



# Home Environment Affordances and Maternal Health Literacy: Predictors of Motor Development in Children Aged 7 - 10

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## Abstract

**Background:** This study aimed to explore the relationship between home environment affordances and maternal health literacy (HL) as predictors of motor development in children aged 7 to 10 years.

**Methods:** A total of 102 girls were selected through random cluster sampling from elementary schools in Tabriz city. The study was conducted in two phases: In the first phase, mothers completed a HL test and the Affordances in the Home Environment for Motor Development Questionnaire (AHMED). In the second phase, children's motor skills were assessed using the Bruininks-Oseretsky test of motor proficiency (BOTMP).

**Results:** Multiple linear regression analysis revealed significant relationships between home environment affordances and gross motor development, as well as between maternal HL and both gross and fine motor skills. Both home affordances and maternal HL were found to be strong predictors of motor development.

**Conclusions:** The findings suggest that enhancing children's play environments and improving maternal HL can significantly support the development of children's motor skills. It is recommended that parents, educators, and educational institutions prioritize the creation of stimulating play environments and efforts to increase mothers' HL to promote motor development during the critical childhood years.

**Keywords:** Affordances, Child Development, Fine Motor Skills, Gross Motor Skills, Maternal Health Literacy

## 1. Background

The question of whether enriched environments play a role in motor development and whether optimal brain growth relies on strong environmental support remains a subject of ongoing debate (1). Bronfenbrenner and Ceci (2) noted that the physical characteristics of the environment can have the effect of inhibiting, hindering or facilitating the interaction of a person with the environment. The environment is considered to have the ability to facilitate or delay a child's motor skill experiences. One of the theories that supports the environment for the development of motor skills is the affordance concept. Children learn through interaction with their environment as well as events and incidents. affordances refer to the opportunities provided by the environment, such as toys, equipment, events, and

space, which facilitate meaningful behaviors (3). Each environment has objects, places, surfaces, events and other people that provide different action opportunities for the child depending on the child's action capabilities. For example, a seat provides seating for a 6-year-old who can sit, but not for a 9-month-old who is just starting to crawl. Therefore, according to this point of view, Affordances are opportunities for individual action that are provided by objects, places, etc. in the environment for living beings. Toys are a significant part of the affordance and if the child has access to them, they can promote his motor development (4). Affordances change with the development of individuals and their availability also varies with the culture and social status of the family [socioeconomic status (SES), the size of the house]. The availability of specific motor skill opportunities for a child in a

particular context does not mean that the child will automatically perceive and act on it, but some environments provide more affordable prospects than others and therefore have more potential for the child's motor development (5). Previous research has indicated that the relationship between toys and motor skill development is stronger than the relationship between motor skill development and other global measures of environmental quality (such as SES) (6). Abbott et al. (7) concluded in a study that despite the lack of statistically significant differences to support the hypothesis of a relationship between the home environment and motor development, relevant evidence suggests that a more supportive home environment is associated with higher infant motor development. Goyen and Lui (8) found that the development of gross and fine motor skills is differently affected by the home environment. And children in the rich environment showed better scores in the development of gross and not fine motor skills.

Mothers have a primary influence on the home environment and the opportunities that it provides a child for movement experiences. One factor that may influence the availability of home affordances is maternal health literacy (HL), whereby health literate mothers may provide environments that afford greater opportunities for child development (vs. those with low literacy). Health literacy describes the knowledge, motivation, and competencies to access, understand, evaluate, and apply health-related information in health care, disease prevention, and health promotion, respectively (9). Mother's HL in early parenthood is essential for understanding a child's health and behavior. Additionally, a child's physical activity significantly affects the development of basic and advanced motor skills (10). Parents play a crucial role in shaping the home environment, which significantly influences the opportunities available for their child's physical activities. The types of toys and floor surfaces in the home serve as examples of these affordances. For instance, shape sorters offer different movement experiences than modern walkers, engaging various muscles and impacting motor skill development differently. While no single affordance is inherently superior, they can have varying effects on a child's motor skills. For instance, a mother with greater HL is likely to offer her child a distinct selection of toys, play areas, and movement opportunities in contrast to a mother with

lower HL (11). This, in turn, may influence level of motor development. In a study by Hernandez-Mekonnen et al. (12), it was found that women with low HL are at least four times more likely to have children with developmental delays. Cheng et al. found that inadequate parental HL was associated with increased television viewing in children (13). Several studies examined the effect of parental HL on child-related health behaviors and the child's health outcomes show that parents' high HL is associated with favorable health behaviors (14). Pawellek et al. stated that strengthening maternal HL will ultimately lead to better health outcomes for both mother and child and should therefore continue to be a public health goal (15). Research on how home environment affordances and maternal HL together impact motor skill development in children aged 7 - 10 is limited. While many studies focus on individual factors, such as socio-economic status or specific parenting behaviors, few consider the combined effects of both the home environment and maternal literacy. Studies like Valadi and Gabbard (16) underscore the importance of environmental factors, such as space and fine motor toys, in motor development. Similarly, Dickson (11) suggests that mothers with higher HL are more likely to create supportive environments conducive to motor development.

