Prevalence of Motor Developmental Disorders in Children in Alborz Province, Iran in 2010

Farin Soleimani 1; Roshanak Vameghi 1,*; Akbar Biglarian 2; Mehdi Rahgozar 2

1Pediatric Neurorehabilitation Research Center, University of Social Welfare and Rehabilitation Sciences, Tehran, IR Iran
2Department of Biostatistics, University of Social Welfare and Rehabilitation Sciences, Tehran, IR Iran
*Corresponding Author: Roshanak Vameghi, Pediatric Neurorehabilitation Research Center, University of Social Welfare and Rehabilitation Sciences, Tehran, IR Iran. Tel: +98-2122180099, Fax: +98-2122180040, E-mail: r_vameghi@yahoo.com

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Background: Unlike developed countries, data from the developing world regarding motor developmental disorders is scarce.

Objectives: In the present study, we used the Infant Neurological International Battery (Infanib) test to determine the prevalence of motor impairment in 4-18 month-old infants in Alborz province, Iran, in 2010.

Patients and Methods: This study was a descriptive-analytic study performed on 6150 infants in Iran. The sample was recruited by convenience sampling from all 4-18 month-old children attended healthcare centers in different districts of Alborz province. Sampling was continued until reaching the desired sample size.

Results: The sample included 3129 boys and 3021 girls. There was no significant difference between the scores of girls and boys (P = 0.403). The number of children with motor developmental abnormality varied depending on the considered cut-off points. In normative cut-off points, 3.7% had motor disorder, whereas based on the Iranian cut-off points, it was 6.5%.

Conclusions: Providing an early detection and intervention system is an urgent public health problem due to the prevalence of motor developmental delay in infants living in Alborz province, because it indicates that most infants had been previously undiagnosed and untreated.

Keywords: Prevalence; Infant; Child Development

1. Background

Many studies described short and long-term negative impacts of developmental and behavioral disorders in children (1-7). Several studies stressed on the critical nature of early identification and intervention for such disorders for successful functioning of affected children (8-12). Early detection of infants and young children with developmental disorders should be performed at an early age. In the first year of life, motor development is an important manifestation of integrity and functionality of the central nervous system. Deviation in motor development can be the first sign of other developmental disorders (13).

Neurological examinations have widely used techniques, generally with a good validity in predicting major developmental disorders and a moderate predictive validity for minor motor disorders and delays (14). However, a thorough and standardized neurologic examination can essentially identify infants with moderate to severe neurological abnormalities, as well as those at risk of neurodevelopmental abnormalities (15). Studies showed that abnormal findings in standardized neurological examinations at 6 and 12 months correct age were significantly related to subsequent developmental at 20 months of age (13-16).

Despite a large number of reports on the prevalence of motor impairment in developed countries, data from the developing world is scarce (17), which may be due to low priority of the issue in view of policy makers. Most children with delays or disabilities live in developing countries (18-20). Some studies have shown that the prevalence of developmental disorders such as mental and motor problems was higher in some developing countries than developed countries (21).

On the other hand, to inform surveillance and intervention services for high-risk children, we need accurate estimates of the prevalence of motor impairment, an understanding of the nature of this impairment and an appreciation of associated risk factors.

2. Objectives

In the present study, as one of the first prevalence studies on infants’ motor impairment performed in Iran, we used the Infant Neurological International Battery (Infanib) test to determine the prevalence of motor impairment in 4-18 month-old infants in Alborz province, Iran, in 2010.
fanib) test to determine the prevalence of motor delays or disabilities in infants living in Alborz province. Alborz is a western neighbor province to Tehran (the capital city of Iran) with approximately 1.2-1.5 million inhabitants mostly immigrants from all over the country, causing a sociocultural and economic diversity in its population. Some authors argued that the attainment of gross motor skills may vary between cultures and new reference norm values may be necessary in every different population (13, 21).

3. Patients and Methods

This was a cross-sectional, descriptive-analytic study performed in Alborz province in Iran. Convenient sampling took about 12 months to complete at 2010. The inclusion criteria were infants aged 4 to 18 months, inhabitants of Alborz province and parent consent for participation in the study. The initial sample size was 6195, 45 of which were excluded because of irrelevant age range. Actually 6150 infants were recruited in our study; 35-40% of all infants living in Alborz province were included (22).

