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DO ENVIRONMENTAL INFLUENCES ALTER MOTOR ABILITIES ACQUISITION?

A comparison among children from day-care centers and private schools

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ABSTRACT - Development occurs in a proper rhythm as result of genetic inheritance and environment factors. This study had the aim to identify some environmental risk factors for the motor development in two groups of healthy children. 100 pre-school aged (five years children) from two day-care centers and a private school were evaluated, in Recife-PE. All the children underwent to a motor skills assessment and their parents answered a questionnaire. The children from the public nursery remained behind in fine motor skills. The results showed that the biologically healthy children development can suffer negative influence of the environmental risk factors. In this research these factors were: the father absence, improper toys use to the correct age, the place were the child was kept in the early childhood, the lack of pedagogical guidance and extra-parental socialization and low familiar socioeconomic status.

KEY WORDS: motor development, environment stimulation, child.

Influências do ambiente podem alterar a aquisição de habilidades motoras? Uma comparação entre pré-escolares de creches públicas e escolas privadas

RESUMO - O desenvolvimento ocorre num ritmo resultante da interação entre herança genética e fatores ambientais. Este estudo teve por objetivo identificar alguns fatores de risco ambientais para o desenvolvimento motor, em dois grupos de crianças saudáveis. Foram avaliadas 100 crianças (idade:5 anos) provenientes de duas creches públicas e uma escola particular, em Recife-PE. Todas as crianças foram submetidas a uma avaliação das habilidades motoras e seus pais responderam a um questionário. As crianças da creche pública mostraram atraso no campo das habilidades motoras finas. Os resultados indicaram que o desenvolvimento das crianças biologicamente saudáveis pode sofrer influência negativa dos fatores de risco ambientais. Os fatores encontrados foram: a ausência do pai; a utilização de brinquedos inadequados para faixa etária; o local onde a criança era mantida em idades precoces da infância; a falta de orientação pedagógica e de socialização extra-familiar precoce, e a baixa condição socioeconômica familiar.

PALAVRAS-CHAVE: desenvolvimento motor, estimulação ambiental, criança.

The child's nervous system presents an intense evolutionary dynamism in the first years of life, due to the progressive myelination and maturation of association areas[1,2]. The increasing maturation of the cortex promotes the improvement on motor functions, with better control of body parts[2,3]. On the other hand, the practice on motor functions also influences the development of the myelination and the structural organization of the central nervous system (CNS)[4]. The processes of growth and development occur according to the rhythm that is established by the genetic potential, and also by the influence of environmental factors[5-8]. The conditions of health and nutrition of the maternal organism have a decisive influence over embryo development[9,10]. Some postnatal factors, as the mother's

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psychological state and child's social relationships, can act as favorable or unfavorable influences for child's development[9-11]. These features may cause undesirable repercussions on motor development[5,11,12]. Among these postnatal factors, the mainly pointed are the nutricional conditions, the social and economics features, the environmental stimulation, the parents relationship, including their participation's degree on child's routine, their cultural level and access to leisure activities, and the mother's intelligence quotient (IQ)[5,11,13-15]. The literature demonstrates that the occurrence of such risk factors is rarely in an isolated way, when impairments over development are seen. They are also found more frequently in poverty conditions, leading to the hypothesis that a low social and economics level amplifies the biological vulnerability[5,7,8,15]. The low weight at birth is a condition very related to visual alterations and delays on the acquisition of the fine motor abilities[5,15-17]. The affective relationships around the children, the family environment and the mother's capacity of interacting with her child have significant effects over his motor and mental development[3, 15]. It was related that children who live with single mothers, as well as that ones whose mothers show a low IQ, have larger risk of presenting cognitive delays[13]. According to the conception of Piaget, the same factors that could impair mental development can also influence motor development[15].

