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AFFORDANCES AND DEVELOPMENT OF HIV-EXPOSED AND UNEXPOSED INFANTS[1]

AFFORDANCES E O DESENVOLVIMENTO DE LACTENTES EXPOSTOS E NÃO-EXPOSTOS AO HIV

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ABSTRACT - INTRODUCTION: Development of infants exposed to the HIV, due to contact with the virus and/or antiretroviral therapy during pregnancy and postnatal period, is a much discussed topic. The environment influences the infant´s overall development regardless of whether it has a risk factor, but even more so if any factor is present. **AIM**: to compare affordances in the environment and the development of infant exposed and not exposed to HIV. **METHOD**: cross-sectional study in which 40 exposed and 40 unexposed infants HIV of both sexes at the ages of 4, 8, 12 and 18 months of age were assessed using the Bayley III scale (motor, cognitive and language development)- and the AHEMD questionnaire addressed to parents about the environment and home stimulation. **DATA ANALYSIS**: Analysis of variance with two fixed factors and Tukey´s multiple comparisons method and Pearson´s linear correlation coefficient. **RESULTS**: No significant differences were found between the groups using the Bayley scale, but infants exposed to the virus presented higher values for the AHEMD scale fine motricity. Age differences were found for AHMED variables, regardless of group; and correlations for Bayley with the AHEMD scale total score. **CONCLUSION**: HIV-exposed infants do not show a delay in motor, cognitive and language development compared to unexposed infants. On the contrary, they may present equal or even better

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performances depending on the home environment and the stimulus given by their caregivers.

Keywords: child development, affordances, HIV/AIDS

RESUMO - INTRODUÇAO: O desenvolvimento de lactentes expostos ao HIV, devido ao contato com o vírus e⁄ou terapia antirretroviral durante a gravidez e o período pós-natal, é muito discutido. O ambiente influencia o desenvolvimento geral da criança, independentemente de ter fator de risco, mas ainda mais se houver algum fator presente. **OBJETIVO**: Comparar os Affordances no Ambiente Domiciliar e o desenvolvimento infantil de lactentes expostos e não expostos ao HIV. **PARTICIPANTES E MÉTODO**: Estudo transversal, realizado em serviço de referência em Santos, no qual foram realizadas avaliações de 40 lactentes, filhos de mães expostas ao vírus HIV de ambos os sexos com as seguintes idades: 4, 8, 12 e 18 meses de vida. Para o grupo controle foram avaliados 40 lactentes filhos de mães não expostas ao HIV na mesma faixa etária. Os lactentes foram avaliados por meio do questionário da AHEMD dirigido aos pais e/ou responsáveis, sobre o ambiente e estimulações domiciliares; e por meio da escala Bayley III, escala que avalia o desenvolvimento motor, cognitivo e da linguagem de lactentes. **ANÁLISE DE DADOS**: Foi realizada análise descritiva para cada domínio estudado nos grupos e idades, além disso, análise inferencial, por meio do modelo de análise de variância com dois fatores fixos e o método de comparações múltiplas de Tukey, e coeficiente de correlação linear de Pearson. **RESULTADOS**: Não foram encontradas diferenças significativas entre os grupos por meio da escala Bayley, mas os lactentes expostos ao vírus apresentaram maiores valores para o domínio Motricidade Fina da Escala AHEMD. Foram encontradas diferenças entre as idades para as variáveis da AHEMD, independentes do grupo. Além disso, foram encontradas correlações para todos os domínios da Bayley com a Pontuação Total da Escala AHEMD. **CONCLUSÃO**: Lactentes expostos ao HIV não apresentaram atraso no desenvolvimento motor, cognitivo e da linguagem. Pelo contrário, eles podem apresentar desempenhos iguais ou até melhores, dependendo do ambiente doméstico e do estímulo dado por seus cuidadores

Palavras-chave: Desenvolvimento infantil; transmissão vertical; HIV; meio ambiente

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INTRODUCTION

According to UNAIDS, in 2017 there were 36.9 million people with HIV in the world, 1.8 million of them were children (under 15) infected with the virus. In Brazil, between 2007 and 2017, 194,217 cases of HIV infection were reported (WHO, 2017). It is known that vertical transmission is the leading cause of HIV infection in children and it has been responsible for 90% of infection cases in children under the age of 13 in Brazil.

The HIV virus can infect several host cells; however, its main target is central nervous system (CNS) and Immune System cells (WRICHT et al., 2018; MELHUISH & LEWTWAITE, 2018). Studies indicate that in adults, the virus when in contact with the CNS can cause dementia, while in children the condition can be identified as encephalopathy, which in itself is an indicator of severe disease (MITCHELL, 2001; CHIRIBOGA et al., 2004; SIRIOS et al., 2013). Knowing the virus proclivity for the CNS, there is a greater concern regarding infants born to seropositive mothers, since the brains of these infants are immature and in an intense process of development, and they may be affected by the virus and/or antiretroviral therapy during pregnancy (SIRIOS et al., 2013; DE KOVEL et al., 2017).