## 2. Objectives

This study addresses the research gap by examining how both home affordances and maternal HL influence the acquisition and development of motor skills, providing a comprehensive perspective that can guide targeted interventions to optimize motor development through practical changes within the home.

## 3. Methods

### 3.1. Subjects

A total of 102 girls were randomly selected through cluster sampling from schools of Tabriz during the 2022 - 2023 academic year. The inclusion criteria specified children aged 7 to 10 years, who were healthy according to their school health records and had no physical disabilities or visual impairments affecting motor development. Conversely, children were excluded if their mothers or primary caregivers did not provide

informed consent or if they were absent for more than 20% of the intervention sessions. The study adhered to ethical standards by obtaining informed consent and ensuring the protection of participants' rights and confidentiality throughout the research process.

### 3.2. Apparatus and Task

**Demographic Characteristics Questionnaire:** This questionnaire was used to record age, health status, and other relevant demographic information.

#### 3.2.1. Test of Functional Health Literacy in Adults

The test of functional health literacy in adults (TOFHLA) measures functional literacy, encompassing 67 items – 50 reading comprehension and 17 numeracy questions. It evaluates an individual's ability to read, comprehend health-related text, and perform health-related tasks (17). The test is highly correlated with the wide range achievement test-revised (WRAT-R,  $r = 0.74$ ) (18). It takes up to 22 minutes to complete, and the total score, ranging from 0 to 100, categorizes participants into three literacy levels: Inadequate (0 - 59), marginal (60 - 74), and adequate (75 - 100) (18). The validity and reliability of this questionnaire in Iranian society have been confirmed in previous studies. Cronbach's alpha values were 0.79 for the numeracy section and 0.88 for the reading comprehension section (19, 20).

#### 3.2.2. Bruininks-Oseretsky Test of Motor Proficiency

The Bruininks-Oseretsky test of motor proficiency (BOTMP) was used to assess the motor performance of children. This comprehensive test comprises eight subtests with 46 sections measuring various motor skills. Administered individually over 45 - 60 minutes, it evaluates gross and fine motor skills and upper limb coordination. Standardized on a sample of 756 children, its reliability coefficient is 0.87, and its validity is 84%.

#### 3.2.3. Affordance in the Home Environment for Motor Development Questionnaire

This questionnaire assesses environmental affordances through four subscales: External space, types of stimulation, fine motor toys, and gross motor toys. Each of these subscales includes variables such as external surfaces, external accessories, and play stimuli, freedom of movement, encouraging stimuli, daily

activities, model toys, educational toys, games, construction toys, natural materials, musical materials, crafted materials, movement materials, and body exploration materials. In Fathirezaie's research, the questionnaire demonstrated an internal reliability of 0.89, as measured by Cronbach's alpha (21). The Affordance in the Home Environment for Motor Development Questionnaire (AGMDQ-1) has a content validity coefficient of 0.92, reliability of 0.91, and internal consistency of 0.93 (22).

### 3.3. Procedure

Informed consent was obtained from parents after explaining the study's objectives and procedures. The assessment occurred in two stages:

(1) Step one: Mothers completed the TOFHLA and AGMDQ-1.

(2) Step two: Children aged 7 to 10 years were assessed using the BOTMP.

### 3.4. Data Analysis

The Kolmogorov-Smirnov test was used to check the normality of the data. Pearson's correlation and multiple linear regression analyses were conducted to explore the relationships between environmental affordances, maternal HL, and children's motor development. Statistical significance was set at 0.05 using SPSS version 23.

## 4. Results

The normality of the data distribution was assessed using the Kolmogorov-Smirnov test, which indicated that most variables followed a normal distribution. Therefore, Pearson's correlation and multiple linear regression analyses were conducted at a significance level of 0.05 to explore the relationships among the variables.

Descriptive statistics, including mean and standard deviation were calculated to confirm that the assumptions for inferential analysis were satisfied. These statistics are presented in Table 1.

