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Risk factors for fine and gross motor development in preterm and term infants

Fatores de risco para o desenvolvimento da motricidade fina e grossa em bebês nascidos pré-termo e a termo

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Keywords

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ABSTRACT

Purpose: To investigate the association of sociodemographic, obstetrical and psychosocial factors with fine and gross motor developmental delay in preterm and term infants, in the age group of three months and one day to twelve months and twenty-nine days. **Methods**: The term and preterm infants were evaluated by the Denver II Test for fine and gross motor skills, investigated in three phases: 165 infants in phase 1 (3 months and 1 day to 4 months and 29 days), 130 infants in stage 2 (8 months and 1 day to 9 months and 29 days) and 102 infants in phase 3 (11 months and 1 day to 12 months and 29 days). Sociodemographic, obstetrical and psychosocial data were obtained through an initial interview with family members and the psychic risk assessment through the Child Development Risk Indicators and PREAUT protocols. Statistical analysis was performed using the logistic regression model. **Results:** Significant factors in the association with fine and gross motor delay were: maternal gestational and obstetric history (planned pregnancy, type of delivery, number of prenatal consultations, use of medication and gestational intercurrence), features and biological risks of the baby (gender, mechanical ventilation, feeding difficulty), sociodemographic factors (career and level of maternal schooling, number of children and people in the house) and psychosocial issues concerning to the family routine participation and presence of psychic risk. **Conclusion:** There was a significant association between motor development delay of the infants, environmental and biological variables, with emphasis on psychic risk.

Descritores

Infância
Desenvolvimento
Motor
Fatores de Risco
Transtorno Autístico
Prematuridade
Psicopatologia

RESUMO

Objetivo: Investigar a associação de fatores sociodemográficos, obstétricos e psíquicos com atraso no desenvolvimento motor fino e grosso, em crianças nascidas a termo e prematuras. **Método:** Os bebês nascidos a termo e pré-termo foram avaliados pelo teste Denver II para motricidade fina e grossa em três fases: 165 crianças na fase 1 (3 meses e 1 dia a 4 meses e 29 dias), 130 crianças na fase 2 (8 meses e 1 dias a 9 meses e 29 dias) e 102 crianças na fase 3 (11 meses e 1 dia a 12 meses e 29 dias). Os dados sociodemográficos, obstétricos e psicossociais foram obtidos em entrevista inicial e o risco psíquico foi avaliado pelos indicadores clínicos de risco ao desenvolvimento infantil e pelos sinais PREAUT. A análise estatística foi realizada por meio de regressão logística. **Resultados:** Os fatores significativos na associação com atraso motor fino e grosseiro foram: histórico gestacional e obstétrico materno (gravidez planejada, tipo de parto, número de consultas pré-natais, uso de medicamentos e intercorrência gestacional), características e riscos biológicos do bebê (sexo, ventilação mecânica, dificuldade de alimentação), fatores sociodemográficos (carreira e nível de escolaridade materna, número de filhos e pessoas na casa) e questões psicossociais relacionadas à participação rotineira da família e presença de risco psíquico. **Conclusão**: Houve associação significativa entre atraso no desenvolvimento motor dos lactentes, variáveis ambientais e biológicas, com ênfase no risco psíquico.

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INTRODUCTION

Biological and environmental factors, including social, economic and family interactions, play a role in childhood development[1,2]. In particular, current studies highlight the relationship between psychic constitution and motor aspects. They analyzed the motor characteristics using family videos recorded during the first two years of infants life who received the diagnosis of autism spectrum after three years old[3,4].

This importance of the body of the infant is also emphasized by Bullinger[5] when he states that from the integration of sensory flows, discrimination and sensorial modulation, the infants construct their mental representations. Other studies also highlight the importance of the initial sensorimotor apparatus of the infants in the relationship with its caregivers[6,7], and others the contribution of parental functions in assigning significance to the actions of the infants, which will derive the subject[8].