Neurological manifestations in infants and adolescents (1 month to 15 years of age) infected and exposed to HIV were found in 67% of the cases. The most common alterations included: neuropsychomotor development delay, language delay, mental disorder, pyramidal syndrome, hyporeflexia 8. The study, using the Bayley Scale, comparing cognitive and motor development between infants born to HIV-positive mothers in the first 24 months of life and infants born to unexposed mothers found that the development of infants exposed to the virus was significantly lower than in non-exposed infants (GAY et al., 1995).

Several factors can interfere with the normal course of the child's development. These factors may be environmental and biological (FREITAS et al., 2017; PRETII et al., 2010). Thus, a stimulating environment promotes the infant´s development, on the other hand, the lack of an appropriate environment may result in delays in various areas of early development even if there is no biological risk factor (MADASCHI, 2012). Without a physically adequate environment, with no appropriate resources such as toys that stimulate fine and gross motor skills development, which can be characterized as home affordances, a developmental delay in infants might occur (NOBRE et al., 2009) .

In the early years of life, there is a major brain development, not only as a result of a natural process of maturation, but also from an intense interaction process between

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environmental stimuli and the infant´s biological potential. At this stage of life, positive stimuli that benefit development and negative stimuli that impair it, are key elements (SHONKOFF, 2011; SHONKOFF & GARNER, 2012). Material circumstances and the amount of care that an infant receives may or may not provide the affordances for its development. Thus, it is necessary to understand the characteristics of each infant, as well as its needs and vulnerabilities throughout its development.

Therefore, this study aimed to identify whether there is a delay in the development of HIV-exposed infants and to compare the impact affordances have in the home environment for HIV-exposed and non-exposed infants at ages 4, 8, 12 and 18 months. The present study also investigated how affordances are connected to the three areas of development: motor, cognitive and language.

METHODS

A cross-sectional study, approved by the Ethics and Research Committee of the Federal University of São Paulo (number:1486/2016) according to Normative Resolution 466/12 of the National Health Council.

Eighty infants, ages 4, 8, 12 and 18 months old, of both sexes, were evaluated. These infants were divided into two groups: 40 HIV-exposed infants, Study Group (SG); and 40 infants not exposed to HIV in the Control Group (CG). A sample calculation, using GPower, estimated a number of 10 infants in each group for a statistical power of 0.7 (SILVA, SÁ, CARVALHO, 2017).

Inclusion criteria for the SG were: infants whose mothers are diagnosed with HIV, who are in a follow-up program of infants born to HIV-positive mothers in health referral service who received antiretroviral therapy during pregnancy and extrauterine life, in addition, they all had cesarean section deliveries, discontinuation of breastfeeding and absence of related diseases. For the CG inclusion criteria, we imitated the SG infants age, gender and economic power status. The Informed Consent Form had to be signed by parents or guardians in both groups, and all the infants had to be born full term.

The age selection described above was chosen considering the main motor development milestones: at 4 months, midline reach; at 8 months, most infants drag and/or crawl; at 12 months, holding a standing posture without support and independent walking, and at 18 months, most can kick a ball forward independently.

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To characterize families by economic class, the Brazilian Socioeconomic Classification Criterion-ABEP (ABEP, 2018) was used. It consists of a questionnaire with a standardized scoring system that indicates the buying power of Brazilians, classifying them into economic classes instead of social classes.

To assess the development level, we used the Bayley Scale of Infant and Toddler Development III - BSITD III (BAYLEY, 2006; MADASCHI, PAULA, MACEDO, 2012), a tool to identify, measure and evaluate child development from 16 days to 42 months of age, which analyzes five developmental domains: motor (fine and gross), cognition, language (expressive and receptive), adaptive and social-emotional behavior. In our study, motor, cognitive and language domains were evaluated.

To assess potential environment interferences on the motor development of these infants, we used the "Affordances in the Home Environment for Motor Development - Infant Scale" (AHEMD-IS) (CAÇOLA et al., 2015), a self-report parental questionnaire designed to assess the quality and the quantity of affordances in the home environment, more specifically in the physical/spatial dimension, the variety of stimulation and playable objects, being applied to infants between the ages of 3 and 18 months. The questionnaire consists of 35 items divided into four sessions: Physical Space, Variety of Stimulations, Fine Motor Skill and Gross Motor Skill, these last two were based on the types of toys the infant has at home.

STATISTICAL ANALYSIS

The Kolmogorov-Smirnov test verified data normality. We then used the analysis of variance (ANOVA) model with two fixed factors (group and age) and Tukey´s method for multiple comparison. The significance level adopted was $p \leq 0.05$. Subsequently, Pearson's correlation coefficient test was performed to verify the correlation between the development scores and affordance (all domains). For all analyzes, $p \leq 0.05$ values were considered statistically significant. We used R statistical software.