To provide an appropriate coverage of major geographic as well as socioeconomic divisions of the province, the northern, southern, eastern, western and central districts of Alborz province were considered. Five governmental and non-referral health-care centers, each located in one of these five districts were chosen. Healthcare personnel at other health-care centers were asked to refer all 4-18 months infants for testing to these centers. Healthcare centers provided about 95% coverage for all children living in Alborz province.

The Infanib test was used to assess the neurological integrity of infants and to detect motor developmental disorders. This examination consists of 20 items assessing infant in supine, prone, sitting, standing and suspended positions for body tone and posture, reflexes and French angles and provides a final score (23, 24). It also provides optimal mean and cut-off values reflecting the norm in the original normative sample. The Infanib test was shown to have high validity (determined by ANOVA F values with the level of significance for the degrees of normality-abnormality) and reliability (0.88 for infants younger than 7 months and 0.93 at 8 months or older) in the reference value (15, 23, 24). Besides, the validity and reliability of the test had been previously determined in Alborz province, which yielded a 90% sensitivity and 83% specificity as well as a 0.99 correlation coefficient (test-retest reliability) (25). In this study, five examiners performed the test for each child. The intraclass correlation coefficient between examiners was 0.9.

In our study, we first determined the Iranian cut-off points, derived from the study population mean scores minus 1 and 2 Standard Deviations (SDs). Next, children were classified into three groups: 1) normal was defined as an Infanib score > 1 SD below the mean, 2) mildly to moderately abnormal was defined as an Infanib score 1 to 2 SD below the mean score and 3) moderately to severely abnormal was defined as an Infanib test score more than 2 SD below the mean score of the Iranian age-appropriate mean scores. Data was analyzed using SPSS 16.0 software. We did not have any missing data.

The study and proposal were approved by the Ethics Committee of University of Social Welfare and Rehabilitation Sciences. An informed consent was obtained from parents. The parents whose children had developmental problems were informed and guided. There was no extra charge imposed on infants’ parents.

4. Results

Our sample included 3129 boys (50.9%) and 3021 girls (49.1%). The mean birth weight was 3180 ± 500 grams and the mean age was 10 ± 4 months. The age and gender distribution of children is demonstrated in Table 1. The Iranian cut-off points, for different age and gender groups are presented in Table 2. As for the final categorization to normal, mild-moderate and moderate-severe abnormal groups, the frequency and percentage of each is demonstrated for gender and age groups in Tables 3. This table shows that total abnormal children and in all gender and age subgroups increased, which means that the Iranian cut-off points are at a higher scoring level than the normative sample. In both cases, it is when Iranian (as demonstrated in Table 4) or the normative cut-off points were considered, there was no significant difference between the scores of girls and boys (P = 0.403). Our results showed that considering the normative cut-off points, 3.7% of Iranian infants had motor developmental disorder, whereas based on the Iranian cut-off points this increased to 6.5% (Table 5).

Table 1. Age and Gender Distribution of Children a

| Age, mo | Girls | Boys | Total |
|--------|-------|------|-------|
| < 6    | 756 (48.9) | 789 (51.1) | 1545 |
| 6-8    | 452 (48.2) | 486 (51.8) | 938 |
| 8-10   | 600 (51) | 576 (49) | 1176 |
| 10-12  | 362 (50.6) | 354 (49.4) | 716 |
| 12-14  | 232 (47.8) | 253 (52.2) | 485 |
| 14-16  | 419 (48.8) | 440 (51.2) | 859 |
| 16-18  | 199 (46.2) | 232 (53.8) | 431 |
| Total  | 3021 (49.1) | 3129 (50.9) | 6150 |

a Data are presented as No. (%).
Table 2. Iranian Cut-off Points of Infant Neurological International Battery in Different Age and Gender Groups

