Iran Red Crescent Med J. 2014 December; 16(12): e16711. DOI: 10.5812/ircmj.16711

Published online 2014 December 25. **Research Article**

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]

[1]Pediatric Neurorehabilitation Research Center, University of Social Welfare and Rehabilitation Sciences, Tehran, IR Iran
[2]Department 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: +98-2122180140, E-mail: r_vameghi@yahoo.com

Received: December 9, 2013; **Revised:** May 20, 2014; **Accepted:** October 1, 2014

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 (In-

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			Boys			Total		
	Mean Score	Mild-Moderate Abnormal	Moderate-Severe Abnormal	Mean Score	Mild-Moderate Abnormal	Moderate-Severe Abnormal	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	96.57-93.77	< 93.77	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 [a]

Age Groups, mo	Normative Sample Cut-Off Points		Iranian Sample Cut-Off Points		
	Normal	Abnormal	Normal	Abnormal	
				Mild-Moderately Abnormal	Moderate-Severely 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)

[a] Data are presented as No. (%).

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

Variable	Girl	Boy	χ^2	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 [a]

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

[a] Data are presented as No. (%).

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 neurodevelopment 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.

Acknowledgements

The authors are thankful to all health care center managers and personnel and all families who cooperated in this study.

Authors' Contributions

Dr. Farin Soleimani the chief investigator contributed

in study concept and design, acquisition of data, drafting of the manuscript, critical revision of the manuscript for important intellectual content and study supervision. Dr. Roshanak Vameghi contributed in analysis and interpretation of data, drafting of the manuscript and critical revision of the manuscript for important intellectual content. Dr. Mehdi Rahgozar contributed in analysis and interpretation of data, critical revision of the manuscript for important intellectual content and statistical analysis. Dr. Akbar Biglarian provided main efforts in statistical analysis, analysis and interpretation of data, critical revision of the manuscript for important intellectual content and statistical analysis.

Funding/Support

The University of Social Welfare and Rehabilitation Sciences supported the research financially.

