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Original article

Developmental status of 5-year-old moderate low birth weight children

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Abstract

Background: Low birth weight (LBW or birth weight < 2500 g) is one of the most serious children problems in today's world. The purpose of this study was to evaluate and compare developmental status of moderately LBW (birth weight: 1500–2499 g) children at the age of five to that of normal birth weight (NBW: birth weight: 2500–4000 g) ones. Methods: In a case-control study, developmental status of five year old children referred for vaccination between December 2008 and June 2009 in Yazd-Iran, evaluated via Persian version of 60-month Ages and Stages Questionnaires (ASQ). NBW and MLBW children were selected as control and case groups, respectively. Results: Frequency of developmental delay in gross motor, fine motor and problem solving domains were significantly higher in MLBW group and mean score in all developmental domains was statistically significant lower in case group. Conclusion: LBW is one of risk factors for developmental delay. So, evaluation and monitoring of development status of LBW should be emphasized for early and timely diagnosis, investigation, management and also rehabilitation.

Keywords: Infant; Low birth weight; Moderately low birth weight; Child development; Ages and Stages Questionnaires (ASQ)

1. Introduction

Low birth weight (LBW or birth weight of less than 2500 g) is one of the major neonatal and postnatal morbidity determinants. LBW neonates are subgrouped according to the first birth weight:

- Moderately low birth weight (MLBW): between 1500 and 2499 g.
- Very low birth weight (VLBW): less than 1500 g.
- Extremely low birth weight (ELBW): less than 1000 g.

In LBW infants, cerebral palsy, mental retardation and other sensory and cognitive dysfunctions are higher than in infants with normal birth weight (NBW or birth weight 2500–4000 g) [1]. According to WHO statistics, the rate of LBW is 17% in the whole world (6% in industrialized countries and 21% in developing ones). The rate in the Islamic Republic of Iran is 10% [2] and in Yazd (central city of Iran) is 8.4% [3].

On the other hand, almost 16% of children have a developmental disorder [4]. Based on recommendation of the American Academy of Pediatrics, for early diagnosis of neurodevelopmental delay, developmental surveillance should be performed in all infants and young children at every well-child visit and formal standardized screening tools must be used at selected age intervals (9, 18, and 24 or 30 months) and also, if there is developmental concerns by the parent or the provider during surveillance [5]. Developmental screening tests

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may be used by trained professionals (Denver II, the Bayley Neurodevelopmental screener, the Batelle Developmental Inventory, etc.) or by the parents (Ages and Stages Questionnaires (ASQ), Parents' Evaluation of Developmental Status, Minnesota Child Development Inventory, Kent Inventory of Developmental Skills, Parent Report of Children's Abilities Revised for Preterm Infants, etc.).

Parental reports screening tests are cost-effective, easy to complete, time saving and terminate the challenge of directly extracting skills from children who, by reasons such as illness, sleepiness, anxiety and fear, may not show their best effort on the testing day and also can detect true problems [6,7]. Amongst the tests, ASQ is currently the most widely used. Sensitivity of the ASQ test is 75% in high risk group and 100% in the community group, with specificity of 95% and 90%, respectively [8]. Validity of this test varies from 76% to 88% and includes 19 different questionnaires that can screen developmental status of children from 4 to 60 months in five different domains: communication, gross motor, fine motor, problem solving and personal-social skills. Each domain is evaluated by six questions on what the child can or cannot do. They are selected so as to be representatives of a developmental quotient of 75–100%. The answer of parents to each question is "yes" to indicate that the child does the special behavior of this item, "sometimes" to indicate an occasional or emerging response and "not yet" to indicate that their child does not yet do the behavior, with a respective score of 10, 5 or 0 points. Then scores of each item summed and final score in each domain is compared to cut-off points of the ASQ guidelines. The score on any domain below the cut-off point or higher than two standard deviations below the mean of the reference group, is considered abnormal and referral for further evaluation [9–13].

The purpose of this study was to evaluate and compare the developmental status of moderately LBW children at the age of five to normal birth weight ones via Persian version of the 60-month ASQ test in Yazd, central city of I.R. Iran.

2. Materials and methods

According to vaccination programs of Iran, 4–6 year old children should be visited in well-child preventive health care centers routinely. Therefore, a case-control study conducted on all 5-year-old children referred for vaccination to primary health care center of Azadshar between December 2008 and June 2009 in Yazd-Iran.

The Azadshar center is one of primary health care centers in the city of Yazd, central city of Iran and 4887 less than 60 months of age children are covered by this center.