| Age Groups, mo | Girls Mean Score | Mild-Moderate Abnormal | Moderate-Severe Abnormal | Boys Mean Score | Mild-Moderate Abnormal | Moderate-Severe Abnormal | Total Mean Score | Mild-Moderate Abnormal | Moderate-Severe Abnormal |
|---------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|---------------------|------------------------|--------------------------|
| < 6           | 75.57            | 70.39-65.21            | < 65.21                  | 76.13            | 71.05-65.96            | < 65.96                  | 75.86               | 70.72-65.58            | < 65.58                  |
| 6-8           | 83.64            | 76.93-70.21            | < 70.21                  | 83.13            | 76.18-69.23            | < 69.23                  | 83.38               | 76.54-69.70            | < 69.70                  |
| 8-10          | 92.86            | 86.12-79.38            | < 79.38                  | 92.70            | 86.23-79.76            | < 79.76                  | 92.78               | 86.18-79.57            | < 79.57                  |
| 10-12         | 96.20            | 88.10-80.00            | < 80.00                  | 96.74            | 90.93-85.12            | < 85.12                  | 96.47               | 89.41-82.35            | < 82.35                  |
| 12-14         | 97.99            | 91.34-84.69            | < 84.69                  | 97.67            | 91.56-85.45            | < 85.45                  | 97.83               | 91.46-85.09            | < 85.09                  |
| 14-16         | 99.36            | 96.57-91.77            | < 91.77                  | 99.20            | 95.59-91.98            | < 91.98                  | 99.28               | 96.04-92.81            | < 92.81                  |
| 16-18         | 99.08            | 94.22-89.37            | < 89.37                  | 98.02            | 89.29-80.55            | < 80.55                  | 98.51               | 91.29-84.07            | < 84.07                  |

Table 3. Distribution of Abnormality in Each Age Group, Based on Normative and Iranian Cut-off Points

| Age Groups, mo | Normative Sample Cut-Off Points | Iranian Sample Cut-Off Points | Normal | Abnormal | Normal | Abnormal | Normal | Abnormal |
|---------------|--------------------------------|-------------------------------|--------|----------|--------|----------|--------|----------|
|               |                                |                               |        |          |        |          |        |          |
| < 6           |                                |                               | 1443 (93.4) | 102 (6.6) | 1379 (89.3) | 117 (7.5) | 49 (3.2) |
| 6-8           |                                |                               | 896 (95.5)  | 42 (4.5)  | 903 (96.3)  | 20 (2.1)  | 15 (1.6) |
| 8-10          |                                |                               | 1134 (96.6) | 42 (3.6)  | 1041 (88.5) | 116 (10)  | 19 (1.5) |
| 10-12         |                                |                               | 697 (97.3)  | 19 (2.7)  | 684 (95.5)  | 23 (3.2)  | 9 (1.3)  |
| 12-14         |                                |                               | 474 (97.8)  | 11 (2.2)  | 473 (97.5)  | 5 (1.1)  | 7 (1.4)  |
| 14-16         |                                |                               | 854 (99.4)  | 5 (0.6)   | 851 (99.1)  | 6 (0.7)  | 2 (0.2)  |
| 16-18         |                                |                               | 420 (97.4)  | 11 (2.6)  | 418 (97)    | 4 (1)  | 9 (2)    |
| ≤ 18          |                                |                               | 5918 (96.3) | 232 (3.7) | 5749 (93.5) | 291 (4.7) | 110 (1.8) |

Table 4. Chi-Square Test Between Different Gender Groups With Developmental Disorders

| Variable | Girl | Boy | χ² | df | P Value |
|----------|------|-----|-----|----|---------|
| Abnormal | 205  | 196 | 0.69 | 1  | 0.403   |
| Normal   | 2815 | 2934|     |    |         |

Table 5. Prevalence of Developmental Disorders Based on Normative and Iranian Sample Cut-Off Points

| Sample Type | Prevalence | Prevalence |
|-------------|------------|------------|
| Developmental Disorder | Iranian Sample | Normative Sample |
|               | 401 (6.5)   | 232 (3.7)  |

5. Discussion

Our results showed that considering the original test norms, 3.7% of infants had motor impairment, whereas based on the Iranian norms, it increased to 6.5%. Identification of a greater rate of delays or disabilities in studies using a local reference sample rather than the test norms, has been previously reported (10).

In the Iranian cut-off points, we classified our children into three groups as “normal”, “mild to moderate” and “moderate to severe” abnormal. We followed the suggestion of Williams to report impairment rates using both levels of impairment for ease of comparison, which is due to large differences between prevalence rates when mild-moderate and moderate impairment cut-offs are used. Therefore, impairment rates were reported accord-
ing to both local and original test norms to allow replication and comparison with other studies (10). However, determining two levels of abnormality using the minus 1 and minus 2 SD from the mean scores may have an additional benefit, namely, allowing differentiation between children with mild delays who need monitoring and promotional interventions from those with more serious abnormalities who benefit from early rehabilitation (10). Rydz estimated that 5-10% of the global pediatric population has some forms of developmental disability (26).

