

At-risk infants: monitoring children's growth in the first year of life**Bebê de risco: acompanhando o crescimento infantil no primeiro ano de vida**Bebé de riesgo: acompañando el crecimiento infantil en el primer año de vida***Anelize Helena Sassá¹, Ieda Harumi Higarashi², Luciana Olga Bercini³, Débora Cristina de Arruda⁴, Sonia Silva Marcon⁵****ABSTRACT**

Objective: To monitor the growth of high-risk babies in the first year of life. **Methods:** Analytical, cohort study, conducted with 237 babies born in Maringá - PR, between May 1 to October 31, 2008, under the Program for the Surveillance of At-Risk Infants. **Results:** Growth changes were present in 188 (79.3%) infants and occurred mainly after the first trimester of life. A slower than expected growth rate showed statistical association with maternal age of less than 18 years, education of less than 8 years, presence of congenital anomalies, and birth weight greater than or equal to 2,500g born at term. **Conclusion:** The evaluation of growth in at-risk infants should include a multidimensional analysis, considering the biological and maturational aspects of each specific risk condition, and adaptation of the baby and his/her family on this evolutionary path.

Keywords: Maternal-child nursing; Child health; Growth; Risk factors

RESUMO

Objetivo: Acompanhar o crescimento de bebês de risco no primeiro ano de vida. **Métodos:** Estudo analítico, do tipo coorte, realizado com 237 bebês nascidos em Maringá - PR, entre 1º de maio a 31 de outubro de 2008, incluídos no Programa de Vigilância do Bebê de Risco. **Resultados:** As alterações de crescimento estiveram presentes em 188 (79,3%) bebês e ocorreram sobretudo, após o 1º trimestre de vida. A velocidade de crescimento abaixo da esperada apresentou associação estatística com idade materna menor que 18 anos, tempo de estudo inferior a 8 anos, presença de anomalia congênita, peso ao nascer maior ou igual a 2.500g e nascimento a termo. **Conclusão:** A avaliação do crescimento dos bebês de risco deve abarcar uma análise multidimensional, considerando os aspectos biológicos e maturacionais específicos a cada condição de risco e a adaptação do bebê e de sua família nesse percurso evolutivo.

Descritores: Enfermagem materno-infantil; Saúde da criança; Crescimento; Fatores de risco

RESUMEN

Objetivo: Acompañar el crecimiento de bebés de riesgo en el primer año de vida. **Métodos:** Se trata de un estudio analítico, de tipo cohorte, realizado con 237 bebés nacidos en Maringá - PR, entre el 1º de mayo al 31 de octubre del 2008, incluídos en el Programa de Vigilancia del Bebê de Riesgo. **Resultados:** Las alteraciones de crecimiento estuvieron presentes en 188 (79,3%) bebés y ocurrieron sobre todo, después del 1º trimestre de vida. La velocidad de crecimiento debajo de la esperada presentó asociación estadística con edad materna menor de 18 años, tiempo de estudio inferior a 8 años, presencia de anomalia congénita, peso al nacer mayor o igual a 2.500 gr. y nacimiento a término. **Conclusión:** La evaluación del crecimiento de los bebés de riesgo debe abarcar un análisis multidimensional, considerando los aspectos biológicos y de madurez específicos a cada condición de riesgo y la adaptación del bebé y su familia en ese recorrido evolutivo.

Descritores: Enfermería materno-infantil; Salud del niño; Crecimiento; Factores de riesgo

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INTRODUCTION

Human growth is characterized by the multiplication and enlarging of cells, expressed through body growth. This is a continuous biological process that presents specific characteristics in different stages of life⁽¹⁾, and is influenced by intrinsic (genetic) and extrinsic (environmental) factors, that either accelerate or slow down the process. Therefore, every person is born with the genetic potential for growth, that might or might not be reached, depending on one's life conditions from conception to adulthood⁽²⁾. The early identification of factors that might interfere in this process are indispensable for children, so as to minimize future repercussions to health⁽¹⁾.

The method used by healthcare professionals to assess children's growth is based on anthropometric parameters, weight measurement and registration, height and head circumference (HC)⁽³⁾. Following up on this variables helps identify children with higher morbidity and mortality risks, so as to promote and protect health through diagnosing and treating nutritional alterations⁽⁴⁾.

Weight is the easiest measurement to obtain, as well as the most affected by acute variations in the nutritional state, and the first to be impacted. Weight should be considered from the intrauterine life, as a parameter to diagnose fetal growth and development alterations⁽⁵⁾. Height is a more stable indicator, presenting alterations in case of chronic malnutrition processes⁽⁶⁾. Finally, HC is the brain growth indicator, used as a reference to diagnose abnormalities that might compromise children's neurological and cognitive development.

