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Comparing Growth and Development of Low and Normal Birth Weight Children at Age of 60 Months

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Abstract

Background: Low birth weight (LBW < 2500 g) is one of the most serious problems in today's world. It is also a predictor for mortality and stunting.
Objectives: This study aimed to compare the growth and development at the age of 60 months between children born with low and normal birth weight in Shiraz, Iran.
Methods: This study is part of the Fars birth cohort (FBC) study with the data of children who were born in 2011. We called mothers and asked them to bring their children to the FBC clinic for further evaluation. We also determined the level of development at the age of 60 months for each child by using the Ages and Stages questionnaire (ASQ) for the children.
Results: Of the children, 304 (51.4%) were girls. Most of them had normal birth weight (93.2%), had exclusive breastfeeding for five to six months (79.9%), and did not have any chronic diseases (77.8%). Growth indices at the age of 60 months were significantly higher in children with normal birth weight than in their LBW peers (P < 0.001). However, we found no significant difference in children's development at the age of 60 months between normal and low birth weight children.
Conclusions: Although growth indices of children at the age of 60 months were higher in children with normal birth weight, we found no significant difference in children's development at the age of 60 months between normal and low birth weight children.

Keywords: Children, Growth, Development, Birth Weight, Iran

1. Background

Low birth weight (LBW < 2500 g) is one of the most serious problems in today's world (1). It is an important indicator of maternal and fetal health and a predictor for mortality, stunting, and chronic conditions in adulthood (2). The estimations by the United Nations International Children's Emergency Fund (UNICEF) and the World Health Organization (WHO) indicate that the global LBW prevalence was 14.6% in 2015. About one in seven live births globally suffered from LBW, half of which occurred in Southern Asia (3). A study in Bangladesh showed that the lack of exclusive breastfeeding can increase underweight at up to four months (4). Exposure to maternal smoking was also mentioned as one of the most important risk factors that negatively affected the development and it was a determinant for underweight in early adulthood (5, 6).

Low birth weight also affects children's development (1). According to previous studies, the frequencies of developmental delays in cognitive aspects, gross motor, fine motor, and problem-solving domains were significantly higher in LBW children (1, 7, 8). Besides, a systematic review found that children born with very LBW (< 1500 grams) were six times more likely to have a moderate motor impairment and almost nine times more likely to have a mild motor impairment (8). Another systematic review indicated that LBW is a predictor of global cognitive impairment in children younger than five years, especially among those with a birth weight of 1,250 g or less (9). In addition, very LBW children were documented to have poorer language function (10).

Although several studies have shown the negative effect of LBW on the growth and development of children, no study has been conducted recently in Iran, where chil-

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dren are closely evaluated by healthcare workers in health centers for free.

2. Objectives

This study aimed to compare the growth and development at the age of 60 months between children born with low and normal birth weight in Shiraz, Iran.

3. Methods

This cohort study was conducted based on the Fars birth cohort (FBC) study, whose protocol was published before (11). The FBC study aims to evaluate the association between exposure since fetal life and the growth and development of children born during 2011 in Fars, Iran. Thus, 6,921 pregnant women who lived in Fars at least six months before the study with a gestational age between 20 and 30 weeks were selected through stratified random sampling. After explaining the project, those who agreed to participate were included. During the FBC study, mothers were called through their phone numbers recorded in the FBC database at 2, 6, and 24 months after delivery. Also, mothers and children were invited to be visited at the FBC clinic when children were 60-months-old. In the present study, we used information recorded at birth and 60-month-old visits. This study was approved by the Ethics Committee affiliated to Shiraz University of Medical Sciences (SUMS) under the code IR.sums.med.rec.1397.375. Besides, we reassured mothers that information would not be enclosed to anybody.

For conducting this study, we had to use some information recorded in the FBC databank, including detailed information regarding the children's birth, medical history of mother and child since childbirth, and the socioeconomic status in which the child had been grown up. Besides, we needed the data on the growth and development of children at the age of 60 months. Thus, we called mothers by phone and asked them to bring their children to the FBC clinic for further evaluation. Of 640 mothers who had been registered in the FBC study, we had to exclude some of them because the child's birth weight was more than 4000 grams or the mothers did not answer our calls although we repeated the calls three times on different days of the week and various times of a day. Besides, some of them did not agree to participate in this phase of the study, and some did not attend the FBC clinic despite that they accepted the invitation. Hence, information of 591 cases was used for analysis.

