

Mother-child bonding, environment, and motor development of babies at risk accompanied by a follow-up

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Abstract

Objectives: to identify factors resulting from the correlation between mother-child bonding, environment, and infant motor development (MD).

Methods: a cross-sectional study was conducted with 130 mothers/guardians and their infants at risk from 3 to 12 months of age, accompanied in an outpatient clinic follow-up at a public maternity. The data were collected using a form with socioeconomic data, mother/child routine at the hospital and home environments, and three other instruments validated in Brazil: Protocolo de Avaliação do Vínculo Mãe-Filho (Mother-Child Bonding Evaluation Protocol), Affordances in the Home Environment for Motor Development – Infant Scale, and Escala Motora Infantil de Alberta (Alberta Infant Motor Scale). Pearson's chi-square test, Fisher's exact test, and a significance level of 5% was used for the correlation.

Results: the data showed a predominance of preterm babies (74.5%), low-income families (86.2%), and domestic opportunities below the adequate (93.8%) for good motor development. Regarding the mother-child bonding, 60% of the mothers showed a strong bonding with their children. A total of 62.3% of the children had typical motor development. Concerning the interaction between variables, statistical significance ($p < 0.05$) was observed in the correlation between bonding and typical motor development.

Conclusion: despite the presence of risk factors, motor development was normal in most of the babies in this study, suggesting that the mother-child bonding favored motor development even with environmental and biological adversities.

Key words Child development, Motor skills, Object attachment, Environmental impact



Introduction

The term "baby at risk" defines exposing a child to situations with a greater chance of unfavorable evolution throughout their development. Risk condition may be present in pregnancy (alcohol and/or drug use), at birth (prematurity and low birth weight), or throughout the child's life (low socioeconomic level, low parental education, and domestic violence) and must be promptly recognized by the health team, demanding special and priority care.¹

Among the resulting injuries, alterations on infant motricity stand out, the integration product between the individual's biology, environmental conditions, and the cognitive and affective domains, besides being influenced by the neuronal plasticity characterized in the period.²⁻⁴ Other aspects have also been pointed out as influencing this process. Among them, the mother-child bonding stands out, the establishment of a secure relationship, theorized by Bowlby,^{5,6} where the presence of the bonding figure increases the quality of exploration and games by the child.^{7,8}

Several current studies,^{7,8} such as one by Ronfani *et al.*,⁹ address the issue of mother-child bonding related to the child's cognitive evolution. Others relate to the influence of the environment to the baby's motor gains. However, the same does not occur correlating to bonding and the environment on the infant motricity.

Based on the above, this research aimed to identify the resulting factors from the correlation between mother-child bonding, environment, and children's motor development (MD) accompanied by a follow up in a public maternity in Fortaleza, Brazil.

Methods

An observational, descriptive, cross-sectional study with a quantitative approach was carried out with 130 mothers or guardians (that is, people playing the "maternal role" in caring for the child, in the complete absence of the biological mother due to death or abandonment), and their babies at risk aged from 3 to 12 months of life, accompanied at an outpatient clinic by a follow-up at the *Maternidade-escola Assis Chateaubriand* located in Fortaleza/CE, Brazil, in period of May to October 2018. Children with severe neurological damage, peri-intraventricular hemorrhage grades 3 and 4, confirmed or suspected syndromes, malformations, under early stimulation treatment, and mothers/guardians who were unable to express themselves due to mental disorders were excluded.

After the approval by the ethics and research committee at the institution, under the document number 2,627,884, all the data were collected by the main researcher, using a form prepared by the researcher him/herself, containing aspects related to the routine of the mothers and children in the hospital and at home environment, the questionnaire from the *Associação Brasileira de Empresas de Pesquisa*¹⁰ (ABEP) (Brazilian Association of Research Companies) for socioeconomic classification, and three other instruments validated in Brazil: *Protocolo de Avaliação do Vínculo Mãe-Filho*,¹¹ (The Mother-Child Bonding Assessment Protocol) aims to assess the mother-child bonding, consisting of 13 questions with yes/no answers, addressing maternal experiences since her childhood to events that occurred before, during, and after the pregnancy. In this protocol, "yes" is an indicator of weak bonding, and when added, the final score ranges from 1 to 13. A positive rating for weak attachment is given with number of positive responses ≥ 5 .

