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Original Article

Correlating Caretakers' Knowledge, Attitudes and Practices of Hygiene and Continued Breastfeeding with Infants' Gross Motor Development Delay

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Abstract ***Background:*** Gross motor development delay is related to lower physical activity and higher adiposity risk for children. As the factor of this issue remains unclear, this study investigated the factors contributing to motor development delay. ***Methods:*** We recruited 132 children and their caretakers in a suburban area of China. The sociodemographic characteristics, child feeding practice, knowledge, attitudes, and practices of hygiene were investigated using a questionnaire. Child's nutritional status and gross motor milestones were assessed using the WHO Multicentre Growth Reference Study. ***Results:*** Approximately 20% of children experienced delayed achievement of certain milestones. Children from high-income families were more likely to experience developmental delay than those from middle-income. Continued breastfeeding at one year and superior hygiene potentially improved motor development. ***Conclusions:*** This study suggests providing telework support can improve mothers continued breastfeeding rates and broader hygiene education for both mothers and grandmothers in suburban areas of China.

Key words *Child development; Continued breastfeeding; Gross motor milestones; Hygiene*

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Introduction

Motor development is a major developmental pathway during early childhood. Motor skills are involved in the movement and coordination of the muscles. However, it is estimated that nearly 250,000,000 children under five years do not achieve their developmental potential in low- and middle-income countries.[1] The delayed achievement of motor milestones have both short- and long-term negative effects on a child's development. Delayed accomplishment of actions like rolling over, sitting, and crawling is associated with the delayed execution of walking autonomously.[2] Moreover, the delayed attainment of motor milestones is also related to lower physical activity,[3] and a higher risk of adiposity later in life.[4] Many of them are exposed to multiple risks, such as poverty, malnutrition, and unstimulating home environments.[5]

The researches concerning children's early development has extensively documented the growth-related issues in low- and middle-income countries.[6,7] A cross-country comparative study that examined Cambodia, Chile, Ghana, Guatemala, Lebanon, Pakistan, the Philippines, and the USA with a focus on socioeconomic status consistently found that the motor scores of children from low-income families were lower than those of children from the middle- and high-income families.[8] Impoverished children were more likely to experience less stimulation and demonstrated a higher prevalence of infectious diseases and other health-related issues.[8,9] However, a high prevalence of motor developmental delay among children under the age of three was reported in China in 2015,[10] whereas China has experienced rapid economic growth in the past decade. In addition to poverty, other risk factors associated with child gross motor development need to be clarified.

The evidence concerning child nutrition showed that child-feeding practices such as breastfeeding has a protective effect on children's motor achievement.[11,12] A study conducted in Greece found a significant positive correlation between breastfeeding duration and cognitive, language, and motor development at the age of 18 months.[13] The WHO recommends exclusively breastfeeding children for the first six months and continued breastfeeding for up to one year or beyond.[14] However, about half of the children did not receive continued breastfeeding in their first year of life in China.[15] Therefore, we hypothesised that the short duration of continued breastfeeding would be a risk factor associated with gross motor development delay in China.

In addition to nutritional factors, gross motor development is also influenced by environmental factors. Mothers' educational level,[16-18] having siblings,[19,20] and attending pre-school[21,22] were found to be the environmental factors for motor development. Moreover, recent studies that focused on children's domestic environment have highlighted the importance of water, sanitation, and hygiene (WASH) for their development. The first three years of a child's life are critical for the consolidation of their gut health and linear growth. Early child development could be affected by the inflammation, stunting, and environmental enteropathy that can occur due to poor WASH.[23] However, there is limited evidence focused on hygiene, which is a non-negligible environmental factor for children.

This study assessed the nutritional status and gross motor development of the children and investigated the child-feeding practices and the hygiene knowledge, attitudes, and practices (KAPs) of their caretakers living in a suburban area of China. The specific objective of this study was to investigate the factors contributing to motor development delay in terms of social-economic status, child nutrition and hygiene.

Methods

Participants

The study was conducted from August to October 2019 in a hospital located in a suburban area within Liaoning province, China. Enlistment was offered to the target children and their respective caretakers who regularly visit the hospital for health check-ups. Healthy children who were 6-36 months old, of singleton birth, had a 37-42 week gestational age, and had a birth weight in the range of 2500-4000 grams, were enrolled in this cross-sectional study. Born prematurely, low birth weight, or serious illness that might directly affect early childhood development were considered as the exclusion criteria. After the purpose of the survey was explained, 132 children (mean age = 18.0, SD = 8.6 months old) and their respective caretakers participated. Data on each pair were collected via anthropometric measurements and a questionnaire. Participants who were absent during the investigation period or skipped particular questions of the interview were excluded (12 pairs). This study was approved by the ethical review committee of the Faculty of Health Sciences, Hokkaido University (No. 20-5). We explained the purpose and subject matter of the study to all participants in Chinese and obtained written consent from all caretakers.