3.1. Child Checklist (Recorded in FBC Databank)

Data at birth included child sex, type of birth (normal vaginal delivery (NVD) or cesarean section (C-section)), weight and height at birth, the place where the newborn was kept after birth (besides mother, in the neonatal ward, or Neonatal Intensive Care Unit (NICU)). Data during the first 60 months of birth included the duration of exclusive breastfeeding, history of hospital admission, and history of any chronic diseases.

3.2. Maternal Checklist (Recorded in FBC Databank)

This checklist consisted of maternal education, occupation, history of smoking, and mental diseases (diagnosed by a physician), as well as the family's economic status according to the mother's belief.

3.3. Children Data at the Age of 60 Months (Gathered by a Trained Nurse at FBC Clinic)

3.3.1. Growth (Weight and Height)

All anthropometric indices were measured by the same digital scale that was calibrated after every 100 measurements.

3.3.2. Development

We determined the level of development at the age of 60 months for each child by using the Ages and Stages questionnaire (ASQ) for 60-month-old children (12). The original version of ASQ is a valid and reliable tool with a 75% sensitivity and 86% specificity in detecting developmental delays, as validated in Iran (12-15). Each domain of ASQ was considered abnormal if it was two standard deviations below normal.

3.4. Maternal Data (Gathered by a Trained Nurse at FBC Clinic)

Considering the importance of maternal mental health in child development, we checked the mental health status of all mothers in interview sessions by using the General Health questionnaire (GHQ). This questionnaire had 28 questions (GHQ-28) whose validity and reliability in the Iranian population were checked by Noorbala and Mohammad (16). The original version of the questionnaire was designed by Goldberg and Hillier as a screening tool to examine four domains, each by seven questions (17). The domains were as follows: Somatic, anxiety/insomnia, social dysfunction, and depression. All questions had Likert scaling systems including "almost always", "usually", "rarely", and "never". Since each question is scored from 3 to 0, the total score for each participant ranged from 0 to 84. A total score of 23 or more and/or a subscale score of 6 or more was considered abnormal (18).

3.5. Statistical Methods

Descriptive statistics were reported as numbers (%) or mean ± SD. The association between categorical variables was examined via the chi-square or Fisher's exact test when appropriate. Also, the independent sample t-test was used to compare continuous variables between the two groups. Statistical analysis was performed using SPSS software, version 21.0, and $P < 0.05$ was considered significant.

4. Results

Of 591 children, 304 (51.4%) were girls. Most of them (93.2%) had normal birth weight, had exclusive breastfeeding for five to six months (79.9%), and did not have any chronic disease (77.8%). The type of delivery for 438 (74.1%) mothers was cesarean sections, 491 (83.1%) mothers were housewives, and most of them scored their family in a middle economic class (94.7%). Also, 383 (64.8%) mothers were categorized in the abnormal group in terms of the total GHQ score.

The associations between the demographic characteristics of mothers and children and birth weight are summarized in Table 1. Most children were girls, but the observed gender difference was not statistically significant. According to our findings, during the first 60 months of children's lives, the prevalence rates of chronic diseases and the history of hospital admission were similar in both LBW and normal birth weight groups. Moreover, in this period, the distributions of maternal job, education level, economic status, history of mental health problems, and proportion of abnormal GHQ scores were similar between the two groups (Table 1).

A higher proportion of children admitted to the NICU, or neonatal wards was underweight (n = 11; 27.5%) compared to those with normal birth weight (n = 47; 8.5%) ($P < 0.001$). Also, a significant association was observed between exclusive breastfeeding and birth weight. In other words, exclusive breastfeeding for periods shorter than the recommendation (at least four months) was significantly ($P < 0.001$) higher among LBW neonates (n = 18; 45%) than in those with normal birth weight (n = 111; 20.1%) (Table 1).

Comparing growth indices, including weight and height at the age of 60 months, we found that these indices were significantly ($P < 0.001$) higher in children with normal birth weight than in their LBW peers. However, the difference was not remarkable clinically. Besides, no significant association was detected between children's development at 60 months of age and birth weight, although normal developmental skills outnumbered in children with normal birth weight compared to their LBW counterparts (Table 2).

Table 2. Association Between Birth Weight and Children's Growth and Development at the Age of 60 Months[a]

Variable	Birth Weight		
	< 2500	2500 - 4000	P Value[b]
Growth at 60 Months of Age			
Height, cm	107 ± 6.2	109 ± 6.0	< 0.001
Weight, g	17925 ± 3670	18186 ± 3210	< 0.001
Development at 60 Months of Age			
Communication			0.71
Normal	28 (70.0)	406 (73.7)	
Abnormal	12 (30.0)	145 (26.3)	
Gross motor			0.30
Normal	39 (97.5)	547 (99.3)	
Abnormal	1 (2.5)	4 (0.7)	
Fine motor			0.60
Normal	39 (97.5)	539 (97.8)	
Abnormal	1 (2.5)	12 (2.2)	
Personality			0.13
Normal	39 (97.5)	550 (99.8)	
Abnormal	1 (2.5)	1 (0.2)	
Problem-solving			0.16
Normal	37 (92.5)	533 (96.7)	
Abnormal	3 (7.5)	18 (3.3)	

[a] Values are expressed as No. (%) or mean ± SD unless otherwise indicated.
[b] P value < 0.05 was considered significant.