Prematurity is one of the most important biological factors of identifying the infant's development, once it has been reported as a risk factor that most exerts child cognitive, language and motor development delay and as the main determinant of morbidity and mortality in newborns[9-11]. The highest preterm infants survival requires its monitoring, as there are studies that found deficits in preterm infants, when evaluated in visual motor skills, perception (visual, auditive, tactile and kinesthetic), and praxis in comparison to term infants. According to Vanier[12] in addition to the motor delay, babies weighing between 500 grams and 2 kilograms are five times more susceptible to develop an autism spectrum than control group.

It is highlighted as environmental risk factors that affect children's development: schooling and family income, the number of adults and children living in the household, the quality of family interaction with the child and the maternal emotional state[1,2,10]. The infants condition may be aggravated by prematurity due to the challenges that hospitalization time and the medical procedures can bring to the infant and its family members[9], whose psychic effects may affect psychomotor development, especially for the emergence of psychomotor symptoms such as psychomotor agitation[13].

The use of early signals which can detect the presence of psychic risk that is related to the biological difficulties of the infant as in autism spectrum and prematurity, or for environmental reasons related to the family psychic or sociodemographic[1,2] difficulties, it is fundamental in the analysis of the infant's psychic constitution. This possibility is presented from research conducted with Child Development Risk Indicators (CDRI)[14] and the PREAUT Signals[15,16], which demonstrated sensitivity and specificity necessary to capture the psychic risk, both for autism or another psychopathology. Another study affirms the relationship between psychic risk and other aspects of development such as language and cognition[17].

The objective of this study is to investigate the association of sociodemographic, economic, obstetrical and psychosocial risk factors with the presence of fine and gross motor development delay in infants from 3-month and one day to twelve month and twenty nine days.

METHODS

The observational and quantitative design was constructed as part of the research project " Comparative analysis of development of premature and -term babies and their relationship with psychological risk: from detection to intervention", authorized in May 2014 in the Research ethics committee (REC) – Universidade Federal de Santa Maria under number of CAE: 28586914.0.0000.5346. Three psychologists, three speech therapists, two occupational therapists and one physiotherapist were part of this research project.

The adults responsible for the infants were informed about the collection procedures, the risks and benefits and signed the Informed Consent Form (ICF), in compliance with Resolution 466/12 of the Comissão Nacional de Ética em Pesquisa (CONEP).

The sample was consisted of full-term and preterm infants (gestational age below 37 weeks), being the most of them late preterm (gestational age between 34 and 36 weeks, 6 days). It should be noted that the corrected age of preterm infants was used in this study.

Infants with malformations, syndromes and visual and auditory disabilities were excluded. In addition, interviews with mothers were conducted by the research psychologists, and infants whose mothers presented impairment of the psychic structure, such as psychosis and schizophrenia, were excluded from the sample. Therefore, infants born full term and preterm without any diagnosis of evident biological disability were included.

Due to the difficulty of returning the infants to the sequence of the evaluations, it was decided to cross-capture the sample in order to increase it. Thus, the infants were intentionally chosen according to the ages of the stages studied, as shown in Table 1, once the exclusion and inclusion criteria have been met and the necessary evaluations have been carried out. The age groups shown in Table 1 are related to important moments in the acquisition of motor skills and also followed criteria determined by the protocols used in the psychic risk assessment that will be described next.

As the sample consisted of all available infants who were being followed up on the project, the sample size was not calculated.

Preterm and term infants were collected at a University Hospital of reference in Rio Grande do Sul state and at the Basic Health Unit where they were monitored in childcare by pediatricians. At this moment, the objectives of the research were clarified and the adults responsible signed the ICF. An initial interview was also conducted to investigate the maternal obstetric history (abortion history, type of delivery, number of visits in the prenatal period, pre / post or postpartum complications, use of medications during pregnancy); the infant history, gestational age, birth weight, hospitalization, the need for mechanical ventilation, type of feeding, feeding difficulty, the participation in family dynamics, the supply of toys, the provision of different positions throughout the day; psychosocial (history of maternal depression, planned pregnancy, feelings about the experience of motherhood, social support); sociodemographic data of the father and mother (age, occupation, educational level, marital status, number of children, number of people in the household) and economic (family income).