For the environmental assessment, the Affordances in the Home Environment for Motor Development – Infant Scale¹² was used, in which allows the qualitative and quantitative assessment, through the parents' self-report, the domestic opportunities offered to the child (affordances).¹³ This instrument has dichotomous questions on a Likert-type scale, arranged in different categories, and descriptive questions, resulting in 35 items divided into 4 dimensions: physical space, variety of stimulation, fine-motor toys, and gross-motor toys. The total score is categorized into 4 descriptions: Less than adequate, Moderately adequate, Adequate, and Excellent. These descriptions of performance, to simplify the final statistical analysis; however, without loss in the results, only two groups were gathered: 1 – Less than/Moderately adequate and 2 – Adequate/Excellent.

The motor development assessment was conducted using the *Escala Motora Infantil de Alberta-AIMS*, (Alberta Infant Motor Scale), an observation instrument¹⁴ consisting of 58 items that describe the development of a spontaneous movement and motor skills in prone, supine, lying, and standing position, enabling the identification of children whose motor performance is atypical concerning the normative group.

Data were tabulated in Microsoft Office Excel, and the statistical analyzes were performed using the Statistical Package for Social Sciences (SPSS) version 22.0 (USA) and R version 3.3.1. Description of means and standard deviations for quantitative variables and percentage and frequency for qualita-

tive variables were obtained. As for categorical variables, data were displayed in frequency and prevalence rates. The investigation association between the variables used the Pearson's chi-square test and Fisher's exact test, with a significance level of 5%.

Results

Of the 130 children evaluated, 28.4% were born with a corrected gestational age (GA) \leq 29 weeks, 46.1% with a GA of 30-35 weeks, 25.5% with GA \geq 36 weeks, and 64.6% remained hospitalized for more than a month. In relation to MD, a total of 62.3% of the babies were typical and only 37.7% were atypical (Table 1).

Regarding maternal characteristics, 86.2% of the population sample studied had low-income based on the ABEP socioeconomic classification criteria,¹⁰ and 93.1% were the babies' biological mothers. As for the schooling level, only 43.1% had graduated from high school. Regarding to professional occupation, 72.3% declared themselves as not having a paying job.

In the data referring to the hospitalization scenario, 96.9% of the mothers/guardians declared having visited the baby, 82.3% visited daily, and only 3.1% did not visit at all. Regarding to the

participation in the hospitalized child's care considered stable (for example, diaper changing and feeding), 82.3% stated that they performed such tasks. As for the domestic environment, 83.8% of the mothers/guardians declared themselves to be the main responsible for the child's care throughout the day, and 61.5% had help from another person, whether a relative or a hired professional (Table 2).

In the analysis of mother-child bonding, a weak bonding was identified in a notable number of mothers/guardians (40%). In this evaluation, it was possible to verify that 91.5% of the mothers/guardians reported perinatal complications, and 89.2% were separated from their babies for a long period of time after childbirth.

As for other contexts of maternal life, 53.1% considered having had a difficult childhood (affective and economic deprivation). However, 73.1% said they had overcome the difficulties and had no personal dissatisfaction.

In the bivariate correlation analysis of gestational age at birth and environment with MD, no association was observed between the variables in any of the age group analyzed (Tables 3 and 4). A significant association was found in the correlation between mother-child bonding and MD in the three gestational age groups, demonstrating that a strong

Table 1

Characteristics related to children at risk accompanied by a follow up at the Maternity, May to October 2018.

| | N=130 | % |
|------------------------------------|-------|-------|
| Corrected gestational age (months) | | |
| 3-5 | 85 | 65.4 |
| 6-8 | 15 | 11.5 |
| 9-12 | 30 | 23.1 |
| Gestational age at birth (weeks) | | |
| \leq 29 | 37 | 28.4 |
| 30-35 | 60 | 46.1 |
| \geq 36 | 33 | 25.5 |
| Sex | | |
| Male | 74 | 56.9 |
| Female | 56 | 43.1 |
| Length of hospital stay (months) | | |
| 1 | 46 | 35.4 |
| \geq 1 | 84 | 64.6 |
| Attend daycare | | |
| Yes | 0 | - |
| No | 130 | 100.0 |
| Motor development | | |
| Typical | 81 | 62.3 |
| Atypical | 49 | 37.7 |