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RESULTS

Developmental characteristics: variables evaluated by Bayley

Regarding cognitive domain, the SG presented predominantly an average classification (55%), while the CG presented predominantly a low average classification (35%), followed by average (30%). For the language domain, both groups mostly presented average classification, SG (40%) and CG (45%). The same result was found in the motor domain, in which both groups had predominantly average classification, SG (55%) and CG (47.5%). The ANOVA results showed that there was no statistically significant difference between the groups (Cognitive p=0.128; Language p=0.472; Motor p=0.444). Despite this result, as it can be observed in Table 1, regarding Cognitive the SG presented mean equal to or greater than the CG in the ages of 4, 8 and 12 months; and regarding Motor, the SG presented higher means.

Table 1: Mean and standard deviation (SD) of compositve score in motor. cognitive anda language for study group (SG) and control group (CG) according for the age group of 4, 8, 12 and 18 months.

Group	*Age (months)*	*Motor Composite*	*Cognitive Composite*	*Language Composite*
SG	4	99.50(±10.76)	95.00 (±23.80)	90.80(±17.12)
	8	102.30(±11.52)	99.00(±13.90)	94.10(± 17.40)
	12	106.10(±19.51)	94.50(±13.43)	99.00(±19.38)
	18	98.70(±11.11)	87.50(±7.17)	100.50(±15.33)
GC	4	98.10(± 11.51)	88.50(±17.49)	91.00(±21.24)
	8	97.70(±18.80)	83.50(±11.80)	80.60(±20.86)
	12	101.60(±14.82)	94.50(±21.14)	105.50(±15.31)
	18	100.30(±10.40)	88.00(±9.49)	95.80(±13.65)

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Characteristics of the home environment: variables evaluated by AHEMD

The variables descriptive measures of AHEMD-IS according to group and age can be seen in table 2. The ANOVA results indicated a statistically significant difference between groups concerning AHEMD Fine Motor Skill (p=0.007), in which the SG presented the best result. (Table 2). A statistically significant difference was observed between the ages of 4 and 12 months, and 4 and 18 months in the following: AHEMD Stimulation Variety (p=0.001), AHEMD Gross Motor Skill (p=0.001), AHEMD Fine Motor Skill (p=0.001) and AHEMD Total Score (p=0.001), regardless of the group. Significant difference between the ages of 8 and 12 months in: AHEMD Stimulation Variety (p=0.001), AHEMD Gross Motor Skill (p=0.008), AHEMD Fine Motor Skill (p=0.001), and AHEMD Total Score (p=0.001), independently of the group. Also, a significant difference between the ages of 8 and 18 in: AHEMD Stimulation Variety (p=0.001), AHEMD Gross Motor Skill (p=0.005), AHEMD Fine Motor Skill (p=0.001) and AHEMD Total Score (p=0.001). No statistically significant differences were found between the ages of 12 and 18 months.

Table 2: Mean and standard deviation (SD) of AHEMD-IS for study group (SG) and control group (CG) according for the age group of 4, 8, 12 and 18 months.

Group	Age	Physical Space AHEMD-IS	Variety of Stimulation AHEMD-IS	Gross Motor AHEMD-IS	Fine Motor AHEMD-IS	Total Score AHEMD-IS
SG	4	3.30(±2.21)	11.60 (± 3.24)	3.20 (±1.55)	2.40 (±1.58)	20.50(± 5.97)
	8	1.70(±1.49)	13.60(± 2.22)	5.00(±2.31)	3.30(± 1.89)	23.60(± 2.99)
	12	3.40(± 1.96)	16,40(± 2.72)	7.50(±1.72)	8.30(± 3.23)	35.60(± 6.64)
	18	2.70(± 2.16)	17.30(± 3.06)	7.60(±2.46)	9.90(± 3.75)	37.50(± 6.42)
CG	4	2.40(± 1.84)	11.40(± 3.06)	3.30(±1.57)	1.30(± 1.16)	18.40(± 4.40)
	8	2.00(±1.33)	13.00(± 2.36)	4.70(±2.36)	2,80(± 2,15)	22,50(± 5,28)
	12	2.60(±2.12)	17.50(± 2.51)	6.60(± .27)	6.80(± 2.20)	33.50(± 6.13)
	18	1.60(± 2.12)	18.40(± 2.32)	6.70(±2.63)	7.00(± 2.49)	33.70(± 4.95)

