Pediatrics

Environmental and personal factors that explain functional abilities and caregiver assistance on children aged 6 to 18 months: a cross-sectional study

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Abstract - aims: This study investigated environmental and personal factors that explain functional skills and caregiver assistance in young infants/toddlers. **Methods:** A cross-sectional study was conducted involving seventy-four children with typical development between 6 and 18 months of age. Functioning skills were evaluated using the Pediatric Evaluation of Disability Inventory, and the home environment was evaluated using the Affordances in the Home Environment for Motor Development-Infant Scale. Statistical analyses were performed by regression models. **Results:** Child's age explained 45% of self-care (β = 0.68); child's age (β = 0.72), attending daycare (β = 0.33) explained 71% of mobility, and child's age (β = 0.80) and breastfeeding duration (β = 0.17) explained 69% of social function. With regards to caregiver assistance, child's age (β = 0.46), attending daycare (β = 0.20) and number of siblings (β = -0.22) explained 31% of self-care; child's age (β = 0.62) and attending daycare (β = 0.34) explained 56% of mobility; and child's age (β = 1.91) and total AHEMD-IS score (environment) (β = 2.63) explained 30% of social function. **Conclusion:** Daycare, breastfeeding duration, number of siblings, stimulation at home, and age explained functional skills and caregiver assistance to toddlers/infants.

Keywords: Functional skills; child; environment; caregiver's assistance.

Introduction

According to the International Classification of Functioning, Disability, and Health, functioning encompasses all functions of the body and the capacity to perform activities and tasks relevant to one's daily routine as well as participate in society[1-3]. An individual develops a repertoire of skills during the infancy to meet daily environmental demands and gradually acquires greater autonomy[3]. Examples of functional skills that children use daily are eating, dressing, expressing needs, caring for personal items, interacting with peers, controlling the behavior of someone in a structured environment, communicating with others and practicing safety[3]. When it comes to children's development of functional skills, the role of the caregiver is fundamental. Caregiver assistance is particularly important for activities with a high degree of difficulty, which may explain the need for a greater or a less assistance depending on the age of the child and the activity being executed[4].

The development of functional skills and caregiver assistance in children of typical and atypical development (e.g., cerebral palsy, autism, myelomeningocele, risk groups, such as premature children) have been systematically reported[5-8]. Moreover, some insights factors such as quality of the educational environment, daycare, breastfeeding, mother's schooling, among others may be associated with the development of functional skills and caregiver assistance in children of typical and atypical development[9-11]. However, important environmental and personal factors that are associated with these outcomes in this population is still unclear. Identifying important factors associated with greater functional skills and less caregiver assistance in young typical children would clarify potential risk factors to be modified. Therefore, this study aimed to investigate environmental and personal factors that explain functional skills and caregiver assistance in infants/toddlers.

This type of investigation is important throughout childhood, especially in the first phase of early childhood (zero to three years of age) because it is a period involving the development of brain structures and the acquisition of fundamental skills that enable the subsequent acquisition of more complex skills[12].

Methods

Study design and participants

The present observational, cross-sectional study was approved by the Human Research Ethics Committee of the Federal University of the Jequitinhonha and Mucuri Valleys in Diamantina, Brazil (number: 3.419.066). The sample was composed of male and female infants and toddlers between six and 18 months of age with typical development. All participants

were on the waiting list for the project entitled "Nothing Better: Aquatic Stimulation for Babies" conducted at the teaching clinic of the Physical Therapy Department of the university.

Procedures and outcomes of interest

After initial contact with the child's guardians and consent, interviews were scheduled and carried out in the first semester of 2019 in a private room of the clinic. Guardians' interviews were performed by a trained investigator using a structured questionnaire to collect data on child's age (in months); the number of siblings; sex (male or female); duration of breastfeeding (up to six months or more than six months); gestation (at term [at least 37 weeks] or preterm [less than 37 weeks]); daycare (yes or no). In addition, the Pediatric Evaluation of Disability Inventory (PEDI) was applied to evaluate the outcomes of interest: children's functional skills and assistance from the caregiver related to self-care, social functions and mobility[13]. The Affordances in the Home Environment for Motor Development-Infant Scale (AHEMD-IS) was also applied to evaluate the opportunities (affordances) in the home environment for the promotion of motor development[14].