The Ministry of Health (MH) considers as high-risk infants those presenting at least one of the following criteria: to live in a high-risk area; Low birth weight – LBW (<2500g); newborn (NB) with less than 37 weeks of pregnancy; serious asphyxia (Apgar < 7 in the 5th minute of life); admission or complications at the maternity hospital or at the healthcare unit where the infant received care; to be the child of an adolescent mother (< 18 years old); to be the child of a mother with few years of education (< 8 years of studies); and to have history of infant death of < 5 years old in the family⁽⁶⁾.

Because of the complications that come with the high-risk classification, these children have higher chances of presenting growth and neuropsychomotor development alterations along the first years of life, which might result in childhood health problems that can continue throughout adolescence and even adulthood⁽⁷⁾.

Considering such fact, follow up and early intervention with regard to high-risk infants' complications will favour conditions for individuals to grow and develop as well as possible, besides providing

support and technical support to families, so that it is ready to care for the infant⁽⁸⁾.

Based on the above exposed, the present study aimed to follow up on the growth of high-risk infants, who were part of the Programa de Vigilância do Bebê de Risco do Município de Maringá – PR (High-risk Infant Healthcare Program of Maringá – PR), during the first year of life.

METHODS

This is a cohort analytical study, performed with infants who were born in Maringá – PR, from the 1st of May to the 31st of October 2008, and were included in the Programa de Vigilância do Bebê de Risco – PVBR (High-risk Infant Healthcare Program) of the city.

The city of Maringá has 308 thousand inhabitants, and the number of live births from resident mothers went down from 4,521, in 2000, to 4,177, in 2007. On the other hand, the percentage of children born with low weight – less than 2.500 grams – went from 7.27%, in 2000, to 8.76%, in 2007, and the number of children included in the PVBR went from 616, in 2003, to 800, in 2008⁽⁹⁾.

The PVBR has been part of the city's health system since the year 2000, and its purpose is to follow up on all infants who present diversified high-risk factors, such as: Low birth weight (LWB < 2.500g), Apgar score lower than or equal to seven on the 5th minute of life, preterm birth (pregnancy of less than 37 weeks), mother with less than 18 years old, abnormalities present, and /or other criteria that include, for instance, child of an HIV positive mother, family's socioeconomic condition, and/or mother with a drug addiction.

The Epidemiologic Surveillance team of the city's Health Department visits all hospitals daily to fill out forms for the live births. When an infant is born with one or more high-risk criteria, it is included in the PVBR during the hospital admission, and an admission file is filled out with two copies. One of these files is kept in the Surveillance Sector and the other is forwarded to a Basic Health Unit, according to the family's address, so that the infant's growth and development are assessed monthly, for 12 months. Studies have shown low PVBR effectiveness, with a number of appointments below the recommended number by the city's Health Department, and mothers who did not even know what the program is, or how it works⁽¹⁰⁾.

During the period infants were included in the study, files kept in the Surveillance Sector were weekly photocopied, and based on the information from the files, telephone calls were made, or home visits (HV) took place, aiming to talk to mothers and invite them to participate in the research.

The high-risk infant whose family accepted to participate was followed up to the 12th month of life, through HV from the nursing team, professors and students (undergraduates and graduates) of the Nursing Department of the Universidade Estadual de Maringá. For the HV to be systematized, teams attended training and qualification workshops, and families were always visited by the same team.

The HV took place in six different moments: on the 15th and 45th days of life, and in the 3rd, 6th, 9th, and 12th months of life. When infants were admitted to the hospital for more than 30 days after birth, due to extreme preterm birth or very low weight, the HV took place after the hospital release, since it is common for such children to be hospitalized for long periods of time.

During each HV, mothers were interviewed through a mixed questionnaire, with questions regarding the family, the mother, and the infant. Besides the interview, infants went through physical and anthropometric exams, weight, height, and head circumference (HC) measurements. In order to measure weight, an electronic digital scale, from Filizola, with 5 grams precision, was used. To measure height, a horizontal wooden anthropometer was used, and to measure the HC, an inelastic measure tape was used, both with 0.1cm scales. According to the study objectives, data concerning the infants and mothers characterization, as well as data related to the anthropometric measurements were used.