Table 1. Distribution of infants according to the evaluation phases (1- 2-3)

Stages	Groups		Total
	Control	Study	
Stage 1: 3 – 4m29d	103 full-term	62 preterm (27 late- 27 moderates - 8 extremely)	165
Stage 2: 8 – 9m29d	84 full-term	46 preterm (24 late- 19 moderates - 3 extremely)	130
Stage 3: 11 12m29d	69 full-term	33 preterm(20 late- 12 moderate - 1 extremely)	102

Source: survey data

The collection began in May of 2014 and the monitoring and new infant collections occurred until March 2016. The stages of collection described were defined from the phases predicted in the protocols of detection of psychic risk, one of the psychosocial aspects investigated.

For each evaluative stage (stages 1, 2 and 3), evaluations were made in a room in the Basic Health Unit, which included continuous interviews regarding changes in the life of the child and the family (change of address, maternal and child emotional status, maternal employment, food and baby sleep, among others) and infant evaluation through the neuropsychomotor development test (DENVER II)[18], adequate for each age group evaluated, concerning the age of the infant; as well as assessment of the psychic risk that consists of an observation of the infant interactions with his or her primordial caregiver, in the case of this research, the mother with the Clinical Indicators of Risk Development (CDRI)[14] and PREAUT Signs[15].

The Indicators of the CDRI[14] were used to detect elements indicative of psychic distress up to the age of 18 months old, in its reduced version (18 risk indicators). The PREAUT signs[15] were applied at approximately 4 and 9 months, in other words, only at phases 1 and 2 of the study. It analyzed whether the infant sought to spontaneously look at the adult or if they made the adult look, when he or she was stimulated or not by the adult. It was considered the interaction between the researcher and the infant, as well as between the mother and the baby. For each protocol response a value was assigned. When the total sum was 15 the infant was considered without risk to autism spectrum, when it was between 5 and 15, it was considered the presence of risk of non-autistic nature, confirmed by the change in the CDRI protocol, and when under 5 was considered a risk for autism spectrum disorder.

The DENVER Test II was used to evaluate and identify children with neuropsychomotor development delay[18]. It consists of 125 items that are divided into four groups: social-personal, language, fine and gross motor, wherein only the last two groups were of interest for this study. The scoring criteria assigned to each item are "pass," "failure," "no opportunity," or "refusal." As some items may be punctuated through reports from parents or guardians, information was obtained from two sources: direct observation of the child or the report of those responsible. All items are tested according to standardized procedures described in the manual, and at the end of the test the global development can be classified as normal (90 to 100% correct performance), suspect / questionable (from 75 to 90%), and altered (less than or equal to 74%).

The data collected were entered into an Excel spreadsheet and posteriorly converted to the STATISTICA 9.1 and PASW 17.0 computer applications. For the statistical analysis, the logistic regression model was used to identify risk factors (covariates), which were significantly associated with the outcome.

It was used as outcome (dependent variable) the fine and gross motor delayed (DENVER Test II) and as covariant the number of risk indicators present at CDRI, the PREAUT signs scores and the definition of presence or absence of psychic risk of these evaluations; the obstetrics, sociodemographic, economics and psychosocial variables.

In order to obtain the three multiple regression models, one for each of the three phases of the study, the non-parametric Chi-square association test was performed, in which the variables that obtained the value of $p \leq 0.25$ entered into the testing of the logistic regression analysis model. In the multiple model, the variables that did not reach p-value less than or equal to 0.10 were removed from the model, and the same was processed again.

In the results we report the co-variables that were significant in the Multiple Logistic Regression. The significance level considered was 10% ($p \leq 0.10$) as a function of sample size and significance for the multiple analyses.

RESULTS

The Table 2 and 3 shown the frequencies, the odds ratios (OR), their respective confidence intervals, and the p-value for the covariant ranges (risk factors) that were significant in the Multiple logistic regression, considering the performance in DENVER II for the fine and gross motor items, in the three age groups analyzed (stages 1, 2 and 3).