The PEDI is used to evaluate functional skills, performance, and the need for assistance in children between six months and 7.5 years of age[15]. The PEDI is based on data obtained during a structured interview with parents and caregivers or the observation of a health professional. This inventory was translated and adapted to Brazilian-Portugues, and its first part addresses functional skills (child's self-care repertoire), with seventy-three questions on personal hygiene and eating[13]. The mobility is investigated with fity-nine questions on locomotion in the internal and external environment. The social function dimension has sixty-five questions on understanding and problem-solving. The sum of the self-care, mobility, and the social function skills generates a raw score. The second part of the inventory addresses the amount of assistance offered by the caregiver during activities involving the same dimensions: self-care (eight tasks); mobility (seven tasks); and social function (five tasks). Each item of the second part is scored in the ordinal scale ranging from 0 (the child requires complete assistance) to 5 (the child is completely independent). The raw score results of the first and second parts are converted into continuous scores ranging from 0 to 100 (higher scores indicate more skills) as recommended[13].

The AHEMD-IS is an instrument based on the reports of parents or caregivers[4,9,16]. The version for children between three and 18 months of age consists of thirty-five questions related to the home environment divided into four dimensions: physical space (internal and external spaces of the home); variety of stimulation (the extent to which the parent/caregiver stimulates the child); toys that enable the practice of fine motor skills (toys of manipulation); and toys that enable the practice of gross motor skills (those that make the children move and walk). This instrument was translated and validated to Portuguese language and the results suggested that it is useful for the assessment of the quantity and quality of affordances in the home environment[4]. Final scores are obtained using a calculator designed by the original instrument (Supplement 1 - AHEMD-IS Calculator 3 to 11 months Beta 1.0.xls; Supplement 2 - AHEMD-IS Calculator 12 to 18 months Beta 1.0.xls). The calculator converts the scores into descriptive categories of the environment (by dimension and total score), and finally provides the classification of resources in the domestic environment: (1) less than adequate; (2) moderately adequate; (3) adequate; it is excellent.

Statistical analysis

The following environmental and personal factors of interest were analyzed, child's age (in months); the number of siblings; sex (male or female); breastfeeding duration (up to six months or more than six months); gestation (full term [at least 37 weeks] or preterm [less than 37 weeks]); daycare (yes or no); and the influence of home environment (AHEMD-IS: less than adequate, moderately adequate, adequate or excellent). The six outcomes of interest collected using the PEDI were functional skills: self-care; mobility; and social function, and assistance from caregiver regarding: self-care; mobility; and social function. Outcomes of interest were analyzed as described above on a scale ranging from 0 to 100 points. The Statistical Package for Social Sciences (SPSS) version 25.0 was used for all analyses. As the Shapiro-Wilk test revealed non-normal distribution, medians (interquartile ranges) and frequencies were reported for continuous and categorical variables, respectively. Hierarchical multivariate regression was used to investigate the association between environmental/personal factors, and functional skills/caregiver assistance. We chose the order (hierarchy) in which the variables entered the equation based on a previous study[17]. For the construction of the regression model, Spearman's correlation coefficient was used for the continuous or ordinal variables, and the chi-square (χ^2) test was used for the categorical variables to identify potential personal and environmental factors (age, breastfeeding duration, sex, number of siblings, daycare and home environment) associated with each of the six outcomes of interest (functional skills: self-care; mobility; and social function, and caregiver assistance regarding: self-care; mobility; and social function). For inclusion in the multivariate regression models, the factors of interest needed to obtain a correlation with the outcomes of interest (p-value <0.20) and not present multicollinearity. All assumptions for the regressions were obtained. Final regression model that explains each of the outcomes of interest included only explanatory factors with a p-value <0.05. The effect size for the regressions was reported using R^2. The sample size was calculated a priori using the G * Power 3.1 software, considering an effect size of 0.20, α of 0.05, and power of 80%. The calculated sample size was 70 participants.

Results

Characteristics of participants

The parents of ninety-six children were contacted and seventy-four children met the inclusion criteria for the study (Figure 1).