Measurements

Anthropometric Measurements

The children's birthdate, gender, and birth weight were obtained using a questionnaire. Recumbent length (children <24 months old) and height (children ≥24 months old and caretaker) were measured (shoeless) to the nearest 0.1 cm using a length board (Seca Model 417, Germany) and a portable stadiometer (Seca Model 213, Germany), respectively. Children were weighed lightly clothed, but shoeless, using a digital weighing scale (BC-754-WH; Tanita, Japan) with a precision of 0.1 kg. The measurement of each item was conducted by only one of the authors to

avoid inter-observer biases.

Anthropometric Z-scores were calculated using the WHO Anthro software (version 3.2.2). Based on the nutritional indices of the WHO Child Growth Standard, malnutrition (stunting, underweight, and wasting) was defined as length/height-for-age Z-scores (L/HAZ), weight-for-age Z-scores (WAZ), and weight-for-length/height Z-scores (WL/HZ) of <–2 SD, respectively. Overweight in children was defined as WL/HZ >+2 SD.[24]

Interview Surveys

An interview survey was conducted with each child's caretaker using a structured questionnaire. The questionnaire inquired about the following: (1) the sociodemographic characteristics, (2) child-feeding practices, (3) the hygiene KAPs of the caretaker, and (4) the child's gross motor development. The sociodemographic characteristics included the child's date of birth, birth weight and length, gender, delivery method, birth order, the caretaker's educational level, occupational status, and household monthly income. The inquiry regarding child-feeding practices covered breastfeeding practices, initiation of solid food, and dietary diversity. The study of breastfeeding practices included ascertaining the timing of initiating and stopping breastfeeding and artificial formula, respectively. The age (in months) at which the child began to eat solid food was also answered by the caretaker. The caretaker reported the child's diet using a 24-hour recall method. The recalled food was categorised into nine food groups to determine its dietary diversity score based on the Chinese Dietary Guidelines.[25] The WASH service level and hygiene KAPs survey was answered by the caretaker. The questionnaire contained 23 questions to test the KAPs of personal hygiene and food hygiene. Child gross motor development was assessed based on the WHO Multicentre Growth Reference Study.[26] The time (in months) of achievement of the six motor milestones (sitting without support, standing with assistance, hands-and-knees crawling, walking with assistance, standing alone, and walking alone) was reported. To minimise recall bias in cases where caretakers were not sure about the requested information, caretakers were asked to confirm the child's motor development attainment using photographs or by consulting with the secondary caregiver. Children who reached each milestone at an age later than the 90th percentile of the WHO references were categorised as suspected of developmental delay.[26] Children who were younger than the 90th percentile and did not achieve the milestone were not included.

Statistical Analysis

Bivariate analyses such as t-tests, Wilcoxon-rank-sum tests, Tukey's honestly significant difference (HSD) test, and Pearson's chi-squared tests were performed between the achievement of motor milestones and each individual variable (i.e., feeding practice, caretaker's KAPs, and social-economic status). To estimate the risk factors associated with motor development delay, a stepwise selection method (combined forward-backward) was performed on the following independent variables: (1) those that had significant differences in achievement of motor milestones on bivariate analysis, and (2) the risk factors associated with early childhood development, as highlighted in previous research. A multivariate logistic regression analysis was then performed using the selected variables. A finding was considered as statistically significant when $P<0.05$. JMP 14.0.0 software (SAS Institute Inc., Cary, NC, USA) was used for all statistical analyses.

Results

Characteristics of the Participants

The characteristics of the mothers and households are shown in Table 1. Most families were of low or middle income. More than half of the mothers had at least graduated senior high school. Most of the mothers were unemployed, while 27% of them worked in local or outside the local areas. The proportion of children who were delivered by caesarean section was much higher than the ideal rate determined by the international healthcare community (10-15%). Although most children were cared for by their mothers, 40% of them were primarily cared for by their grandmothers. The mean values of L/HAZ, WAZ, and WL/HZ were all positive, the nutritional status of children was generally good. Based on the WHO definitions, the prevalence of stunting, underweight, and wasting was 2.3%, 0%, and 2.3%, respectively. On the other hand, 4.5% of them were overweight (data not shown).