Because the objective of the present study was to follow up on growth, and not to provide a nutritional diagnosis, infants' growth was analysed through growth speed (GS). The GS follow up is more effective than the simple correlation among growth criteria and standards, because they are based on a sample from which measurements are taken for comparison, and therefore, the individual factors implicated are not considered⁽¹¹⁻¹²⁾. Speed means space divided by time. Thus, to measure the weighed GS gains, a calculation was performed: weight measurement from the immediately previous visit was subtracted from the current visit measurement, divided by the interval between visit days. To assess linear and head circumference growth, GS was calculated based on the subtraction of values from the current and previous visits, divided by the visit interval in months. The equations used for the GS calculations are described below:

$$\text{GS weight(g/day)} = \frac{\text{weight visit current(g)} - \text{weight immediately previous visit(g)}}{\text{Day interval between visit}}$$

$$\text{GS linear(cm/month)} = \frac{\text{height visit current(cm)} - \text{height immediately previous visit(cm)}}{\text{Day interval between visit}/30}$$

$$\text{GS cefálico(cm/month)} = \frac{\text{HC visit current(cm)} - \text{HC immediately previous visit(cm)}}{\text{Day interval between visit}/30}$$

In order to calculate GS in the first quarter, birth

anthropometric data were used as a reference.

To facilitate the description and understanding of the findings, values obtained were categorized according to what was expected for each quarter and semester of the infant's first year of life. Therefore, the weighed growth was assessed through the daily weight gain, considering what is expected for the 1st and 2nd quarters (23g/day - 700g/month and 20g/day - 600g/month, respectively), and for the 2nd semester (15g/day - 450g/month)⁽¹³⁾. The linear growth assessment was calculated based on the height monthly growth, considering what is expected for the 1st quarter (3cm/month), for the 2nd quarter (2cm/month), and for the 2nd semester (1cm/month)⁽¹³⁾. In order to analyse the head circumference growth, the expected HC growth for the first quarter (2cm/month), 2nd quarter (1cm/month), and 2nd semester (0.5cm/month) were considered⁽¹¹⁾.

The birth weight was classified according to the World Health Organization document⁽¹⁴⁾ that considers: extremely low weight (less than 1.000g), very low weight (1.000 - 1.499g), low weight (1.500 - 2.499g), insufficient weight (2.500 - 2.999g), satisfactory weight (3.000g - 3.999g), and excessive weight (above 4000g).

Data collected and results obtained through the calculations were categorized and entered in a database of the program *Microsoft Excel* 2003. The descriptive analysis used simple frequency and proportions. The statistic association was verified through the Chi-Square test, whose significance levels considered were $p < 0.05$, with a confidence interval of 95%.

The dependent variable was the growth speed in the 1st and 2nd quarters and in the 2nd semester, based on weight gain (g/day), linear growth (cm/month) and head circumference growth (cm/month).

The independent variables studied were: mother's age and education, NB gender, pregnancy weight and age at birth, and which high-risk criteria infants carried.

The study was developed in compliance with the guidelines determined by Resolution n.º 196/96, from the Conselho Nacional de Saúde⁽¹⁵⁾ (National Health Council), and the research project was approved by the Permanent Human Being Research Ethics Committee of the Universidade Estadual de Maringá, according to the Legal Opinion n.º 451/2008. Only infants whose mothers signed the Informed Consent Term authorizing information disclosure for research purposes participated in the present study.

RESULTS

In the studied period, 387 high-risk infants were born in Maringá - PR. From this group, 237 participated in the study, and the excluded cases were families who did not accept participating in the research (40), those with

wrong addresses (7), families who had moved to other cities/towns after the infant's birth (86), and those whose infant had died (17).

From the total number of infants, 125 (52.7%) were females. As to the criteria which determined the NB was a high-risk infant, it is worth highlighting that, several times, one or more criteria were connected, and the association between Low birth weight and prematurity presented the highest percentage (27%). Following such association, there were: mother below 18 years old (25.4%), prematurity (15.6%), and Low birth weight (13.9%). Data in Table 1 present the infants' distribution according to high-risk criteria.

Table 1 – Proportion of infants according to high-risk criteria. Maringá – PR, May to October, 2008

High-risk criteria	n	%
Low birth weight + prematurity	64	27.0
Mother age < 18	60	25.4
Prematurity	37	15.7
Low birth weight	33	13.9
Other criteria associations	14	5.9
Congenital anomaly	13	5.5
Apgar in the 5th minute < 7	11	4.6
Others*	5	2.1
Total	237	100.0

*Children of mothers who have HIV, toxoplasmosis and/or hepatitis B.

High-risk criteria

Data revealed that the most commonly found risk criterion was LBW, as an isolated or associated risk factor, totalling 103 (43.5%) cases. Of these, 64 (62.1%) were added to preterm LBW, 33 (32.1%) isolated LBW, and 6 (5.8%) other associations of risk criteria including LBW.