The Pearson correlation analysis (Table 2) showed significant positive relationship between physical space, various stimuli, gross motor toys, affordance, reading comprehension, calculation, maternal HL, and children's gross motor development. No significant

**Table 1.** Descriptive Statistics for the Variables of the Study

| Variables                     | Mean $\pm$ SD     |
|-------------------------------|-------------------|
| Physical space                | 5.44 $\pm$ 1.58   |
| <b>Various stimuli</b>        | 8.36 $\pm$ 4.22   |
| Gross motor toys              | 5.72 $\pm$ 3.02   |
| <b>Fine motor toys</b>        | 5.47 $\pm$ 2.04   |
| Affordance                    | 25.00 $\pm$ 8.98  |
| <b>Reading comprehension</b>  | 35.58 $\pm$ 5.99  |
| Calculation                   | 28.88 $\pm$ 10.16 |
| <b>Literacy</b>               | 64.45 $\pm$ 14.82 |
| Gross motor development       | 4.76 $\pm$ 2.12   |
| <b>Fine motor development</b> | 5.27 $\pm$ 2.38   |

**Table 2.** Correlations Coefficient Between Motor Development and Predictive Variables of the Research

| Variables                    | Gross Motor Development | Fine Motor Development |
|------------------------------|-------------------------|------------------------|
| Physical space               | 0.209 <sup>a</sup>      | 0.128                  |
| <b>Various stimuli</b>       | 0.258 <sup>b</sup>      | 0.227 <sup>a</sup>     |
| Gross motor toys             | 0.255 <sup>b</sup>      | 0.200 <sup>a</sup>     |
| <b>Fine motor toys</b>       | 0.144                   | 0.150                  |
| Affordance                   | 0.258 <sup>b</sup>      | 0.182                  |
| <b>Reading comprehension</b> | 0.546 <sup>b</sup>      | 0.202 <sup>a</sup>     |
| Calculation                  | 0.568 <sup>b</sup>      | 0.257 <sup>b</sup>     |
| <b>Mothers' HL</b>           | 0.601 <sup>b</sup>      | 0.262 <sup>b</sup>     |

Abbreviation: HL, health literacy.

<sup>a</sup>  $P < 0.05$ .

<sup>b</sup>  $P < 0.01$ .

relationship was observed between fine motor toys and gross motor development. Similarly, significant positive correlations were found between various stimuli, gross motor toys, reading comprehension, calculation, and mothers' HL with children's fine motor development. No significant relationships were found between physical space, affordance, and fine motor toys with fine motor development.

#### 4.1. Predicting Gross Motor Skills

The regression model for four affordance factors in the home environment with gross motor skills as the criterion variable was significant ( $F_{(4, 97)} = 3.58$ ,  $P =$

0.009). The adjusted  $R^2$  value indicated that the predictor variables explained 12% of the variance in gross motor development, making the model appropriate for examining gross motor skills. Gross motor toys was the only significant predictor of gross motor skills (Table 3).

#### 4.2. Predicting Fine Motor Skills

The regression model for affordance factors predicting fine motor skills was not significant ( $F_{(4, 97)} = 1.44$ ,  $P = 0.22$ ), suggesting these factors did not explain variability in fine motor development.

**Table 3.** Predictive Coefficients for Gross Motor Skills

| Variables        | Unstandardized Coefficients |            | Beta   | t      | P     |
|------------------|-----------------------------|------------|--------|--------|-------|
|                  | B                           | Std. Error |        |        |       |
| Physical space   | 0.065                       | 0.154      | 0.049  | 0.425  | 0.672 |
| Various stimuli  | 0.069                       | 0.066      | 0.137  | 1.037  | 0.302 |
| Gross motor toys | 0.215                       | 0.107      | 0.306  | 2.010  | 0.047 |
| Fine motor toys  | -0.158                      | 0.132      | -0.152 | -1.200 | 0.233 |

**Table 4.** Predictive Coefficients for Gross Motor Skills

| Variables             | Unstandardized Coefficients |            | Beta  | t     | P     |
|-----------------------|-----------------------------|------------|-------|-------|-------|
|                       | B                           | Std. Error |       |       |       |
| Reading comprehension | 0.115                       | 0.036      | 0.327 | 3.173 | 0.002 |
| Calculation           | 0.069                       | 0.021      | 0.334 | 3.245 | 0.002 |

#### 4.3. Health Literacy and Gross Motor Skills

The regression model for maternal HL predicting gross motor skills was significant ( $F_{(2, 99)} = 27.02$ ,  $P = 0.001$ ) and explained 35% of the variance in gross motor development. As shown in Table 4, both reading comprehension and calculation significantly predicted gross motor skills.

#### 4.4. Health Literacy and Fine Motor Skills

The regression model for maternal HL predicting fine motor skills was also significant ( $F_{(2, 99)} = 32.23$ ,  $P = 0.001$ ), explaining 39% of the variance in fine motor development. As shown in Table 5, both reading comprehension and calculation were significant predictors of fine motor skills.

