Original Article

Growth monitoring in children with low and normal birth weight up to two years: A retrospective cohort study

Mina Danaei[1], Zeynab Amighi[2], Mohsen Momeni[3], Ali Khalooei[4*]

[1] Assistant Professor of Community Medicine, Social Determinants of Health Research Center, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran

[2] General Physician, Health Services Management Research Center, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran

[3] Assistant Professor of Community Medicine, Regional Knowledge Hub and WHO Collaborating Centre for HIV Surveillance, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran

4 Assistant Professor of Community Medicine, Research Center for Modeling in Health, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran

Corresponding author and reprints: Ali Khalooei. Assistant Professor of Community Medicine, Research Center for Modeling in Health, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran.

Email: khalooei@kmu.ac.ir

Accepted for publication: 24 November 2016

Abstract

Background: The present study was conducted to compare the growth indices in two-year-old children with a history of low birth weight and normal birth weight children.

Methods: A retrospective cohort study was conducted on two-year-old children with low birth weight and normal weight children who were covered by health centers of Kahnooj, in 2015. Cares at birth, 1, 2, 4, 6, 7, 9, 12, 15, 18, and 24 months of age were studied, and child growth indices (weight, height, and head circumference), along with some demographic variables, were studied. Data was analyzed using IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.

Results: There were significant differences in children's growth for both groups in all periods of care. Despite the same slope, growth pattern in children showed a significant difference. Children who had young mothers, female children, and children with preterm birth were more likely to be born with low birth weight.

Conclusion: Trends and growth patterns of weight, height, and head circumference in underweight children have a significant difference with normal children and, despite the same slope, these children cannot compensate for the backwardness of growth to the age of two. So, separate growth curves should be plotted for these children and possible preventive measures should be taken to prevent bearing an underweight baby.

Keywords: Birth weight; Infant; Growth monitoring; Retrospective studies

Cite this article as: Danaei M, Amighi Z, Momeni M, Khalooei A. Growth monitoring in children with low and normal birth weight up to two years: A retrospective cohort study. SDH. SDH. 2016;2(4):130-137. DOI: http://dx.doi.org/10.22037/sdh.v2i4.14536

Introduction

Low Birth Weight (LBW), defined as birth weight less than 2500 grams, is one of the most serious health problems of the modern world. According to the previous surveys conducted by the World Health Organization, nearly two million infants are born annually with low birth weight most of whom are born in the developing and developed countries (1). Approximately 50 percent of the deaths and 50 percent of disabilities in children occur in this group (2). Underweight children are

at greater risk of mortality even at younger than age 15, and those who survive suffer from long and short-term disabilities two to three times more than those in other children (3,4).

Different studies demonstrated several risk factors of LBW including preterm birth, maternal demographic, anthropometric and lifestyle variables, history of substance abuse in mother and number of pregnancy care (5). The results of some studies demonstrated that maternal weight gain is associated with the birth weight of infants (6, 7).

It is expected that low birth weight children will compensate for their growth retardation. If the child failed to do so, especially for the head circumference, the possibility of developing cognitive impairment and academic failure will increase (8).

Several factors, including quality of care in hospitals, especially in neonatal intensive care, feeding, particularly breastfeeding, socioeconomic status of families, and many other factors may affect growth impairment in this group of children. These variables differ from one community to another (9, 10).

In a study conducted by Nayeri et al., comparison of the growth of underweight and normal weight children at birth showed that, despite the significant difference in weight between the two groups of children up to age one, weight gain trend in children with low weight was appropriate and the weight gain speed was not significantly different between the two groups. This trend was observed to be true for the children's height and head circumference, as well (11). In Abd-Yazdan et al. study, comparison of the trends of growth between these two groups up to year two showed better growth trend in children with low birth weight than in children with normal weight (12). In another study, it was shown that very low birth weight males remain shorter and more tin than normal body weight children until 20 years of age, but female children who had low birth weight catch up in growth (13).