5. Discussion

We evaluated 591 children to investigate the association between birth weight and growth and development at the age of 60 months. Most children had normal birth weight with exclusive breastfeeding for five to six months. However, the duration of exclusive breastfeeding and the place where the newborn was kept after birth were significantly different between neonates with LBW and normal birth weight. We found that other studied sociodemographic characteristics of newborns and their mothers were similar between LBW and normal birth weight groups.

Most of the studied children who were breastfed for the first 5 - 6 months of their lives had normal birth weight. In other words, the proportion of inadequate exclusive breastfeeding was higher among underweight children. Similarly, a study in Nigeria found that non-exclusive

breastfeeding for at least 12 months was a strong determinant of wasting and underweight in children aged 0 - 59 months (19). This is confirmed by Kuchenbekher et al. (20) that stated exclusive breastfeeding is important in the prevention of growth retardation.

In the studied sample, normal birth weight was much more prevalent among newborns kept beside their mothers when compared to neonates admitted to NICUs or neonatal wards. It indicates the importance of the early initiation of breastfeeding after birth in increasing exclusive breastfeeding duration, as also recommended by the WHO (21). Thus, it is expected that the majority of LBW newborns were not kept beside their mothers after birth due to poor conditions; hence, breastfeeding could have been started later than in newborns with the normal condition, which resulted in the decreased duration of exclusive breastfeeding.

We also found that both height and weight at the age of 60 months had a significant association with birth weight. Hence, children born with LBW had lower weight and height at the age of 60 months than their peers with normal birth weight. Despite that the differences seem to be not remarkable clinically, it was consistent with a recent study on 475 families with one child aged 6 - 24 months. It showed that child's weight at birth was significantly associated with stunting and underweight at the ages of 6 to 24 months (22). However, a study on the postnatal weight increase and growth of VLBW infants showed more severe growth impairment in VLBW infants with major morbidities (23), which shows the importance of considering morbidities.

Previous studies showed that less maternal education was associated with the delivery of low birth weight infants (24), but this association was not significant in the current study. It could be due to the effect of social media as a rich source of information. In recent years, the internet has become a popular source of health information among pregnant women so that when they refer to the physician, they have some knowledge about the problem (25, 26). Therefore, it seems that the majority of mothers, regardless of their education level, search their questions on the internet, which disrupts the relationship between mothers' education and child growth.

Although normal developmental skills were more prevalent in children born with normal birth weight, we found no significant relationship between different dimensions of developmental skills and birth weight. This is contrary to previous studies that showed a significant association between birth weight and various domains of child development (1, 27, 28). The results of our study could be due to the effective role of government health centers in Iran that monitor infants very closely free of charge. In Iran, special health care workers are trained, called Behvarz (29). One of their most important responsibilities is to monitor children's growth and development in the first six years of life, especially in the first two years. Indeed, they monitor the growth and development of children very meticulously and track underweight children for extra care and referral for physician examination (30). If they find any delay, based on the severity of the problem, they may refer the child to the pediatrician or train mothers to solve the problem before it affects child development in the future.

This study had some weaknesses that limit the generalization of the results to other parts of Iran. The most important one was the place (Shiraz), where the study was conducted, which is one of the biggest cities in Iran. Thus, the situation cannot be compared with rural areas with limited access to modern NICUs and even a well-equipped neonatal ward. However, it has some strong points, including the type of study, which was a prospective cohort study. Indeed, we used the data from the FBC databank, so recall bias was negligible. Also, Shiraz is the fifth populous city of Iran, where different ethnicities live. Furthermore, all children were examined with the same examiner and the same tool, which minimizes the inter-examiner bias.

5.1. Conclusions

Although the growth indices of children at the age of 60 months were higher in children with normal birth weight, we found no significant difference in children's development at the age of 60 months between normal and low birth weight children. Besides, in this study, many factors that have been considered confounding in previous studies were similarly distributed in both normal and LBW groups. Thus, we could claim that the environment where children were grown up was very similar. However, due to the low prevalence of underweight in the study sample, we could not generalize the results. More investigation with more LBW newborns is needed to confirm these results.