The data on birth weight and postnatal weight gain are shown in Table 2.

It is possible to observe that, although 30% of children are born with satisfactory weight (between 3.000 to 3.999g), a considerable proportion of 25.7% was underweight at birth.

In most infants, weight gain was adequate during the first quarter (FQ) (76.2%), but this ratio fell in both the second quarter (SQ) and in the second semester (SS). As to the main risk criteria among infants with insufficient gain were: children of mothers aged less than 18 years (SQ = 27.2%, SS = 32.5%), only preterm and LBW (SQ = 24.3%, SS = 25.3%), only preterm (SQ = 17.5%, SS = 13.2%), only those with LBW (SQ = 11.6%, SS = 12%), followed by other criteria in smaller proportions.

Statistical analysis showed an association between poor weight and three independent variables: birth

weight greater than or equal to 2.500 g; not having associated LWB and prematurity as a risk criterion, and having the presence of congenital anomalies as a risk criterion.

Table 2 - Birth weight and weight maintenance in the first year of life. Valid data. Maringá - PR, May-October 2008

Variables	n	%
Birth Weight* (n=237)		
Extremely Low Weight (ELW)	3	1.3
Very Low Weight (VLW)	8	3.4
Low Weight (LW)	92	38.8
Insufficient Weight (INW)	61	25.7
Satisfactory Weight (SW)	71	30.0
Excessive Weight (EW)	2	0.8
Weight Assessment at 3 months (n=206)		
Gain < 23g/day	49	23.8
Gain equal to or > 23g/day	157	76.2
Weight Assessment at 6 months (n=165)		
Gain < 20g/day	103	62.4
Gain equal to or > 20g/day	62	37.6
Weight Assessment at 12 months (n=143)		
Gain < 13g/day	83	58.0
Gain equal to or > 13g/day	60	42.0

*ELW = <1000g, VLW 1000 to 1499g, LW= 1500 to 2499, INW = 2500 to 2999, SW=3000 to 3999, EW 4000g⁽¹⁴⁾.

Of the total number of infants with congenital anomaly, only 12 could have assessed their weight gain in the first quarter, six of which have not reached the expected weight gain. Congenital anomalies of these babies included: cleft lip palate (1), hydrocephalus (1) Down Syndrome (2), external malformation (1) and congenital dislocation of hip (1). Among infants who reached the expected weight gain was noted hydrocephalus, meningocele associated with hydrocephalus, hypospadias, arthrogryposis of the elbow, agenesis of the left arm, and polydactyly.

With regard to height, as shown by data in Table 3, the second quarter had a higher proportion of infants with growth that was lower than expected (55.6%). These children presented the following risk criteria: children of adolescent mothers (28.2%), preterm infants with LBW (23.9%), preterm infants (18.3%) or only with low birth weight (8.4%).

The linear growth below expectations was associated with the variables: birth weight greater than or equal to 2.500 g, mother aged less than 18, mother with less than 8 years of education, and gestational age greater than or equal to 37 weeks.

Results concerning head circumference (HC) growth, are described in Table 4.

Although more than half of the children showed adequate HC growth, and no statistical association was

found between the head circumference growth and the independent variables in the three periods analysed (1st and 2nd quarter, and 2nd semester of life) significant proportions of head circumference growth below expectations were found, with values of 41.7%, 48.4% and 44.5%, respectively.

Table 3 - Height increase in the first year of life *. Valid data. Maringá - PR, May-October 2008

Period	n	%
1 st Quarter (n=178)		
< 3cm/ month	33	18.5
Equal to or > 3cm/ month	145	81.5
2 nd Quarter (n=160)		
< 2cm/ month	71	55.6
Equal to or > 2cm/ month	89	44.6
2 nd Semester (n=128)		
< 1cm/ month	20	15.6
Equal to or > 1cm/ month	108	84.4

* Calculations based on height at birth and at 3, 6 and 12 months respectively.

Table 4 - Head circumference growth in the first year of life *. Valid data. Maringá - PR, May-October 2008

Period	n	%
1 st Quarter (n=163)		
< 2cm/ month	68	41.7
Equal to or > 2cm/ month	95	58.3
2 nd Quarter (n=153)		
< 1cm/ month	74	48.4
Equal to or > 1cm/ month	79	51.6
2 nd Semester (n=128)		
< 0,5cm/ month	57	44.5
Equal to or > 0,5cm/ month	71	55.5

* Calculations based on head circumference at birth and at 3, 6 and 12 months respectively.