The Health Intervention Survey on Disabilities conducted on children aged 4 to 59 months in the U.S. reported a 3.3% rate of functional and a 3.4% rate of general developmental delays (27). Moreover, the national survey of Child and Adolescent Health Measurement Initiative reported a rate of 3.4% developmental problems in American children (4). Another study performed in the USA identified a 3.2% rate of developmental delays in preschoolers (1).

The prevalence rates reported from some other countries are widely varying. In Canada, as a result of a 2-year follow-up study, To et al. reported a 46% prevalence of all kinds of developmental disorders in children aged 1-5 years (28). In another study, motor performance of 100 Dutch children, aged 0-12 months was measured using the normative cut-off points of the Alberta Infant Motor Scale (AIMS), which was originally produced in Canada. In this study, 17-29% of the children showed motor developmental delays by the reference values (13). The mean percentile score of the Dutch children was 28.8 (± 22.9, range 1-85). The percentile scores of this group were significantly lower than the Canadian norm population (P < 0.001), whereby 75% of the Dutch children scored below the 50th percentile. These lower scores were not explained by gender, racial differences or congenital disorders and observed in all age groups. The authors concluded that new reference values should be defined on the AIMS test for the age group of 0-12 months for Dutch children. They recommended determining new normative data in all other European countries. Although they considered only motor developmental delays and the age range of children was nearly the same of ours, their result was not consistent with ours in different figures for delays. Besides, the authors assumed that using the original Canadian cut-off points resulted in rather high figures for developmental delays in Dutch children, our study showed the opposite regarding the Infanib test.

The World Health Organization Regional office for Europe indicated prevalence rates of up to 10% for neurodevelopmental disorders in Eastern Europe and post-soviet republics (29). Unfortunately, there is limited information regarding the prevalence of neurodevelopmental delays in nonindustrialized countries. In Colombia, the Colombian National Neuro-epidemiological Study found a 46.1% prevalence of neurodevelopmental disorders in a multiregional survey conducted on children younger than seven years (30), while two other Colombian studies found prevalence rates of 18.6% and 30.8% for combined NDD, respectively (6).

Other studies reported such wide rates as 6% neurological impairment in children in Kenya (18), 9.4% abnormal development rate and 2.1% fine and gross motor problems in two year-old children in Georgia (7), and 26% disability in 2 year-old children in some very low-income areas in India (31). In Iran like many other developing countries, studies on developmental status of children are very few and the results are different from other studies around the world. In a study performed on 7500 children aged 1 month to 3 years in Tehran, a 1.87% rate of motor development delays was determined (32). Kowsarian showed a 12.3% rate of developmental concerns in children younger than 6 years in Sari, using the PEDS questionnaire (33). In another study on 0-2 year-old infants in Tehran, a prevalence rate of 15-22% was found for global developmental delays (34).

Such discrepancies in results and a wide range of prevalence rates even in similar populations, might be due to: underestimation relied on parental reporting (1, 35), different interpretations of the word ‘delay’ by parents with different cultural backgrounds (36), using different criteria for identification of developmental problems in different studies, underestimation due to delay between the onset of symptoms and diagnosis of developmental problems in cases where the latter is considered as inclusion criteria for the research, and underestimation because of limited provision of developmental assessments in primary care settings (1), different methodologies (longitudinal vs. cross-sectional), different sample size and selection criteria (6).

Our limitations in this study were short follow-up and assessment of development exclusively in the motor domain. The strong points were the large sample number and use of the Infanib test, which incorporates several methods of neurological evaluation of infants in one instrument with quantified scores. Regarding the considerable prevalence of motor developmental delay and disorder in infants living in Alborz province, meaning that most had been previously undiagnosed, provision of an early detection and intervention system in Alborz province is an urgent public health requirement. It needs substantial investment and planning from public and non-public sectors. We also suggest performing similar studies, preferably including other age groups and developmental domains in Alborz as well as other Iranian cities and provinces, to provide a more vivid profile of the developmental status of Iranian children.

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Authors’ Contributions

Dr. Farin Soleimani the chief investigator contributed
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