Sample size based on Z formula and confidence interval of 95% with 80% power to detect a significant difference between the two groups with a level of 0.05, was assessed on 300 persons (150 in each group).

The children in case and control groups enrolled in the study successively and based on the birth weight in health records, these children were distributed into two groups. One hundred and fifty of whom were MLBW (case group) and other 150 as control group, had NBW (birth weight: 2500–4000 g).

Multiple pregnancies, severe asphyxia, NICU admission, children with major congenital malformations, chromosomal abnormalities and genetic syndromes were excluded. Then developmental status of these children assessed based on Persian version of the 60-month ASQ screening test after interview with parents in all cases and controls. The score of each domain below the cut-off point considered as developmental delay in this domain.

The data were analyzed using SPSS:15 statistical software. Chi-square test or Fisher exact test were used for data analysis of qualitative variables and mean values in two groups and in more than two groups were compared using independent T-test and ANOVA (analysis of variance) test, respectively. Differences were considered significant at P values of less than 0.05.

This study has been approved by the ethic committee of Shaheed Sadoughi University of Medical Sciences and Health Services, Yazd, Iran.

3. Results

Fifty-three children (35%) in case group and 75 (50%) in control group were female and sex distribution was not different in the two groups (P value = 0.4).

The race in case and control groups was the same. In MLBW group, maternal educational levels were illiterate, primary and secondary school, high school and higher education by the amounts of 12%, 49%, 33% and 6%, while these figures were 13%, 48%, 34% and 5% in control group, respectively (P value = 0.5). Therefore maternal educational level distribution was not different in case and control groups.

Mean of birth weight was 1833.4 ± 173.8 g (range = 1620–2350 g) in MLBW group and 3120.4 ± 212.8 g in NBW group. (P value = 0.02).

One hundred and three children (69%) in case group and 12 (8%) in control group were premature (gestational age of less than 37 weeks) and prematurity was more in MLBW group (P value = 0.001).

Frequency distribution of developmental delay in all developmental domains of both groups is shown in Table 1 which indicates that in gross motor, fine motor and problem solving domains, abnormal developmental status was significantly higher in MLBW group.

Comparison of mean scores in all developmental domains presented in Table 2. ANOVA test showed that mean score in all developmental domains were

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Table 1
Frequency of developmental delay in each developmental domain in groups.

Developmental domain		Moderately low birth weight	Normal birth weight	*P* Value
Gross motor	Normal	141	150	0.003
	Delay	9	0	
Fine motor	Normal	136	149	0.001
	Delay	14	1	
Problem solving	Normal	121	146	0.001
	Delay	39	4	
Personal-social skills	Normal	150	150	0.5
	Delay	0	0	
Communication	Normal	149	150	0.1
	Delay	1	0	

statistically significant, lower in MLBW children and especially in birth weight of 1500–1999 g.

4. Discussion

Developmental outcome studies on the LBW is usually restricted to VLBW and ELBW and studies on MLBW are rare.

In Pietz et al. study in Germany, neurodevelopmental outcome (via neuropsychological test battery comprising tests for language, visual-perceptual, visual-motor, fine and gross motor abilities) were evaluated in seventy 7-year-old, low-risk, LBW children without neurological impairment and were compared to the control group born at term. Mean score in language and visual-motor domains were statistically significant lower in LBW preterm group and slightly LBW group (2000–2499 g) had poorer language abilities [14].

In Schendel et al. study in Chamblee – USA, prevalence of neurodevelopmental delay based on Denver Developmental Screening Test II at a median adjusted age of 15 months compared in VLBW, MLBW and normal birth weight singleton children. Well VLBW children were apparently consistent at greater risk for both moderate and severe delay [15].

In Zhang et al. study in Shanghai-China on preterm infants discharged from NICU at the age of one, critical and abnormal neurological development were seen in 29.0% and 12.4% of them, respectively. Prematurity, low education level of parents, multiple pregnancies, severe intracranial hemorrhage and apnea, were risk factors of developmental delay [16].

In present study, developmental delay in problem solving domain was higher in MLBW children. In another study on small-for-gestational-age fetuses with normal umbilical artery Doppler, showed significantly lower neurodevelopmental centile in the problem solving and personal-social skills [17].

In a Spanish study, developmental outcome of 116 extremely low birth weight infants who were in the first three years of life was assessed and cerebral palsy was seen in 50% of them while psychomotor and speech development was normal in most of these children [18].

In Mikkola et al. study, 25% of ELBW infants had normal development at the age of five [19].

Two other studies showed that prematurity and VLBW were accompanied by significant motor impairment at the age of seven [20] which persisted throughout childhood [21].

