Abstract

Objective: to describe the linear growth and growth velocity of preterm infants born small for gestational age according to variables such as weight, length and head circumference, from birth to three months of corrected age.

Methods: prospective study of one hundred preterm infants born small for gestational age from 28 to 36 weeks after birth and classified as small according to the weight for their gestational age. The anthropometric data was obtained at birth, and continued to be measured weekly until the probable delivery date and monthly until three months of corrected age. Growth curves were calculated according to the mean values adjusted by the polynomial function of Count model.

Results: the infants' growth curves for the three variables were much below the ones of the preterm infants with adequate size for gestational age until the fortieth week. However, the head circumference growth reached the 10th percentile curve of the NCHS at the fortieth week, and the 25th percentile at three months of corrected age. The weight growth curve reached the 10th percentile curve around one month and a half for males and two months and a half for females. The length growth curve reached the 10th percentile for males at three months of corrected age and it almost reached that percentile for females after the same period of time.

Conclusions: a tendency of recovering weight and length related to preterm infants with adequate size and term newborns was observed. The head circumference showed an obvious and early recovery.

Introduction

The growth assessment of preterm newborns (PN) and, especially, of those small for gestational age (SGA), who were probably affected by some kind of intrauterine growth retardation (IGR), is important so that their health condition and their prognosis can be determined. IGR, defined as a deviation from the expected fetal growth pattern, is caused by multiple adverse effects on the fetus. The term small for gestational age (SGA) describes a child whose birthweight is below a predetermined cutoff point regarding his/her gestational age, which varies according to different studies. IGR and SGA do not have the same meaning, even though SGA condition at birth is frequently associated with IGR.1-3

During the growth recovery process of newborns who were affected by IGR, an increase in growth speed is
observed; this phenomenon is called catch-up.4 There is controversy in the literature about the occurrence of catch-up and the moment at which it takes place in the life of the SGA PN, especially, due to the several different criteria used for its definition.5-8

The performance of small for gestational age preterm newborns (SGA PN) regarding their growth and development, as well as their genetic potential, depends on the quality of medical care and hospital service. After hospital discharge, this will depend on the socioeconomic conditions of their family.

Under satisfactory conditions, these newborns can naturally recover their growth by reaching the growth curve of non-small for the gestational age (NSGA) preterm newborns and/or the curve of full-term newborns.1

Under the current conditions of neonatal care in Brazil, how does the growth of SGA PN evolve during the first months of life? In this study, we assessed this growth until three months of corrected age.

Methods

A prospective study was performed from January 1994 to August 1995, and from April 1996 to April 1997. The final sample consisted of 100 newborns aged between 28 and 36 weeks, whose birthweight for gestational age was below the 10th percentile.9 Gestational age was evaluated according to the information reported by the mother about the last menstruation and verified through clinical and neurological examination in 64% of the cases; only through clinical and neurological examination in 31%11,12 and through early ultrasound exam, confirmed by clinical and neurological examination, in 5% of the cases. The initial sample included 149 cases, of which 24 (16.1%) were excluded. The exclusion criteria were: infections and congenital malformations, severe neurological damage, negative clinical evolution that prevented measurement, multiple births and death during the study period. More than 60% of the total measurements proposed for each gestational age at birth were regarded as a satisfactory number of measurements for the longitudinal evaluation. Loss accounted for 20% of the cases.

