dysmorphic syndromes and chronic diseases in addition to conditions of severe loss of family structure. Regarding the frequency of overweight/obesity in the first year of life, this study emphasized the need to identify family histories of obesity, metabolic syndrome, and cardiovascular disease (CVD)<sup>(20-22)</sup> due to the importance of prevention and early diagnosis of overweight in children. Nevertheless, the complexity of the factors involved requires multiple actions, thus strengthening the importance of multi-professional and multi-sector actions in the assistance of affected children.

Hospital admissions during the first year of life, although not statistically significant, were more frequent in the group of children classified as HR, whereas respiratory infections in the post-natal period represent a category of diseases requiring special attention and care by healthcare services<sup>(4,9)</sup>. The role of primary health care in the response to spontaneous demand is once again emphasized regarding better conditions for receiving patients and their families, establishing sound relation-

ships with these individuals, and ensuring continuity of healthcare. These occasions are opportunities not only to treat acute affections that might become severe but also to establish a channel favoring the assistance and follow-up of chronic conditions<sup>(9,23)</sup>.

## CONCLUSION

The frequency of risk factors exhibited important changes, particularly regarding increases in neonatal problems and mothers younger than 18 years old and a reduction in nutritional deficits. No deaths occurred among the children included in this study. Low birth weight was the only factor that exhibited an association with hospitalizations during the first year of life, thus confirming the importance of this indicator in planning healthcare actions. The results of this study represented an important contribution for the reformulation of the Program in 2010, which involved a wide-scoped discussion among the team from the Federal University of São Paulo, healthcare providers affiliated with the Program for Children, and the county's managers to define changes regarding risk factors, schedules, and healthcare actions.

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