Child Feeding Practice

More than half of the surveyed mothers did not initiate breastfeeding within 24 hours of delivery. Breastfeeding (both exclusive and mixed breastfeeding) was widespread among the population, whereas only half of children received continued breastfeeding at one year. A significant proportion (26%) of the children did not take solid food by the age of six months. As for the dietary diversity score,

half of the children had consumed above seven kinds of food over a 24-hour recall period (Table 2).

WASH Service Level and Caretaker's KAPs of Hygiene

Most households used tap water as their water source (85%), while the remaining households used well water (Table 3). Instead of pit latrines, most of the households installed their private flush toilet. Most of the caretakers had good knowledge and attitudes regarding hygiene. However, in terms of the handwashing practices, while almost all the participants reported that they washed their hands after using the toilet, 85% of them claimed that they did so before feeding the baby. Most of the caretakers reported that they always washed their hands with soap, while only half of them always washed their child's hands with soap. The scores of knowledge and attitudes were generally good for caretakers, difference in KAPs scores was mainly in practice category. Grandmothers had significantly lower hygiene KAPs scores compared to mothers ($P<0.01$).

Gross Motor Development

The achievement of gross motor development of the children was shown in Table 4. Almost all the children achieved the six motor milestones within the age ranges specified by the WHO, except for one child who achieved sitting without support and one child who attained walking alone later than the maximum data of WHO age ranges. Upon using the WHO reference's 90th percentile as the cut-off value, it was found that approximately 20% of the children demonstrated delayed achievement in at least one gross motor milestones (except for crawling). The median age at which the children attained sitting without support, hands-and-knees crawling, standing alone, and walking alone was similar to the median age of the WHO standard. Standing with assistance and walking with assistance appeared to occur after a one-to-two-month delay.

The differences in the month age at which children of different family monthly income achieved certain gross motor milestones are shown in Figure 1. For sitting alone, children in the 'mid-income' group attained milestone earlier than the 'low-income' group ($P=0.032$). For standing alone, children in the 'mid-income' group attained milestone earlier than the 'low-income' group ($P=0.001$). For walking alone, children in the 'mid-income' group attained milestone earlier both than the 'low-income' group and the 'high-income' group ($P=0.004$ and $P=0.037$, respectively).

Table 5 shows the risk factors associated with walk delay in multivariate logistic regression analysis. Continued breastfeeding at one year (adjusted odds ratio [OR]=0.14, 95% confidence interval [CI]: 0.04-0.49), a senior high school (adjusted OR=0.16, 95% CI: 0.03-0.71) or college-level (adjusted OR=0.24, 95% CI: 0.06-0.99) educational attainment among the mothers were associated with lower odds of child motor development delay. Child's

Table 1 Subject characteristics (n=132)

Characteristics	***n***	**(%)**
Maternal and household characteristics		
Age at delivery (years)		
≤25	18	(14)
25-35	102	(77)
≥35	12	(9)
Maternal education		
Completed primary education	45	(34)
Completed senior high education	42	(32)
Completed college education	45	(34)
Maternal occupation		
Not employed	96	(73)
Working in the local area	28	(21)
Working in the nonlocal area	8	(6)
Family monthly income (CNY)		
≤3000	33	(25)
3000-5000	46	(35)
≥5000	53	(40)
Child characteristics		
Gender		
Boy	71	(54)
Girl	61	(46)
Method of delivery		
Vaginal delivery	78	(59)
Caesarean section	54	(41)
Birth order		
First	98	(74)
Second or third	34	(26)
Primary caretaker		
Mother	84	(64)
Grandmother	48	(36)
Anthropometric measurements (mean ± SD)		
Length/height-for-age Z-scores	0.35 ± 1.32	
Weight-for-age Z-scores	0.60 ± 1.12	
Weight-for-length/height Z-scores	0.59 ± 1.19	

mother worked outside the local area (adjusted OR=12.76, 95% CI: 1.54-105.97), low hygiene KAPs scores (adjusted OR=5.52, 95% CI: 1.26-24.21) significantly predicted the delayed achievement of walking with assistance.

Discussion

In this cross-sectional study, we investigated the nutritional status and motor development of children and determined the factors contributing to motor development delay. Approximately 20% of children had delayed achievement in at least one gross motor milestones. Children in this study achieved gross motor milestones earlier than the children from Vietnam and India, and obtained a similar result to the children from the USA (Table 4).[27-29] To our surprise, children who lived in the study area faced developmental problems in spite of their household's financial status. The multiple comparison analysis showed that the children in the high-income group attained the walking alone milestone later than those in the middle-income group (Figure 1). Previous studies reported that better financial conditions were correlated with higher maternal education and mental health, less family stress and child illness, and consequently had a positive effect on children's early development.[22,30,31] However, this finding was contrary to previous research. Further analysis was needed to explain this unexpected finding.