Weight, length and head circumference after birth were checked once a week until the 40th week and once a month until three months of corrected age in the 100 newborns included in the final sample. The newborns were weighed by the nursing team during hospital stay, according to their routine of services. The children were weighed, with their clothes off, before their first meal by means of an electronic scales. In the case of children who were carrying any piece of equipment, the weight of such equipment was not considered. At the clinic, the children’s weight was verified by the researchers. The length and the head circumference (HC) were checked by the researchers during both phases of the study. The length of unstable newborns, who were kept in incubators and in cribs equipped with radiant heat, was obtained by means of an anthropometric measuring tape. A measuring stick was used for stable newborns and during the follow-up at the clinic. The crown-heel length was measured using both measuring tapes while the children were in a supine position. Their head top touched the fixed support and, with the help of an experienced assistant, the children’s knees were kept stretched until the mobile end was touched by the sole of their feet. The HC measure was checked using a flexible steel measuring tape, adjusted to the head, around the supraorbital region and the occipital protuberance. The largest diameter was recorded. The newborns’ nutritional habits followed the routine of both maternity wards. The goal was to reach caloric needs of 120-130 cal/kg/day and a water intake of 180-200 ml/kg/day by the end of the second week of life. The data obtained were analyzed by EPI-Info software, version 6.0, which provided the means, standard deviations and medians of the measurements, for each corrected age and gender separately. Due to the size of the sample and to the statistical model, the values of the median were used, since it is a measure of central tendency, which is more adequate in this case. The main objective of the statistical analysis was to obtain a mathematical model that could properly explain how the anthropometric variables behave. With that purpose, some mathematical models were tested according to Hauspie’s review (1989). Those models could explain the behavior of growth curves. Using the SPSS statistical software, the models were adjusted using the least squares method. In order to identify the model that best fitted the database being used, the graphic comparison between observed and expected models was employed. A numerical criterion often used to discriminate regression models was chosen because it balances simplicity (fewer parameters) and better adequacy (expected models close to observed models). In the case of adjustment using the least squares method, it corresponds to the adjusted coefficient of determination (R²) and is represented by the expression: 1 - (n - 1) / (n - p) (1 - R²); where n is the sample size, p is the number of parameters of the model and R² is the adjustment coefficient of determination of the least squares method.

The parameter estimates were obtained by taking into consideration all the sample values and also the medians of each assessment time. The expected values for each one of the models together with the observed medians were graphically presented for each studied variable, separated according to gender. All the expected curves were close to the curves of the observed values. However, we chose Count model due to its simplicity, and also because this model is more frequently used for the study of growth curves.

Count model = b0 + b1 time + b2 ln(time), where b0, b1 and b2 are the coefficient of the estimated model based on the observed values.
For the study of speed, we calculated the growth rate, obtained through the mathematical equation derivative of Count model. The influence of the gender variable on growth was assessed by adding a coefficient for gender to the mathematical equation, and the values of “p” were calculated regarding each variable.

All mothers who were interviewed received information about the study and agreed to take part in the research, signing the consent form.

This study was approved by the Research Ethics Committee of Universidade Federal de Minas Gerais (process 042/99, 19/05/99).

**Results**

Table 1 shows the distribution of SGA PN regarding gestational age and birthweight.

For the design of the growth curves, the values of the median adjusted for each variable were placed in axis y and the gestational age, from 28 weeks up to 3 months of corrected age, was placed in axis x. The dividing line at 40 weeks indicates the date on which the term would be complete.

Figure 1-A shows that the weight growth curves for both genders are almost coincident, that is, the growth pattern is similar. We observed a similarity between weight growth and speed. Figure 1-A shows a growing increase in weight, while Figure 1-B shows a growing increase in weight speed. We observed a lower speed of weight growth in boys up to 39 weeks, which becomes higher than girls’ weight growth speed after that age.

Figure 2 refers to the length growth curves and to the length growth speed for each gender. We observed a gradual increase in linear length (A), even though these increases are smaller and smaller, which may be explained by the decrease in length speed (B) during the study period. Children grew less every week, but the decrease in speed was more evident in boys.

With regard to head circumference growth between genders (Figure 3-A), we observed that the curves superpose each other from 28 to 40 weeks; after this date, boys showed a more evident growth. Figure 3-B shows that the shape of the curves of head circumference growth speed is different for each gender. Even though the speed is always positive during the period studied, the values are still higher for males, and lower for females.