The sensorimotor integration plays an important role in the motor learning[3,18]. A minimum level of stimulation is needed to show to the child all his potential to explore the environment, therefore improving his motor and intellectual abilities. In this sense, there's facilitation in all developmental aspects, concerned to motor, structural, cognitive and emotion areas[3,18]. The acquisition and maintenance of posture and movement depend on the learning and repetition of activities that will lead to the acquisition of sensory feedback and feedforward[18, 19]. The feedback represents an early learning through information provided by sensory receptors, which will be used by the child to begin and continue his voluntary movements and the reactions for the maintenance of the posture[18,20]. Many of these sensorial information are acquired by playing, when the toys act as tools with which the child develops his fine motor abilities and as well as those of gross motor development[12,18,21]. In this early period, the child's permanence in a favorable environment will facilitate a normal development and offer possibilities to a larger potential of exploration and interaction[3, 5]. It can be found many works about the effects of environmental risk factors on children's psychomotor development[5,12,14,16]. However, these kinds of information related to healthy children are still scarce.

Thus, the present study had as objective the evaluation of the gross and fine motor development, by the approach of balance and coordination in healthy children. It was made an approach in two different types of environment, to discuss the correlation among features related with each one.

METHOD

100 healthy children of both sexes in preschool age (4,9 to 5 years), participated of this study. They were enrolled at two day-care centers (DC, n=50) or one private school (PS, n=50) in Recife - PE. The director of each institution permitted the work. The children's responsible were informed about this work, and expressed their agreement by signing the Free and Clarified Consent Term (FCCT), according to the resolution 196/96 of the National Health Council –Ministry of Health/Brazil, described in the project of this work, which was approved by the Committee of Ethics in Research of the Center of Health Sciences - Federal University of Pernambuco (registration number: 67/2000-CEP/CCS).

To participate in the study, the children should not present neurological and/or motor affections which could impair the execution of the tests; be in the normal pattern of weight and height (according to the data of National Center for Health Statistics - NCHS[22]); be free of any discomfort like fever, cold or respiratory diseases.

Procedures

A questionnaire was given to the parents or responsible for the children, to identify the occurrence of features considered as pre or postnatal risk factors for the development, as well as to obtain information about gestational history, birth, development, family history, economic condition and others.

All the children were submitted to a simplified evaluation of the motor abilities. The tests were presented like a joke, in an interactive way. Children were tested in the own school or nursery. Such evaluation followed the protocols published by Coelho (1999), based on the Evolutive Neurological Examination (ENE) developed by Lefevre[23]. Each child was examined just once, during approximately 25 minutes. Before the evaluation, the child went by an adaptation period, in which could manipulate the objects used for the evaluation. An weight/height evaluation was accomplished, (portable balance *Filizola*, 0-125 kg; ruler for measurements *Top-Long*, 0-5 m). It was considered as normality levels for the weight/height relation the percentile 50 of the NCHS pattern.

The next stage was the evaluation of the *static balance*, accomplished in an only proof (child in standing position with the eyes opened, one foot ahead of the other: he should stay in this position for 10 seconds).

Soon after, it was made the evaluation of the *dynamic balance*, through six tests:

1st: the child should walk to the front (2m, in straight line, over a demarcation), placing one foot right in front of the other. 2nd: the child should run and jump with the two feet (minimum 30 cm of height). An extended rope was placed 30 cm over the ground, as a reference. 3rd: the child should jump again over the rope, with both feet, starting from a standing position. 4th: From the standing position, the child must jump and rotate his body over himself, falling again in the initial point (minimum 180 degrees of rotation). 5th: the child must move in an extension of five meters, jumping with the feet together. 6th: as described in the previous test, the child now should jump using only one foot.

Finally, it was accomplished more five tests for the evaluation of the fine motor abilities and manipulatory coordination**:**

1st: it was showed to the child a card (10x10 cm) that contained a circle, and the child was asked to copy it. It was accepted as appropriate answer a draw with the general form of a circle, which must be perfectly closed. 2nd: another card (10x10 cm) was shown to the child, with the drawing of a square, and he was asked to copy it. The draw must have the general form of a square with the four right angles, approximately. It wasn't required the equivalence of the lines' size. 3rd: the child should play a tennis ball in a 30x30 cm target, placed on the wall (two meters distant) in front of the child, height approximately of his shoulder. The ball must be thrown being the child in standing position with shoulder and elbow flexed. 4th: the child should touch with the tip of the thumb each one of the other fingers of the hand, successively, beginning by the 5th and coming back to it. The proof was made separately to each hand. The child had two attempts for each hand. 5th: The child was asked to open one hand while closing the other, alternately. The child should place his arms extended forward, with the palms of the hands down. The dominant hand must be closed initially, and the movements must be done as fast as he was able to do, during 10 seconds.

