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Status and Determinants of Motor Impairment in Preschool Children from Migrant Families in China

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Abstract

Background: Although poor health conditions and decreased developmental levels have been investigated in migrant children, no study in China has focused on these children's individual motor development.
Objectives: This study aims to explore the prevalence of motor impairment in Chinese migrant children and to determine the contributory factors.
Patients and Methods: In this cross-sectional study, a structured questionnaire was administered to primary caregivers of preschool children aged 3 - 6 (n = 2,976) in ten kindergartens from two districts of Suzhou, China, to assess the children's home socioeconomic status and motor environment, that is, the presence of affordances for motor development. Motor ability was assessed using the Movement Assessment battery for children-second edition (MABC-2). Multiple logistic regression analysis was used to determine the risk factors for motor impairment in migrant children.
Results: Migrant children showed correlations with impairment in manual dexterity, aiming and catching, and motor development (odds ratios [ORs] = 1.320, 1.255, 1.260, respectively; $P < 0.05$). Outdoor movement affordances and toys for fine motor development were significantly associated with motor impairment in migrant children (ORs = 0.834 [movement affordances, 0.843 [toys], $P < 0.05$).
Conclusions: Chinese migrant children are at a high risk of motor impairment, which is associated with a lack of outdoor movement affordances and toys for fine motor development. Future prevention and intervention should focus on the motor environment of the home.

Keywords: Motor Impairment, Migrant, Children, Mainland China

1. Background

Migration is common in a number of countries and has become a topic of worldwide interest since the 1990s (1). Migrant children are more vulnerable to developmental challenges due to family socioeconomic disadvantages. Poor health conditions, low levels of language, and impaired motor and socioemotional development have been reported in the early lives of migrant children (2-4).

China has also experienced major internal population migration, with millions of people moving from rural to urban areas seeking employment and better living standards without obtaining permanent urban residency (hukou) (5). This population is characterized by rural-to-urban migrants, and as more and more migrant workers move with their families or start families after having arrived in cities, the number of school-aged migrant children in these cities is increasing. The percent of migrant families with children reached 62.5% in 2012 and will continue to grow (6). Previous studies have reported low socioeconomic status, less social assistance, and poor living conditions in Chinese migrant families (7, 8); however, no study has focused on individual development in children from migrant families in China. What differs from other countries is that language may not be a major problem for Chinese migrant children, as Mandarin is in common use. Instead, motor development has become the primary problem.

Motor development is critical to a child's individual development and is related to a healthy quality of life. Even minor abnormalities in early motor development may have dramatic long-term consequences (9). Children with motor impairment experience deep and persistent trouble in daily activities (10, 11) and tend to experience

poor health, low self-esteem, depression, and other psychiatric problems (12-14). Children with motor impairment showing difficulties in the activities of daily living have been labeled as having developmental coordination disorder (DCD), and a prevalence of this disorder in 4% - 6% of school-aged children has been reported (15, 16). In China, a higher prevalence was reported, for example, with 8.3% in mainland Suzhou (17). Evidence showed that besides biological factors, the quality of the family environment, including living conditions, family size, and overall socioeconomic circumstances, seems to be directly associated with motor development in family members, as motor development occurs in specific social contexts with related environmental aspects (18, 19). We hypothesize that growing up in a migrant family would be correlated with a higher prevalence of motor impairment, and a limited home motor environment may explain motor impairment to some extent.

2. Objectives

Our study aims to explore the prevalence of motor impairment in preschool children from migrant families and to investigate the association between the home physical and social environment and motor impairment in migrant children.

3. Patients and Methods

3.1. Study Design and Sampling

A cross-sectional study was conducted in Suzhou city to achieve our study aim. Suzhou is located in southeast China, next to Shanghai, and is a popular destination for rural migrants. Migrants accounted for approximately half of the population of Suzhou through the end of 2012. This project was approved by the local education board and ethics committee of the children's hospital affiliated to Soochow university.