The results demonstrated, in stage 1, that female infants were three times more susceptible to present fine motor skills delay when compared to male infants; the infants at psychic risk on the PREAUT Signs were twice more likely to present delays in the fine motor compared to the risk-free infants; and infants with up to four people residing in the household have shown twice as much the chance of having a delay in fine motor skills compared to infants living in homes with more than four people.

In the stage 2, it was verified that the fact of the infants that have psychic risk in the PREAUT Signals, increased their chance of delaying the fine motor by eight times; the mother who has a professional activity, that is, work and/or study, represented twice as many chances of her children to present delay in fine motor skills in relation to the children of mothers who did not work. The infants born by cesarean delivery were three times more likely to have fine motor development delay compared to the normal delivery infants. Infants whose parents reported participating in the family routine had eleven times the chance of fine motor skills delay when compared to infants whose parents reported did not participate so much in the family routine. Lastly, it was found that infants with feeding difficulties had

three times the chance to present fine motor skills delay when compared to others without feeding difficulties.

In the stage 3, the significant risk factors for abnormal performance of fine motor development were the gender of the infant, the professional activity of the mother and factors related to the baby's gestation (gestational intercurrence and number of visits in the prenatal period) and also the type of delivery. Male infants demonstrated five times the chance of developing abnormal fine motor function when compared to females. The children of mothers who did not work showed seven times the chance of having delayed fine motor skills when compared to the children of working mothers. Therefore, an opposite result to the second stage.

Still in phase 3, infants born from cesarean delivery showed four times the chance of presenting fine motor delay when compared to normal delivery. Infants whose mothers

Table 2. Independent sociodemographic, psychosocial, obstetric and psychic risk variables in relation to the thin motor (dependent variable) in stages 1, 2 and 3

Co-variable	FINE MOTOR			
	Abnormal (%)	Normal (%)	OR_{Aj}(CI90 %)	p-valor
Stage 1 (n=165)				
PREAUT Signals				0.037
At risk	15 (57.7)	54 (38.8)	2.60(1.22-5.53)	
No risk	11 (4.3)	85 (61.2)	1	
Gender				0.018
Female	19 (73)	66 (77.7)	3.22(1.42-7.28)	
Male	7 (27)	73 (91.3)	1	
Number of people in the house				0.047
Up to 4	21 (80.8)	79 (56.8)	2.92(1.20-5.53)	
More than 4	5 (19.2)	60 (43.2)	1	
Stage 2 (n=130)				
PREAUT Signals				0.001
At risk	12 (35.3)	11 (11.5)	8.04(2.99-21.66)	
No risk	22 (64.7)	85 (88.5)	1	
Professional activity of the mother				0.072
Work/Study	19 (55.9)	42 (4.7)	2.42(1.07-5.45)	
Stay at home mother	15 (44.1)	54 (56.3)	1	
Type of delivery				0.043
Normal	5 (14.7)	38 (39.6)	1	
Cesarean section	29 (85.3)	58 (60.4)	3.17(1.24-8.11)	
Family routine participation				0.036
Yes	33 (97.1)	87 (90.6)	11.80(1.70-81.91)	
No	1 (2.9)	9 (9.4)	1	
Feeding difficulty				0.021
Yes	16 (47)	29 (30.2)	3.18(1.39-7.25)	
No	18 (53)	67 (69.8)	1	
Stage 3 (n=102)				
Gender				0.017
Female	6 (31.6)	42 (50.6)	1	
Male	13 (68.4)	41 (49.4)	5.38(1.69-17.11)	
Professional activity of the mother				0.004
Work/Study	5 (26.3)	47 (43.7)	1	
Stay at home mother	14 (73.7)	35 (56.3)	7.535(2.34-24.24)	
Type of delivery				0.043
Normal	3 (15.8)	30 (36.1)	1	
Cesarean section	16 (84.2)	53 (63.9)	4.88(1.34-17.74)	
Gestacional Intercurrence				0.038
Yes	14 (73.7)	39 (47)	4.01(1.33-12.03)	
No	5 (26.3)	44 (53)	1	
Number of prenatal visits				0.004
Up to 5 visits	6 (31.6)	9 (10.8)	9.04(2.57-31.75)	
More than 5 visits	13 (68.4)	74 (89.2)	1	