Poor Hygiene KAPs of Caretaker

The relatively lower hygiene KAPs of grandmothers may explain this unexpected finding of children facing developmental problems despite coming from high income households. Low scores on the hygiene KAPs significantly predicted the delayed achievement of walking with assistance (Table 5). Intervention studies conducted in Kenya and Bangladesh found that combined interventions focused on water quality, sanitation, hygiene, and nutrition facilitated the improvement of child motor development; however, they did not explore the effects of nutrition and hygiene separately.[13,32] Caregivers' poor personal hygiene, food, and environmental hygiene KAPs may fail to protect the child from the transmission of infectious diseases and gut health problems such as environmental enteropathy, eventually leading to low nutrient absorption and poor early development in children.[23] Therefore, whilst our

Table 2 Child feeding practices (n=132)

Feeding practices	*n*	(%)
Initiation of breastfeeding		
Within 1 hour	56	(42)
Between 1 and 24 hours	24	(18)
After 24 hours	52	(39)
Feeding types within 6 months		
Exclusive breastfeeding	21	(16)
Mixed feeding	100	(76)
Formula feeding	11	(8)
Continued breastfeeding at one year		
Yes	76	(57)
No	56	(43)
Time of solid food initiation		
4-6 months	98	(74)
>6 months	34	(26)
Dietary diversity score		
Low (1-4 food group)	21	(16)
Medium (5-6 food group)	48	(36)
High (7-9 food group)	63	(48)

Table 3 Water, sanitation, and hygiene (WASH) status of household (n=132)

WASH status	*n*	(%)
Source of drinking water		
Tap water	112	(85)
Well water	20	(15)
Type of sanitation facility		
Flush toilet	110	(83)
Pit latrine	22	(17)
Important time for handwashing		
After using the toilet	131	(99)
Before eating	124	(93)
Before feeding baby	112	(85)
Hand wash behaviour		
Always handwashing your hands with soap	91	(69)
Always handwashing your child's hands with soap	44	(33)
Caretaker's knowledge, attitudes, and practices of hygiene (mean, range)		
Knowledge		5.9 (3-6)
Attitudes		7.7 (5-8)
Practices		7.3 (3-9)

results provide evidence for the relevance of hygiene and gross motor development, the mechanism of how hygiene affects child motor development remains unclear. Further study with a comprehensive assessment that includes hygiene KAPs, household faecal contamination and children's disease prevalence may facilitate an understanding of the mechanism related to this issue.

Nevertheless, grandmothers had significantly lower hygiene KAPs scores compared to mothers. In this study, grandmothers were the primary caretakers of children from families that had a higher monthly income. Intergenerational parenting is common (50-70%) among many families in China.[33] Leaving children with grandparents allowed both mother and father to work and receive a better family monthly income. However, as demonstrated earlier, poor KAPs of hygiene was associated with gross motor development delay. Compared to mothers, grandmothers may pose a higher risk of motor development delay to the child due to their poor hygiene KAPs. Therefore, considering the intergenerational parenting situation in China, it is important to include not only mothers but also grandmothers in the promotion of hygiene KAPs.

Low Prevalence of Continued Breastfeeding

In addition, the low prevalence of continued breastfeeding may also lead to developmental delay in children from high-income families. The present study found that continued breastfeeding at one year was associated with lower odds of child motor development delay (Table 5). Continued breastfeeding at one year is one of the core indicators for assessing child feeding practices.[34] The beneficial effects of continued breastfeeding include accelerated child development and a reduced risk of all-cause mortality and obesity.[35-37] Previous studies focused on the relationship between continued breastfeeding and child gross motor development have also demonstrated that longer breastfeeding duration was associated with increased motor development scores.[37,38] These findings support the idea that continued breastfeeding at one year is important for an infant's health and development.

However, the practice of continued breastfeeding in China is poor. Only about half of the children in this study continued breastfeeding. The prevalence of continued breastfeeding at one year (57%) was consistent with the 2017 national data (51%).[15] The continued breastfeeding rate was low in China compared to Bangladesh (95%), Vietnam (81%), and Indonesia (80%).[39] A global study reported a strong inverse correlation between the duration of breastfeeding and gross domestic product per capita after utilising the national data of 153 countries.[40] These results suggested that the prevalence of continued breastfeeding in the study site, as well as in China, needs to be improved. Further research on how economic growth reduces continued breastfeeding rates in China may help develop relevant countermeasures.