References

1. Blanchard LT, Gurka MJ, Blackman JA. Emotional, developmental, and behavioral health of American children and their families: a report from the 2003 National Survey of Children's Health. *Pediatrics.* 2006;**117**(6):e1202–12.
2. Centers for Disease C, Prevention.. Economic costs associated with mental retardation, cerebral palsy, hearing loss, and vision impairment--United States, 2003. *MMWR Morb Mortal Wkly Rep.* 2004;**53**(3):57–9.
3. World Health Organization . Burden of mental and behavioral disorders. *World Health Report 2001.*; 2011. pp. 21–45.
4. Data Resource Center on Child and Adolescent Health . *National Survey of children's Health.* 2003. Available from: www.childhealthdata.org.
5. van Dyck PC, Kogan MD, McPherson MG, Weissman GR, Newacheck PW. Prevalence and characteristics of children with special health care needs. *Arch Pediatr Adolesc Med.* 2004;**158**(9):884–90.
6. Velez van Meerbeke A, Talero-Gutierrez C, Gonzalez-Reyes R. Prevalence of delayed neurodevelopment in children from Bogota, Colombia, South America. *Neuroepidemiology.* 2007;**29**(1-2):74–7.
7. Tatishvili N, Gabunia M, Laliani N, Tatishvili S. Epidemiology of neurodevelopmental disorders in 2 years old Georgian children. Pilot study - population based prospective study in a randomly chosen sample. *Eur J Paediatr Neurol.* 2010;**14**(3):247–52.
8. Screening infants and young children for developmental disabilities. American Academy of Pediatrics Committee on Children with Disabilities. *Pediatrics.* 1994;**93**(5):863–5.
9. Walker SP, Wachs TD, Gardner JM, Lozoff B, Wasserman GA, Pollitt E, et al. Child development: risk factors for adverse outcomes in developing countries. *Lancet.* 2007;**369**(9556):145–57.
10. Williams J, Lee KJ, Anderson PJ. Prevalence of motor-skill impairment in preterm children who do not develop cerebral palsy: a systematic review. *Dev Med Child Neurol.* 2010;**52**(3):232–7.
11. Glascoe FP. Early detection of developmental and behavioral problems. *Pediatr Rev.* 2000;**21**(8):272–9.
12. Reynolds AJ, Temple JA. Cost-effective early childhood development programs from preschool to third grade. *Annu Rev Clin Psychol.* 2008;**4**:109–39.
13. Fleuren KM, Smit LS, Stijnen T, Hartman A. New reference values for the Alberta Infant Motor Scale need to be established. *Acta Paediatr.* 2007;**96**(3):424–7.
14. Grimmer I, Metze BC, Walch E, Scholz T, Buhrer C. Predicting neurodevelopmental impairment in preterm infants by standardized neurological assessments at 6 and 12 months corrected age. *Acta Paediatr.* 2010;**99**(4):526–30.
15. Ellison P. The Neurologic Examination of the Newborn and Infant. In: Ronald BD editor. *Child and Adolescent Neurolog.*. St. Louis: Mosby; 1998. pp. 15–54.
16. Heineman KR, Hadders-Algra M. Evaluation of neuromotor function in infancy-A systematic review of available methods. *J Dev Behav Pediatr.* 2008;**29**(4):315–23.
17. Aly Z, Taj F, Ibrahim S. Missed opportunities in surveillance and screening systems to detect developmental delay: A developing country perspective. *Brain Dev.* 2010;**32**(2):90–7.
18. Mung'ala-Odera V, Meehan R, Njuguna P, Mturi N, Alcock KJ, Newton CR. Prevalence and risk factors of neurological disability and impairment in children living in rural Kenya. *Int J Epidemiol.* 2006;**35**(3):683–8.
19. Goodman A, Fleitlich-Bilyk B, Patel V, Goodman R. Child, family, school and community risk factors for poor mental health in Brazilian schoolchildren. *J Am Acad Child Adolesc Psychiatry.* 2007;**46**(4):448–56.
20. Soleimani F, Vameghi R, Biglarian A. Antenatal and intrapartum risk factors for cerebral palsy in term and near-term newborns. *Arch Iran Med.* 2013;**16**(4):213–6.
21. Tan KL, Yadav H. Reassessment on the development of children with disability in Malaysia. *Med J Malaysia.* 2008;**63**(1):17–20.
22. Iran Statistics Center.. *Iranian National Census.* 1385. Available from: www.Amar.org.ir.
23. Ellison PH, Horn JL, Browning CA. Construction of an Infant Neurological International Battery (Infanib) for the assessment of neurological integrity in infancy. *Phys Ther.* 1985;**65**(9):1326–31.
24. Pedersen SJ, Sommerfelt K, Markestad T. Early motor development of premature infants with birthweight less than 2000 grams. *Acta Paediatr.* 2000;**89**(12):1456–61.
25. Soleimani F, Dadkhah A. Validity and reliability of Infant Neurological International Battery for detection of gross motor developmental delay in Iran. *Child Care Health Dev.* 2007;**33**(3):262–5.
26. Rydz D, Shevell MI, Majnemer A, Oskoui M. Developmental screening. *J Child Neurol.* 2005;**20**(1):4–21.
27. Simpson GA, Colpe L, Greenspan S. Measuring functional developmental delay in infants and young children: prevalence rates from the NHIS-D. *Paediatr Perinat Epidemiol.* 2003;**17**(1):68–80.
28. To T, Guttmann A, Dick PT, Rosenfield JD, Parkin PC, Tassoudji M, et al. Risk markers for poor developmental attainment in young children: results from a longitudinal national survey. *Arch Pediatr Adolesc Med.* 2004;**158**(7):643–9.
29. *Draft Baseline Report on neurodevelopmental disorders in the framework of the European Environment and Health Strategy, version 2.*: Technical Working Group on priority diseases, subgroup neurodevelopmental disorder; 2003.
30. Pradilla AG, Vesga AB, Leon-Sarmiento FE, Geneco.. [National neuroepidemiological study in Colombia (EPINEURO)]. *Rev Panam Salud Publica.* 2003;**14**(2):104–11.
31. Natale JE, Joseph JG, Bergen R, Thulasiraj RD, Rahmathullah L. Prevalence of childhood disability in a southern Indian city: independent effect of small differences in social status. *Int J Epidemiol.* 1992;**21**(2):367–72.
32. Sajedi F, Vameghi R, Mohseni Bandpei MA, Alizad V. , Hemmati Gorgani S, Shahshahani Pour S. Motor developmental delay in 7500 Iranian infants: Prevalence and risk factors. *Iranian J Child Neurol.* 2009;**3**(3):43–50.
33. Kowsarian M, Vahidshahi K, Shafaat A. B. . Screening of child developmental disorders in day-care centers of Sari2006. *Pajoohesh.* 2007;**17**(59):69–75.
34. Vameghi R, Hatamizadeh N, Sajedi F, Shahshahanipoor S, Kazemnejad A. Production of a native developmental screening test: the Iranian experience. *Child Care Health Dev.* 2010;**36**(3):340–5.
35. Rosenberg SA, Zhang D, Robinson CC. Prevalence of developmental delays and participation in early intervention services for young children. *Pediatrics.* 2008;**121**(6):e1503–9.
36. Love JM. Indicators of problem behavior and problems in early childhood. In: Hauser RM, Brown BV, Prosser W. R. editors. *Indicators of Children's Well-being.*. New York: Russell Sage Foundation; 1997. pp. 409–27.