Given the importance of the growth of babies born with low birth weight and existence of a few studies in this field, the present study was conducted to assess and to compare the growth parameters in children, including weight, height, and head circumference, in 2-year-old children with underweight background at birth and normal birth weight children in Kahnooj city.

Methods

The present retrospective cohort study was conducted in Kahnooj primary health care centers, Kerman, Iran, between May and October 2015.

The health records of all 2-year-old children, kept in the primary health care centers of Kahnooj were the statistical population. Among these records, all low birth weight children (birth weight less than 2500 grams) were enrolled and for each low birth weight child, three normal weight children (birth weight 2500 to 4000 grams) were selected as controls. Health records as well as the anthropometric indices at birth, 1, 2, 4, 6, 7, 9, 12, 15, 18, and 24 months after birth were evaluated for each child. Twins, non-Iranian nationals, children with obvious congenital abnormalities and a history of severe diarrhea or acute respiratory infection health records as well as those with a history of hospitalization due to illness were excluded.

A data collection form, developed by the researchers, was used. The main variable of the study was child development index (weight, height, and head circumference). Also, the child's gender, birth order, the birth interval of children with a previous child in the family, gestational age (premature birth), family size, parents' occupation and education, and maternal age were explored. The researcher filled out the data collection form based on the eligible medical files available in health centers. Next, using IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY:

IBM Corp., data was analyzed running descriptive statistics, means and standard deviations, the two groups Chi-square test, independent t-test, repeated measurement test, and binary logistic test (forward conditional method) to make comparisons. The significance level was set at 0.05.

Results

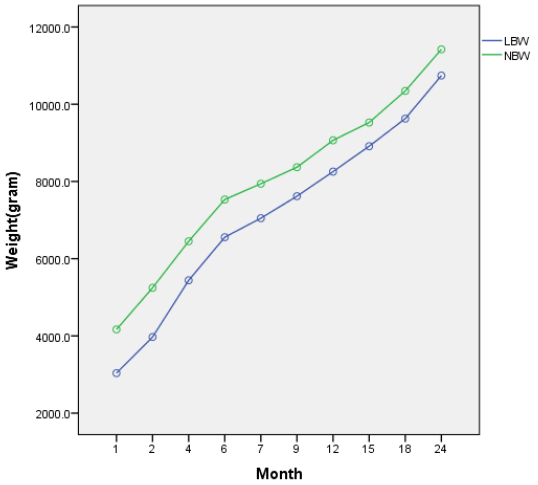
In the present study, 340 two-year-old children were selected from health centers of Kahnooj city: 85 children were born with low birth weight and 255 children with normal weight. The mean±SD birth weight of children in the control group and low birth weight group were 3240±347.64 grams and 2284.3±318.98 grams, respectively. Less than half the children (47.6%) were girls.

In Table 1, the mean and standard deviation of weight, height, and head circumference of children are shown in terms of care in months. Comparison of low birth weight children with normal weight children individually in each different month revealed a statistically significant difference between the two groups in terms of mean weight in all months except for 18-month babies. Therefore, the first group was observed to have less weight than the second group. Comparison of weight growth pattern between the two groups, using repeated measures (Figure 1), showed that there is a statistically significant difference between the two groups in the process of weight gain over time, taking into account the effect of gender (P<0.001).

The results of the current study showed that, in terms of average height in different months, there was a significant difference between the two groups of children (Table 1); this means that the average height of children with normal birth weight is higher than that of the other group. Also, comparison of height growth pattern in Figure 2 shows that there is a statistically significant difference in the increase in the height of the two groups over time, taking into account the effect of gender (P<0.001).

The results showed that the average head circumference of low birth weight children during different months of care is significantly less than that of the other group (Table 1).