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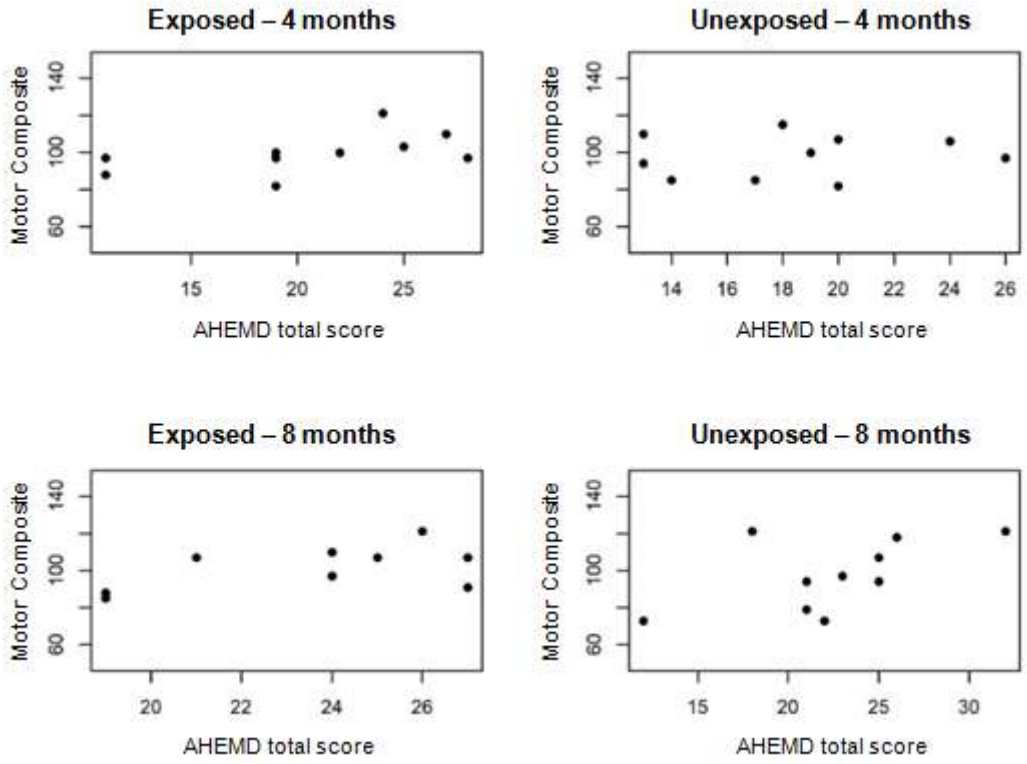
The following are the correlation results between development and affordances. There was no correlation between the AHEMD Physical Space and the Bayley Scale development domains for either group. There was a moderate correlation between AHEMD stimulation variety and motor composite in the SG at 12 months of age (r= 0.67; p=0.036), and a strong correlation in the CG at 8 months (r=0.73; p=0.018). However, no correlations were found between Stimulation Variety and Cognitive and Language. A strong correlation was found between Gross Motor Skill and Language at 12 months only in the SG (r=0.81; p=0.005); and between Gross Motor Skill and Cognitive at 12 months of age in the SG (r = 0.78; p = 0.007). For the Fine Motor variable, a strong correlation was observed at 12 months in the SG with Cognitive (r=0.78; p=0.007), Language (r=0.82; p=0.004) and Motor (r=0.75; p=0.012). In conclusion, there is a strong correlation between AHMED and Motor total score (r=0.70; p=0.025) at 12 months in the SG (Figure 1), moderate correlation with Cognitive (r=0.66); p=0.038) at 12 months in the SG (Figure 2), and Language (r=0.74; p=0.014) (Figure 3).

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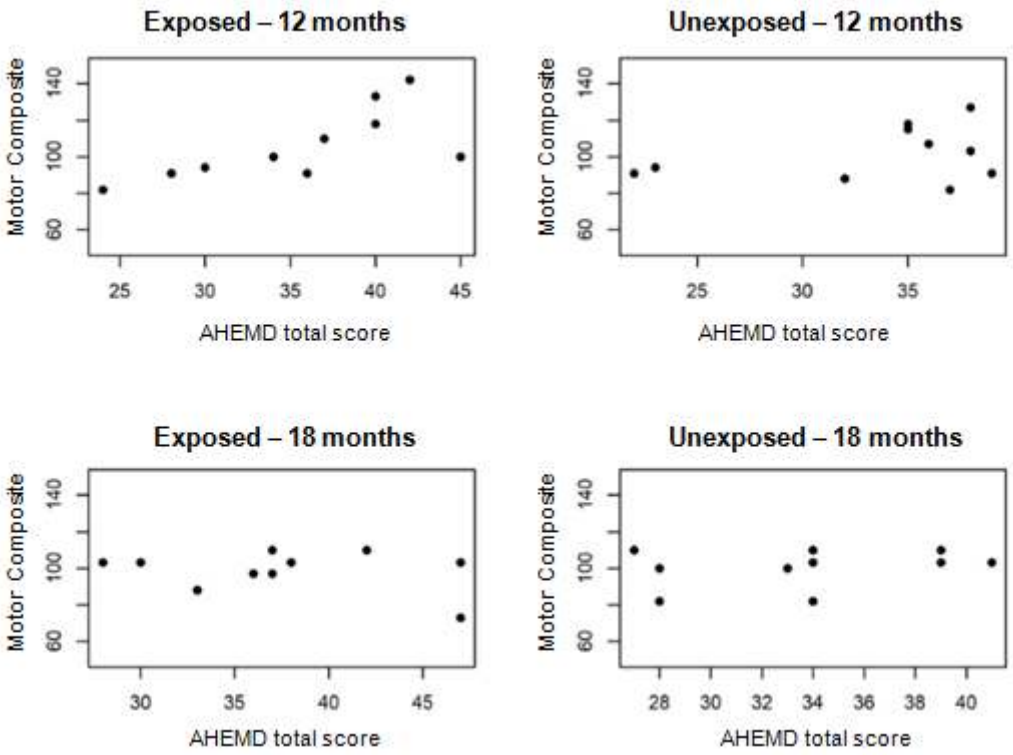
Figure 1. Correlation between Motor Composite and AHEMD total score for Exposed and as Unexposed for ages 4, 8, 12 and 18 months