In another study in Germany, development status of 65 low-risk LBW preterm infants compared to that of 41 term born controls from childhood to late adolescence. School enrollment of LBW children was mostly delayed, and lower school graduation was more seen in LBW kids. In general, LBW showed no main deficits in late adolescence, but manifested subtle neurodevelopmental deficits in LBW [22].

In Datar study, mental and motor development of VLBW and MLBW babies who were at the first two years of life was compared to that of normal birth weight ones. LBW has a small adverse effect on mental and motor development in first two years of life [23].

Lindsay et al. study, showed the ASQ is useful to detect severe developmental delay in children with hypoxic–ischemic encephalopathy at birth, but this test failed to detect mild delay [10].

The results of this study showed that MLBW is one of risk factors of developmental delay at the age of five. Boardman et al. found in their study that birth weight is significantly related to developmental outcomes. The effect associated with adverse birth outcomes is significantly more pronounced at VLBW than at MLBW and the effect of MLBW status, when compared to race/ethnicity and mother's education is small. The

Table 2
Comparison of mean scores in each developmental domain in two groups.

Developmental domain	Groups			
	MLBW Mean ± SD		NBW Mean ± SD	*P* value
	1500–1999 g	2000–2499 g		
Gross motor	53.8 ± 2.73	55.1 ± 3.92	59.1 ± 1.58	0.0001
Fine motor	45.5 ± 12.2	48.4 ± 10.8	52.07 ± 6.42	0.0001
Problem solving	40.5 ± 11.1	43.7 ± 12.1	50.33 ± 7.59	0.0001
Personal-social skills	55.7 ± 5.46	57.1 ± 4.85	59.3 ± 2.01	0.001
Communication	52 ± 6.5	54 ± 5.9	58.4 ± 2.8	0.0001

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observed differentials between MLBW and NBW children are substantially smaller among older children in comparison to younger ones [24].

In Mervis et al. study, risk of mental retardation (intelligence quotient $\leqslant$70) was higher for VLBW children than for the MLBW, and higher for severe mental retardation (intelligence quotient <50) than for mild mental retardation (intelligence quotient 50–70). Adding gestational age to the models revealed that NBW children who were born preterm were also at increased risk of having mental retardation at 10 years [25].

Today with dramatic improvement in neonatal care, survival rates of LBW neonates have been increased and life quality of survivors has caused more concern. Problems of VLBW and ELBW infants are so much profound and recent research, mostly focused on these children and clinicians pay less attention to the risk that MLBW infants may face longer-term outcomes. The present study showed that developmental delay was more frequent in children with birth weight 1500–2499 g (MLBW) comparing to NBW kids and children with birth weight 1500–1999 g had the lowest mean score in all developmental domains and it is in compliance with other studies which suggested MLBW children were significantly more likely than NBW children to be identified as having a learning disability [26–28].

LBW neonates (premature or small for gestational age) are not a homogeneous group and however, the majority of LBW children have normal outcomes but they are high risk for further broad spectrum of growth, health and developmental problems [26]. The lower birth weight is associated with more medical problems (such as prematurity, apnea and respiratory distress, hypoglycemia, hypothermia, hyperbilirubinemia, etc.), subnormal growth, illnesses, and neurodevelopmental delay. On the other hand, side effects of medical treatments in these patients (such as retinopathy of prematurity due to oxygen therapy, hearing problems from aminoglycosides and other ototoxic medications, etc.), prolong hospitalization of these neonates until their weight approaches 2000 g and delay in neonate–mother bonding, hospital infections [1], etc. may be contributing to developmental outcome of these children.

Maternal, environmental, sociodemographic and genetic factors have an important role in determining birth weight and future mental, motor, and physical development of children [23]. However, changes in psychological test scores between ages were the predominant reason for a change in classification of disability over time and children could be above the cut-off point at one age and below that at another age and the longer the period of follow up, the more certain are the diagnoses of neurosensory impairments and disabilities [29].

In present study, ASQ test used for developmental assessment and other researches with longer follow up period, different developmental screening tests and more than number of patients should be done.

5. Conclusion

In MLBW infants, developmental assessment is necessary. Follow up and accurate recording of development status of LBW infants including low-risk populations by personnel of health centers, regular and frequent visiting of these children, education of their parents about development process and follow up should be emphasized for early and timely diagnosis, investigation, management and rehabilitation in LBW children. Recognizing children with developmental delay before school entry, instead of waiting for harsh problems which may arise later on, could aid to halt unnecessary problems for these children and their parents.

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