In the current study, families with employed mothers were likely to have a higher family monthly income than those with unemployed mothers. However, when the child's mother worked outside the local vicinity, it significantly predicted the delayed achievement of walking with assistance (Table 5). This separation of mother and child leads to inadequate child-feeding practice. Previous studies highlighted that maternal occupational status was the main barrier to continued breastfeeding in high-income

Table 4 Motor milestone attainment by age among different cohorts of children

	WHO[24]		Present study		Vietnam[27]	India[28]	USA[29]
Gross motor milestones	**Median (Range)**	**Cut-off †**	**Median (Range)**	**Delay‡, n (%)**	**Median**	**Median**	**Median**
1) Sitting without support	5.9 (3.7-9.4)	7.6	6 (4-10)	23 (17.9%)	8.3	6.0	6.4
2) Standing with assistance	7.4 (5.0-13.9)	9.6	9 (5-13)	24 (19.8%)	10.9	10.4	8.2
3) Hands-and-knees crawling	8.3 (4.7-11.7)	10.7	8 (5-12)	2 (1.6%)	9.9	9.1	8.2
4) Walking with assistance	9.0 (5.8-14.1)	11.2	10 (6-14)	27 (23.7%)	12.2	10.9	9.5
5) Standing alone	10.8 (6.7-17.4)	13.6	11 (8-16)	19 (18.4%)	13.2	12.8	10.8
6) Walking alone	12.0 (8.0-18.0)	14.6	12 (10-19)	21 (21.6%)	15.7	13.7	12.2

†90th percentile cut-off of WHO Multicentre Growth Reference Study Group.

‡Delay in specific milestones was determined using the cut-off in the present study.

WHO, World Health Organization.

regions. The mothers who had full-time employment,[41,42] longer working hours,[43] and shorter maternity leave[44,45] were less likely to breastfeed their children for a longer duration. Such associations may support employment outside the local vicinity as a plausible cause for mothers' shorter breastfeeding duration. Furthermore, the childcare tasks shifted to the grandmother when mothers worked outside the local vicinity. The lower KAPs and educational status of grandmothers thus become risk factors for gross motor development delay among children. Adequate legal policies, sufficient social and family support, and sound strategies for telework may help working mothers continue breastfeeding their children.

The discussion above further consolidates the unexpected result that high household income is a predictor of gross motor development delay in the