First, 115 classes from ten public kindergartens located in two districts, Wujiang and Kunshan in Suzhou city, were randomly selected and agreed to participate in this study. Children from both migrant and non-migrant families live and attend school in these two districts. A total of 3,125 children were recruited for the study. Second, from March to April 2012, lectures by our researchers on DCD and on our study were held in the kindergartens, and parents were invited to attend on the school's open day. A questionnaire concerning residence and socioeconomic status was given directly to the parents at the end of the lectures. Parents who volunteered to participate in the study had to fill out the questionnaire and return it within half an hour. Our group then checked the questionnaires and called the parents if missing items were found; this accounted for less than 5% of the questionnaires.

Finally, 2,979 children moved on to the next step and took part in the movement assessment battery for children-second edition (MABC-2) test. Following the MABC-2 manual instructions, children were asked to accomplish all eight tasks and were individually scored by trained testers in a safe, quiet place (20) (in their classrooms, accompanied by their teachers in this study). Forty-six testers had completed an MABC-2 training class held in March 2012 in Wujiang, focusing on test guidance for the Chinese version. The testers carried out a series of practice assessments on a small number of children; three children left the test because they felt physically uncomfortable, but finally, 2,976 children finished all the tests. This study was conducted in accordance with the declaration of Helsinki and was conducted with approval from the ethics committee of the children's hospital affiliated to Soochow university. Written informed consent was obtained from all participants.

3.2. Child Motor Development

The MABC-2 was used to evaluate motor ability. The MABC-2 is an ecological approach to intervention for children with DCD and other movement difficulties (21). The test refers to a series of fine, gross, and balance motor tasks. In this study, we chose the age band 1 of the MABC-2 test, which refers to children aged 3 - 6. The validity and reliability of the Chinese version of the age band 1 MABC-2 has been examined; the Cronbach alpha value was 0.502, and the average item-content validity index was 0.985, suggesting that the internal reliability of the test was not good but acceptable (22), implying that it could be a useful approach by which to assess motor coordination.

Eight tasks are grouped in the following three motor subtests: 1, manual dexterity, including posting coins, threading beads, and drawing trails; 2, aiming and catching, which consists of catching a beanbag and throwing a beanbag onto a mat; and 3, balance, which includes a one-leg balance, walking with heels raised, and jumping on mats. Ten raw scores obtained from the eight MABC-2 tasks were recorded and then converted into standard scores. The better a child's performance, the higher the standard score. The children scoring at or below the 15^{th} percentile of the age-specific norm on the MABC-2 were considered to have motor impairment.

3.3. Home Physical and Social Environment for Motor Development

The family environment scale on motor development for preschool urban children (FESMDP) (in Chinese) was

designed in order to assess the availability of resources related to motor development and to assess parental policies to support a child's daily activity and self-care in China (23).

The physical home environment referred to the availability of active toys and exercise equipment and was assessed with a checklist based on FESMDP, which could be scored by presence (score 1) or absence (score 0). Four factors were included: outdoor movement affordances (six items, such as a special area nearby, allowing children to run or jump, etc.); indoor movement affordances (six items, such as a special area in which children could play); toys for fine motor development at home (eight items, for example, toys of the pile-up kind); and toys for gross motor development at home (eight items, for example, a bicycle). Pictures were presented to the parents when toys on the checklist for fine and gross motor development were considered. A total score for each subscale, ranging from 0 to 6 for outdoor and indoor movement affordances and from 0 to 8 for toys for fine and gross motor development, was calculated for analysis.

A survey questionnaire focusing on parental policies from the FESMDP consisted of 18 questions such as parents play with child every day and enjoy it, using a 5-point Likert scale. The total scale ranged from 1 (never like that) to 5 (always like that). The Cronbach alpha for the parental policies total score was 0.894, which can be considered moderate. For descriptive purposes, we distinguished between two groups based on the data distribution; higher scores suggested more supportive policies (46.8%), and lower scores suggested less supportive policies (53.2%).

Additionally, the Kaup index, similar to body mass index (BMI), was calculated using a child's weight and height. A child with a Kaup index > 18 was considered overweight, which may be related to motor performance.