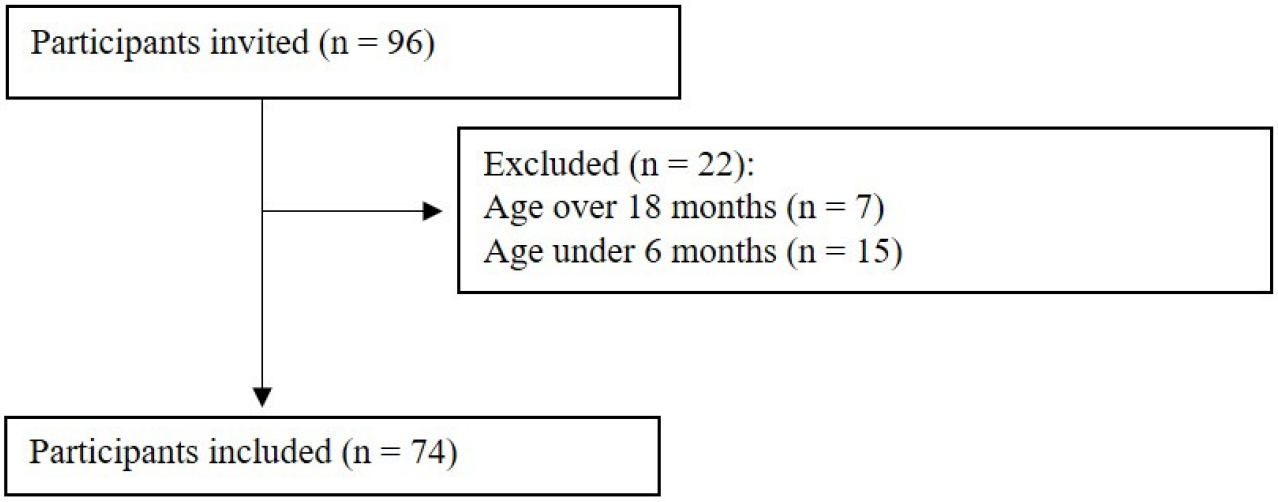

Figure 1 - Flow participants in the study.

Table 1 shows the characteristics of the children who participating in the study. Children's median age was 11 months (interquartile range: 7.8 – 13; minimum and maximum: 6 and 18 months, respectively). The median gestation age was thirty-nine weeks (interquartile range: 38 – 40; minimum and maximum: 33 and 42 weeks, respectively). The majority of the children (n = 64; 86.5%) was born at full term (gestational age ≥ 37 weeks). Sex distribution was balanced (38 girls [51.4%] and 36 boys [48.6%]). Approxinately half of the children did not attend daycare (n =39; 52.7%). Regarding parents' schooling, mothers had more schooling than fathers; 37 mothers (50%) had university and post-graduate degrees. Most families (n= 45; 60.8%) were nuclear (father, mother and children living together) and had only one child (n = 49; 66.2%). The frequency of postpartum depression was low (n =16; 21.6%).

Table 2 shows the classification of the opportunities (affordances) at the home environment. The category with the highest percentage was moderately adequate (n = 27; 36.5%). Analyzing the subcategories, the highest index was found for the adequate classification of toys for gross motor skills (n = 36; 48.6%), and the lowest index was found for the excellent classification of toys for fine motor skills (n = 6; 8.1%). The variation of stimulation had a higher percentage of the less than adequate classification (n = 45; 60%). The toys for fine motor skills had a higher percentage of classifications below the adequate level (n = 45; 61%).

Table 3 shows the continuous PEDI scores for dimensions of functional skills (self-care, mobility and social function) and caregiver assistance (regarding self-care, mobility and social function). All children had medians below 50 on the task scale, ~~as the age range was very small~~, leading to a certain homogeneity in the results.