![Figure 1](image-url)  
**Figure 1** - Mean weight growth (A) and speed (B) of SGA preterm newborns according to corrected age

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Discussion

Few authors studied the growth of NSGA PN and SGA PN separately. The importance of separating these two groups lies in the possibility of establishing a growth pattern for each group, which is not well defined for the SGA PN. The type, duration and severity of IGR seems to have an influence on the dynamics of their postnatal growth.\(^2,14\)

In order to discuss that, we used a graphical comparison with studies of preterm newborns that employed a similar methodology. After 40 weeks of corrected age, we verified the growth of SGA PN according to the NCHS\(^15\) reference for full-term infants. This is the reference that was adopted by the Brazilian Ministry of Health.

If we observe Figures 4 to 9, as to the growth curves of weight, length and head circumference of NSGA PN in studies with similar methodology,\(^2,16\) the curves of SGA PN are quite low up to the 40th week, but from that moment on, they have an inclination, crossing the curve of the 10th percentile (10th P) of the NCHS,\(^15\) which indicates a tendency towards catch-up growth. With regard to weight, the curve of female SGA PN surpasses the 10th P at one and a half months (Figure 5), while the curve of male SGA PN do so at two and a half months of corrected age (Figure 4). As to length, it is evident that SGA PN were way below the results obtained in previously mentioned studies throughout the study period. However, the curve of male SGA reached the 10th P of the NCHS at three months of corrected age (Figure 6), while the curve of female SGA were close, but did not reach the curve of full-term newborns during the study period (Figure 7). The head circumference showed evident catch-up growth if compared to longitudinal studies of NSGA PN. In the 40th week, the SGA reached the 10th P, and at three months of corrected age, they reached the 25th P of the NCHS (Figures 8 and 9).

Figure 2 - Mean length growth (A) and speed (B) of SGA preterm newborns according to the corrected age

Figure 3 - Mean head circumference growth (A) and speed (B) of SGA preterm newborns according to corrected age
According to some authors, catch-up growth is preceded by an increase in growth rate, even though the rate pattern is not defined. Figure 1-B shows increasing rates for weight growth in both genders, indicating a probable peak rate after three months of corrected age. In Figure 2-B, the curves of length growth rate decrease for both genders, which could indicate an early peak rate, possibly before 28 weeks of gestation. During the study period, there was a continuous linear growth of SGA PN, although the rate was gradually lower. On the other hand, considering HC (Figure 3-B), the growth rate, albeit positive, showed increased values for males and decreasing values for females. Since the growth curve of HC showed an earlier tendency towards catch-up, reaching the 10th P of the NCHS in the 40th week of corrected age, it is possible that the peak rate occurred before this age. Regarding the HC, Fujimura & Seryu (1977), when studying NSGA PN, found the peak rate in 31 weeks of corrected age, while Brandt (1986) found it in 34 weeks of corrected age.

We consider that the study period of SGA PN growth up to three months of corrected age might be too short to obtain more conclusive results about the catch-up phenomenon, or to state that those children reached their original growth channel. To reach that purpose, an individualized growth curve, including intrauterine life, should be obtained before the process that led to growth retardation. Researchers should estimate optimal growth in order to verify whether catch-up occurs after the causes of deficit are eliminated; however, in practice, this is a quite difficult procedure.
In this study, we used the curve of the NCHS as a reference for the assessment of SGA PN growth after 40 weeks of corrected age, considering the 10th percentile as the cutoff point, from which catch-up growth is expected to occur. The SGA PN surpassed this cutoff point for weight, length (only males) and head circumference during the study period, indicating that the process of catch-up growth was taking place. On the other hand, although the curve of SGA surpassed the 10th percentile of the NCHS and showed a tendency towards that obtained for SGA PN and also towards the 50th percentile of full-term newborns, how will SGA PN behave regarding growth and development after study period? Evidently, the natural difficulties found in our country in using a longer follow-up period prevented us from making a more detailed assessment of catch-up growth.

Even though, the graphs show that SGA PN presented a significant tendency towards catch-up growth under the current conditions of perinatal care.

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References

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