Data in Table 5 show the distribution of variables that demonstrated having statistical associations with growth speed below the expected, according to the

Table 5 - Distribution of variables which presented statistical association ($p < 0.05$) with weight gain and linear growth below expectations. Maringá - PR, 2008.

Variables	Weight gain below expectations			Linear growth below expectations		
	1 st Quarter	2 nd Quarter	2 nd Semester	1 st Quarter	2 nd Quarter	2 nd Semester
Neonatal						
BW > 2500g	-	p 0.006	p 0.046	-	p 0.005	p 0.011
Gest. Age > 37s	-	-	-	p 0.022	-	p 0.003
Not having LBW+PT	-	p 0.030	p 0.023	-	-	-
Cong Anomaly	p 0.028	-	-	-	-	-
Mother-related						
Age < 18 years old	-	-	-	-	-	p 0.013
Education time < 8 years	-	-	-	-	-	p 0.024

Subtitles: BW = birth weight; Gest. Age = Gestational Age.

*Head growth below expectations did not present any statistical association with the studied variables.

period they occurred.

In general, growth alterations were present in 188 (79.3%) infants, and 81 (43.1%) had, at some point in the first year of life, weight, height and HC below expectations, 43 (22.9%) presented HC and weight problems, 19 (10.1%) only presented low weight gain, 19 (10.1%) weight gain and height below expectations, 15 (8%) HC growth below the expected, 7 (3.7%) presented problems with height and HC, and 4 (2.1%) only presented height below expectations. Such alterations were more common in infants who presented the risk criteria of: being the child of mothers under 18 years old (27.1%), being preterm and LBW infants (26%), being preterm (14.9%) or having low birth weight (13.8%). It is relevant to highlight that when analysing growth below expectations in general (regardless of being related to weight, height or HC), no statistical association was found.

DISCUSSION

The first year of life is characterized by a rapid growth of the child, and is considered a period of great biological vulnerability, given the influence of factors such as birth and extra-uterine adaptation, socioeconomic conditions, access to healthcare, housing, sanitation, hygiene, and food in sufficient quality and quantity⁽¹⁶⁾.

At this age bracket, monitoring the infants becomes crucial, since studies have shown that linear growth deficits that could be totally recovered begin around the third month of life and continue for two or three years⁽¹⁷⁾.

When it comes to high-risk infants that present a higher risk of morbidity and mortality⁽¹⁸⁾, because of disorders or conditions that are uncommon to the normal course of events associated with birth, the growth monitoring process plays an even greater role. Such condition of growth vulnerability requires a

thorough knowledge of its course, as well as means for close monitoring, preventive care, children's diseases healthcare actions, nutrition and immunization, which can provide an early diagnosis of possible disorders that interfere in the process of normal growth⁽¹⁶⁾.

Risk criteria and reflections on the growth process

Results showed that the determining criteria for NB to be considered high-risk, in many cases, are related not only to other risk factors but also to other variables that directly or indirectly influence the evolution and adaptive capacity to such condition. Thus, assessing the influence of risk factors cannot be restricted to an isolated and linear analysis, but instead, it should always consider the multiplicity and combination of situations and contexts.

Prematurity, for example, very commonly relates with other disorders, such as low birth weight and the risk for perinatal and intrapartum complications, and may result in neonatal hypoxia/ anoxia, with a consequent worsening of the infant's prognosis. Such conditions often lead to extended admission periods, requiring more technical resources in the NB's first days of life, and leading to a need for adaptation, which affects the family, and the requires mechanisms to include the new member within the family routine.

Also, from organic perspective, prematurity and low birth weight, trigger a greater difficulty breastfeeding and increased vulnerability, which are some of the main responsible factors related to nutritional risk and growth deficit at the end of the first year of life⁽¹⁹⁾. A study published in 2002 aimed to identify the profile of 99 children who were hospitalized in an institution for severe malnutrition, in a period of 12 months, and found that most of them had less than 6 months of life (88.9%) and had a history of LBW (42.4%) and prematurity (36.4%)⁽²⁰⁾.

In the present study, an interesting fact observed was that although premature infants and low birth weight have been prominent among those whose weight gain and linear growth was insufficient, it was also possible to verify that birth weight that was greater than or equal to 2.500 g and gestational age at birth that was greater than or equal to 37 weeks were associated with both low weight gain and slow height gain, which is contrary to what has been stated in the literature.

However, prematurity and low birth weight can have a positive effect on weight gain, particularly when infants need longer periods of hospitalization and intensive care after birth. Such context favours the guidance and support to families with regard to healthy feeding and appropriate care, and especially breastfeeding⁽²¹⁾. Moreover, such infants should be frequently followed

up, due to their vulnerability, and the possibility of early diagnosis and intervention to deviations from normality.

