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Opportunities in the home environment for motor development

ABSTRACT

OBJECTIVE: To assess the opportunities present in the home environment for motor development of infants.

METHODS: This was a cross-sectional population-based epidemiological study on 239 infants aged three to 18 months who were living in the municipality of Juiz de Fora, Southeastern Brazil, in 2010. The participants were selected by means of stratified random sampling, in clustered multiple stages. To assess the quality and quantity of motor stimulus in the home environment, the "Affordances in the Home Environment for Motor Development – Infant Scale" instrument was used. Bivariate analysis was performed, with application of the chi-square test followed by multinomial logistic regression, in order to investigate associations between the opportunities present in the home and biological, behavioral, demographic and socioeconomic factors.

RESULTS: The opportunities for environmental stimulation were relatively low. In the bivariate analysis, for the age group from three to nine months, associations with the following factors were found: birth order ($p = 0.06$), socioeconomic classification ($p = 0.08$), monthly income ($p = 0.06$) and per capita income ($p = 0.03$). In the regression model, the socioeconomic classification prevailed (OR = 7.46; $p = 0.03$). For the age group from 10 to 18 months, bivariate analysis showed that the following factors were associated: mother's marital status ($p < 0.01$), father living with the child ($p = 0.08$), head of the family ($p = 0.04$), number of people in the household ($p = 0.05$), mother's schooling level ($p < 0.01$), father's schooling level ($p < 0.01$), socioeconomic classification ($p < 0.01$) and per capita income ($p = 0.03$). In the regression model, the mother's marital status (OR = 4.83; $p = 0.02$), mother's schooling level (OR = 0.29; $p = 0.03$) and father's schooling level (OR = 0.33; $p = 0.04$) remained associated with the opportunities for environmental stimulation.

CONCLUSIONS: Stable partnership between the parents, higher maternal and paternal schooling levels and higher economic level were the factors associated with better opportunities for motor stimulation in the home.

DESCRIPTORS: Infant. Psychomotor Performance. Motor Activity. Growth and Development. Housing. Cross-Sectional Studies.

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INTRODUCTION

Infant motor development can be influenced by factors such as exposure to biological, genetic and/or environmental risks.[7,11] Among these factors, the home environment has been indicated as the extrinsic factor that most influences infant development.[13] As well as the characteristics of the home, which is the first environment experienced by the infant at the beginning of life, the degree of interaction with the parents, the variety of stimuli and the availability of toys are also critical indicators for home environment quality.[a]

Programs directed towards infant health should also be aimed at the environment that the child lives in, because it is within this that the child becomes structured as an individual and social being.[9] In Brazil, there are few population-based studies concerning child development and risk factors for delay, limitations and functional incapacities.[2] Within the sphere of public health, there have been many advances in child health; however, the need for promotion and prevention actions, in situations in which there is a greater likelihood of abnormalities or delays in child development, still seems to be a great challenge. Studies have shown that many deficiencies or abnormalities of neuropsychomotor development can be prevented. The earlier the intervention is, if necessary, the smaller the consequence of these problems will be in the future and, thus, the lower the impact on the healthcare system will be.[2,3,6]

Based on this association between the environment and child health and development,[9] the objective of the present study was to evaluate the opportunities present in the home environment for infant motor development.

METHODS

This was an epidemiological, cross-sectional study that formed part of a health survey in the municipality of Juiz de Fora,[b] which was conducted by the Healthcare Advisory, Training and Study Center of the Universidade Federal de Juiz de Fora, in 2010.

The participants were chosen through stratified random sampling, in clustered multiple stages. The primary sampling units were census tracts. For the draw, the tracts were grouped in strata, defined according to the different types of healthcare, subdivided into: primary care, secondary care and areas without coverage by the public health system. The tracts were selected using probabilities proportional to their size, based on the resident population in the northern administrative area of the municipality of Juiz de Fora, according to the demographic census of 2000. This administrative area was chosen because it is the one that best represents the municipality and because it has the greatest concentration of children.

