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Parents attending to nurse visits and birth age contribute to infant development: A study about the determinants of infant development

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ABSTRACT

Life experiences and parenting play an important role in infant development. To prevent developmental risks and support parents in their educational role, it is important to identify the determinants of infant development. In this study, we investigate the association between child, maternal, family and social variables, and infant development, as well as we investigate the determinants of infant development. A sample of 86 healthy infants and their mothers participated in this study. At 11-months, infant development was assessed with Schedule of Growing Skills II (SGSII). To assess mother-infant quality of interaction, the dyads were observed in free play at 12-months using CARE-Index. Maternal sensitivity and infant cooperative behavior were correlated with SGSII global scores and sub-scales. Infant development was associated with maternal years of education, number of siblings, birth weight or risks in pregnancy. Number of nurse visits attended by parents during the infant first year and birth age were determinants of infant development.

1. Introduction

Infant cognitive, social and motor competencies are developed in daily objectal and social experiences. Mothers play an important role in promoting infant development by introducing their infant to new experiences, scaffolding emerging skills, and providing opportunities for the practice [1]. The first year of life is a particularly critical period during which infant development changes rapidly. At the end of the first year of life, infants begin to introduce some symbolic actions into their functional play, the emergence of which is seen in the infant's first words, gestures and play.

Infant symbolic competence is developed at the “zone of proximal development” [2] and requires the adult's sensitive elaboration of the infant's behavior into a shared meaning. Indeed, according to Vygotsky, the adult guides the child by working one step ahead of the child's emerging skills and offering the child support to shift to a progressive symbolic complexity. By offering age appropriate experiences, parents help infants in maintaining attention for longer periods, persisting in their curiosity during exploration, and engaging in reciprocal interactions required to enhance infant cognitive development (e.g., [3–5]). In turn, improvements in infant development encourage parents to engage in more rewarding and sophisticated interactions [6].

Most of these learning experiences occur in social interactions with parents and depends on mothers' sensitive response. Ainsworth and her colleagues originally defined maternal sensitivity as the ability to perceive and to accurately interpret the signals and communications implicit in her infant's behavior and, given this understanding, to respond to them appropriately and promptly [7]. Ainsworth et al. [7] established four main attributes for assessing maternal sensitivity in early mother-infant interactions: sensitivity, acceptance, cooperation, and accessibility. Infants develop internal working models regarding their caregivers' availability and responsiveness and act according to their interaction-based expectations [8]. Accordingly, parents read infants' behavior and adjust their own behavior according to how their infants react.

Learning experiences in the context of parents' sensitive interactive behavior provide the confidence for children to explore news problems and to persist in solving them [9]. A large body of research indicates that mothers contribute to infants' positive developmental outcomes (revision in [10]) and social adjustment (e.g., [11]). Indeed, maternal sensitivity is predictive of a wider array of child outcomes, such as better emotional and physiological regulation [12,13], lower levels of

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aggression [4], behavioral problems [3,5] and mother-infant attachment (e.g., [14,15]). However, fewer research reported direct associations between maternal sensitivity and maturity of object play [16], gains in language acquisition ([17,18]), and cognitive outcomes [3,19].

Many developmental and family theorists stressed that early socialization is a bi-directional, reciprocal, relationship-based process between infant and caregiver (e.g., [20–23]). The use of dyadic measures in infant-caregiver research has increased during the last two decades. However, similarly to the definition of maternal sensitivity, the task of re-conceptualizing "the quality of infant-caregiver interaction" in dyadic terms has led to multi-construct definitions and a wide range of assessment methods (revision in [24]). It is of most importance that multidisciplinary teams with health, development and education professionals, intervene in families at risk for parental problems in repairing dyadic interactions.

Pregnancy and the early years of the child's life offer an opportune time to prevent a range of adverse maternal, child, and family outcomes. Nursing intervention with parents have been successful in achieving the improvement of parental care of the child reflected in better infant emotional and language development [25]. Regular nurse visits promote a close professional relationship with families allow them to play an important role in monitoring children's health, nutrition as well as parents health [26]. According to Prado and Dewey [27], when a child has adequate nutrition is better able to interact with environment and caregivers. These experiences are necessary to optimize brain development. Equally important mother's physical and mental health has an important impact not only on fetal health and development but also on the future child's health [28].