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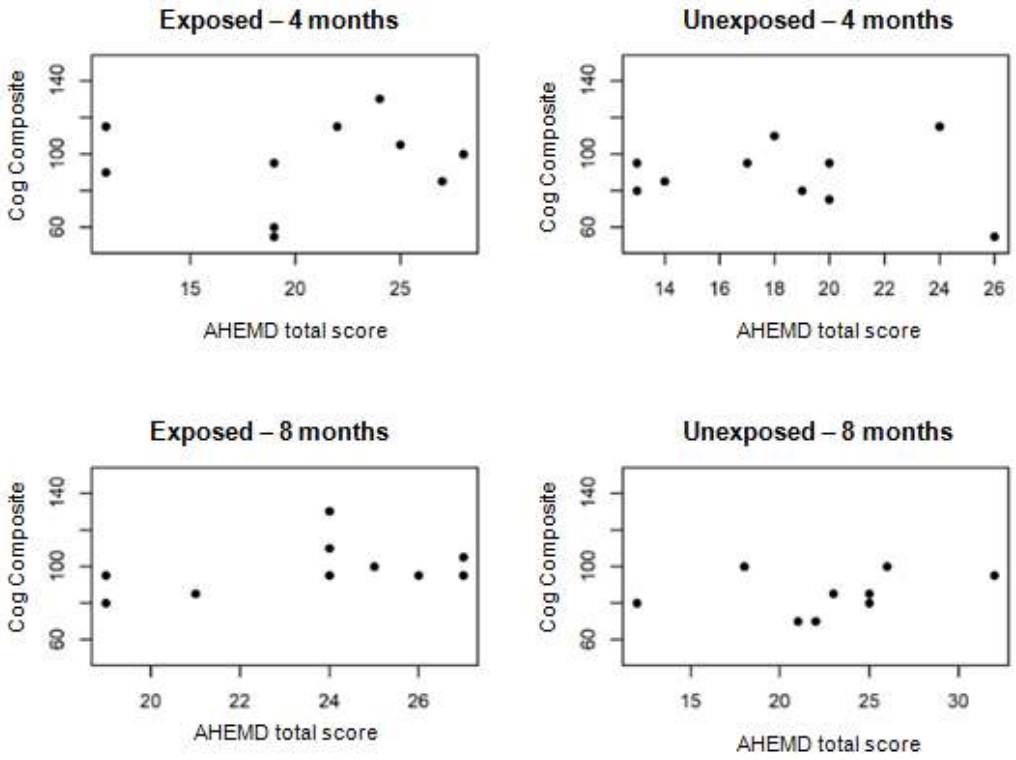


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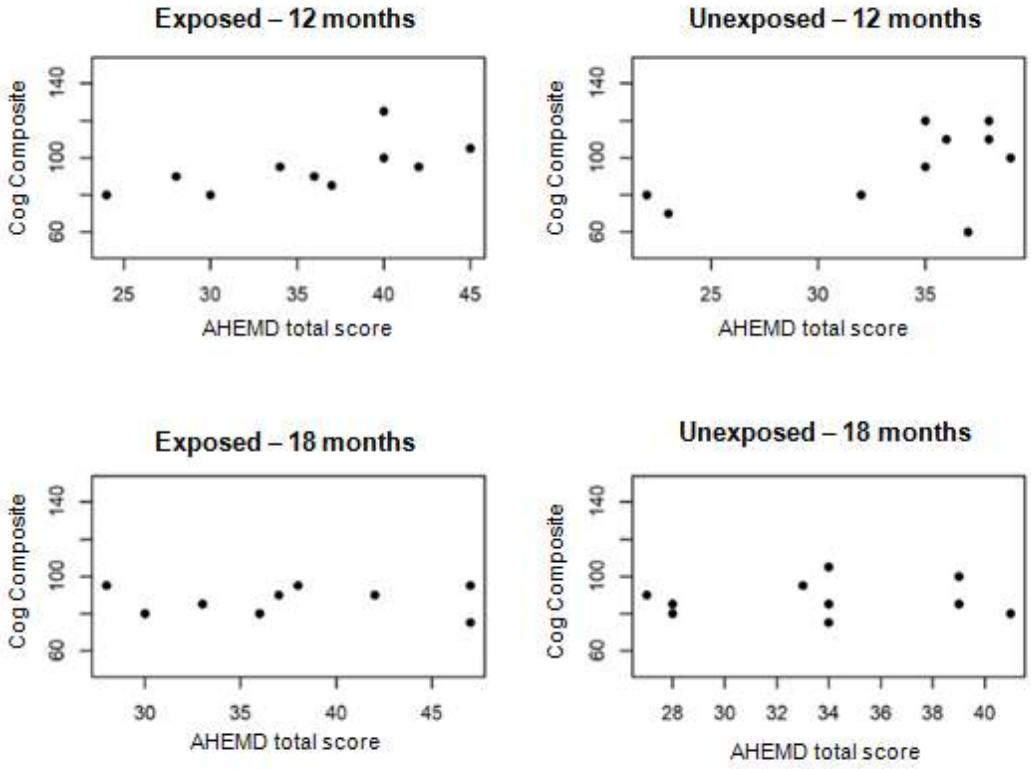
Figure 2. Correlation between Cognitive Composite (COG) and AHEMD total score for Exposed and Unexposed for ages 4, 8, 12 and 18 months