The population basis used in the present study was built from a previous triage. In this, one in every five homes was chosen and visited, with the objective of identifying any residents belonging to the group of interest. Information concerning neighboring homes (two to the left and two to the right) was also gathered. All infants between three and 18 months of age living in the census tracts within the coverage area were invited to take part in the study. There were no exclusion criteria.

The Affordance in the Home Environment for Motor Development – Infant Scale (AHEMD-IS) instrument was used. This simply, rapidly and effectively evaluates the affordances (i.e. opportunities) for motor development present in the context of the home environment.[4,12,13] The AHEMD project was developed by the Polytechnic Institute of Viana do Castelo, in Portugal, jointly with the Laboratory of Motor Development of Texas A&M University, USA. AHEMD-IS evaluates children between three and 18 months old, and was translated and adapted to Brazilian sociocultural conditions, with support from the Neuromotor Development Research Laboratory of the Methodist University of Piracicaba, and is currently in the process of final validation in Brazil.[c]

Since the rules for calculating the AHEMD-IS score were unavailable until the time of data analysis, the same criteria applied by the group responsible for its validation was used. The questionnaire consisted of 48 questions divided into three dimensions: physical space, daily activities and toys. The score for one dimension was calculated through summing the points obtained from all the questions within each dimension. The total score was obtained through summing the scores from the three dimensions. This score was divided based on the tertiles found in the sample and classified as "low (1st tertile)", "medium (2nd tertile)" and "high (3rd tertile)" opportunities. Since the motor skills and the opportunities for motor development present at home are very heterogeneous within the age group studied, the total AHEMD-IS score was calculated for two groups: three to nine months old, and ten to 18 months

[a] Iltus S. Significance of home environments as proxy indicators for early childhood care and education. Paper commissioned for the EFA Global Monitoring Report 2007, Strong foundations: early childhood care and education. New York: Unesco; 2007 [cited 2010, Jan 10]. Available from: http://unesdoc.unesco.org/images/0014/001474/147465e.pdf

[b] Universidade Federal de Juiz De Fora. Núcleo de Assessoria Treinamento e Estudos em Saúde. Inquérito de Saúde no Município de Juiz de Fora – MG: relatório técnico. Juiz de Fora; 2011.

[c] Instituto Politécnico Viana do Castelo (PORT). Texas A&M University (EUA). Projecto AHEMD: oportunidades de estimulação motora na casa familiar. Viana do Castelo/ College Station, [S.d.]. Available from: http://www.ese.ipvc.pt/dmh/AHEMD/pt/ahemd_1pt.htm

old. The following score criteria were used: for the age group from three to nine months, the classification was considered to be "low" when the score was ≤ 37 points, "medium", when between 38 and 49 points and "high" when ≥ 50 points; and for the age group from ten to 18 months, "low" when ≤ 50 points, "medium" when between 51 and 68 points, and "high" when ≥ 69 points.

The instruments were applied by researchers in the School of Physiotherapy, Universidade Federal de Juiz de Fora, and by a supervising researcher. All of them received previous training for data gathering. After identifying which homes had children aged three to 18 months, the research procedures were explained to the person responsible for the child. If the person agreed to participate, he/she signed the free and informed consent statement. Then, data were gathered in relation to the child, the family and the economic classification criteria of the Brazilian Association of Polling Companies (ABEP).[d]

Following this, the parents filled out the AHEMD-IS questionnaire. In cases of illiterate or semi-illiterate parents, the interviewer was responsible for filling out the questionnaire based on information gathered from the parents through reading out and explaining the instrument.

The data were filed and analyzed in the SPSS 14.0 software.

First, bivariate analysis was performed. The dependent variable for this was the AHEMD-IS total score classification. The significance of the associations was ascertained through the chi-square test (χ^2).

The independent variables were divided and structured according to affinity: infant characteristics, family/home structure and family socioeconomic situation. Among the infant characteristics, the following variables were considered: birth weight, gestational age, twinning, duration of breastfeeding, birth order, sex, hospitalization during the first year of life, presence of any pathological condition, whether the infant attended any daycare (type), and any intervention program/follow up. The variables relating to the family/home structure were: number of siblings, mother's marital status, mother's age, whether the mother worked outside home, father living with the child, main caregiver, head of the family, number of people (adults and children) in the home, and type of home. Concerning the family socioeconomic situation, the following variables were included: father's educational level, mother's educational level, economic classification, monthly income, and *per capita* income.