In sum, many risks in family context can affect infants' emotional and cognitive development namely: stress, poverty, low parental education, and number of siblings [29,30] but early intervention, which includes nurses, may prevent development delays and improve parents-infants' interaction [50].

1.1. Present study

The primary aim of this study was to investigate the association between mother-infant quality of interaction and infant Passive Posture, Active Posture, Locomotor, Manipulative, Visual, Hearing and Language, Speech and Language, Interactive Social, Self-care Social; Cognition and global development. The second major goal was to identify other contributes for infant development. Those variables, namely, birth age, infant gender, APGAR, birth weight, number of siblings, socio economic status (SES), services to support families (e.g., nurse visits at Primary Health Care Center, medical services), and maternal years of formal education were tested to verify their association with infant development.

2. Material and methods

This is a sub-study of a larger quasi-experimental and longitudinal (11 and 12 months measures are repeated at 23 and 24 months) study focused on studying the impact of a clinical nursing intervention using the Touchpoints approach on parenting and child development between the first and the second year of life. Our goal is to frame the use of this approach as a technique likely to be incorporated in nursing practice. Thus, the same sample and similar proceedings are published in other publications of this team.

2.1. Participants

Participants were 86 healthy Portuguese infants (48 first born; 46 girls; 40 boys) and their mothers (M maternal age = 30.63 years, SD = 6.40, range: 18–48). Except for two infants (one born with 34 weeks of birth age and another with 36), all were full-term and had no sensory or neuromotor disabilities.

In our study, 13 mothers (15.12%) had pregnancy risks factors associated to mothers age (older than 40 years) and six mothers (6.98%) had diabetes or other chronic illness. Only mother with any known mental health or drug/alcohol addiction problems were selected to participate.

Infants' birth weight ranged from 2060 to 4840 g (M = 3276.45, SD = 508.267) and their birth age at delivery ranged from 34 to 41 weeks (M = 38.98 weeks, SD = 1.39). APGAR scores at 5-minute ranged from 8 to 10 (M = 9.82, SD = 0.50).

The participant families were from middle-class socio-economic backgrounds according to the Graffar Social Classification (12.9% low-income, 34.9% lower middle-class, 31.4% middle-class, 11.6% upper middle-class and 9.3% upper class).

All parents were literate and > 70% complete mandatory education, 18.6% of the mothers and 26.8%of the fathers completed high school and 26.8% of the mothers and 16.3% of the fathers had obtained a college degree or higher education. The remaining 21 mothers (24.4%) and 24 fathers (27.9%) did not complete mandatory education. Unemployment affected 18 mothers.

2.2. Ethics procedures

The board Primary Health Care Center of Angra do Heroism - Azores and the scientific committee of *Instituto de Ciências Biomédicas Abel Salazar da Universidade do Porto* approved the study. This research involved several ethical procedures namely: (i) parents were informed about the study aims and methods and gave their full consent to participate; (ii) anonymity and confidentiality of the data was fully ensured; (iv) guarantee that no harm was expected to be caused to any of the participants; (v) parents were informed that they could withdraw participation at any point.

2.3. Procedures

Mother-infant dyads were recruited at the Primary Health Care Center of Angra do Heroísmo, (Azores, Portugal) by a female research that explained the purpose and procedures of the study. To determine eligibility, the researcher administered a brief interview to collect demographic information after regular consultations.

A total of 96 eligible families agreed to participate in this longitudinal study. Of these, 10 infants lost their eligibility for different reasons: death of child, death of mother, change residence, significant delay in infant development, or by dropping out of the study. The final sample comprised of 86 mother-infant dyads (Fig. 1).

2.3.1. Follow-up visit procedures

The 86 mothers and their infants participated in 2 follow-up visits. In the first visit infant development was assessed using the Schedule of Growing Skills II [31], when infant were around 11 months (M = 11 months and 10 days; SD = 5.42). Following this assessment, family variables were collected with: Family Support Scale [32], Family Needs Survey [33], and Graffar Social Classification [34].