Insufficient weight at birth (INW) represents an important risk factor for multiple health problems, such as infectious diseases (mainly diarrhea), acute respiratory infections, delayed growth and development, and increases the infant mortality rate^(19,22).

Among the live births in the city in 2007, infants with insufficient weight at birth accounted for 25.1%, which is significantly higher number than those with LBW (8.7%)⁽⁹⁾. Therefore, while INW is not an inclusion criterion for PVBR, it is important to observe it and not take it for granted, as it is considerably present among infants included in the program.

The risk criterion "presence of congenital anomaly" had a statistical association with low weight gain during the first quarter. Some congenital anomalies such as cleft lip and palate, although not associated with genetic syndromes, alter the child's normal genetic growth potential, for significantly interfering with breastfeeding and the intake of nutrients in the first months of life, and triggering growth deficit in this period⁽²³⁾.

As for Down Syndrome, it is important to note that children with this genetic abnormality usually have thyroid disorders, and muscular hypotonia, which can determine body composition and expected weight gain differently from those considered normal⁽²⁴⁾. Therefore, it is essential to consider such characteristics when assessing the growth of these children. Moreover, having a child with a congenital anomaly might make it difficult for parents and families to provide home care. Such situation reinforces the need to provide the necessary guidance to parents before discharge and during follow-up, considering the infant's special needs, and any doubts parents and family might have about providing home care.

Mother's age and education as factors that affect child growth

The second risk criterion responsible for including infants in the PVBR was mothers with less than 18 years old. It is noteworthy that adolescent pregnancy is considered by some authors, a risk factor for prematurity, LBW and low vitality are twice more risky in children of adolescent mothers⁽²⁵⁾. But in the present study, such high-risk condition (mother with 18 years old or less) was isolated, because, despite the biological and maturational aspects, this factor can become a risk condition due to the socio-emotional consequences of pregnancy and motherhood at this stage of life. Therefore, it is important to consider the fact that this is a special population that needs specialized care, taking into account the stage of life the adolescent mother is in, which demands actions that facilitate educational and

psycho-emotional needs that may influence care provided to the infant.

Studies confirm that the mother's socioeconomic conditions are associated with the child's nutritional state. Adverse conditions such as adolescent motherhood, low education, low per capita income and poor living conditions and sanitation interfere with the understanding and practice of child care, boosting nutritional risks^(2,26).

In this study, both the time of education (less than eight years) and the maternal age (less than 18 years old) are statistically associated with linear growth below expected in the second semester. In addition, the proportion of infants who had insufficient weight gain in both the second quarter and the second semester, as well as those with linear growth below expectations in the second quarter, was more pronounced among those whose mothers were adolescents.

These findings corroborate with the results of a study published in 2007, which demonstrated that, with one year of age, children of adolescent mothers presented weight and body mass index lower than those in the control group (children of non-adolescent mothers) and no differences were observed with regard to the neuropsychomotor development⁽²⁷⁾. In another review study conducted in 2004, it was possible to observe that low maternal education has significantly contributed to slower children's growth and is associated with infant mortality, hospitalizations and anthropometric indicators (weight/ age and height / age)⁽²⁾.

The weight gain and linear growth during the first year of life among children of adolescent mothers and/ or mothers with a low education, suggest the need to better discuss issues related to exclusive breastfeeding versus the introduction of complementary foods considering these mothers' ability to deal with the food transition process.

Head growth assessment and implications related to monitoring developmental risk

Regarding the assessment of head growth, although no statistical associations were found, all studied periods presented a considerable proportion of infants with head growth below expectations. It is important to emphasize that the HC measure is very important, especially in the first year of life, for it indirectly indicates brain growth⁽⁵⁾. It is an important health indicator, since the detection of measures above or below two standard deviations, can be related to neuropathologies, such as microcephaly (of genetic or environmental causes) and hydrocephalus, thus requiring better assessment and addressing⁽⁴⁾.

Thus, this finding certainly deserves a closer look at healthcare services, in particular with respect to the infants included in the PVBR, considering results presented by other researches, in which inappropriate growth of the

HC was associated with abnormal results in developmental assessments at 12 months of age⁽²⁸⁾. It is also important to remember that infants have different risk factors that predispose them to having brain growth alterations, such as prematurity, low birth weight and increased risk of infections.

It is relevant to highlight that the period of greatest acceleration of brain growth ranges between the 30th week of pregnancy and the end of the second year of life, and at the end of the first year, the brain may be already 83.6% of the adult brain size⁽²⁹⁾. During this period, there is a greater risk of permanent damage⁽²⁹⁾. Therefore, it is essential to monitor the evolution of the HC during the entire period.