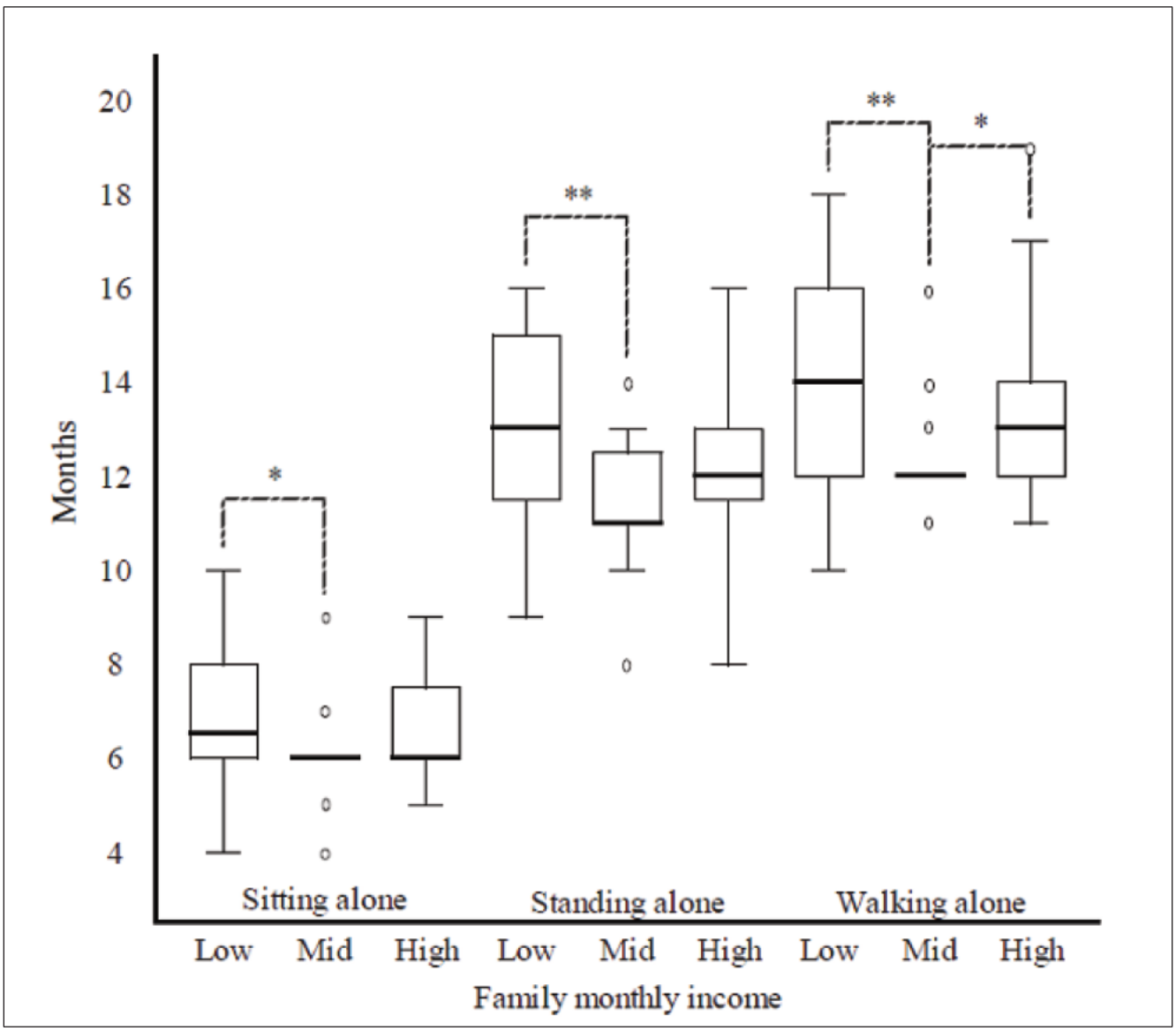

Figure 1 Month age of achievement of gross motor milestones at different family monthly income. Tukey's honestly significant difference (HSD) test is used to conduct these comparisons. For sitting alone: children in the 'mid-income' group attained milestone earlier than the 'low-income' group (P=0.032). For standing alone: children in the 'mid-income' group attained milestone earlier than the 'low-income' group (P=0.001). For walking alone: children in the 'mid-income' group attained milestone earlier both than the 'low-income' group and the 'high-income' group (P=0.004 and P=0.037, respectively). *P<0.05, **P<0.01.

examined suburban area of China. Families in which the grandmother is the primary caretaker and the mother works away from home tend to get a higher income. However, these factors lead to children a shorter period of continued breastfeeding and subsequent nutrition, and less protection in terms of hygiene.

There were several limitations to this study. First, the site of our study was a single suburban area of China, and thus there is a need to obtain more data from other cities to confirm the accuracy of the results. The population of this study demonstrated socioeconomic and gender diversity, and therefore may be reflective of other suburban areas of China. Moreover, we assessed the child's gross motor development based on the WHO Multicentre Growth Reference Study. The WHO standard included children from six geographically diverse countries: Brazil, Ghana, India, Norway, Oman, and the USA. Although we found a similar developmental outcome in children from the USA, more evidence is needed to verify the feasibility of this standard to measure Chinese children. Finally, a correlation was found between the hygiene KAPs of caretakers and gross motor development. Although the specific mechanism of this topic remains unclear, our findings provide evidence for the correlation between hygiene and child early development.

Conclusion

The children's nutritional status was generally good, whereas 20% of them experienced gross motor development delay in this study. Factors associating lower risks of gross motor developmental delay were continued breastfeeding at one year and caretaker's hygiene KAPs. Children from high monthly income families were less likely to receive continued breastfeeding for their mothers

Table 5 Factors associated with walk delay in multivariate logistic regression analysis (n=114)

Characteristics	Adjusted OR†	95% CI	*P* value
Continued breastfeeding at one year			
No	1.00		
Yes	0.14	0.04-0.49	0.002**
Maternal occupation-			
Not employed	1.00		
Working in the local area	2.65	0.59-11.91	0.200
Working in the nonlocal area	12.76	1.54-105.97	0.018*
Time of solid food initiation			
4-6 months	1.00		
>6 months	2.92	0.81-10.53	0.101
Maternal education			
Completed primary education	1.00		
Completed senior high education	0.16	0.03-0.71	0.016*
Completed college education	0.24	0.06-0.99	0.049*
knowledge, attitudes, and practices score of caretakers			
High & medium	1.00		
Low	5.52	1.26-24.21	0.023*
Primary caretaker			
Mother	1.00		
Grandmother	0.33	0.08-1.32	0.118
Type of sanitation facility			
Flush toilet	1.00		
Pit latrine	3.20	0.77-13.28	0.109

*P<0.05, **P<0.01; †R^2: 0.31, Akaike information criterion corrected: 105.68.