The second appointment took place around 12 months (M = 12 months and 4 days; SD = 6.19) when mother-infant interaction was videotaped during free play according to CARE-Index protocol. [35].

2.4. Measures

2.4.1. Medical and familial demographic information

At the 11 months visit, mothers were interviewed about their infant's medical status and familial demographics. Medical and demographic factors included the infant's delivery method, APGAR score at 1 and 5-minute, birth age at delivery, birth growth measurements (weight, length, head circumference), gender, parity, health status at delivery, prenatal health care (number/frequency of medical

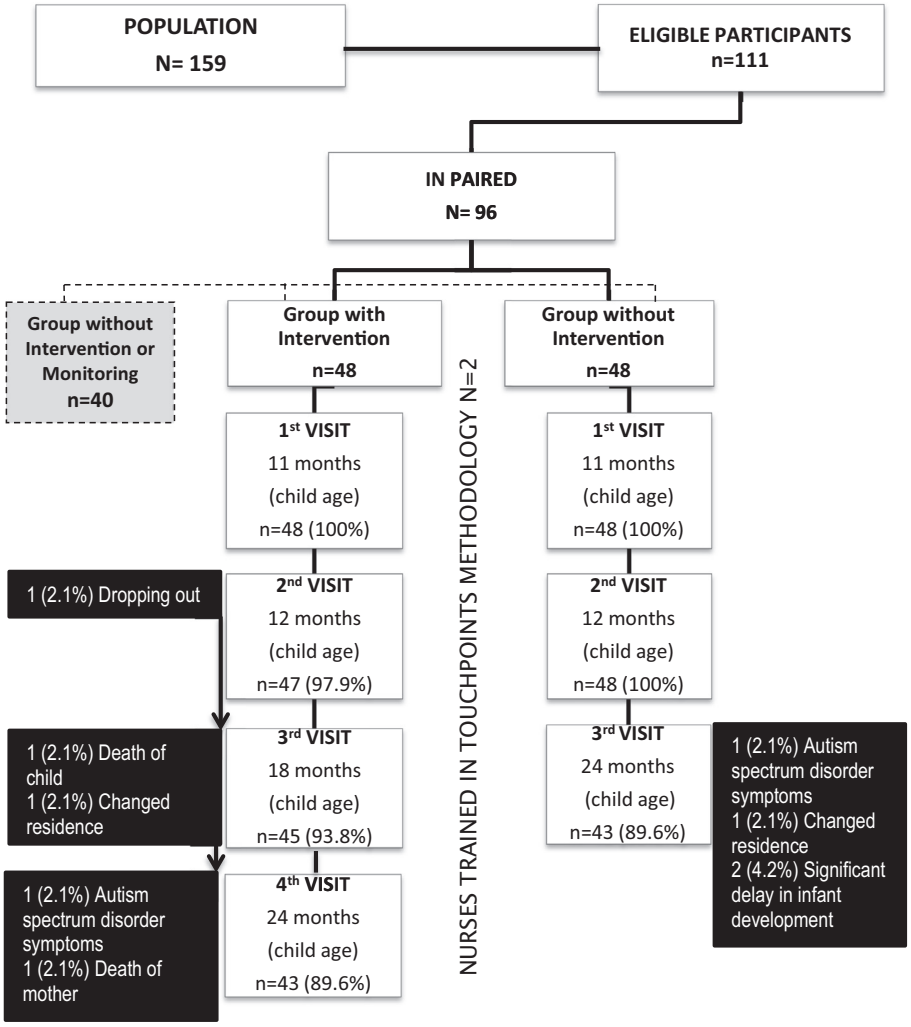

Fig. 1. Sample flowchart.

consultations), and infant health conditions (identification, frequency and severity). Mothers reported the family attendance of medical and nurse visits at Primary Health Care Center (during pregnancy and after the infant's delivery) and frequency of these visits, family socio-economic status, parents' years of completed education, age, employment status, marital status, number of siblings and infant health status during the first year of life.