3.4. Analysis

The characteristics of the study population were assessed. To compare the mean score of motor ability between migrant and non-migrant children, differences were analyzed with a t-test, while a chi-square test was used to compare the ratios of motor impairment. The Mann-Whitney test was used to compare differences in the physical home environmental characteristics. Additionally, to compare other group differences, we analyzed scores using either a t-test or a chi-square test. Then, multilevel logistic regression was used, and both the crude and adjusted odds ratios (ORs) were estimated to determine the relationship strength.

In order to determine what would contribute to impairment, migrant children were classified into motor-impaired and normal groups, according to the dependent variable (MABC-2 scores). All home environmental characteristics were compared between the two groups. Subsequently, using a multilevel logistic regression model with a random intercept, the crude and adjusted ORs were estimated to determine the strength of association. The dependent variable in this study was whether or not there was motor impairment (0 = no, 1 = yes). A mixed model was used to investigate whether the associations of motor impairment could be explained by aspects of the home physical and social environment. Because age, sex, Kaup index, and parental educational level may be related to a child's motor ability, we controlled for these variables in the analysis. The data were analyzed using the SPSS program version 19.0.

4. Results

4.1. Home Environment of Migrant Children

Table 1 presents the characteristics of all children, including 1,161 migrant children and 1,815 native non-migrant children. The mean age of children, the maternal age, the percentages of boys and girls, the Kaup index, and the parental education level, which are considered related to a child's motor development, are shown at the top of the tabulation. More migrant mothers had lower or middle education levels (6.4%, 60.5%, respectively), and fewer (33.2%) migrant mothers had a higher education level compared to the non-migrant group (4.8% had a lower education level, 46.8% a middle level, and 48.4% a higher level, $P < 0.01$). The fathers' education levels were similar. More migrant fathers had a lower or middle education level, and fewer had a higher education level ($P < 0.01$). Migrant children had fewer outdoor and indoor physical movement affordances or toys for both fine and gross motor development ($P < 0.01$). Moreover, fewer migrant parents (43.7%) were supportive of a child's daily activities and self-care than non-migrant parents (48.9%, $P < 0.01$).

4.2. Motor Impairment in Migrant Children

With regard to motor development, as expressed in the MABC-2 scores at the bottom of Table 1, migrant children showed lower mean total scores ($P < 0.01$) but also lower mean scores for manual dexterity ($P < 0.01$) and aiming and catching ($P < 0.05$), while no differences were found in balance scores. Also, when classified into motor-impaired and normal groups, migrant children showed a higher prevalence of impairment in manual dexterity (21.7%), aiming and catching (24.1%), and motor ability (19.6%) than the non-migrant group (16.4%, 19.7%, 14.8%, respectively, $P < 0.01$).

Table 1. Sample Characteristics and Motor Impairment Between Migrant and Non-Migrant Children (n = 2976)[a]

Characteristics	Non-Migrant (n = 1815)	Migrant (n = 1161)
Age, Y	5.18 (0.88)	5.15 (0.89)
Maternal age, Y	25.97 (3.60)	25.79 (3.91)
Sex, No. (%)		
Boys	985 (54.3)	664 (55.4)
Girls	830 (45.7)	497 (44.6)
Kaup		
≤ 18	1529 (84.2)	971 (83.6)
> 18	286 (15.8)	190 (16.4)
Mother's education level, %		
Low	4.8	6.4[b]
Middle	46.8	60.5[b]
High	48.4	33.2[b]
Father's education level, %		
Low	3.5	4.6[b]
Middle	42.9	54.1[b]
High	53.6	41.3[b]
Outdoor movement affordances, M (Q1, Q3)	4 (5,6)	4 (5,6)[b]
Indoor movement affordances, M (Q1, Q3)	4 (5,6)	4 (5,6)[b]
Toys for fine motor development, M (Q1, Q3)	6 (5,8)	5 (4,7)[b]
Toys for gross motor development, M (Q1, Q3)	6 (4,7)	5 (3,6)[b]
Supportive parental policies, %	48.9	43.7[b]
Motor ability		
Manual dexterity	27.48 (6.15)	26.28 (6.34)[b]
Aiming and catching	17.99 (4.79)	17.61 (5.09)[c]
Balance	35.58 (4.32)	35.47 (4.82)
Total score	81.04 (10.05)	79.36 (11.40)[b]
Motor impairment		
Manual dexterity-impaired, %	16.4	21.7[b]
Aiming and catching-impaired, %	19.7	24.1[b]
Balance-impaired, %	18.3	17.1
Motor-impaired, %	14.8	19.6[b]