To observe the associations between the independent variables and the environmental stimulus opportunities, while controlling for the studied variables, multinomial logistic regression analysis was used. The "low opportunity" category was considered to be the reference for the outcome variable. The factors that presented p values less than 0.10 in the bivariate analysis were considered eligible to compose the regression models. The enter method was used, with inclusion of variables in hierarchical affinity groups.

This study was approved by the Research Ethics Committee of the Universidade Federal de Juiz de Fora, under report nº 277/2009, and the ethical care required by the Declaration of Helsinki was respected.

RESULTS

In total, 239 infants and their families took part in the present study (Table 1).

The mean AHEMD-IS total score was 46.9 (standard deviation [sd] = 16.8) for the age from three to nine months, and 61.9 (sd = 21.2) for the age from ten to 18 months. The medians were 43 and 58, respectively. No participant reached the maximum possible value for the instrument (167 points). The values ranged from 20 to 102 points for three to nine months old, and from 29 to 135 for ten to 18 months old.

For the age group from three to nine months old, in the bivariate analysis, infants who were the second child and had a better economic level presented better opportunities for motor stimulation at home. Table 2 presents the results from the bivariate analysis only for the factors with descriptive p values of less than 0.10.

In the multinomial logistic regression analysis on this age group, the variable "birth order" was firstly included in the model, followed by the variables relating to the economic conditions: "monthly income", "*per capita* income" or "economic classification". The economic variables were included separately, since they were highly correlated and captured similar effects.

After controlling for economic conditions, the "birth order" variable ceased to be significantly associated with the environmental stimulus opportunities. Infants aged three to nine months belonging to the higher social classes (A and B) presented a 646% higher chance of having better opportunities for motor development at home, compared with the infants in lower social classes (D and E) (Table 3).

For the age group from ten to 18 months, in the bivariate analysis, infants who always lived with their fathers,

[d] Associação Brasileira de Empresas de Pesquisa. Critério de Classificação Econômica Brasil 2010. São Paulo; 2010 [cited 2010, Apr 20]. Available from: http://www.abep.org/novo/Utils/FileGenerate.ashx?id=46

Table 1. Frequency distribution of the independent variables relating to the infant characteristics, family/home structures and family socioeconomic situation. Juiz de Fora, Southeastern Brazil, 2011.

Variable	n	%
Age group (months)		
3 to 9	128	53.6
10 to 18	111	46.4
Sex		
Female	126	52.7
Male	113	47.3
Birth weight (g)		
< 2,500	24	10.0
≥ 2,500	215	90.0
Gestational age (weeks)		
< 37	29	12.1
37 to < 42	189	79.1
≥ 42	21	8.8
Breastfeeding duration		
Up to 6 months	162	67.8
7 months and over	77	32.2
Hospitalization (1st year)		
No	187	78.2
Yes	52	21.8
Nº of brothers and sisters		
0	104	43.5
1 to 2	109	45.6
3 or more	26	10.9
Birth order		
First	110	46.0
Second	70	29.3
Third or subsequent	59	24.7
Father living with the child		
Never/Hardly ever	38	15.9
Often/Always	201	84.1
Mother's marital status		
Married/Stable relationship	159	66.5
Single/Divorced/Widowed	80	33.5
Head of the family		
Father	146	61.1
Mother/Grandparents/Other	93	38.9
Nº of adults in the home		
Up to 2	136	56.9
3 or more	103	43.1
Type of household		
Apartment	51	21.3
House	188	78.7
Nº of children in the household		
1	100	41.8
2	75	31.4
3 or more	64	26.8
Nº of people in the household		
Up to 3	69	28.9
4	73	30.5
5 or more	97	40.6
Monthly income (in Reais)[a]		
≤ R$ 510.00	36	15.1
R$ 511.00 to R$ 1,000.00	84	35.1
R$ 1,001.00 to R$ 2,000.00	83	34.7
≥ R$ 2,001.00	33	13.8
Per capita income (in Reais)[a]		
≤ R$ 150.00	64	26.8
R$ 151.00 to R$ 400.00	117	49.0
≥ R$ 401.00	55	23.0
Economic classification		
A2 and B1/B2	57	23.9
C1	61	25.5
C2	77	32.2
D/E	44	18.4
Mother's educational level		
Up to 9th grade (elementary)	123	51.5
High school/university	116	48.5
Father's educational level[b]		
Up to 9th grade (elementary)	106	44.4
High school/university	119	49.8