Processing and analysis of the data

All the data were typed in couple entrance, with the purpose of checking the consistence of the obtained information. For the processing, it was used the computer program Epi-Info version 6.0. For the statistical analysis of the results it was used the Qui-square test and Pearson association, in a 2x2 table with correction of Yates and, when necessary, the Fisher test, considering the critical trust level of 95% (0,05) in all the calculations, using the software Epi-Info and SPSS.7.5 for Windows. The statistical tests of association were made when the size of the sample was enough; in otherwise, it was made just a descriptive analysis of the differences among the observed proportions.

RESULTS

Considering the total of the sample, 63 male (PS:31; DC:32) and 37 female (PS:19; DC:18) children were appraised (n=100).

Descriptive analysis of the data collected in the questionnaires:

The collected data were used to trace a profile about the structure and family environment. It was verified, in relation to the parents' civil status, that 93,33% of the children of PS live with married parents, while that percentile in DC was only 23,08%.

The prenatal accompaniment was accomplished by 100% of the mothers from PS and in 92,31% of DC. The undesirable facts during the gestation, such as hypertension, infections or threatens of abortion were reported in a similar way in the two groups, being 36,67% in PS and 33,33% in DC. In DC, 66,67% of the appraised children was born by normal birth, while in PS this value was of 50%. Habits as smoking and/or alcoholism were referred by 10,26% of the mothers of DC. In the PS, this habits occurred in 3,33%.

The parity distribution was similar among the mothers of both groups: 1 birth in 15.39% of DC and in 26.67% of PS; 2 births in 51.28% of DC and in 46,67% of PS; 3 or more births in 33,32% of DC and in 26,67% of PS. Problems during birth or soon after, like jaundice and low birth weight were referred just by the mothers of DC, representing 15,38% of the group. The medium period of breast-feeding was 6 months or more (61.54% in DC and 60% in PS)(Figure 1).

To characterize the environmental opportunities for the infantile development, the parents were asked about the place where children spent the most part of their days in the first year of life. The amount of daily time spent by the parents with the child was also asked. The results are showed in the Table 1 and Figure 2, respectively. The parents' daily time spent with the child was similar in the two groups. The children of PS, however, had a larger amount of daily time to play in the floor without space limitation in more precocious ages, when compared to the ones of DC ($p < 0,05$)(Table 1).

The questionnaire also collected data about major events of the motor development. It was observed that 86,67% of the PS group acquired the ability of sitting at an appropriate age (5/6 months); 69,22% of the group DC made the same (Table 2). Crawling was reached by most of the two groups between 7 to 8 months (93,33% of PS and of 79,48% of DC (Table 2). The age that most of the children began to walk was, considered appropriate, among 11-12 months, being 79.49% of the children of DC and 86.66% in PS (Table 2). The use of baby-walkers was more frequent by the children of PS (36.67%, against 12.82% of DC; $p<0,05$).

Another requested aspect was regarding to the toys used by the children at home. On PS 86,67% of

Tabela 1. Place were the child used to spend most of his daily time.

	Day-care centers		Private schools	
	N	%	N	%
CRIB	13	33.33	2	6.67
HELD BY AN ADULT	14	35.90	2	6.67
BABY CARRIAGE	4	10.26	4	13.34
FENCED MATTRESS	1	2.56	2	6.67
FLOOR	6	15.38	17	56.67

Qui-square test in association with Pearson: $X^2=21,4$; $p=0,0002$ (Private schools compared to day-care centers); N, absolute number; %, relative number.

Tabela 3. Age in the beginning of extra-family socialization.