[a]Values are expressed as mean (SD) unless otherwise indicated.
[b]$P < 0.01$.
[c]$P < 0.05$

Compared to non-migrant children, migrant children showed a correlation with manual dexterity impairment, aiming and catching impairment, and motor impairment after adjusting for children's characteristics and parental education (OR = 1.320, 1.255, 1.260, respectively, $P < 0.05$) or not adjusting (OR = 1.411, 1.293, 1.397, respectively, $P < 0.01$) (Table 2).

4.3. Associations of Home Environment With Motor Impairment in Migrant Children

The association of the home physical and social environment with motor impairment in migrant children is presented in Table 3. In Chinese migrant children, outdoor movement affordances and toys for fine motor development were significantly associated with motor impair-

Table 2. Association of Migrant Children With Motor Impairment

Characteristics	Manual Dexterity		Aiming and Catching		Balance		Motor Ability	
	cOR[a] (95% CI)	aOR[b] (95%CI)	cOR[a] (95% CI)	aOR[b] (95%CI)	cOR[a] (95% CI)	aOR[b] (95%CI)	cOR[a] (95% CI)	aOR[b] (95%CI)
Non-Migrant	Ref.		Ref.		Ref.		Ref.	
Migrant	1.411 (1.171,1.701)[c]	1.320 (1.091,1.597)[c]	1.293 (1.083,1.554)[c]	1.255 (1.039,1.541)[d]	0.915(0.754,1.111)	0.962 (0.787,1.175)	1.397(1.150,1.697)[c]	1.260 (1.027,1.546)[d]

[a] Crude odds ratio
[b] Adjusted odds ratio (adjusted for children's age, gender, Kaup index, parental education level, and other variables in Table 1)
[c] $P < 0.01$
[d] $P < 0.05$

ment when the child and family characteristics were adjusted (OR = 0.834, 0.843, respectively, $P < 0.05$) or were not adjusted (OR = 0.839, 0.854, respectively, $P < 0.05$). However, indoor movement affordances, toys for gross motor development, and parental policies were not statistically related to motor impairment ($P > 0.05$).

5. Discussion

To our knowledge, this is the first study focusing on the prevalence and determinants of motor impairment in the preschool children of migrant families in China. It is reasonable to conclude that growing up in Chinese migrant families shows a correlation with motor impairment in preschool children and that outdoor movement affordances and toys for fine motor development are important determinants.

Because motor impairment is related to central nervous system pathology, we focused on the motor environment in our study. Information, experience, and environmental stimuli during the developmental period are critical to motor development, although several potential adverse factors including undernutrition may also adversely affect brain development. Previous studies indicated that migrant children had poor health conditions, less physical activity, and motor developmental delays (24-26). Similar results were found in this study. Preschool children from migrant families are more likely to have motor impairments. Compared to children from non-migrant families, they scored lower in manual dexterity as well as in aiming and catching, when the Kaup index and other variables were adjusted. The physical and social home environment may be related to this phenomenon, as a population-based birth cohort study in Taiwan indicated that home environment played a central role in developmental outcomes among children of cross-border marriage groups (26). Limited by their low education levels, migrant workers are more likely to take jobs involving heavy labor and low income, for example, work in the manufacturing or construction industry or the service sector. Migrants usually undertake a greater physical workload and longer working hours, but they receive less labor protection. Their economic status as well as the stress induced by migration itself, by unstable living situations, and by poor working conditions may cause health and mental problems and cause parents to be less supportive and more likely to neglect a child's normal requests (7, 8, 27). Nor do migrant families have medical insurance, while parents do not regularly take their children to doctors for health care and developmental assessment; this may cause them to have deficient knowledge with respect to children's development and parental skills (28).