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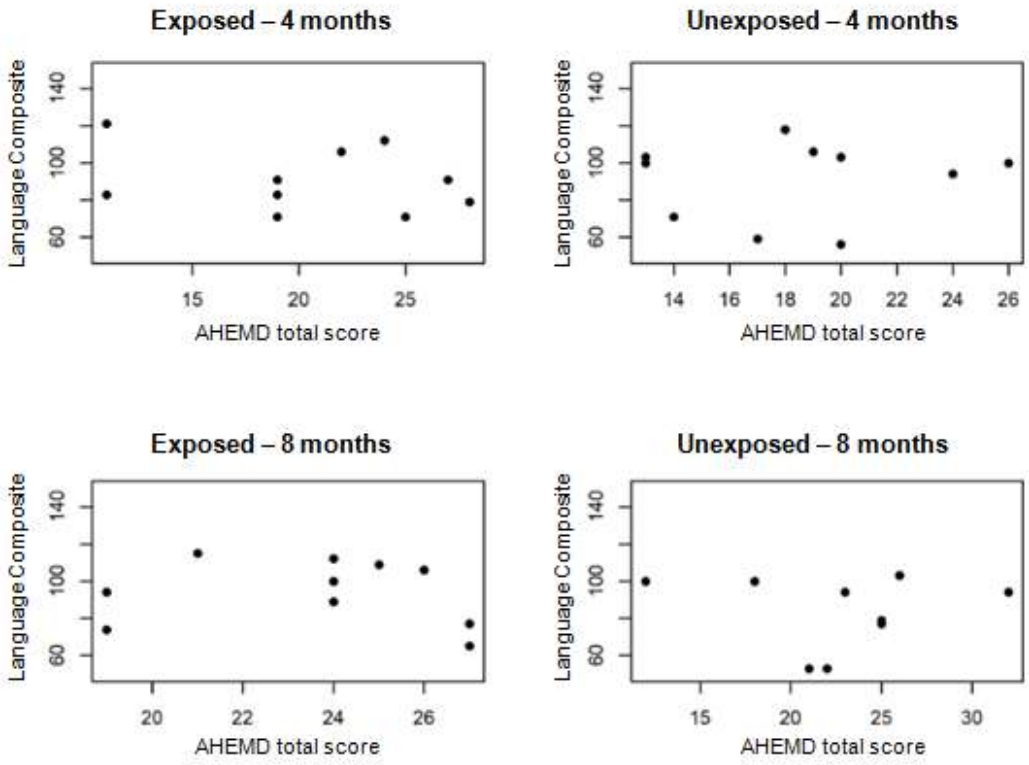


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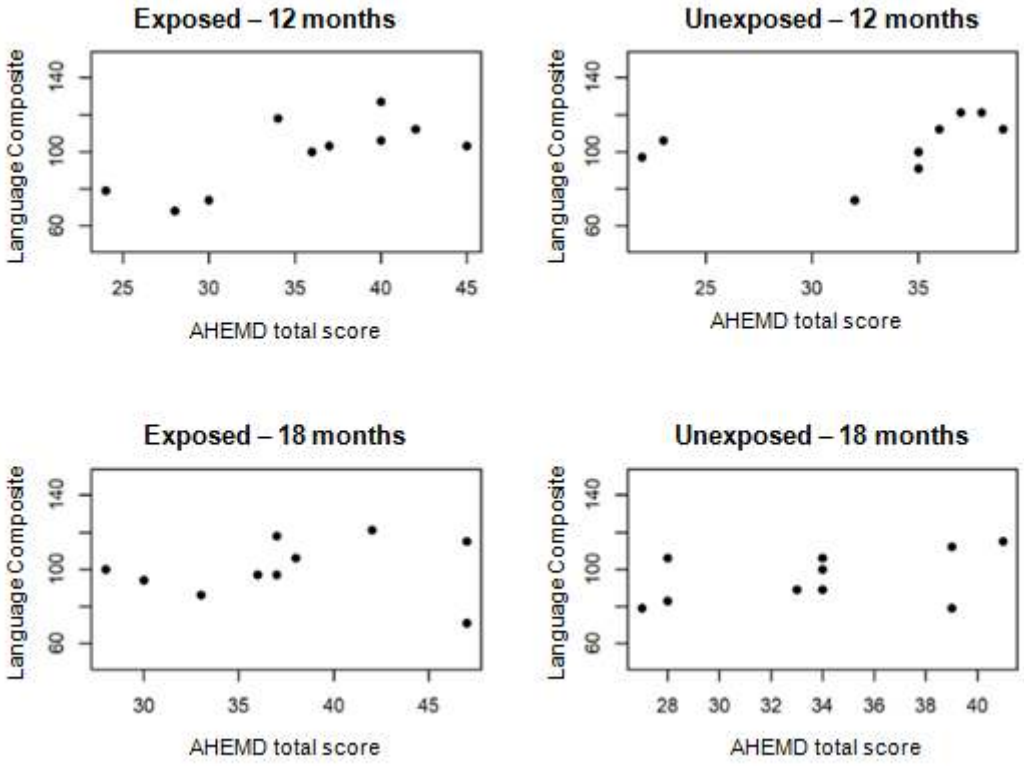
Figure 3. Correlation between Language Composite and AHEMD total score for Exposed and Unexposed for ages 4, 8, 12 and 18 months.