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Footnotes

Authors' Contribution: Conceptualization: Kamran Bagheri Lankarani and Hadi Raeisi Shahraki. Methodology: Najmeh Maharlouei and Abbas Rezaianzadeh. Data Analysis: Hadi Raeisi Shahraki. Data Gathering: Sogand Farhangian. Investigation: Sogand Farhangian and Abbas Rezaianzadeh. Writing and original drafting: Najmeh Maharlouei, Sogand Farhangian, and Hadi Raeisi Shahraki. Writing, review, and editing: Abbas Rerezaianzadeh and Kamran Bagheri Lankarani. Funding acquisition: Najmeh Maharlouei. Supervision: Najmeh Maharlouei and Kamran Bagheri Lankarani.

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Table 1. Association Between Demographic Characteristics of Mothers and Child with Birth Weight[a]

Variables and Subgroups	Birth Weight[b]		
	< 2500	2500 - 4000	P Value
Child Information			
Gender			0.43
Girl	23 (57.5)	281 (51.0)	
Boy	17 (42.5)	270 (49.0)	
The place the child was kept after birth			< 0.001
Beside mother	29 (72.5)	504 (91.5)	
Neonatal ward	2 (5.0)	26 (4.7)	
NICU	9 (22.5)	21 (3.8)	
Exclusive breastfeeding			< 0.001
< 1 month	15 (37.5)	80 (14.5)	
1 - 4 months	3 (7.5)	31 (5.6)	
5 - 6 months	22 (55.0)	440 (79.9)	
Child chronic diseases			0.96
No	31 (77.5)	429 (77.9)	
Yes	9 (22.5)	122 (22.1)	
History of hospital admission			0.99
No	21 (52.5)	352 (63.9)	
Yes	19 (47.5)	199 (36.1)	
Maternal Information			
Age	33 ± 4.1	34 ± 5.0	0.41
Number of children (Median; minimum-maximum)	1; 1 - 3	1; 1 - 3	0.98
Type of delivery			0.89
NVD	10 (25.0)	143 (26.0)	
C-section	30 (75.0)	408 (74.0)	
Education			0.47
Below diploma	9 (22.5)	143 (26.0)	
Diploma	19 (47.5)	207 (37.6)	
University degree	12 (30.0)	201 (36.5)	
Job			0.052
Housewife	30 (75.0)	461 (83.7)	
Part-time	1 (2.5)	29 (5.3)	
Fulltime	4 (10.0)	42 (7.6)	
Two shifts	5 (12.5)	19 (3.4)	
Economic status[c]			0.28
High	3 (7.5)	18 (3.3)	
Middle	34 (85.0)	492 (89.3)	
Low	3 (7.5)	41 (7.4)	
Smoking history (cigarette or hookah)			0.86
No	22 (55.0)	311 (56.4)	
Yes	18 (45.0)	240 (43.6)	
History of psychiatric problem [c]			0.77
No	36 (90.0)	505 (91.7)	
Yes	4 (10.0)	46 (8.3)	
GHQ 1[e]			0.85
Normal	10 (25.0)	128 (23.2)	
Abnormal	30 (75.0)	423 (76.8)	
GHQ 2[f]			0.99

Normal	9 (22.5)	131 (23.8)	
Abnormal	31 (77.5)	420 (76.2)	
GHQ 3[g]			0.75
Normal	18 (45.0)	263 (47.7)	
Abnormal	22 (55.0)	288 (52.3)	
GHQ 4[h]			0.50
Normal	28 (70.0)	350 (63.5)	
Abnormal	12 (30.0)	201 (36.5)	
GHQ total[i]			0.39
Normal	17 (42.5)	191 (34.7)	
Abnormal	23 (57.5)	360 (65.3)	

Abbreviations: C-section, cesarean section delivery; NICU, neonatal intensive care unit; NVD, normal vaginal delivery.
[a]Values are expressed as No. (%) or mean ± SD unless otherwise indicated.
[b]Out of 478 cases.
[c]According to the mother's belief.
[d]It was considered positive if the diagnosis was made by a physician.
[e]GHQI: Somatic symptoms (items 1 - 7); abnormal level: score $\geq$ 6.
[f]GHQII: Anxiety/insomnia (items 8 - 14); abnormal level: score $\geq$ 6.
[g]GHQIII: Social dysfunction (items 15 - 21); abnormal level: score $\geq$ 6.
[h]GHQIV: Severe depression (items 22 - 28); abnormal level: score $\geq$ 6.
[i]GHQ-28: General health questionnaire (items 1 - 28); abnormal level: total score $\geq$ 23.