Figure 1. Comparison of weight growth pattern between two study groups



The results showed that the average head circumference of low birth weight children during different months of care is significantly less than that of the other group (Table 1). Comparing head circumference growth pattern of children with and without a history of low birth weight and before the age of two, as given in Figure 3, shows that statistically, there is a significant difference between the two groups in the process of increased head circumference over time, taking into account the effect of gender (P<0.001).

The results of independent t-test showed that birth order, family size, and maternal age are factors that affect birth weight, but the interval between the child birth and birth of the previous children in the family was not found to be significantly associated with birth weight (Table 2).

Also, the results of chi-square test showed that gender was significantly associated with the baby's birth weight (P=0.01) so that 19.8% of males and 30.9% of female infants experienced low birth weight.

Figure 2. Comparison of height growth pattern between two study groups

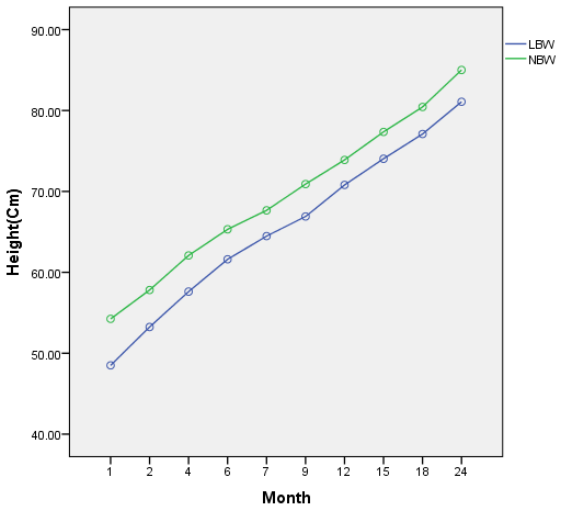


Table 1. Comparison of mean and SD of Anthropometrics according to time between two study groups

Indicator	Age	Mean±SD Normal weight	Mean±SD Low birth weight	*P*
Weight (Gram)	1 month	4254.7±566	3512.9±787	<0.001
	2 month	5279.7±662	4550±861	<0.001
	4month	6510.1±809	5860±924	<0.001
	6month	7588.6±305	6790.8±936	0.01
	7month	8154.1±369	7254.1±955	0.02
	9month	8510.9±972	7800±100	<0.001
	12month	9173.7±104	8494.7±112	<0.001
	15 month	9623.9±151	9190.5±118	0.01
	18 month	10744.3±579	9805.2±124	0.13
	24 month	11501±126	10795±167	<0.001
Height (cm)	1 month	53.7±2	51±3.3	<0.001
	2 month	55±3.2	53±2	<0.001
	4month	59±2.9	57±2.3	<0.001
	6month	63±2.7	61±2	<0.001
	7month	65±2.7	65±2.7	<0.001
	9month	68±3	67±2.7	<0.001
	12month	72±3	70±2.8	<0.001
	15 month	75±3	73±2.9	<0.001
	18 month	79±3	77±3	<0.001
	24 month	82±3	80±3	<0.001
Head circumference (cm)	1 month	37±1.1	36.6±1.9	<0.001
	2 month	38.8±1	37.8±1.7	<0.001
	4month	40.7±1.1	39.9±1.6	<0.001
	6month	42±1.1	41.5±1.5	<0.001
	7month	43.2±1.1	42.4±1.4	<0.001
	9month	44.2±1	43.6±1.5	<0.001
	12month	45.3±1.2	44.7±1.5	0.001
	15 month	46.2±1.1	45.7±1.6	0.002
	18 month	47.3±1.2	46.7±1.7	0.001

Also, the preterm birth was found to be significantly associated with the birth weight of children so that 8.2% of newborns were born with low birth weight, but only 0.8% of babies with normal birth weight were born prematurely (*P*=0.001). Father's job (*P*=0.84), mother's job (*P*=0.60), mother's education (*P*=0.19), and father's education (*P*=0.631) were not found to be relevant.