2.4.2. Schedule of growing skills II

Infant development was assessed with Schedule of Growing Skills II (SGS II) at 11 months. The SGS II [31] comprises ten areas: Passive Posture, Active Posture, Locomotor, Manipulative, Visual, Hearing and Language, Speech and Language, Interactive Social, Self-care Social and Cognition. The SGS II allows us to obtain the developmental age and the coefficient of development, both in general and in each distinct area of development.

The degree of reliability and validity of the SGS II was tested with excellent scores (Cronbach, between 0.88 and 0.97, [31]).

2.4.3. Family needs survey

The needs of each family were identified using Family Needs Survey [33]. This is instrument includes seven content areas: Information, Family & Social Support, Explaining to Others, Community Services; Child Care; Financial, and Professional Support. The original instrument consists of 35 items (and space for additional topics) which family members can rate on a three point scale: do not need; not sure, and definitely need help with this. Test-retest correlations over a six-month period for total scores were reported to be 0.67 for a sample of mothers and 0.81 for fathers (Bailey et al., 1988).

2.4.4. Family socioeconomic status (SES)

To assess families' socioeconomic status (SES) the following variables were considered: income, level of education, profession, and type of home using five socio- economic layers using Graffar Social Classification ([34], validated in Portuguese samples by Amaro [36] in 1990 and revised in 2010).

2.4.5. Family support: the Family Support Scale

Family Support Scale (FSS; [32], validated in Portuguese samples by Coutinho [37] in 1999) allows families to identify and quantify their sources and social support as they rear their young children. The FSS includes family, friends, social groups and professional serve providers. FSS comprises 19 items and their score is indicated on a Likert scale of 5 points from 1 (Not at all helpful) to 5 (Extremely helpful). The degree of reliability and validity of the scale were confirmed in the study developed by Dunst et al. [32], with an internal consistency of 0.77 and a confidence level of 0.75 (coefficient of the bipartition).

2.4.6. CARE-Index

At the 12 months lab visits, mother-infant interaction was accessed in free play according to the instructions of the CARE-Index manual [35]. Each dyad played as they typically would at home for about 5 min

(3 min minimum). Mothers were asked to play with their infant with standard set of age-appropriate toys provided by researcher assistant, arranged on a blanket on the floor of the play room.

The CARE-Index assesses three dimensions of parents' interactive behavior with their infant (Sensitive, Controlling/Intrusive, and Unresponsive), and four dimensions of the infant's interactive behavior with parents (Cooperative, Compulsive-Compliant, Difficult and Passive). According to manual guidelines, the coders score parental and infant behavior independently but from a dyadic perspective (i.e., the coder scores each partner taking into account the behavior of the other).

Two trained and reliable coders scored the CARE-Index. All cases were scored independently by the two coders. All disagreements in classification were resolved in conference until reaching consensus.

To assess inter-coder reliability, a third trained coder (masked to background variables and the study's hypotheses), re-scored a subset of 20 videotapes. The intra-class correlations among the first two coders for mothers' Sensitivity and Infant Cooperative behavior were 0.94 and 0.89 respectively, and the ratings for the three coders (taking the final scores achieved by the two coders and the score of the third coder) were 0.91 and 0.86 respectively.

2.5. Analysis

A multi-step plan was used to analyze the specific aims of the study. In preliminary analyses, the normal distribution of all study variables was evaluated.

First, descriptive analyses, (means and standard deviations) for maternal sensitivity, infant cooperation and infant development (dependent variables) at 12 months, were carried out. Second, associations between maternal sensitivity and infant cooperation with infant development scores (using SGS II subscales) were evaluated using bivariate correlations. The association between dependent variables scores with demographics variables was evaluated using bivariate and univariated analyses. Finally, the independent contribution of infant, maternal, and demographic factors to infant development was evaluated using multiple regression analyses. Only variables identified as being significantly associated in the bivariate analyses were included in the multiple regression analyses. Statistical significance was defined at 0.05.