Age (years)	Day-care centers		Private school	
	N	%	N	%
1	6	15.38	3	10.00
2	4	10.26	24	80.00
≥ 3	28	71.80	3	10.00
N/R	1	2.56	0	0

Data evaluated as a whole, according to the age. Qui-square test in association with Pearson (Yates correction). Private schools compared to Day-care c.enters: $x^2=34,99$; $p<0,01$; N, absolute number; %, relative number; A/R, absence of response.

the children used appropriate toys for your age. In DC, this observation was referred in only 23,08% ($p<0,05$). The remaining children of each group played with any toy, or even with other children.

The age at the beginning of the extra-family socialization, characterized as the beginning of the frequency in PS and DC varied ($p < 0,05$). While 90% of the children of PS began among 1 and 2 years, 61,54% of the DC ones began between 3 and 4 years of age (Table 3).

The family income was quite differentiated between the two groups. In DC, 35.90% earn less than 1 minimum wage (reference to salary/Brazil, approximately US$ 70); 53.85% earn 1 to 2 minimum wages; 2.56% earn 2 to 4 and 2.56%, 4 to 5 minimum wages. In PS, 6.67% earn 4 to 5 minimum wages and 93.33% more than 6 minimum wages.

Results of the evaluation of the motor abilities - Among the tests of dynamic balance, it was found a lower score in the DC group in the fourth test (jump and turn his body) ($p=0,03$). Concerning to fine motor abilities and coordination, the scores were worse in the DC group in four among the five tests used (Table 4).

Table 2. Developmental abilities.

	Day-care centers		Private schools	
	N	%	N	%
Sitting:				
5-6 months	27	69.22	26	86.66
7-8 months	6	15.38	4	13.33
9 months or more	6	15.38	0	0
A/R	0	0	0	0
Crawling:				
7-8 months	31	79.48	28	93.33
9-10 months	1	2.56	1	3.33
A/R	7	17.95	1	3.33
Walking:				
11-12 months	31	79.49	26	86.66
13-14 months	6	15.38	1	3.33
A/R	2	5.13	3	10

Data analyzed as a whole, according to the age. Fischer's test: ns. N, absolute number; %, relative number; A/R, absence of response.

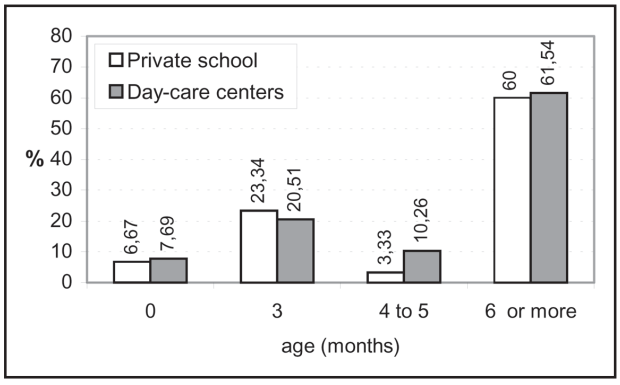

Fig 1. Breastfeeding period. Data obtained by questionnaires (induced response). Qui-square test in association with Pearson ($x^2= 2.56$ e $p= 0.463$).

DISCUSSION

The activities of fine motor abilities were the ones that presented larger differences, being late in the children of DC. Some features known as risk factors for the infantile development were identified in that group: the father's absence, the use of toys that were not adequate for his age, the lack of an appropriate pedagogic orientation in the DC, a higher age in the beginning of extra-family socialization and an inadequacy in the place where the child was maintained during most of his day. It is known that the fine motor development is one of the most affected areas in case early malnutrition[17]. Although in the age when the tests were applied all the children were in normal pattern of weight and height, according to NCHS, the low economic level of DC families can be