Table 2

Characteristics related to mothers/caregivers of children at risk accompanied by a follow up at the Maternity, May to October 2018.

| | N=130 | % |
|--|-------|------|
| Kinship with the baby | | |
| Biological mother | 121 | 93.1 |
| Others | 9 | 6.9 |
| Socioeconomic classification | | |
| D-E | 46 | 35.4 |
| C1-C2 | 66 | 50.8 |
| B1-B2 | 17 | 13.0 |
| A1-A2 | 1 | 0.8 |
| Schooling | | |
| Incomplete primary school | 27 | 20.8 |
| Complete primary school | 8 | 6.2 |
| Incomplete high school | 22 | 16.9 |
| Complete high school | 56 | 43.1 |
| Incomplete higher education | 6 | 4.5 |
| Complete higher education | 11 | 8.5 |
| Does the mother have a paying job? | | |
| Yes | 36 | 27.7 |
| No | 94 | 72.3 |
| Does the mother visit the baby in the hospital? | | |
| Yes | 126 | 96.9 |
| No | 4 | 3.1 |
| Frequency of hospital visits to the baby | | |
| Daily | 107 | 82.3 |
| 3-5 times per week | 12 | 9.2 |
| 1-2 times per week | 7 | 5.4 |
| No visits | 4 | 3.1 |
| Maternal participation in the care of the hospitalized baby | | |
| Present | 107 | 82.3 |
| Absent | 23 | 17.7 |
| How many hours does the mother/caregiver take care of the baby throughout the day? | | |
| All day | 109 | 83.8 |
| Morning and afternoon | 8 | 6.2 |
| Only 1 shift (morning, afternoon, or evening) | 13 | 10.0 |
| Mother-child bonding | | |
| Strong | 78 | 60.0 |
| Weak | 52 | 40.0 |
| Difficult maternal childhood (emotional, socioeconomic deprivation) | | |
| Yes | 69 | 53.1 |
| No | 61 | 46.9 |
| Personal dissatisfaction | | |
| Yes | 35 | 26.9 |
| No | 95 | 73.1 |
| Perinatal complication | | |
| Yes | 119 | 91.5 |
| No | 11 | 8.5 |
| Mother-baby separation for a long period of time | | |
| Yes | 116 | 89.2 |
| No | 14 | 10.8 |
| Emotional problems during pregnancy (depression, anxiety) | | |
| Yes | 63 | 48.5 |
| No | 67 | 51.5 |

mother-child bonding predisposed their children to a typical motor development (Table 5).

Discussion

In this present study, the primary questions addressed the babies' biological factors, family's socioeconomic, and relation to the mother-child routine in the hospital and at home environment. According to the results described, with the excep-

tion of sex, all other aspects are considered risk factors for infant development. Prematurity is the condition mostly related to delays in acquiring motor skills, especially in the first 12 months of life.

However, from the results presented in Table 3, no statistical significance was observed on the interaction between GA and MD ($p = 0.532$), thus corroborating current research on the subject.^{5,15-17} A similar result was observed in Pereira,¹⁸ study who affirmed that the effects of different risk factors,

Table 3

Analysis on the Gestational Age at Birth versus Motor Development in children at risk accompanied by a follow up at the Maternity, May to October 2018.

| | Typical Motor Development | Atypical Motor Development | Total |
|-------------|---------------------------|----------------------------|---------------|
| ≤29 weeks | 21 56.8% | 16 43.2% | 37 100.0% |
| 30-35 weeks | 37 61.7% | 23 38.3% | 60 100.0% |
| ≥36 weeks | 23 69.7% | 10 30.3% | 33 100.0% |
| Total | 81 62.3% | 49 37.7% | 130 100.0% |

Pearson's chi-square test $p = 0,53$.