[a] 3 participants (1.2%) could not inform their monthly income; therefore, it was not possible to calculate their *per capita* income.
[b] 14 families (5.8%) could not report the father's educational level.

lived in homes with five or more people, whose father was the head of the family, whose mother lived in a steady relationship and whose families had better socioeconomic situation presented better opportunities for motor development in the home (Table 4).

In the multinomial regression model, the significant variables relating to the family/home structure (mother's marital status, father living with the child, head of the family and number of people in the home) were firstly included. Among these variables, only the "mother's marital status" kept a statistically significant association. Then, the variables "mother's educational level" and "father's educational level" were included. These also presented significant values. Married mothers or those who lived in a

Table 2. Bivariate analysis between the total score of the Affordance in the Home Environment for Motor Development - Infant Scale and the variables selected for the age group from 3 to 9 months. Juiz de Fora, Southeastern Brazil, 2011.

Variable	Total score						
	Low		Medium		High		descriptive p
	n	%	n	%	n	%	
Birth order							
First	17	29.3	24	41.4	17	29.3	
Second	13	33.3	7	17.9	19	48.7	
Third or subsequent	13	41.9	11	35.5	7	22.6	0.06
Economic classification							
A2 and B1/B2	5	16.1	12	38.7	14	45.2	
C1	8	26.7	11	36.7	11	36.7	
C2	20	43.5	11	23.9	15	32.6	
D/E	10	47.6	8	38.1	3	14.3	0.08
Monthly income (in Reais)							
≤ R$ 510.00	13	59.1	6	27.3	3	13.6	
R$ 511.00 to R$ 1,000.00	14	31.8	12	27.3	18	40.9	
R$ 1,001.00 to R$ 2,000.00	12	28.6	14	33.3	16	38.1	
≥ R$ 2,001.00	3	16.7	9	50.0	6	33.3	0.06
Per capita income (in Reais)							
≤ R$ 150.00	13	36.1	15	41.7	8	22.2	
R$ 151.00 to R$ 400.00	26	38.2	15	22.1	27	39.7	
≥ R$ 401.00	3	13.6	11	50.0	8	36.4	0.03

steady relationship presented a 383% higher chance of offering a high opportunity for motor development (p = 0.02), in comparison with single, divorced or widowed mothers. Mothers with lower educational levels presented a 71% lower chance of offering high motor stimulus opportunities in the home (p = 0.03), compared with the mothers with higher educational level. Fathers who had attended school until the eighth grade presented a 67% lower chance of offering medium environmental stimulus opportunities (p = 0.04), compared with fathers who attended high school or completed higher education.

When the variables relating to economic classification were included, a significant association between the socioeconomic level according to ABEP and the environmental opportunities was observed. However, the confidence limits of some categories were excessively wide, thus suggesting low robustness, probably due to the very low frequencies. For this reason, Table 5 presents only the results from the model that included the other variables.

DISCUSSION

The environmental stimulus opportunities for the motor development were relatively low. Half of the participants reached the maximum of 58 points, which represented approximately one third of the possible

Table 3. Multinomial logistic regression between the total score of the *Affordance* in the Home Environment for Motor Development - Infant Scale and the economic classification for the age group from 3 to 9 months. Juiz de Fora, Southeastern Brazil, 2011.