Associations between environmental/personal factors and functional skills/caregiver's assistance

Spearman's correlation and chi-square test (χ^2)

The Spearman (ρ) and chi-square (χ^2) tests revealed factors associated with the dependent variables. Regarding functional skills, self-care was associated with child's age ($\rho = 0.67$, $p < 0.001$) and gestation time ($\chi^2 = 2.69$, $p = 0.101$); mobility was associated with age ($\rho = 0.77$, $p < 0.001$) and attending daycare ($\chi^2 = 7.74$, $p < 0.005$); and social function was associated with age ($\rho = 0.80$, $p < 0.001$), gestation time ($\chi^2 = 1.85$, $p < 0.174$), sex ($\chi^2 = 3.46$, $p < 0.060$) and attending daycare ($\chi^2 = 4.39$, $p = 0.036$). Regarding caregiver assistance, self-care was associated with age ($\rho = 0.49$, $p < 0.001$), number of siblings ($\rho = -0.24$, $p < 0.037$), gestation time ($\chi^2 = 4.16$, $p < 0.041$), sex ($\chi^2 = 5.41$, $p < 0.020$) and attending daycare ($\chi^2 = 2.66$, $p = 0.103$); mobility was associated with age ($\rho = 0.66$, $p < 0.001$), gestation time ($\chi^2 = 4.16$, $p < 0.041$) and attending daycare ($\chi^2 = 6.56$, $p = 0.010$); and social function was associated with age ($\rho = 0.54$, $p < 0.001$), total AHEMD-IS score ($\rho = 0.15$, $p < 0.191$), sex ($\chi^2 = 3.41$, $p < 0.065$) and attending daycare ($\chi^2 = 2.52$, $p = 0.112$).

Multivariate regression

Table 4 displays results of the multivariate regression analysis. With regards to functionals skills, child's age explained

45% of self-care (β = 0.68, R^2 = 0.45); child's age (β = 0.72) and attending daycare (β = 0.33) explained 71% of mobility (R^2 = 0.71); and child's age (β = 0.80) and breastfeeding duration (β = 0.17) explained 69% of social function (R^2 = 0.69). With regards to caregiver's assistance, child's age (β = 0.46), attending daycare (β = 0.20) and number of siblings (β = -0.22) explained 31% of self-care (R^2 = 0.31); child's age (β = 0.62) and attending daycare (β = 0.34) explained 56% of mobility (R^2 = 0.56); and child's age (β = 1.91) and total AHEMD-IS score (environment) (β = 2.63) explained 30% of social function (R^2 = 0.30).

Table 1 - Characteristics of the participants (n = 74).

Variables	Classification	n = 74	%	Median	Interquartile Range
Age (in months)	-	-	-	11	(7.8 – 13)
Gestational time	To term	64	86.5	-	-
	Preterm	10	13.6	-	-
Breastfeeding Time	Up to 6 months	38	51.4	-	-
	More than 6 months	36	48.6	-	-
Sex	Male	36	48.6	-	-
	Female	38	51.4	-	-
Number of siblings	Only child	49	66.2	-	-
	1 brother	16	21.6	-	-
	2 brothers	7	9.5	-	-
	3 brothers	2	2.7	-	-
Paternal education	Elementary	8	10.8	-	-
	High school	41	55.4	-	-
	Higher	18	24.3	-	-
	Postgraduate studies	7	9.5	-	-
Maternal education	Elementary	2	2.7	-	-
	High school	35	47.3	-	-
	Higher	30	40.5	-	-
	Postgraduate studies	7	9.5	-	-
Father's Presence	No paternal presence	14	18.9	-	-
	With paternal presence	60	81.1	-	-
Maternal depression	Yes	16	21.6	-	-
	No	58	78.4	-	-
Daycare attendance	Yes	35	47.3	-	-
	No	39	52.7	-	-

n◦, absolute number; %, percentage; term = born 37 weeks or older, preterm = born less than 37 weeks

Table 2 - AHEMD-IS classification and its dimensions (n = 74).

Variables		N	%
Physical space			
	Less than adequate	16	21.6
	Moderately adequate	16	21.6
	Adequate	27	36.5
	Excellent	15	20.3
Variety of Stimulation			
	Less than adequate	33	44.6
	Moderately adequate	19	25.7
	Adequate	12	16.2
	Excellent	10	13.5
Fine-motor toys			
	Less than adequate	22	29.7
	Moderately adequate	23	31.1
	Adequate	23	31.1
	Excellent	6	8.1
Gross-Motor Toys			
	Less than adequate	6	8.1
	Moderately adequate	18	24.3
	Adequate	36	48.6
	Excellent	14	18.9
Total score AHEMD-IS			
	Less than adequate	12	16.2
	Moderately adequate	27	36.5
	Adequate	22	29.7
	Excellent	13	17.6

n°= absolute number; % = percentage

Table 3 - Functional skills and caregiver assistance in the dimensions of self-care, mobility and social function (n = 74)