Multivariate regression analysis showed that when considering all significant variables in the presence of each other, factors such as maternal age, the sex of the children, and preterm birth have significant relationships with the occurrence of low birth weight. Preterm birth and the female gender of the baby were found to increase the chance of low birth weight by, respectively, 13.4 and 1.8 times. Also, with each year increase in the maternal age, the chance of low birth weight decreased by 0.9 times (Table 3).

Figure 3. Comparison of head circumference growth pattern between two study groups

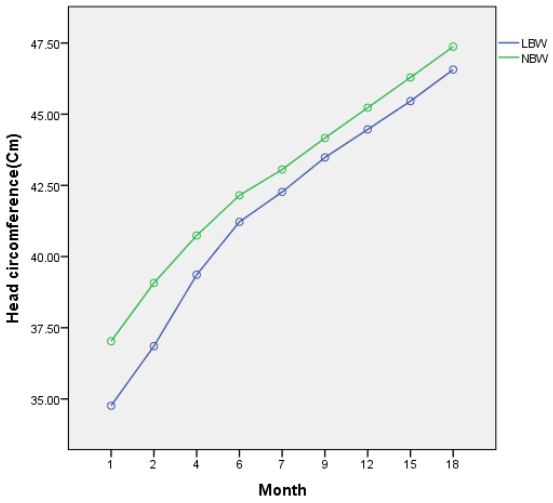


Table 2. Comparison of LBW and NBW children in terms of maternal age, birth order, birth interval, number of family members

Variable	Mean±SD Normal weight	Mean±SD Low birth weight	*P*
Birth order	2.22±1.3	1.77±1.1	0.005
Birth interval	3.12±3.1	2.71±3.4	0.38
Number of family members	4.44±1.2	4.05±1.1	0.008
Maternal age	28.23±5.5	26.34±5.2	0.005

Table 3. Predictors of low birth weight using logistic regression analysis

Variable	B	SE	df	*P*	Odds ratio
Maternal age	0.75	0.25	1	0.003	0.928
Female sex of neonate*	0.600	0.263	1	0.02	1.822
Preterm labor**	2.59	0.839	1	0.002	13.406
Constant	-3.75	1.13	1	0.001	-

*Reference: Male, ** Reference: Term labor

Discussion

Comparison of the average weight of infants at each follow-up between the two groups showed that, except for the age of 18 months, the average weight of low birth weight infants was significantly higher compared with that of the control group. Also, in a simultaneous comparison of average height and head circumference of the two groups at each follow-up, the average height and head circumference of control group infants were significantly higher than those of the low birth weight group. The results of other studies are consistent with findings of the present study. The results of the studies conducted on children with low birth weight and normal birth weight up to one year of age showed significant differences in weight, length, and head circumference between the two groups (11). Comparison of children with low birth weight and normal children up to 18 months of age showed a significant difference in weight, height, and head circumference in each comparison (14). This difference was observed in both groups of a study conducted in Isfahan on children until the age of two years (15). Also, up to the age of five, a significant difference was observed in the measures of weight, height, and head circumference between the two groups (16). As a result, it can be concluded that the differences in children's anthropometric indices at birth can be continued in older children. To have healthier children, special attention must be paid to in utero or even before pregnancy in moms, so that in the future, new born children and the following generations enjoy better health.

Comparison of trends in growth in the two groups showed that, over time, taking into account the effect of gender, two groups of children with low birth weight and normal birth weight undergo different growth pattern of weight, height, and head circumference over time. Although the slope of the growth charts for the children with low birth weight and normal birth weight was nearly identical, the retardation due to the birth weight in the entire growth trend of children is observed to be significant and underweight children were not able to offset their growth retardation. The results of the study by Niri et al. conducted up to one year of age, are to some extents similar to our results. In the study of Nayeri et al., the weight and head circumference were significantly different while the trend of height growth was not significantly different (11). Moreover, another study conducted in Iran showed that the percentile of weight-for-age, height-for-age, and head circumference for age up to two years in children with low birth weight and normal birth weight children were different (12). Formaga et al. study showed that underweight children up to the age of two continue the same growth trend of natural children and, differences seen in anthropometric indices of the two groups are mainly caused by preterm birth in these two groups. Therefore, the use of corrected age can be useful (17). It is likely that the differences in the various studies are due to the differences in the follow-up period and type of care received by children because of living in different geographical areas, which could have affected the children's growth process.