OR_{A}j = adjusted odds ratio; CI = Confidence Interval; At risk in the PREAUT Signs <5 points; No risk on PREAUT Signals> 5 points; N. prenatal visits = Number of prenatal consultations; MV = Mechanical ventilation. Stage 1 = age range of 3 months and one day to 4 months and 29 days; Stage 2 = 8 months and 1 day to 9 months and 29 days; Stage 3 = 11 months and 1 day to 12 months and 29 days, n=number of subjects, p≤0.10

Table 3. Independent sociodemographic, psychosocial, obstetric and psychic risk variables in relation to the gross motor (dependent variable) in stages 1, 2 and 3

Covariables	GROSS MOTOR			
	Abnormal (%)	Normal (%)	OR_{Aj}(CI 90%)	p-valor
		Stage 1(n=165)		
PREAUT Signals				0.008
At risk	26 (61.9)	43 (35)	2.82 (1.49-5.37)	
No risk	16 (38.1)	80 (65)	1	
Mother schooling				0.001
ES	25 (59.5)	33 (26.8)	3.63(1.92-6.88)	
HS	13 (30.9)	73 (59.3)	1	
HE	4 (9.52)	17(13.8)		
Planned pregnancy				
Yes	15 (35.7)	66 (53.6)	1	
No	27 (64.3)	57 (46.4)	3.04(1.04-3.81)	0.081
		Stage 2 (n=130)		
PREAUT Signals				0.014
At risk	7 (38.9)	16 (14.3)	4.13(1.59-10.71)	
No risk	11 (61.1)	96 (85.7)	1	
Use of medication during the pregnancy				0.020
Yes	14 (77.8)	53 (47.3)	4.15(1.51-11.41)	
No	4 (22.2)	59 (52.7)	1	
		Stage 3 (n=102)		
Siblings				0.047
Yes	1 (12.5)	48 (51)	1	
No	7 (87.5)	46 (49)	9.32(1.47-59.08)	
Need of MV				0.061
Yes	3 (37.5)	14 (14.9)	4.91(1.21-19.87)	
No	5 (62.5)	80 (85.1)	1	

ORAj = adjusted odds ratio; CI = Confidence Interval; At risk in the PREAUT Signs <5 points; No risk on PREAUT Signals> 5 points; Elementary schooling: ES = Elementary School, HS = High school, HE = Higher education; MV= Mechanical ventilation. Phase 1 = age range of 3 months and one day to 4 months and 29 days; Phase 2 = 8 months and 1 day to 9 months and 29 days; Phase 3 = 11 months and 1 day to 12 months and 29 days, n=number subjects, p≤0.10

presented intercurrences during pregnancy had four times the chance of having fine motor delay when compared to those without gestational intercurrences. Regarding the number of consultations in the prenatal period, the results indicated that the children of mothers who had up to five consultations had nine times the chance of delays in the fine motor when compared to the children of mothers who performed more than five visits during that period

Table 3 shows the results concerning the analysis of the gross motor performance of the infants in the three stages studied.

Regarding the gross motor, in stage 1, the risk factors for the infant were identified as having a psychic risk in the PREAUT Signs, low maternal schooling and lack of pregnancy planning. Infants at risk on the PREAUT Signs were twice more likely to have abnormal performance in the gross motor compared to the no risk infants. Regarding maternal schooling, the majority of the infants with the abnormal gross motor were the children of mothers whose education corresponded to Elementary School (complete or incomplete), evidencing three times the chance of presenting a delay in gross motor skills when compared to the children of mothers with higher education. Concerning pregnancy planning, infants from an unplanned pregnancy were three times more likely to present a delay in the gross motor when compared to the planned pregnancy.