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DISCUSSION

The present study identified and compared the impact affordances in the home environment have in the development of HIV exposed and unexposed infants. In this case, the results did not indicate a significant difference between groups in the Bayley domains, however higher means were observed in the SG. These results are contrary to those observed in the study by Silva, Sá, Carvalho (2017), who evaluated same age HIV-exposed and unexposed infants using the Bayley scale, and it showed a significant difference between the groups in the Cognitive at 8 and 18 months of age; and a better performance of unexposed infants compared to exposed infants. It is noteworthy that the

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study by Silva, Sá, Carvalho (2017) did not evaluate the home environment in which these exposed and unexposed infants were inserted. In the present study, we find that unexposed infants are more susceptible to be vulnerable, due to the environment in which they are inserted and developing; plus, they receive less stimulation by parents than infants exposed to HIV; this may explain the contradictory results between the studies. Regarding the Bayley Motor domain, the results of this study corroborate the results by Silva et al., not evidencing significant differences; the same was also observed in the study by Alimenti et al., (2006) which, using the Bayley scale, found no difference between HIV-exposed and unexposed infants regarding motor development, but found lower performances among HIV-exposed infants.

Regarding Bayley's language domain, the present study also found no significant differences between the groups. Unlike a longitudinal study that found significant language delay in infants, mainly 12-month-olds, using this scale (ALIMENTI et al., 2006). This opposite result may be due to the fact that our study is cross-sectional. It is also worth noting that the study by Neves and Sá (2020) did not evaluate the home environment in which these infants were inserted, that is, it is not known how much stimulation this infant was exposed to, what the family condition is for the development of the infant, since it has been proven that home stimulation helps the infant's overall development (SILVA, SÁ, CARVALHO, 2017).

Unlike previous studies that only evaluated the development of exposed and unexposed infants (SILVA, SÁ, CARVALHO, 2017; ALIMENT et al., 2006; NEVES & SÁ, 2020), the present study also evaluated the environment in which these infants were developing, and correlated that with their overall development, which makes this a pioneering study. Through the AHEMD questionnaire, significant Fine Motor Skills differences were found between the two groups, in which the SG presented better results than the CG. The fact that the SG had better scores does not mean that the home environment is adequate, however in the overall context the SG environment was better compared to that of the CG.

These scores may have been so due to the fact that the SG is located in a single referral center, which serves the entire Santos bay and has diverse housing conditions, in spite of being a low-income population; unlike the CG, where everyone lived in the same neighborhood, which is known for being an extremely precarious neighborhood with a lack of minimum housing standards, an environment scarce of stimuli for the proper development of these infants, also indicating that the way the family raises their children, how they live in the place where they reside, is a relevant factor in the infant's

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development. This shows that both territorial and household conditions were not adequate for the development of these infants, especially in the CG. Descriptive results pointed out that most infants in the CG never attended daycare, another factor that negatively affects child development (PEREIRA, SACCANI, VALENTINI,2016).

Regarding the CG, in addition to having a more disadvantaged socioeconomic and environmental context, it is important to point out that the development of infants in the SG is monitored at a referral center, where they receive a monthly follow-up from a multidisciplinary and interdisciplinary team, in contrast, the CG sporadically receives follow-ups after the sixth month of life and are only followed by a pediatrician.

The mother´s care and the posture of infants during stimulation are of fundamental importance for their development. Studies show that putting the infant on the floor for stimulation is ideal, positively influencing its development (SILVA, SANTOS, GONÇALVES, 2006). This fact highlights an important observation of this study which is that mothers in the SG showed greater orientation regarding the importance of stimulation.

With these results, despite the HIV exposure factor, which at first would be a risk for development, it is observed that the environment in which this exposed population is developing is more conducive to promoting the infant´s overall development. However, despite these differences, we are not concluding that the SG home environment is adequate for development, but rather that it is better in relation to that of the CG.