OR, odds ratio; CI, confidence interval.

working status, and most of their primary caretaker was the grandmother who had relatively lower hygiene KAPs, which could explain the reason why high income associated with gross motor development delay. These findings suggest several courses of action to provide friendlier telework support for mothers to improve continued breastfeeding rates and conduct a broader hygiene education that includes both mothers and grandmothers in the examined suburban area of China.

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Declaration of Interest

The authors declare that they have no conflict of interests.

References

1. Black MM, Walker SP, Fernald LCH, et al. Early childhood development coming of age: science through the life course. Lancet 2017;389:77-90.
2. Kimura-Ohba S, Sawada A, Shiotani Y, et al. Variations in early gross motor milestones and in the age of walking in Japanese children. Pediatr Int 2011;53:950-5.
3. Brouwer SI, Stolk RP, Corpeleijn E. Later achievement of infant motor milestones is related to lower levels of physical activity during childhood: the GECKO Drenthe cohort. BMC Pediatr 2019;19:388.
4. Neelon SEB, Oken E, Taveras EM, et al. Age of achievement of gross motor milestones in infancy and adiposity at age 3 years. Matern Child Health J 2012;16:1015-20.
5. Grantham-McGregor S, Cheung YB, Cueto S, et al. Developmental potential in the first 5 years for children in developing countries. Lancet 2007;369:60-70.
6. Lu C, Black MM, Richter LM. Risk of poor development in young children in low-income and middle-income countries: an estimation and analysis at the global, regional, and country level. Lancet Glob Heal 2016;4:e916-22.
7. McCoy DC, Peet ED, Ezzati M, et al. Early childhood developmental status in low- and middle- income countries: national, regional, and global prevalence estimates using predictive modeling. PLoS Med 2016;13:e1002034.
8. Fink G, McCoy DC, Yousafzai A. Contextual and socioeconomic variation in early motor and language development. Arch Dis Child 2020;105:421-7.
9. Black MM, Hess CR, Berenson-Howard J. Toddlers from low-income families have below normal mental, motor, and behavior scores on the revised Bayley scales. J Appl Dev Psychol 2000;21:655-66.
10. Wei QW, Zhang JX, Scherpbier RW, et al. High prevalence of developmental delay among children under three years of age in poverty-stricken areas of China. Public Health 2015;129:1610-7.
11. Iannotti L, Jean Louis Dulience S, Wolff P, Cox K, Lesorogol C, Kohl P. Nutrition factors predict earlier acquisition of motor and language milestones among young children in Haiti. Acta Paediatr Int J Paediatr 2016;105:e406-11.
12. Frongillo EA, Nguyen PH, Saha KK, et al. Large-scale behavior-change initiative for infant and young child feeding advanced language and motor development in a cluster-randomised program evaluation in Bangladesh. J Nutr 2017;147:256-63.
13. Leventakou V, Roumeliotaki T, Koutra K, et al. Breastfeeding duration and cognitive, language and motor development at 18 months of age: Rhea mother–child cohort in Crete, Greece. J Epidemiol Community Heal 2015;69:232-9.
14. World Health Organization. Global strategy for infant and young child feeding, 2003. https://www.who.int/publications/i/item/9241562218
15. Wu HH, Li H, Zhang YQ, Zhu ZH, Yu Y. National survey showed that Chinese city children under two years of age had similar feeding patterns to developed countries. Acta Paediatr 2018;107:1555-61.
16. Patra KP, Greene MM, Patel AL, Meier P. Maternal education level predicts cognitive, language, and motor outcome in preterm infants in the second year of life. Am J Perinatol 2016;33:738-44.
17. Voss W, Jungmann T, Wachtendorf M, Neubauer AP. Long-term cognitive outcomes of extremely low-birth-weight infants : the influence of the maternal educational background. Acta Paediatr 2012;569-73.
18. Ko G, Shah P, Lee SK, Asztalos E. Impact of maternal education on cognitive and language scores at 18 to 24 months among extremely preterm neonates. Am J Perinatol 2013;30:723-30.
19. Beaino G, Khoshnood B, Kaminski M, et al. Predictors of the risk of cognitive deficiency in very preterm infants: the EPIPAGE prospective cohort. Acta Paediatr 2011;100:370-8.
20. Erbaugh SJ, Clifton MA. Sibling relationships of preschool-aged children in gross motor environments. Res Q Exerc Sport 1984;55:323-31.
21. Giagazoglou P, Karagianni O, Sidiropoulou M, et al. Effects of the characteristics of two different preschool-type setting on children's gross motor development. Eur Psychomot J 2008; 1:54-60.
22. Venetsanou F, Kambas A. Environmental factors affecting preschoolers' motor development. Early Child Educ J 2010;37:319-27.
23. Ngure FM, Reid BM, Humphrey JH, Mbuya MN, Pelto G, Stoltzfus RJ. Water, sanitation, and hygiene (WASH), environmental enteropathy, nutrition, and early child development: making the links. Ann N Y Acad Sci 2014;1308:118-28.
24. De Onis M, Onyango AW. WHO child growth standards. Lancet 2008;371:204.
25. Wang S, Lay S, Yu H, Shen SR. Dietary guidelines for Chinese residents (2016): comments and comparisons. J Zhejiang Univ B 2016;17:649-56.
26. WHO Multicentre Growth Reference Study Group. WHO Motor Development Study: Windows of achievement for six