In stage 2 the psychic risk and use of medication during gestation showed a statistically significant association with the abnormal performance of gross motor development. Infants at risk on the PREAUT Signs were four times more likely to present gross motor delay compared to those with no risk. It was also observed that infants with records of medication use by the mother during pregnancy demonstrated four times the chance of presenting a delay in gross motor activity.

At the stage 3, it is observed that the fact of the baby has a sibling and did not need mechanical ventilation at birth acted as protective factors to good gross motor performance, once infants without siblings demonstrated a nine times the increase in the chance of delay in the gross motor when compared to infants with one sibling and infants in need of mechanical ventilation were four times more likely to present gross motor delay.

DISCUSSION

When the results of each phase are observed, the presence of psychic risk in the PREAUT Signs emerges as the most recurrent factor associated to motor delay, in the fine and gross motricity. Considering that PREAUT Signs[15] shows good sensitivity to detect risk of progression to autism spectrum, its association with motor alterations confirms the predictions of

some studies[3,19] that have shown the first two years of children who received a later diagnosis of autism spectrum, based on the analysis of family films. Although such studies differ from the analysis presented here on large motor milestones, since they refined motor analyzes through the study of body asymmetry, motor instability and hypoactivity, this research demonstrates that these children may also have delays in the major motor milestones, confirming the interaction between psychic aspects and motor development.

The gender of the infant was important in the association between infants of female sex and fine motricity delay in stage 1, and association between infants of male gender in the third stage. The association with males was also investigated in one study[19], which suggests that the association with females was a particularity of this sample.

The results concerning the highest number of people being protective for the fine motor development in stage 1 agree with an study[20] whose results showed that premature infants who live with more people in the houselhod had a lower risk in the area of language evaluated in Denver Test II.

Regarding maternal labor activity, it was observed that the mother being at home was a protective factor for fine motricity in stage 2 and working out or studying became protective in the third stage. The results, that were observed in stage 2, confirms the results of a study[21] that found a better performance in the static balance in infants from stay at home mothers. On the other hand, the results of stage 3 confirm a previous study that found that maternal work, in addition to generating income and facilitating access to assets and resources, provides satisfaction and motivation to the mother that enhances positive experiences with the child[1].

The most frequent type of delivery was cesarean section, which was associated with alterations in fine motor skills in stages 2 and 3. This factor may be associated with other risk factors such as perinatal anoxia manifested in apgar. This hypothesis is proposed once the infants of the sample were born in the Unified Health System (UHS) where cesarean delivery is not elective as in the supplementary health system. It is only effective when the infants enter into some suffering and there is risk to they and their mothers. A study[1] found apgar score lower than 9 associated with psychic risk in its sample, which may be related to the production of archaic distress in the infant. It is possible to hypothesize that micro functional brain alterations have been generated by mild anoxia to the point of impacting the motor milestones analyzed, which should be investigated in the future with more refined neurological research.

Regarding infants who participates in the family routine presents a risk in fine motor skills in phase 2, it is important to emphasize that not only the presence of the infants in family activities, but the quality of their participation can explain the result found. Once being immersed in the routine of the family does not mean having good stimulation for playing and psychomotor stimulation or having good cognitive support. It is also important the type of affective relationship that the playing scene evidences[2]. Thus, this statistical result suggests the need for a deeper investigation into the daily lives of infants in future studies.

Another aspect that emerged as important was the presence of feeding difficulty correlated to fine motor alterations (stage 2). The feeding process of the infant from 8 months to 9 months and 29 days demands at least the intake of thin and thick liquid. Some babies who have several teeth may already be transitioning to semi-solid foods and some solids using teeth and tongue crunches to achieve successful bolus construction. Such skills are of fine motor motricity as well as the body abilities investigated by the DENVER Test II. Thus, the association found is consistent with anatomopathological aspects. It is also reinforced by a study[1] that found an association between gagging and eating difficulties and psychic risk, which again reinforces the associations between motor and psychic risk also found at this stage in pooled studies[19].