Economic classification	Total score							
	Medium				High			
	descriptive p	OR	LL	UL	descriptive p	OR	LL	UL
A2/B1/B2	0.13	3.38	0.70	16.30	0.03	7.46	1.25	44.46
C1	0.48	1.66	0.41	6.69	0.10	4.06	0.78	21.20
C2	0.61	0.71	0.19	2.64	0.35	2.12	0.45	10.09
D/E		1				1		

OR: *odds ratio*; LL: lower limit; UL: upper limit

Table 4. Bivariate analysis between the total score of the Affordance in the Home Environment for Motor Development - Infant Scale and the variables selected for the age group from ten to 18 months. Juiz de Fora, Southeastern Brazil, 2011.

Variable	Total score						
	Low		Medium		High		descriptive p
	n	%	n	%	n	%	
Mother's marital status							
Married/Stable relationship	22	28.2	23	29.5	33	42.3	
Single/Divorced/Widowed	16	48.5	13	39.4	4	12.1	<0.01
Father living with the child							
Never/Hardly ever	9	50.0	7	38.9	2	11.1	
Often/Always	29	31.2	29	31.2	35	37.6	0.08
Head of the family							
Father	17	25.8	22	33.3	27	40.9	
Mother/Grandparents/Other	21	46.7	14	31.1	10	22.2	0.04
Nº of people in the household							
Up to 3	6	17.1	16	45.7	13	37.1	
4	15	44.1	11	32.4	8	23.5	
5 or more	17	40.5	9	21.4	16	38.1	0.05
Mother's educational level							
Up to 9th grade (elementary)	28	50.9	16	29.1	11	20.0	
High school/university	10	17.9	20	35.7	26	46.4	<0.01
Father's educational level							
Up to 9th grade (elementary)	23	46.0	13	26.0	14	28.0	
High school/university	9	17.3	20	38.5	23	44.2	<0.01
Economic classification							
A2 and B1/B2	3	11.5	7	26.9	16	61.5	
C1	7	22.6	13	41.9	11	35.5	
C2	14	45.2	11	35.5	6	19.4	
D/E	14	60.9	5	21.7	4	17.4	<0.01
Per capita income (in Reais)							
≤ R$ 150.00	14	50.0	8	28.6	6	21.4	
R$ 151.00 to R$ 400.00	18	36.7	17	34.7	14	28.6	
≥ R$ 401.00	5	15.2	11	33.3	17	51.5	0.03

total (167 points). These findings were similar to those indicated in the studies by Batistela (2010)[e] and Nobre et al[10] (2009). These authors stated that the opportunities presented in the homes of the participants in their studies were insufficient for motor development.

Batistela[e] (2010) studied a sample of 79 children between three and 18 months old living in the municipality of Piracicaba, Southeastern Brazil. Out of the 184 possible points in the total score of the first version of AHEMD-IS, the group studied scored a maximum of 126 points, with a mean of 61.38. The wide range of total scores obtained showed that there was great variability in the opportunities offered in the home environment. In the present study, despite using the second version of the AHEMD-IS instrument, the results were similar to those found in the study by Batistela (2010).[e]

The results from the present study suggest that infants with better socioeconomic levels presented more favorable opportunities for motor development. For the age group between ten and 18 months, the opportunities for motor development in the homes presented associations with the "mother's marital status", "mother's educational level", "father's educational level" and "economic classification" variables. This indicated that infants with better socioeconomic levels and whose mothers lived in a steady relationship presented more favorable opportunities for motor development.

[e] Batistela ACT. Relação entre as oportunidades de estimulação motora no lar e o desempenho motor de lactentes: um estudo exploratório [master's dissertation]. Piracicaba: Faculdade de Ciências da Saúde da Universidade Metodista de Piracicaba; 2010.

Table 5. Multinomial logistic regression between the total score of the *Affordance* in the Home Environment for Motor Development - Infant Scale and the variables selected for the age group from ten to 18 months. Juiz de Fora, Southeastern Brazil, 2011.