Comparison of demographical factors between low birth weight children and children with no underweight history showed that the baby's sex, birth order, gestational age, maternal age, and family size are factors effective in birth weight. In many studies, maternal age has been expressed as a factor affecting birth weight. Especially, newborns to the 40-year-old mothers and teenage mothers are more at risk (18-20). Birth order in different studies has been reported to be associated with a history of low birth weight: in a study conducted in the city of Yazd, it was shown that the highest rate of low birth weight births was related to the first birth order (21, 22). In addition, prematurity (gestational age less than 37 weeks) in many studies is expressed as a very strong risk factor for

low birth weight. Also, several studies have shown that family size and gender of the baby can affect birth weight (23, 25,26). In the present study, factors such as interval with the previous child's birth, occupation, and educational level of the parents were not found to be significantly associated with birth weight. A study conducted in Esfahan had obtained similar results (15).

Children with low birth weight, compared with those with normal weight, are having difficulty receiving care in all cases in terms of weight, height, and head circumference up to age two. Also, the growth pattern of weight, height, and head circumference of children with normal growth pattern proved to be significantly different from those of the other group. These children were observed to be unable to offset the retardation up to the age of two. So, separate growth curves are to be plotted for these children and possible preventive measures should be taken to prevent birth of underweight babies.

According to the appropriate sample size and follow-up of children up to the age of two, the present study can present reliable results in the field of developmental process of underweight children. Using secondary data on children's health centers and the lack of direct follow-up by researchers are accounted as limitations of the study. It is suggested that studies on underweight children, especially very low-weight ones, be designed prospectively and the children be monitored even after the age of two.

Conflict of interest

Authors declare no conflict of interests.

Acknowledgments

We would like to thank all health center workers in the city of Kahnooj who help us sincerely to implement the current project. The present article is based on the thesis by Zeynab Amighi and was financially supported by Kerman University of Medical Sciences (Grant No. 93/396).

References

1. Ehsanpour S, Abdyazdan Z, Javanmardi Z. Comparative study on growth indicators of children born with low birth weight and normal birth weight in two years after birth. Shahrekord Univ Med Sci. 2001;3(1):69-74. (Full Text in Persian)

2. Nelson WE. Nelson Textbook of Pediatrics. 18th ed. Philadelphia: Saunders; 2007.

3. Ball JW, Bindler RC, Cowen KJ. Child health nursing. Prentice Hall; 2009.

4. Xu B, Rantakallio p, Jarvelin MR. Mortality and hospitalizations of 24 years old members of the low birth. Epidemiology. 1998;9(6):662-5.

5. Momeni M, Esfandyarpour R, Danaei M. The neglected Sociobehavioural risk factors of low birth weight. Social Determinants of Health. 2016 12;1(3):97-103.

6. Ludwig DS, Currie J. The Relationship Between Pregnancy Weight Gain and Birth Weight: A Within Family Comparison. Lancet. 2010;376(9745):984-990.

7. Ludwig DS, Rouse HL, Currie J. Pregnancy weight gain and childhood body weight: a within-family comparison. PLoS Med. 2013;10(10):e1001521.

8. Cooke R, Foulder-Hughes L. Growth impairment in the very preterm and cognitive and motor performance at 7 years. Archives of Disease in Childhood. 2003 Jun;88(6):482. Arch Dis child. 2003;88(6):482-7.