Most mothers who had a cesarean delivery, fewer prenatal consultations, and gestational intercurrences appear to be combined in stage 3 in association with the outcome of fine motor development alteration. As previously announced cesarean birth in the UHS is not elective and therefore used only in hazardous situations. The fact that the mothers did not have the ideal prenatal follow-up or even had gestational intercurrences confirms the hypothesis launched in the previously explained stage that the infants may have had some alteration of the cerebral functioning by light anoxia that could explain the outcome found here. The number of appointments in the prenatal period may operate in a protective way to infant development, since it prevents gestational intercurrence, and this was a risk factor for the infant's performance in fine motor development in stage 3. This result confirms the prediction of a study[1] that the number of five or fewer visits in the prenatal period presented four times more chance of risk to infant development than the infants of mothers who had six or more visits during that period[1]. The appointments in the prenatal period and the groups of pregnant women have the role of preventing intercurrences and promote health in the line of maternal and child care.

Regarding gross motor development, the higher maternal level of education associated with better motor development in stage 1 shows this as a factor of protection of child development, as demonstrated by several studies[1,20,21].

The association between absence of pregnancy planning and gross motor development delay in stage 1 confirms the findings of a study[22], in a research of maternity in the working classes, which found that the mother's pregnancy occurred unplanned, especially in single mothers, without the support of the father of the child and marked by a solitary and suffered experience[2]. This could also be observed in other studies[1,2], that is, not only the fact that it is not planned but also how it can impact on the maternal psyche.

A study[1] showed that the infant that experiences different body positions, either because of its potentiality and/or because of the opportunity offered by the mother, was a protective factor. This fact seems to be a factor in the association between gross motor development and psychic risk in stage 2.

Use of medication during pregnancy (stage 2) is usually associated with previous illnesses or during the gestational period. It can be assumed that the mothers of this sample had a higher risk during pregnancy, which should be better informed in future research.

The infant gross motor performance in stage 3 presented as risk factors the baby that had to undergo mechanical ventilation at birth, which confirms study[16] with infants with less weight, lower gestational age and neuropsychomotor delay in DENVER Test II between 10 and 14 months. The use of mechanical ventilation may be part of the early stages of care of prematurity.

Another variable associated with the gross motor delay in phase 3 was the absence of sibling, that is, the importance of a sibling as a stimulating agent in the gross motor development was evidenced. A study[23] found that children with more than three siblings were 90 percent more likely to present a delay in Denver Test II, confirming that in families with larger numbers of children, there is generally less incentive for children to explore their potential development. This lower stimulus is probably associated with lower availability of maternal care for the child. Therefore, the sibling may or may not compensate for the difficulty of the mother giving attention to the infant by having to take care of several children. The infants in this study were fortunate that the siblings stimulated their development, possibly because they were well stimulated by their mother.

CONCLUSION

In this study, it was found that child development depends on multiple factors in the complex relationship between genetic potential and the environment. Regarding motor delay, the psychic risk of the infant was significantly associated with the fine and gross motor outcome of premature and full-term infants in the stages in which the PREAUT Signals were investigated (stages 1 and 2).

It was evident that good prenatal care, which prevents gestational complications and the use of medication, which facilitates vaginal delivery without suffering to the baby, are fundamental factors for the biological health of the infant and act as protective for motor delay. In social and economic terms, mothers who had higher education, well-structured families who may have one more child to stimulate their sibling, who do not need to go back to work immediately after the infant's born can better stimulate their child.

The results suggest that the observation of the development of children's health teams in maternal-infant care must add, when looking at the biological aspects of the infant and its evolution in terms of great motor milestones, the psychic and relational dimension of the infant with his family. This will allow identifying the psychic risk in time to prevent not only the structuring of psychopathologies, but also to prevent the emergence of instrumental deficits such as motor ones. Therefore, the research indicates that an extensive work of continuous training of the childcare teams must be initiated, together with a change of health paradigms already in the university, with more interdisciplinary looking for the childhood.

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Author contributions

FMB: conception, collection and analysis of the research, writing of the article; ABM: statistical analysis. FSP: translation and revision of the article; APRS: conception of the research, revision of the writing of the article and theoretical analysis.