gross motor development milestones. Acta Paediatr 2006;95:86-95.
27. Kulkarni S, Ramakrishnan U, Dearden KA, et al. Greater length-for-age increases the odds of attaining motor milestones in Vietnamese children aged 5-18 months. Asia Pac J Clin Nutr 2012;21:241-6.
28. Gupta A, Kalaivani M, Gupta S, Rai SK, Nongkynrih B. The study on achievement of motor milestones and associated factors among children in rural North India. J Fam Med Prim Care 2016;5:378-82.
29. Wylie A, Sundaram R, Kus C, Ghassabian A, Yeung EH. Maternal prepregnancy obesity and achievement of infant motor developmental milestones in the upstate KIDS study. Obesity 2015;23:907-13.
30. Engle PL, Black MM. The effect of poverty on child development and educational outcomes. Ann N Y Acad Sci 2008;1136:243-56.
31. Barnett LM, Lai SK, Veldman SLC, et al. Correlates of gross motor competence in children and adolescents: a systematic review and meta-analysis. Sport Med 2016;46:1663-88.
32. Stewart CP, Kariger P, Fernald L, et al. Effects of water quality, sanitation, handwashing, and nutritional interventions on child development in rural Kenya (WASH Benefits Kenya): a cluster-randomised controlled trial. Lancet Child Adolesc Heal 2018;2:269-80.
33. Jingxiong J, Rosenqvist U, Huishan W, Greiner T, Lian G, Sarkadi A. Influence of grandparents on eating behaviors of young children in Chinese three-generation families. Appetite 2007;48:377-83.
34. World Health Organization. Indicators for assessing infant and young child feeding practices part 2: measurement, 2010. https://apps.who.int/iris/bitstream/handle/10665/44306/9789241599290_eng.pdf?sequence=1&isAllowed=y
35. Sankar MJ, Sinha B, Chowdhury R, et al. Optimal breastfeeding practices and infant and child mortality: a systematic review and meta-analysis. Acta Paediatr 2015;104:3-13.
36. Yan J, Liu L, Zhu Y, Huang G, Wang PP. The association between breastfeeding and childhood obesity: a meta-analysis. BMC Public Health 2014;14:1267.
37. Grace T, Oddy W, Bulsara M, Hands B. Breastfeeding and motor development: A longitudinal cohort study. Hum Mov Sci 2017;51:9-16.
38. Chiu WC, Liao HF, Chang PJ, Chen PC, Chen YC. Duration of breast feeding and risk of developmental delay in Taiwanese children: A nationwide birth cohort study. Paediatr Perinat Epidemiol 2011;25:519-27.
39. World Health Organization. Indicators for assessing infant and young child feeding practices part 3: country profiles, 2010. https://apps.who.int/iris/bitstream/handle/10665/44368/9789241599757_eng.pdf?sequence=1&isAllowed=y
40. Victora CG, Bahl R, Barros AJD, et al. Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. Lancet 2016;387:475-90.
41. Ryan AS, Zhou W, Arensberg MB. The effect of employment status on breastfeeding in the United States. Women's Heal Issues 2006;16:243-51.
42. Haider SJ, Jacknowitz A, Schoeni RF. Welfare work requirements and child well-being: Evidence from the effects on breast-feeding. Demography 2003;40:479-97.
43. Mandal B, Roe BE, Fein SB. The differential effects of full-time and part-time work status on breastfeeding. Health Policy 2010;97:79-86.
44. Johnston ML, Esposito N. Barriers and facilitators for breastfeeding among working women in the united states. J Obstet Gynecol Neonatal Nurs 2007;36:9-20.
45. Sloan S, Sneddon H, Stewart M, et al. Breast is best? Reasons why mothers decide to breastfeed or bottlefeed their babies and factors influencing the duration of breastfeeding. Child Care Pract 2006;12:283-97.