3. Results

3.1. Infant development, maternal sensitivity and infant cooperation

Using the SGS II global score, our findings indicated that the infants were 11 months of chronological age but showed a developmental level corresponding to about 12 months ($M = 7.37$, SD = 0.58), with the exception of locomotion that were approximately 11 months and the cognition that were around 10 months.

3.2. Association between maternal sensitivity, infant cooperation and infant development

Most of SGS II subscales are associated with maternal sensitivity and infant cooperation scores, except for Locomotor and Self-care social (see Table 1).

3.3. Association between infant development and demographic variables

Most SGS II subscales were positively correlated with family SES, maternal education, birth weight, APGAR at 5-minute, birth age and number of nurse visits, and were negatively correlated with the number of infant siblings (see Table 2).

Risks in pregnancy (presence or absence of factors that may affect negatively mothers health during pregnancy or intrauterine development) affected infant development, namely in: Locomotor [$t(83) = 2.310$; $p < 0.05$]; Hearing and Language [$t(83) = 3.136$; $p < 0.005$]; Self-Care Social [$t(83) = 1.859$; $p < 0.05$] and overall in Global Scores [$t(83) = 2.734$; $p < 0.005$]. Moreover, infants that were fed with bottle milk (cow's milk) against medical advice had poorer results in: Active Posture [$t(83) = 13.611$; $p < 0.001$]; Locomotor [$t(23) = 3.823$; $p < 0.001$]; Manipulative [$t(23) = 9.305$; $p < 0.001$]; Visual [$t(23) = 2.850$; $p < 0.01$]; Hearing and Language [$t(23) = 5.372$; $p < 0.001$]; Speech and Language [$t(23) = 3.735$; $p < 0.001$]; Interactive Social [$t(23) = 10.249$; $p < 0.001$]; and overall in Global Scores [$t(23) = 10.445$; $p < 0.001$].

Table 1
Pearson correlations between maternal sensitivity and infant cooperation with infant developmental scores with schedule of growing skills II.

SGS II	Maternal sensitivity	Infant cooperation
• Active Posture	0.265*	0.230*
Locomotor	0.156	0.102
• Manipulative	0.215*	0.243*
• Visual	0.408**	0.396**
• Hearing and Language	0.223*	0.198
• Speech and Language	0.285**	0.251*
• Interactive Social	0.262*	0.253*
• Self-Care Social	0.103	0.005
• Cognition	0.349**	0.241*
• Global Scores	0.377**	0.317**

** $p < 0.01$.
* $p < 0.05$.

3.4. Determinants of infant development

A multiple regression analysis was performed to identify what variables, if any, were predictive of infant development (using global scores), maternal sensitivity and infant cooperation.

All factors previously associated with infant development (global scores with SGS II) were tested simultaneously, namely: maternal sensitivity, infant cooperation with mother in free play, infant number of siblings, maternal years of formal education, birth weight, birth age, family attendance of nursing visits at Primary Health Care Center, and pregnancy health status (non-risk or at risk). Birth age and family attendance of nursing visits at Primary Health Care Center were retained as possible determinants of infant global development (Table 3).

4. Discussion

The study indicates that maternal sensitivity and infant cooperative behavior were correlated with SGS II global scores and sub-scales (except for Locomotor and Self-care Social). Also, infant development was associated with several factors like maternal years of education, number of siblings, birth weight, or risks in pregnancy. It is worth mentioning that only the number of nurse visits attended by parents during the infant first year and birth age were determinants of infant development.

As expected, better infant developmental outcomes are more likely in dyads with higher maternal sensitivity and infant cooperation. In this one trial study, a positive determinant link was found between infant development (Passive Posture, Active Posture, Manipulative, Visual, Hearing and Language, Speech and Language, Interactive Social and Cognition and taking SGS II global scores) and maternal sensitivity. It is interesting that maternal sensitivity was not only associated with global scores but with all specific areas of development. According to the Care-index [35], assessment, maternal sensitivity is defined in terms of the mother effect in infant, namely: maternal ability to engage in reciprocal turn-taking interactions (that may promote *infant participation*); maternal ability to wait for infant actions and to support their effort to play and explore their environment (possible promoting *infant autonomy and*

Table 2
Pearson correlations between infant developmental scores with schedule of growing skills II and infant or family factors.