9. Islami Z, Aflatonian A. study to determine the prevalence of low birth weight (LBW) infant in yazd. j shahid Sadoughi univ Med Sci. 2002;1(2):3-8. (Full Text in Persian)

10. Golestan M, Fallah R, Akhavan Karbasi S. Neonatal mortality of low birth weight infants in Yazd, Iran. International Journal of Reproductive BioMedicine. 2008;6(4):205-8.

11. Nayeri F, Kheradpisheh N, Shariat M, Asbagh PA. A comparison between the growth trend of normal and low birth weight newborns during the first year of life. Tehran University Medical Journal. 2009;67(4).

12. Abdeyazdan Z, Ehsanpoor S, Javanmardi Z. A Comparative study on growth pattern of Low Birth Weight and Normal Birth Weight neonates. Iranian Journal of Nursing and Midwifery Research. 2008;12(3)106-10.

13. Hack M, Schluchter M, Cartar L, Rahman M, Cuttler L, Borawski E. Growth of very low birth weight infants to age 20 years. Pediatrics. 2003;112(1 Pt 1):e30-8.

14. Ehsanpour S, Hemmati E, Abdeyazdan Z. Comparison of neonatal growth in normal, low and very low birth weights until 18 months. Iran J Nurs Midwifery Res. 2012;17(2 Suppl 1):S131-6.

15. Ehsanpour S, Javanmard Z, Abdyazdan Z. A comparative study on growth indicators of children born with low birth weight and normal birth weight in 2 years after birth. Iranian Journal of Nursing and Midwifery Research. 2010;8(3).
16. Karimi M, Fallah R, Fallahzadeh M, Dehghanpoor A, Mirzaee M. Comparison of Growth Parameters in Five Year-Old Children with and Without History of Low Birth Weight. SSU_Journals. 2012;19(6):766-74. (Full Text in Persian)
17. Furmaga-Jablonska W. Methods of growth assessment for low-birth-weight children. Med Wieku Rozwoj. 2003;7:109-20.
18. Zahed Pasha Y, Esmaeili MR, Haji Ahmadi M, Asgardoon Gh, Ghadimi R, Baleghi M and etal. Effect of risk factors on low birth weight neonates. J Babol University Med Sci. 2004; 22(6): 18-24. (Full Text in Persian)
19. Lasker JN, Coyle B, Li K, Ortynsky M. Assessment of risk factors for low birth weight deliveries. Health Care Women Int. 2005;26(3):262-80.
20. Makki AM. Risk factors for low birth weight in Sana'a City, Yemen. Ann Saudi Med. 2002; 22(5-6):333-5.
21. Eslami Z, Aflatounian A. A study to determine the prevalence of low birth weight (LBW) infants in Yazd. J Shahid Sadoughi University Med Sci Health Serv. 2002;2(10):3-8. (Full Text in Persian)
22. Takimoto H, Yokoyama T, Yoshiike N, Fukuoka H. Increase in low-birth-weight infants in Japan and associated risk factors, 1980-2000. J Obstet Gynaecol Res. 2005;31(4):314-22.
23. Bener A, Saleh NM, Salameh KM, Basha B, Joseph S, Al Buz R. Socio-demographic and consanguinity risk factors associated with low birthweight. J Pak Med Assoc. 2013;63(5):598-603.
24. Sclowitz IK, Santoz Ida S. Risk factors for repetition of LBW, IUGR and prematurity in subsequent pregnancies. Cad Saude Publica. 2006; 22(6): 1129-36.
25. Ko YL, Wu YC, Chang PC. Physical and social predictors for pre-term births and low birth weight infants in Taiwan. J Nurs Res. 2002;10(2):83-9.
26. Momeni M, Danaei M, Kermani AJ, Bakhshandeh M, Foroodnia S, Mahmoudabadi Z, Amirzadeh R, Safizadeh H. Prevalence and risk factors of low birth weight in the Southeast of Iran. International journal of preventive medicine. 2017;8:12.