ORIGINAL ARTICLE

Inattention symptoms in early pregnancy predict parenting skills and infant maltreatment during the first year of life

Jordana Verano de **Oliveira**,[1] iD Daniel **Fatori**,[1] iD Elizabeth **Shephard**,[1,2] iD Mauro **Xavier Neto**,[3] Alicia **Matijasevich**,[4] Alexandre Archanjo **Ferraro**,[5] Luis Augusto **Rohde**,[6,7] Anna Maria **Chiesa**,[8] Euripedes Constantino **Miguel**,[1] Guilherme V. **Polanczyk**[1] iD

[1]Departamento de Psiquiatria, Faculdade de Medicina da Universidade de São Paulo (FMUSP), São Paulo, SP, Brazil. [2]Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, UK. [3]FMUSP, São Paulo, SP, Brazil. [4]Departamento de Medicina Preventiva, FMUSP, São Paulo, SP, Brazil. [5]Departamento de Pediatria, FMUSP, São Paulo, SP, Brazil. [6]Serviço de Psiquiatria da Infância e da Adolescência, Hospital de Clínicas de Porto Alegre, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil. [7]Instituto Nacional de Psiquiatria do Desenvolvimento para Crianças e Adolescentes, São Paulo, SP, Brazil. [8]Escola de Enfermagem, Universidade de São Paulo (USP), São Paulo, SP, Brazil.

Objective: Maternal attention-deficit/hyperactivity disorder has not been investigated in relation to parenting skills in adolescent mothers. This study investigated whether maternal inattention and hyperactivity/impulsivity symptoms early in pregnancy predict poorer parenting skills and infant maltreatment during the first year of life in adolescent mothers living in adverse environmental conditions.
Methods: The participants in this study were 80 adolescent mothers aged 14-19 years and their babies who were taking part in a randomized controlled trial on the effects of a home-visiting program on infant development. Symptoms of maternal attention-deficit/hyperactivity disorder were assessed in the first trimester of pregnancy. Parenting skills (maternal competence, attachment to the baby, home environment) and child maltreatment were assessed when the infants were aged 6 and 12 months. Multilevel linear regression models were constructed to test the extent to which prenatal maternal inattention and hyperactivity/impulsivity symptoms predicted these parenting variables during the first year of the infant's life.
Results: Prenatal inattention symptoms significantly predicted lower maternal competence and attachment, a poorer home environment, and greater maltreatment during the first year of life. Hyperactivity did not significantly predict parenting skills or maltreatment.
Conclusions: Our findings suggest that inattention symptoms may interfere with parenting abilities in adolescent mothers and should be considered in early intervention programs.

Keywords: Attention-deficit/hyperactivity disorder; mother-child relations; parenting; social vulnerability; child maltreatment

Introduction

A considerable proportion of women become pregnant and give birth during their teenage years, particularly in developing countries.[1] Adolescent motherhood is associated with living in impoverished environments,[2] increased maternal mental health problems, including depression and attention-deficit/hyperactivity disorder (ADHD),[3] and poor long-term educational and socioeconomic outcomes.[4] In addition, the children of adolescent mothers often show impairment in cognitive, motor, socioemotional, and behavioral development,[5] which may in part be mediated by their mothers' parenting skills.

Parenting can be defined as the set of knowledge, attitudes, and practices used by parents or caregivers to raise children and prepare them for their future lives in society.[6] Parenting directly influences very early childhood experiences, playing a crucial role in development throughout life; it consists of various emotional and behavioral dimensions, such as involvement, competence, attachment, organization of a stimulating home environment for the child, and disciplinary practices. It is also influenced by a number of variables, including personal factors (prior experience of being parented, exposure to adversities, psychopathology), child characteristics (sex, temperament, health), and the environment, including

both proximal (marital relationship, family, and social support) and distal (public policies that support parenting) environmental factors.[6-8] These parenting skills have been reported to be impaired in adolescent mothers,[9] who tend to be less responsive and show less involvement with their infants than adult mothers[10,11] and tend to display more negative discipline,[12] such as irritability, harshness, and being more controlling.[9] However, the specific factors that contribute to impaired parenting skills in adolescent mothers are not yet clear.