Table 4. Evaluation of motor abilities

	DC				PS					
	N^+	%	N^-	%	N^+	%	N^-	%	p	χ^2
Static balance	32	64	18	36	33	66	17	34	1.000	0.00
Dynamic balance										
1st Test	37	74	13	26	40	80	10	20	0.634	0.23
2nd Test	47	94	3	6	46	92	4	8	1.000	-*
3rd Test	45	90	5	10	47	94	3	6	0.714	-*
4th Test	42	84	8	16	49	98	1	2	0.030	-*
5th Test	45	90	5	10	48	96	2	4	0.487	-*
6th Test	45	90	5	10	45	90	5	10	0.738	0.11
Fine motor abilities										
1st Test	25	50	25	50	40	80	10	20	0.003	8.62
2nd Test	22	44	28	56	36	72	14	28	0.008	6.94
3rd Test	24	48	26	52	27	54	23	46	0.689	0.16
4th Test	31	62	19	38	45	90	5	10	0.002	9.27
5th Test	25	50	25	50	40	80	10	20	0.003	8.62

PS, private schools; DC, day-care centers; N^+, number of children with success in the test; N^-, number of children which failed in the test; %, relative number; p, Fischer's test; χ^2, qui-square test; *, qui-square was not possible.

related with any early nutricional inadequacy, not referred in the questionnaires. In poverty conditions the risk factors rarely occurs in an isolated way, and a larger number of those factors multiply the adverse effects over development[5]. In the study of Bruno and Costa[14], the maintenance of breastfeeding for less than three months of age it was the risk factor more related to the retard on motor development[14], reinforcing the idea of nutritional influences on this area.

Concerning to the motor development, it is observed that when the child is maintained during most of the day without conditions to move freely (held by an adult, in the baby carriage, baby-chair, etc), he can suffer damages in the learning and use of feedback and feedforward systems, which are essential for the acquisition of motor abilities[7,18]. Consequently, he can present delays on the psychomotor development[7, 24]. Therefore, the fact of most of the children of DC be maintained held by an adult or in the crib most of the dayduring childhood was probably a negative condition for the normal development.

The use of the baby-walkers promotes a false impression of safety, because the child starts to use his musculature in an inappropriate way of the physiologic point of view[24]. In the age when he should be strengthening and extending musculature of trunk and arms, essential for the standing position, rectification and balance reactions, the child is maintained in an intermediate position in the baby-walker, neither in stand nor seated[24-26]. The possibility of disturbances on the motor development leads the therapists and physicians to consider this resource as inadvisable[25]. Despite the lower use by DC children if compared to PS, baby-walkers must be seen as one additional risk factor for the motor development in a fragile population. The cognitive and motor development is strongly associated with the stimulation level of family environment and parental relationship[5,7,15,17]. The existence of a greater number of single mothers in DC may demonstrate some failure in the amount or quality of stimulation at home.

In DC and in PS the extra-family socialization occurred early, specially in PS children. Although it might exist many critics about the children's precocious frequency to nurseries or schools, due to higher morbidity rates compared to children who are cared at home, nowadays it's a social need[27]. However, the children whom preschool or day-care center offer an adequate infrastructure, equipment and appropriate care, as well as a specific pedagogic methodology for the age group, will have more opportunities for an appropriate development of motor abilities and learning about social behavior[8]. In this work, it was observed that DC had as basic function the guard and the hygiene/feeding care of the children. Thus, these children will have an adequate pedagogic orientation lately, because the minimum age for the

access in public schools commonly is 6 or 7 years. The lack of a pedagogic approach and, as result, the poor training on the hands use (drawing, playing with games, etc) may probably contributed to the delay found in the fine motor abilities of DC group[8, 21].

The consequences of delays in some areas of development constitute a real danger for the global development of the child. It is in the first years of life that children can develop their potentialities, exploring all their possibilities to learn, due to brain plasticity[2,18,19]. Many times, undesirable consequences of errors or impairments in this early phase of life will be seen only at an older age, as learning problems, behavioral inadequacy or affective disorders[28-30].

It can be concluded that the precocious identification of possible risk factors that could impair normal development, the investment in prevention and health promotion, as well as the intervention in already installed processes, can minimize the damages of a less favorable environment over infantile development. The use of recreational activities in direction to the training of fine motor abilities and a safe and opportunity-rich environment favors the normal motor development. Furthermore, the presence of professionals of health qualified for the evaluation and intervention on the infantile development among the team responsible for child's primary attention in the preschool phase certainly would be of great value to prevent impairments over development and, thus, more expensive and extended therapeutic interventions in the future.

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