Variables	Continuous Score	
	Median	Interquartile Range
Functional Skills - Self Care	39.9	34.1 – 45.6
Functional Skills - Mobility	36.0	21.6 – 45.3
Functional Skills - Social Function	42.2	35.7 – 50.0
Caregiver Assistance - Self Care	39.3	14.8 – 50.0
Caregiver Assistance - Mobility	36.6	17.9 – 50.9
Caregiver Assistance - Social Function	47.4	39.4 – 55.8

Range score – Task difficulty: 0-100 points, scores near 0 = easier tasks; scores close to 100 = harder tasks

Table 4 - Multivariate regression analyzes (n = 74)

Variables	Estimates				
	B	IC 95%	β	P	R^2
*Continuous Score - Functional S*kills - *Self Care*					
Age of child	1.63	1.20 – 2.05	0.68	<0.001	0.45
*Continuous Score - Functional S*kills - *Mobility*					
Age of child	2.83	2.32 - 3.34	0.72	<0.001	0.71
Daycare attendance	8.82	5.41 - 12.22	0.33	<0.001	
*Continuous Score - Functional S*kills - *Social Function*					
Age of child	1.80	1.50 - 2.11	0.80	<0.001	0.69
Breastfeeding time	2.51	0.50 – 4.52	0.17	0.015	
Continuous Score - Caregiver Assistance - Self Care					
Age of child	2.79	1.60 - 3.98	0.46	<0.001	
Daycare attendance	8.06	0.12 - 16.01	0.20	0.035	0.31
Number of siblings	-5.76	(-10.79) - (-0.73)	-0.22	0.025	
Continuous Score - Caregiver Assistance - Mobility					
Age of child	3.90	2.90 - 4.90	0.62	<0.001	0.56
Daycare attendance	14.13	7.49 - 20.78	0.34	<0.001	
Continuous Score - Caregiver Assistance - Social Function					
Age of child	1.91	1.22 – 2.60	0.55	<0.001	0.30
Total score AHEMD-IS	2.63	0.25 – 5.01	0.22	0.031	

B = non-standard regression coefficient; 95% CI = 95% confidence interval; β = regression coefficient standardized, estimate of the increase or decrease of the dependent variable for each increase of one unit of the variable independent; p = statistical significance < 0.05; R^2 = coefficient of determination

Discussion

The results of the present study show that personal and environmental factors explain functional skills and caregiver assistance in children six to 18 months of age with typical development. There are several studies examining the factors that can influence child development[9-11]. However, the literature on the acquisition of functional skills and caregiver assistance is scarce and mainly focused on children with atypical development[18-20]. The child's age was a personal factor while attending daycare and breastfeeding duration were environmental factors that explained the acquisition of functional skills.

The child's age exerted an influence on all domains of functional skills and caregiver assistance. Indeed, older children have more functional skills and greater independence regarding self-care, mobility and social function. This finding is in agreement with data reported in the literature, demonstrating that functioning increases with the growth of a child; older children have a larger number of experiences and are able to perform a larger number of tasks of increasingly complexity[13,21]. A previous study have examined the global development of children from two to five years of age comparing the quantity and quality of tasks of each year. The authors found that children are able to perform tasks proposed for their current age and their previous age as well as tasks proposed for two years, on average, older than their current age[22]. Likewise, it was investigated the growth and development of children 24 to 36 months of age and they found that age is a determinant of more elaborate tasks due to the development of language[23].

In the present study, the attending daycare exerted an influence on the acquisition of functional skills and caregiver assistance with regards to mobility and social function. According to the literature, the inclusion of children in the daycare leads to significant improvements in personal/social skills[24]. Daycare experiences seem to promote greater autonomy mainly due to the stimulation received in this setting. The children tend to perform better with regards to tasks, increasing their repertoire of skills and becoming more independent from their caregivers[25]. Thus, the positive association between the functional skills and attending daycare found in our study suggests that children in daycare tend to be more independent and perform more complex tasks compared to children who do not attend daycare. It is notheworthy, the importance of the quality of the daycare environment which was not evaluated in the present investigation. Indeed, a previous study compared child development using the Denver II test, and they found that children who attended daycare centers with inadequate quality did not exhibit greater development in comparison to those who did not attend in daycare[8]. According to Morais et al.[26], daycare contributes to child development, but the services must be of good quality, especially for children whose home environment does not offer opportunities for development. Thus, future studies should evaluate whether the quality of daycare also exerts an influence on the acquisition of functional skills in our community.