SGS II	SES	Number of siblings	Birth weight	Gestational age	APGAR	Number of nursing visits	Maternal education
Active posture	0.201	−0.249*	0.195	0.249*	0.108	0.112	259*
Locomotor	0.155	−0.254*	0.120	0.316**	0.160	0.324**	282*
Manipulative	0.064	−0.184	0.233*	0.335**	−0.072	0.136	0.060
Visual	0.179	−0.338**	0.060	0.308*	0.072	0.155	0.156
Hearing and Language	0.158	0.047	0.294**	0.202	0.016	0.154	0.148
Speech and Language	−0.003	−0.033	0.107	0.158	0.220*	0.220*	0.007
Interactive social	0.131	−0.264*	0.065	0.258*	0.237*	0.102	0.098
Self-care social	−0.005	−0.051	0.120	0.193	−0.002	0.232*	−0.078
Cognition	0.206*	−0.177	0.125	0.343**	0.049	−0.177	0.148
Global score	0.192	−0.282**	0.206*	0.397**	0.145	0.271*	0.207*

** $p < 0.01$.
* $p < 0.05$.

safe exploration); and maternal positive affectivity and communication with their infant (likely to inform infant about interactions and about their role in those interactions). Such aspects of maternal behavior possibly involve infants in a positive atmosphere for exploration and learning.

In our study, a range of factors besides maternal sensitivity were positively associated or related with infant development, namely: birth age, birth weight and health status.

This finding is not surprising, as it has been described elsewhere (e.g., [38,51]). Nevertheless, it is worth mentioning that, in Portugal, nursing interventions included education and nutritional adaptations information during the first year of life. Several studies found that the attention directed to parents/caregivers by nurses throughout the adaptation and exercise of parenting process focuses on orientation and anticipatory support of the parental role in facilitating and promoting child development [39]. Different themes are addressed, among which stand out feeding/breastfeeding, immunization, hygiene, sleep and rest, play, discipline, safety, and affection.

Another key result is the association between parents attending nurse visits during pregnancy and infant development. Based on our findings we may assume that having monthly appointments with health professionals (particularly nurses) and psychologists, can indeed help parents to prepare them for future parenting, answering their questions, and offering advisement. This can be reassuring for parents and may promote more positive parental attitudes and believes [40]. Yet, most of the success of nursing interventions is influenced by the quality of the relationship established between the nurse and the dyad child-family (e.g., [26,41]).

Considering that both maternal sensitivity and infant cooperation were associated with infant development, we decided to investigate which factors influenced mothers and infants' interactive behavior; SES was a major influence. Moreover, longitudinal studies have shown that there is a negative and persistent effect of low SES on infants' social, emotional, and cognitive development (e.g., [42]). In our study, SES directly affected the dyadic interactive behavior. In turn, the parent-infant interactive behavior affected infant development. Thus, SES may affect multiple aspects of families' lives by affecting their jobs stability, life conditions, health services access, and others which have an impact on infant development and parent's sensitivity, being, therefore, necessary to take into consideration and to prevent. We suggest that social government policies should be based on a multidimensional and integrated approach that privileges the provision of social care to families with young children through partnerships with local community leaders and other essential services that may constitute a supportive network for families. Several professionals (e.g. health, psychology, education, social) in early childhood interventions services may play an important role in the early identification of family's needs, resources and strengths, ensuring that families have the necessary resources: to satisfy their basic needs, to support their children development and to engage in positive interactions [43]. In support of this suggestion, our study indicates that family's needs and concerns with child care, finances, and community services were related with mother-infant quality of interaction.

From all variables studied only few predictive factors of infant development, maternal sensitivity and infant cooperation were found and retained in multiple regressions analyses (Fig. 2).

Indeed, infant development was predicted by health services (e.g., family attendance of nurse visits at Primary Health Care Center) and infant neonatal status (e.g., birth age).