Our study went even further in determining that outdoor movement affordances and toys for fine motor development were the most important determinants in the physical and social home environment. It is logical that outdoor movement affordances become one of the most important determinants, as children who spend more time outdoors are more active than children who spend less time there (29). When more outdoor public exercise equipment and entertainment facilities are available, children are more willing to play outside. The Chinese government has implemented the sports for all plan nationwide since 2011 and has invested in building many sports facilities in communities to promote outdoor exercise (30). However, migrant families benefit little from the plan, because they tend to rent small houses far from the city center, which results in limited areas for exercise and a lack of outdoor public facilities and exercise equipment. Migrant parents and children are likely to stay home, as no attractive activity is present nearby. Negative attitudes of migrant parents towards outdoor activities could also be bad role models for their children (31, 32). Migrant parents also tend to prefer to engage their children in academic learning during leisure time, because they want their children to have a better life when they grow up, and they believe that cultural education will help (33).

Toys are important for a child's individual develop-

Table 3. Associations of Home Movement Environment With Motor Impairment in Migrant Children

Characteristics	Normal (n = 934)	Motor-Impaired (n = 227)	cOR[a] (95% CI)	aOR[b] (95%CI)
Physical environment				
Outdoor movement affordances M (Q1, Q3)	5 (4,6)	5 (3,6)	0.834 (0.756, 0.920)[c]	0.839 (0.759, 0.928)[c]
Indoor movement affordances M (Q1, Q3)	5 (4,6)	5 (4,6)	1.133 (0.984, 1.304)	1.104 (0.956, 1.275)
Toys for fine motor development M (Q1, Q3)	6 (4,7)	4 (3,6)	0.843 (0.769, 0.925)[c]	0.854 (0.776, 0.939)[c]
Toys for gross motor development M (Q1, Q3)	5 (4,7)	4 (3,6)	0.972 (0.885, 1.069)	0.967 (0.887, 1.065)
Supportive parental policies				
Non-Supportive, No. (%)	521 (55.8)	133 (58.6)	1.133 (0.984, 1.304)	1.054 (0.766, 1.450)

[a] Crude odds ratio
[b] Adjusted odds ratio (adjusted for children's age, gender, Kaup index, parental education, and other variables in the tabulation).
[c] $P < 0.05$.

ment in all domains, cognitive, motor, and language, during the early years after birth (34) The presence of toys provides more opportunities for children to practice imitation and communication (35, 36). The presence of toys in the home is related to the economic status of the family as well as to parental capability (37). At home, migrant children have fewer toys, which are extremely important to a child's individual development (38, 39). For most migrant families, gross motor toys are too expensive for their economic status and are too large for a small living area, which may explain why fine motor toys, rather than gross motor toys, play a key role in motor impairment in migrant children.

Although Chinese migrant children are at a high risk of motor impairment, we found no difference in balance scores between the migrant and non-migrant groups, despite their home environment differences. Movements can be classified into transitive and intransitive actions. Transitive actions refer to goal-directed actions involving objects, for example, cutting paper and drawing, while intransitive actions refer to actions that do not involve objects, for example, running and jumping (40). There is no doubt that intransitive gestures are more independent and much easier to practice than transitive gestures. Most intransitive gestures contribute to balance ability, which could explain why migrant children can play as well as non-migrant children with regard to balance.

5.1. Conclusions

The present study has shown that the prevalence of motor impairment in Chinese preschool children from migrant families was higher than for those from non-migrant families. Outdoor movement affordances and toys for fine motor development were determinants in migrant children's motor impairment. This study indicates a need for prevention and intervention by addressing living conditions related to migrant children's motor development. The government should expand the range of the sports for all plan to migrants' gathering areas. However, as a cross-sectional study, the findings of this report cannot be used to determine whether the observed factors cause motor impairment in migrant children. Further study is needed to clarify the relationship and to determine how children's motor development is affected in the post-migration period.

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Footnotes

Authors' Contribution: Study concept and design, Guixiong Gu; analysis and interpretation of data, Hua Jin, Jing Hua and Jianqiang Shen; drafting of the manuscript, Hua Jin; critical revision of the manuscript for important intellectual content, Hua Jin and Guixiong Gu; statistical analysis, Lijuan Feng and Guixiong Gu.

Conflicts of Interest: All of the authors declare that they have no conflicts of interest regarding this paper.

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