Table 4

Analysis in relation to Environment X Motor Development in children at risk accompanied by a follow up at the Maternity May to October 2018.

| | Typical MD | | | Atypical MD | | | Total |
|--------------------------------|-------------|-------------|-----------|-------------|--------------|--------------|-------|
| | ≥29w GA | 30-35w GA | ≥36w GA | ≥29w GA | 30-35w GA | ≥36w GA | |
| Less than/Moderately adequate | 19 90.5% | 35 94.6% | 20 87% | 15 93.8% | 23 100.0% | 10 100.0% | 122 |
| Adequate/Excellent environment | 2 9.5% | 2 5.4% | 3 13% | 1 6.3% | 0 - | 0 - | 8 |
| | 21 | 37 | 23 | 16 | 23 | 10 | 130 |

GA (Gestational age at birth) ≤29 weeks: Fisher's exact test, $p > 0.999$; GA = 30-35 weeks: Fisher's exact test, $p = 0.519$; GA ≥36 weeks: Fisher's exact test, $p = 0.536$. MD= Motor development.

Table 5

Analysis in relation to Mother-Child Bonding X Motor Development in children at risk accompanied by a follow-up at the Maternity, May to October 2018.

| | Typical MD | | | Atypical MD | | | Total |
|----------------|-------------|-------------|-------------|-------------|-----------|----------|-------|
| | ≥29w GA | 30-35w GA | ≥36w GA | ≥29w GA | 30-35w GA | ≥36w GA | |
| Strong bonding | 16 76.2% | 32 86.5% | 17 73.9% | 7 43.8% | 3 13% | 3 30% | 78 |
| Weak bonding | 5 23.8% | 5 13.5% | 6 26.1% | 9 56.3% | 20 87% | 7 70% | 52 |
| | 21 | 37 | 23 | 16 | 23 | 10 | 130 |

GA (Gestational Age at Birth) ≤29 weeks: Pearson's chi-square test, $p=0.044$; GA = 30-35 weeks: Pearson's chi-square test, $p<0.001$; GA ≥36 weeks: Fisher's exact test, $p = 0.026$. MD = Motor development.

including the repercussions associated with GA, may vary throughout time, emphasizing the importance of the psychosocial context in this process.

Of the factors related to the socioeconomic context, most of the population studied has a low-income. Ronfani *et al.*⁹ observed that socioeconomic status can affect the infant neural development through various mediators, such as prenatal factors, parenting care, cognitive stimulation, nutrition, stress, toxins, and drug exposure.

As well as the socioeconomic aspect, maternal schooling also proved to be essential for adequate infant development, reflecting on the way the mother raises a child, in her understanding of the development stages and the appropriate stimuli at each stage.^{15,19} In a research carried out by Morais *et al.*,¹⁹ the authors observed that highly educated mothers were more concerned with stimulating the infant development.

Most of the environments evaluated were considered inadequate to favoring the child's MD, corresponding to the socioeconomic level found. This result is consistent with that obtained in a research carried out by Pizzo *et al.*²⁰ and Gomes,²¹ which evidenced the influenced factor on socioeconomic aspects on the availability of materials to stimulate children's motricity. For low-income families, access to toys is not a priority, and the lack of experience with these possibilities can negatively effect on acquiring new skills.

None of the children in this study attended daycare until the time of the assessment, restricting their opportunities to receive stimuli rather than at their home environment, which could be considered limiting since studies by Santos *et al.*²² and Morais

et al.,²³ reveal that attendance at good quality daycare centers is related to higher cognitive performance in children, this dimension is closely related to motricity.

In a bivariate analysis between environment and MD, the results did not show statistical significance. Such result may have been caused by the homogeneity of the investigated sample concerning the environmental opportunities offered and the socioeconomic aspects, not allowing the establishment of comparisons that would allow the intended analysis. Nonetheless, these data show that the inadequate environment did not prevent most evaluated children from developing in a typical way, raising the question of which variables would favor an adequate infant MD, despite their socioeconomic, environmental, and biological difficulties.

In the analysis of the mother-child bonding, more than half (53.1%) of the evaluated mothers declared to have had a difficult childhood, 48.5% reported emotional problems during pregnancy, and 89.2% experienced prolonged separation from their babies after birth. The above findings indicate the presence of several risk factors for the formation of a healthy mother-child bonding.