Multifactorial analysis of risk

Weight, height and HC deficits in the 2nd quarter of this study may be associated with some intervening factors. The end of the second quarter is marked by the feeding transition period, and the inclusion of complementary feeding. Deficits in height or weight at this stage may be related to a deficient diet (in quantity and/ or quality) or to difficulties related to adapting to new foods, flavours and textures. In developing countries, in general, impaired growth begins between four and six months of life. It occurs when breast milk is replaced by foods of poor nutritional value that are often contaminated, making infants vulnerable to infections, especially diarrhea. Thus, this phase must be considered as the most vulnerable for many families that monitor their high-risk infants, due to the emergence of doubts and insecurities on how to provide appropriate care, how to introduce new foods in the infant's diet without causing nutritional deficits and other risks that affect growth.

Therefore, assessing the growth of high-risk infants as a whole, or in a particular way (weight, height or HC) must encompass multidimensional analyses of the growth process, considering not only the biological and maturational risks related to each high-risk condition, but also the contextual factors and adaptation of infants and families to this evolutionary path.

CONCLUSION

In this study, adolescent motherhood, low education, the presence of congenital anomalies, and whether or not the infant was born at term and/ or with appropriate weight stood out as factors associated with growth deviations of high-risk infants in the present study. The fact that preterm infants and/ or infants with low birth weight accounted for a considerable proportion of those with growth alterations over the first year of life suggests the need for special monitoring, so as to protect

them against unsatisfactory growth.

The second quarter presented the highest frequency of discrepancies related to the expected growth, and alterations in this period were associated with the mother's age, more than 37 weeks gestational age at birth, and birth weight of more than 2.500g.

High-risk factors at birth are defined according to the possibility of sequelae development in children's growth throughout their first year of life. Especially during the second quarter, there are multiple changes in the infant's life and routine, as this is the period where other foods are introduced and the diet changes, and some primitive reflexes disappear, while voluntary movements emerge, improving balance and the interaction with the environment, among others. The population at risk, experiencing this diagnosis, such as parents, often develop a sense of deep insecurity about what conduct to take and their own future as a family unit.

Thus, besides the adoption of preventive measures during the prenatal and childbirth in order to reduce risks, it is important that the family and the infant, when considered high-risk, are fully monitored and supported through guidance, planning and implementation of joint actions, which gives them care and educational support,

REFERENCES

1. Spyrides MHC, Struchiner CJ, Barbosa MTS, Kac G. Efeito das práticas alimentares sobre o crescimento infantil. *Rev Bras Saúde Matern Infant.* 2005;5(2):145-53.
2. Romani SAM, Lira PIC. Fatores determinantes do crescimento infantil. *Rev Bras Saúde Matern Infant.* 2004;4(1):15-23.
3. Cardoso LEB, Falcão MC. Importância da avaliação nutricional de recém-nascidos pré-termo por meio de relações antropométricas. *Rev Paul Pediatr.* 2007;25(2):135-41.
4. Brasil. Ministério da Saúde. Grupo Hospitalar Conceição. Gerência de Saúde Comunitária. Atenção à saúde da criança de 0 a 12 anos. Porto Alegre: Hospital Nossa Senhora da Conceição; 2009.
5. Brock RS, Falcão MC. Avaliação nutricional do recém-nascido: limitações dos métodos atuais e novas perspectivas. *Rev Paul Pediatr.* 2008;26(1):70-6.
6. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Ações Programáticas e Estratégicas. Agenda de compromissos para a saúde integral da criança e redução da mortalidade infantil. Brasília: Ministério da Saúde; 2004.
7. Ferraz ST, Frônio JS, Neves LAT, Demarchi RS, Vargas ALA, Ghetti FF, Filgueiras MST. Programa de follow-up de recém-nascidos de alto risco: relato da experiência de uma equipe interdisciplinar. *Rev APS.* 2010;13(1):133-9.
8. Weiss MC, Fujinaga CI. Prevalência de nascimentos baixo peso e prematuro na cidade de Irati-PR: implicações para a fonoaudiologia. *Rev Salus.* 2007;1(2):123-7.
9. Brasil. Ministério da Saúde. DataSUS. Informações de Saúde. Estatísticas Vitais. Nascidos Vivos. Acesso 25 de junho de 2010. Disponível em: [http://www2.datasus.gov.br/DATASUS/index.php?area=0205&VObj=http://](http://www2.datasus.gov.br/DATASUS/index.php?area=0205&VObj=http://tabnet.datasus.gov.br/cgi/defthtm.exe?sinasc/cnv/nv)
10. Lopes MCL, Santander CA, Marcon SS. Acompanhamento dos recém nascidos de risco de uma unidade básica de saúde de Maringá-PR. *Rev RENE.* 2010;11(1):114-24.
11. Zeferino AMB, Barros Filho AA, Bettiol H, Barbieri MA. Acompanhamento do crescimento. *J Pediatr (Rio J).* 2003;79(Supl 1):S23-32.
12. Augusto RA, Souza JMP. Crescimento de crianças em aleitamento materno exclusivo no primeiro semestre de vida. *Rev Bras Crescimento Desenvolv Hum.* 2007;17(2):1-11.
13. Leão E, Starling ALP. Semiologia pediátrica: aspectos gerais. In: López M, Laurentys-Medeiros J. *Semiologia médica: as bases do diagnóstico clínico.* 5a ed. Rio de Janeiro: Revinter; 2004. p. 1129-38.
14. Use and interpretation of anthropometric indicators of nutritional status. WHO Working Group. *Bull World Health Organ.* 1986;64(6):929-41.
15. Brasil. Ministério da Saúde. Conselho Nacional de Saúde. Resolução N° 196 de 10 de outubro de 1996. Diretrizes e normas regulamentadoras de pesquisas envolvendo seres humanos. Rio de Janeiro: Ministério da Saúde Fundação Osvaldo Cruz; 1998.
16. Mello DF, Barros DM, Pinto IC, Furtado MCC. Seguimento de enfermagem: monitorando indicadores infantis na saúde da família. *Acta Paul Enferm.* 2009;22(6):748-54.
17. Monte CMG. Desnutrição: um desafio secular à nutrição infantil. *J Pediatr (Rio J).* 2000;76(Supl 3):S285-97.
18. Whaley LF, Wong DL. *Enfermagem pediátrica: elementos essenciais à intervenção efetiva.* 5a ed. Rio de Janeiro: Guanabara Koogan; 1999.
19. Motta MEFA, Silva GAP, Araújo OC, Lira PI, Lima MC. O peso ao nascer influencia o estado nutricional ao final