Variable	Total score							
		Medium				High		
	descriptive p	OR	LL	UL	descriptive p	OR	LL	UL
Mother's marital status								
Married/Stable relationship	0.86	1.10	0.38	3.23	0.02*	4.83	1.30	18.00
Single/Divorced/Widowed		1				1		
Mother's educational level								
Up to 9th grade (elementary)	0.11	0.41	0.13	1.24	0.03*	0.29	0.09	0.89
High school/university		1				1		
Father's educational level								
Up to 9th grade (elementary)	0.04*	0.33	0.11	0.99	0.08	0.37	0.12	1.14
High school/university		1				1		

OR: *odds ratio*; LL: lower limit; UL: upper limit

According to the literature, income is a determinant for the quality of life of families concerning access to health, education, food and housing.[9] The parents' economic level seems to be related to higher access to information and, consequently, greater knowledge about the mechanisms that could generate more appropriate motor development and a more stimulating environment for their children, regardless of the infant's age.

In the study by Halpern et al[5] (2000), children with lower income had twice as much chance of presenting suspected developmental delay, compared with children with better income. According to Martins et al[9] (2004), families with lower income are more exposed to risky environments, because the constant difficulties associated with poverty hinder the parents' psychological wellbeing and the interpersonal environment of the home. These authors also reported that good-quality child upbringing requires considerable expenditure, which favors infant development.[9] Thus, the condition of poverty seems to amplify the child's vulnerability, thus leading to unfavorable motor development results.

According to some studies,[1] the partner's presence positively influences the quality of the stimulation available in the home environment, through providing greater security of performance of the maternal function. The fact that the children are raised by parents in a steady relationship and count on positive stimuli in the home seems to constitute a protective mechanism within the context of psychosocial adversity that some families live in.[8]

In the present study, higher educational level among the mothers was associated with better opportunities for environmental stimuli. This result seems to be explained by the fact that the mothers with higher educational levels had higher incomes, greater access to information and better knowledge about the development process of their children. This contributed positively towards the stimulus opportunities available at home. Hence, a higher maternal educational level improves the quality and organization of the physical environment, and the variety of daily stimulation, through the availability of proper material and games for the child. This enables a greater emotional and verbal involvement between mother and child.[1]

In the study by Martins et al[9] (2004), mothers with higher educational levels also presented lower percentages with risky environments. Halpern et al[5] (2000) stated that the risk of neuropsychomotor development delay increases as the mother's educational level decreases. In their study, illiterate mothers presented a 2.2 times greater chance of bearing a child with suspected developmental delay, compared with mothers with higher educational level. Thus, educational level seems to positively influence the quality of the environmental stimulation received by the child.

The father's educational level also presented a significant association with the motor development opportunities available in the home. According to Santos et al[14] (2009), low educational level among fathers is considered to be a risk factor for motor development, because it is associated with delays in locomotion motor skills. Moreover, there appears to be a direct relationship between the father's educational level and the economic level. Studies[8] have suggested that the higher the father's educational level is, the better his job and income may be, thereby allowing him to provide better structural conditions for adequate motor development.

One of the possible limitations of the present study is the fact that it only used one portion of the municipality of Juiz de Fora as a sample. However, the area studied

covers the largest physical area, the second greatest population, wide economic variability and the greatest concentration of children in the municipality. Thus, the sample studied presents characteristics similar to those of the entire municipality and also to those of the Brazilian population concerning biological and socioeconomic characteristics. This suggests that for the entire population of infants in the municipality of Juiz de Fora, the results may be similar to those found in the present study.

Another limitation that should be taken into account was the lack of rules for calculating the scores reached in the AHEMD-IS questionnaire. Therefore, the results should be viewed cautiously, since opportunity classifications determined by the percentages found in the sample of the present study were used, rather than in accordance with the final criteria of the instrument validation, which were unavailable at that time. Nonetheless, this instrument seems to have captured the characteristics of the environment that is essential for the motor development of infants between three and 18 months of age, in all of its dimensions.

It can be concluded that the opportunities for motor development that are present in the home seem to be associated with many factors, especially regarding the family's socioeconomic level and the mother's marital status.

The main factors associated with the opportunities present in the home for motor development were identified through an overview of the context within which the child lives. These findings may provide support for development of policies, programs and actions aimed towards the infant population, through guiding practices that seek to minimize the effect of environments that are inappropriate for child development and that consequently promote health and disease prevention.

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