The present results reveal better functional skills regarding social function among children who were breastfed longer, although there was no specification regarding whether breastfeeding was exclusive or whether complementary foods were offered. The literature reports that breastfeeding exerts an influence on the social dimension and contributes to both physical health and neuropsychomotor development10,27. Studies examining the effects of breastfeeding in the acquisition of functional skills are scarce. However, in a cohort study conducted in Greece, Leventakou et al.28 investigated the association between breastfeeding and all aspects of child development (motor, language and cognitive) in children 18 months of age. The main finding was a positive linear association; children who were breastfed for a longer period of time achieved better results on the Bayley III test. Accordingly, Haorta et al.29 found that breastfeeding has long-term benefits and contributes to better performance on intelligence tests.

The number of siblings and quality of the home environment were environmental factors, along with age and attending daycare, that explained caregiver assistance were investigated in our study. There is no consensus in the literature regarding the influence of the number of siblings on child development and the acquisition of functional skills. According to Silva et al.[30], the fraternal relationship is fundamental to development not only in the initial years but throughout one's entire life since it is the most lasting of all family relationships[13]. Depending on the family environment, however, this relationship can exert either a positive or negative influence on the acquisition of skills in children[11]. Younger siblings generally have older siblings to serve as a model and tend to exhibit faster development[31]. However, the results of the present study demonstrate that children with fewer siblings exhibit greater independence. In agreement with that, Halpern et al.[32] found that children with more than three siblings were at greater risk of delayed development[32]. Similarly, a previous study found that the number of siblings was negatively associated with the development of children between two and five years of age[11].

In the present study greater opportunities for stimulation at home also exerted an influence on less need for assistance from the caregiver with regard to social function. According to the International Classification of Functioning, Disability and Health33,34, the characteristics of the physical, social and attitudinal environment can exert either a positive or negative influence on functioning in children. Thus, the environment is capable of serving as either a facilitator or barrier. Azevedo et al.4 conducted a study involving children with three to six years of age at environmental risk in a shelter and found delays in the acquisition of self-care skills, with the need for greater assistance from a caregiver. Thus, a stimulating environment with adequate affordances improves functioning and increases the degree of independence in children.

For a better understanding of these results, it should consider the population studied and all factors that can influence the environment, such as the characteristics of the family. In the present study, most of children were born at full term, had no siblings, belong to nuclear families (father, mother, and children residing together) and had mothers with a higher level of schooling, and a lower frequency of postpartum depression. These indicators may be related to the better quality of the home environment. Moreover, the percentage of the classification "less than adequate" was low regarding affordances for environmental stimulation[35].

The present study has limitations that should be considered. As the cross-sectional design does not enable establishing cause-and-effect relations, we cannot state the personal and environmental factors studied affected the functioning of the children. However, the STROBE checklist for cross-sectional studies[36] was used, and we followed all guidelines for a study of quality. Another factor to be considered is the age range of the children, who were in the earliest phase of childhood. Although this is a period sensitive to changes and therefore important to investigate, the acquisition of functional skills increases in magnitude with the advance in the age during the childhood. Future studies should investigate associations between these same variables in older children. Moreover, longitudinal studies should be conducted to investigate risk factors for delayed development in this population considering modifiable factors, such as attending daycare, breastfeeding duration and the environment in which the child lives, adjusting for confounding factors, such as child's age and number of siblings. Researchers should also test whether interventions addressing these factors can result in improvements in the acquisition of functional skills and less need for assistance from a caregiver.

Our findings can foster discussions on factors that explain the acquisition of functional skills in children with typical development, for which the literature is scarce. Another contribution of this study is a calculator for the AHEMD-IS for children three to 11 months and 12 to 18 months of age. the environmental factors "daycare", "breastfeeding duration", "number of siblings" and "stimulation at home" and the personal factor "age" explained functional skills and caregiver assistance in infants/toddlers.

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