### 5. Discussion

This study aimed to investigate the relationship between home environment affordances and maternal HL as predictors of motor development in children aged 7 to 10 years. The results revealed significant positive relationships between certain home affordances and gross motor development, while maternal HL emerged as a strong predictor of both gross and fine motor skills. Three factors of the home environment – physical space, various stimuli, and gross motor toys – were positively associated with children's gross motor development. Among these, gross motor toys emerged as the strongest predictor of gross motor skill

development, highlighting the critical role of accessible play materials that engage children in physical activity.

However, the findings showed no significant relationship between fine motor toys and either gross or fine motor development, nor any significant relationship between physical space and fine motor development. These results suggest that while certain environmental affordances can promote gross motor skills, they may not have the same impact on fine motor skills, which could be influenced by other factors, such as the quality of adult interactions during play, opportunities for skill practice, and activities that promote fine motor development, like arts and crafts or puzzles. Previous studies have consistently shown that home environment affordances are correlated with motor development across various age groups (16, 23), aligning with the present findings. Fatahi and Zamani Sani (24) found that environmental affordances predicted fine motor skills, but this was not observed in the current study. The inconsistency could be due to other factors influencing fine motor development, such as genetic, neurological (25), muscular (26), and nutritional (27) aspects. These factors may interact with environmental affordances differently depending on individual child characteristics and developmental contexts.

The results support Bronfenbrenner's ecological systems theory and Gibson's affordances theory. According to Bronfenbrenner, the home environment (the microsystem) plays a vital role in shaping

**Table 5.** Predictive Coefficients for Fine Motor Skills

| Variables             | Unstandardized Coefficients |            | Beta  | t     | P     |
|-----------------------|-----------------------------|------------|-------|-------|-------|
|                       | B                           | Std. Error |       |       |       |
| Reading comprehension | 0.092                       | 0.035      | 0.259 | 2.596 | 0.011 |
| Calculation           | 0.091                       | 0.021      | 0.434 | 4.361 | 0.001 |

developmental outcomes by offering opportunities for interaction and imposing specific demands on children's motor behavior. The presence of various stimuli, ample physical space, and motor-engaging toys promotes the development of gross motor skills by creating an environment that fosters physical engagement (28). Gibson's theory of affordances further reinforces this, suggesting that the opportunities for action provided by the environment directly influence motor behaviors.

This study also found a significant positive relationship between maternal HL and children's motor development. Specifically, maternal reading comprehension and calculation abilities were strong predictors of both fine and gross motor skills. These results are consistent with previous research by Dickson (11), which reported a positive correlation between maternal literacy and motor development in younger children. Mothers with higher HL are likely to create more enriched home environments that promote motor skill development, through greater knowledge and understanding of the child's developmental needs.

In the context of perception-action theory, these findings suggest that a mother's ability to interpret health-related information can directly influence the motor affordances provided within the home environment. Mothers with better HL are more likely to offer varied play opportunities, enhance their child's motor development through richer interactions, and provide verbal and social encouragement that fosters action-oriented behaviors (29). For example, Adolph et al. (30) demonstrated that maternal social cues could influence infants' willingness to engage in physically challenging tasks, like walking on sloped surfaces. Similarly, in this study, mothers with higher HL might create environments that support both gross and fine motor development, offering a wider variety of toys and opportunities for skill refinement.

In conclusion, this study highlights the significant impact of home environments and maternal HL on children's motor development. Gross motor affordances, such as toys and physical space, are essential for fostering physical growth, while maternal HL plays a key role in both gross and fine motor skill development. Improving home settings and implementing programs to enhance maternal literacy can provide children with vital support for effective motor skill development, promoting their overall growth and well-being.

The retrospective design of this study further constrains the ability to establish causal relationships between home environment factors, maternal HL, and motor development. Longitudinal studies would offer stronger evidence of how these factors interact over time. Additionally, exploring targeted interventions to improve home affordances and maternal HL, and assessing their impact on motor development through more rigorous designs, would be valuable. There remains a notable gap in comprehensive research on the combined effects of maternal HL and home affordances on child development. Addressing this gap in future studies could provide critical insights into how these factors synergistically shape developmental outcomes.

#### Footnotes

**Authors' Contribution:** M. C.: Study design and data curation; R. K.: Study design, investigation, writing original draft– review and editing.

**Conflict of Interests Statement:** The authors declare no competing interests.

**Data Availability:** The dataset presented in the study is available on request from the corresponding author during submission or after publication.

**Ethical Approval:** Informed consent was obtained from students, ensuring their autonomy and understanding. The research adhered to the ethics code, which was granted by Institutional Research Ethics Committee in Urmia University. The ethical code of this work is [IR.URMIA.REC.1403.026](#).

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**Informed Consent:** Informed consent was obtained from all participants.

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