The importance of the home environment was also found in a study that assessed its influence on motor development of full and preterm infants through the Alberta Scales and the AHEMD Questionnaire, which observed that environmental factors were significantly associated with motor development, as much as or even more than some biological factors, concluding that human development is the product of each individual's biological changes combined with multifactorial environmental contexts (SACCANI et al., 2013).

About the differences found between age groups regarding Stimulation Variety, Fine and Gross Motor Skills and Total Score variables, we noticed that at 12 months of age, infants had significantly better results than at 4 and 8 months; at 18 months significantly better than at 4 and 8 months, however no significant differences were found between the ages of 4 and 8 months, and 12 and 18 months. These results indicate that infants are stimulated and are presented with more choices of toys as they get older, that is, a 4-month-old infant is still poorly stimulated compared to a 12-month-old infant, however when compared to 12 and 18 month-olds, these results do not happen, due to the

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infant's own stimulation autonomy and the ability to explore the surrounding environment, independently of an adult. These results demonstrate that in every month evaluated in our study there is the need for stimulation, as observed in a study that shows that maternal stimulation and the adopted floor posture, as of 6 months of age, positively influence the infant's development, reaffirming that progression in development occurs every month of life (SILVA, SANTOS, GONÇALVES, 2006).

We can see the importance of paying greater attention to the development of the infant, with or without any biological risk factor, up to 24 months of age, since this is the period that requires the most stimulation each month of life (SANTOS et al., 2009; STREHLAU et al., 2016), that is, stimulation influences in a positive way each step and month of the infant's life, corroborating our findings. When we performed the correlation tests between the Bayley Scale and the AHEMD Questionnaire, we did not find significant correlations in the AHEMD Physical Space in relation to the Motor, Cognitive and Language in neither of the groups. In contrast, associations were found between Stimulation Variety and Motor domain, showing that the greater the stimulation variety, the higher the score in the motor domain. This result corroborates a study that evaluated the relationship of home environment opportunities with motor and cognitive development of infants aged 0 to 18 months, through the Alberta Motor Scale and the Bayley Cognitive Scale (NEVES & SÁ, 2020). Significant associations were found between motor development with cognition and household factors (parental education, availability of toys, home physical space, maternal practices, parental knowledge about child development, time in school). It was also observed that these external factors had more consequences in development than biological factors, indicating that a stimulus-rich environment can minimize the effects of biological vulnerability, whereas restricted environments may increase the risk of developmental delays (NEVES & SÁ, 2020).

The study also found a correlation between gross motor skills development in infants unexposed to HIV, and the father's educational level, showing that the higher the education level, the higher the infant's gross motor development (SANTOS et al., 2009; STREHLAU et al., 2016), corroborating our results in the present study, which it was observed a higher education fathers in the SG compared to the CG, and a higher average of fathers present in the SG infants' lives.

Regarding AHEMD Gross Motor Skills, a strong correlation was found with the Cognitive and Language domains. And regarding AHEMD Fine Motor Skills, a correlation was found with all Bayley domains. Although we found no association between Gross Motor Skills variables and Motor domains, a study that evaluated 9-

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month-old infants with the Bayley Scale in the Motor and Cognitive domains, and the environment with AHEMD, reported that the home environment provided a significant influence on fine motor skills of infants. The best AHEMD scores were correlated with better motor and cognitive scores, which corroborates our results (MIQUELOTE et al., 2012).

Lastly, we found correlations between the AHEMD Total Score with all Bayley domains, therefore, the higher the AHEMD score of these infants, the higher the scores on motor, cognitive and language development using the Bayley scale. This was confirmed in the present study by verifying a better Bayley score in the SG when better affordances in the home environment were present.

Pizzo et al. (2015) evaluated the home environment and the development of older children, without biological risk factors, but with different socioeconomic levels and it revealed a higher AHEMD score for the development of fine and gross motor skills in children with better economic conditions, as they are more able to purchase toys. However, a greater variety of stimulation was found in low-income children, probably due to a greater interaction between parents and children even with not many resources available (PIZZO et al., 2015). This fact could also explain the better SG development in this study, given the families' greater concern regarding their development, even though both groups had low economic power. This result was also confirmed by Freitas et al. (2013), who evaluated the relationship between socioeconomic status and home environment opportunities. Freitas et al., (2013) observed that physical space and materials, such as toys, were directly related to higher socioeconomic levels; however, it had no impact regarding stimulation variety, but rather in the parent-child relationship. Although there was no correlation between all developmental scores and AHEMD variables, most were strongly correlated. However, it is important to highlight we clinically observed that the SG home environment was more conducive to development than the CG home environment.

CONCLUSION

HIV-exposed infants do not show a delay in motor, cognitive and language development compared to unexposed infants. On the contrary, they may present equal or even better performances depending on the home environment and the stimuli given by their caregivers.

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It is also concluded that the environment is an important factor in motor, cognitive and language development for both exposed and unexposed infants, since our unexposed infants had some lower scores in development, and in the domestic environment

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