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- do primeiro ano de vida? *J Pediatr (Rio J)*. 2005;81(5):377-82.
20. Falbo AR, Alves JGB. Desnutrição grave: alguns aspectos clínicos e epidemiológicos de crianças hospitalizadas no Instituto Materno Infantil de Pernambuco (IMIP), Brasil. *Cad Saúde Pública*. 2002;18(5):1473-7.
 21. Colaizy TT, Morriss FH. Positive effect of NICU admission on breastfeeding of preterm US infants in 2000 to 2003. *J Perinatol*. 2008;28(7):505-10.
 22. Helena ÉTS, Sousa CA, Silva CA. Fatores de risco para mortalidade neonatal em Blumenau, Santa Catarina: linkage entre bancos de dados. *Rev Bras Saúde Matern Infant*. 2005;5(2):209-17.
 23. Montagnoli LC, Barbieri MA, Bettiol H, Marques IL, Souza L. Growth impairment of children with different types of lip and palate clefts in the first 2 years of life: a cross-sectional study. *J Pediatr (Rio J)*. 2005;81(6):461-5.
 24. Santos JA, Fraceschini SCC, Priore SE. Curvas de crescimento para crianças com Síndrome de Down. *Rev Bras Nutr Clin*. 2006;21(2):144-8.
 25. Tauil PL, Chaloult E, Rodrigues FRA, Nogueira LSC, Costa PETF, Santos SF. Gravidez em adolescente: aspectos relativos ao pré-natal, parto e recém-nascido. *Brasília Méd*. 2001;38(1/4):7-12.
 26. Fisberg RM, Marchioni DML, Cardoso MRA. Estado nutricional e fatores associados ao déficit de crescimento de crianças frequentadoras de creches públicas do Município de São Paulo, Brasil. *Cad Saúde Pública*. 2004;20(3):812-7.
 27. Vieira MLF, Bicalho GG, Silva JLCP, Barros Filho AA. Crescimento e desenvolvimento de filhos de mães adolescentes no primeiro ano de vida. *Rev Paul Pediatr*. 2007;25(4):343-8.
 28. Pontes TB. Crescimento e desenvolvimento de recém-nascidos pré-termo com muito baixo peso no primeiro ano de vida. *Cad Terapia Ocupac UFSCar*. 2009;17(2).
 29. Cravioto J, Arrieta MR, Villicaña R. Desnutrição e sistema nervoso central. In: Diament A, Cypel S. *Neurologia infantil*. 3a ed. São Paulo: Atheneu; 1996. p.1075-90.