Madigan *et al.*²⁴ showed that maternal adverse experiences at childhood are associated with difficulty attuning to their children's cues and presenting psychological or emotional unavailability to the necessity of their offspring. According to Cavalcante *et al.*,²⁵ mothers with low socioeconomic and schooling levels may present a higher incidence of negative patterns regarding to the ability to respond to the child's demands, with greater verbal negativity, low affective warmth, and less involvement,

thus being less supportive to the child's activities .

In relation to perinatal complications, Santos *et al.*²² and Vulcão²⁶ showed that the separation of the mother and her newborn represents a crisis, harming the process of bonding formation. This aspect is noteworthy when it is observed that 89.2% of the mothers evaluated in this study, were separated from their babies for a long period of time.

However, other dimensions showed results that favored the formation of a mother-child bonding. There are issues related to whether they wanted to get pregnant or not, as for the majority declared that they to get pregnant, this is relevant according to Pontes,²⁷ which portrays the desire to get pregnant and the acceptance of the pregnancy as important factors for the formation of a harmonious mother-child bonding.

Other scenarios that also interfere in the mother-child bonding formation were explored using the questionnaire created by the main researcher. When asked about visiting their babies, most mothers/guardians declared that they used to visit the hospital daily and participated in the baby's caring routines. Such factors are suggested as favoring the continuity of the bonding, hampered by the circumstances mentioned above.^{23,26,28} In this context, in the general assessment of mother-child bonding, 60% of the participants had a strong mother-child bonding.

Pereira¹⁸ highlights parental practices in child care are understood as the quantity and quality of biological and psychological care for the offspring, profoundly influenced in their development. In contrast, low parental commitment has a negative impact on child development. Such examples of parental unavailability are not reported in the results of this study.

The bivariate analysis correlating the mother-child bonding and MD resulted in a significant association ($p < 0.05$) in all age groups at birth, showing that a strong mother-child bonding predisposed their children to typical motor development.

In the correlation between environment (affordances) and MD, the results did not show statistical significance ($p > 0.999$), and this may be due to the homogeneity of the studied population concerning the environmental opportunities offered to the children and the socioeconomic aspects in not allowing to establish comparisons that would enable the intended analysis.

Thus, the data found in this research suggest that the variable mother-child bonding is relevant to MD, surpassing even the environmental issue.

Recent studies corroborate to this hypothesis, as

Sacanni *et al.*,¹⁵ research evaluating children aged 0-18 months. The interactive activities of the babies with their parents, such as interactions involving toys, were significantly associated ($p < 0.05$) with MD. The same result was found in the study by Miquelote *et al.*²⁹

Saur *et al.*³⁰ carried out a study to investigate whether children with secure and insecure attachment patterns differ in cognitive, linguistic, and motor performance. It was observed that those with secure attachment patterns were more competent in the assessed domains than those with insecure patterns.

Overall, these results show that the home environment and the interaction between mother and child are important factors on the infant development. The next logical step of this study is to examine the long-term effect of environmental factors and the mother-child bonding on infant MD through longitudinal research since the cross-sectional nature of this study did not allow inferences of causality. This will also help us to overcome the limitations related to the socioeconomic homogeneity of the studied population.

Thus, the data presented suggest that, despite the biological, socioeconomic, and environmental risk factors present in the studied population, the context of these variables did not prevent most babies from having a typical DM. This result was justified by the analysis in relation to the variations between the mother-child bonding and motricity, which found that mothers are strongly linked to their children in favoring their MD. The importance of this relationship is to highlight the inadequate opportunities observed in most of the environments studied, a variable that is already recognized in the literature as fundamental for MD.

Given the above results, measures emphasizing the importance of the link between the mother/guardian and her offspring are needed. An adequate home environment, taken from the period of hospitalization and continued in the follow-up clinics, can contribute to favoring MD in babies at risk.

Such actions should focus not only on the children's family but also the health team that accompanies them, offering theoretical subsidies that support the approach of babies at risk and their families, especially concerning the issue of infant motor development and its relationship with the environment and mother-child bonding.

Authors' contribution

Chaves KYS and Nobre RA contributed to the study design. MMMS and Chaves KYS performed the data collection and analysis. All authors approved the final version of the manuscript and are publicly responsible for the content of the article.

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