The results for predictive factors were somewhat unexpected. Generally, birth age is presented as a possible risk factor for infant development and parent-infant relationships in prematurely born infants (e.g., [13,15,44]) but not for full-term infants. One possible explanation is that, although birth age in full-term samples is not a risk factor per se, it is in the presence of other social and family risk factors, like low maternal education as in our sample (e.g., [45–47]).

4.1. Strengths, limitations and directions for further research

To the very best of our knowledge, this is the first study evaluating the relation between of maternal sensitivity and infant development in a Portuguese Sample. The study is original in finding that the number of

Table 3
Predictors of infant development, maternal sensitivity and infant cooperation.

Model	Un-standardized coefficients		Standardized coefficients			95% Confidence interval for B	
	B	*Std. Error*	*Beta*	*t*	*P <*	Lower bound	Upper bound
Infant global scores in SGS II (Constant)	3.243	1.638		1.98	0.05	−0.019	6.505
- Family attendance of nursing visits at	0.030	0.0122	0.241	2.43	0.05	0.005	0.055
- Gestational age	0.098	0.0466	0.236	2.14	0.05	0.007	0.189
- Number of siblings	−0.070	0.0633	−0.116	−1.10	ns	−0.195	0.056
- Maternal Sensitivity	0.052	0.0511	0.222	1.03	ns	−0.049	0.153
- Gestational weight	0.000	0.0000	0.042	0.41	ns	0.000	0.000
- Maternal years of formal education	0.004	0.0155	0.026	0.24	ns	−0.027	0.034

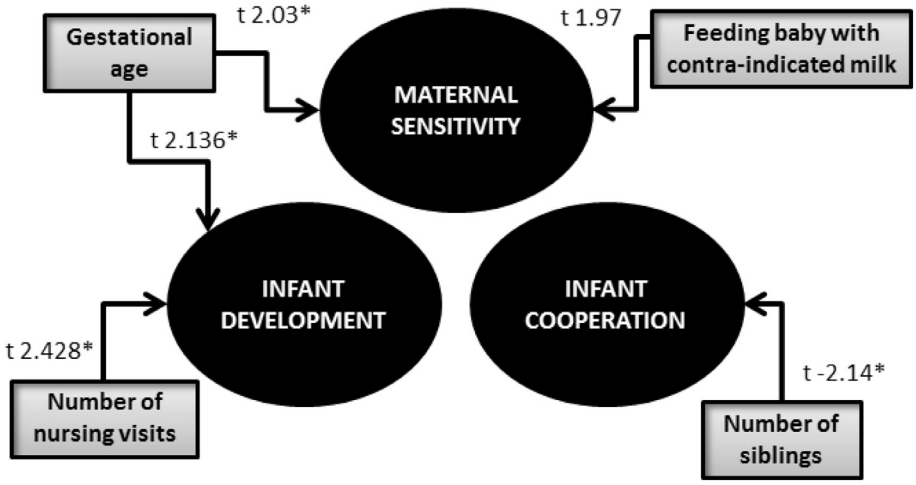

Fig. 2. Predictive factors of infant development, maternal sensitivity and infant cooperation.

nurse visits attended by parents during the infant first year was determinant for infant development.

Nonetheless, the study has some limitations. Firstly, the study consisted of one single trial, and more trials, with infants of different ages, could have helped to test the results obtained. Secondly, we tried to collect a sample that represented the Portuguese Azores society in terms of maternal education, family SES, religious and ethnic groups. This is simultaneously a limitation, as findings cannot be generalized, and a strength of our study, as it included variables with respect to the child, the family and the context on a multilevel approach of infant development. Given the uniqueness of this culture and the risk of outermost regions being left out of relevant research, we trust that this piece of work provides a culturally sensitive contribution to the research on infant early development and parenting.

5. Conclusion

We contribute to the body of knowledge that indicates that maternal sensitivity affects infant development. Infant development was associated with several factors like maternal years of education, number of siblings, birth weight or risks in pregnancy indicating that human development is complex process depend of contextual factors and multitransitions. Supporting the thesis that early intervention services are necessary to support families in enhancing children health and development, the number of nurse visits attended by parents during the infant first year and birth age were determinants of infant development.

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