One factor that is known to influence parenting skills is maternal psychopathology, especially when occurring early in pregnancy and during the first years of the baby's life.[13] Previous studies have shown that maternal depression affects maternal sense of competence,[14] attachment to the child,[15] organization of the domestic environment,[16] and the occurrence of child abuse.[17] These effects also occur in samples of adolescent mothers.[18-21]

One form of maternal psychopathology that has not been investigated in relation to parenting skills in adolescent mothers is ADHD. ADHD is a common neurodevelopmental condition with a worldwide prevalence of ∼ 5%.[22] The condition is characterized by persistent, developmentally inappropriate, and impairing symptoms of inattention, hyperactivity and impulsivity.[23] ADHD is typically diagnosed in the school-age years[24] and persists into adulthood in approximately 25% of individuals.[25] Three subtypes of ADHD are defined clinically: combined type (both inattention and hyperactive/impulsive symptoms); predominantly inattentive type (symptoms of inattention but not hyperactivity/impulsivity); and predominantly hyperactive/impulsive (symptoms of hyperactivity/impulsivity but not inattention).[23] In addition to core symptoms, individuals with ADHD often experience impairments in executive function, such as inhibitory control and working memory.[26]

Work in adult mothers indicates that ADHD symptoms can have a negative impact on parenting. For instance, Babinski et al.[27] found that mothers of adolescents with ADHD who were also affected by the disorder were less involved with their children, knew less about their children's routines, and adopted more inconsistent disciplinary practices compared to mothers without ADHD. ADHD symptoms are also associated with high levels of home chaos, an independent risk factor for impaired child development.[28] ADHD symptoms may negatively impact the household environment in terms of disorganized routines, instability or lack of resources, and positive stimulation, increased noise, inconsistent rules, crowding, and more interference in maternal responsiveness. Importantly, chaos in the household seems to mediate the relationship between maternal ADHD symptoms and aggressive behavior in preschool children[29] and between maternal ADHD symptoms and poorer parenting practices, such as inconsistent discipline and unsupportive responses to children's negative emotions.[30] Besides chaos, maternal ADHD may contribute to other negative parenting practices, such as violence. In fact, maternal ADHD symptoms have been found to be associated with overly rigid responses to the expression of negative emotions by teenagers.[31] In a unique study investigating the relationship between ADHD in adult parents and physical violence against the child, Tachibana et al.[32] followed mother-infant dyads from gestation to 4 months after delivery. They found that postpartum maternal ADHD symptoms predicted child abuse at 4 months. However, other factors that influence parenting were not assessed, such as child characteristics, and the presence of depression and anxiety.[32]

Because the relationship between maternal ADHD and parenting is likely to be complex, it is important to consider the influence of other factors. First, other mental disorders, such as depression and substance use, may co-occur with ADHD and are likely to contribute to negative parenting practices.[13,33,34] Second, it is necessary to consider that child characteristics can influence the relationship with the mother and her parenting practices. For example, difficult child behaviors can trigger dysfunctional behaviors in parents. This aspect becomes relevant in the context of maternal ADHD, since mothers with high levels of inattention and hyperactivity/impulsivity have a high chance of having children with the disorder.[35] Infants with a higher likelihood of ADHD also show behavioral difficulties, including hyperactivity and difficult temperament, in the first months of life.[36] Inattentive, hyperactive, and impulsive behaviors in the child often negatively impact parenting practices, regardless of parental symptom severity.[37,38] Third, inattention and hyperactivity-impulsivity may affect parenting differently.[39-43] Supporting this, Farbiash et al.[29] reported associations between maternal and paternal inattention and aggression levels in their preschool children, while maternal and paternal hyperactivity symptoms were not associated with aggression levels in children.

Considering the range of negative effects of maternal ADHD on parenting skills in adult mothers, it is likely that the high rate of ADHD symptoms in adolescent mothers contributes to parenting difficulties in this population. A better understanding of the relationship between ADHD symptoms and parenting skills in these young mothers will be crucial for the design and implementation of appropriately targeted interventions to support the development of their parenting practices. Thus, the first aim of this study was to investigate how maternal ADHD symptoms measured early in pregnancy affect adolescent mothers' parenting skills and infant maltreatment rates during the first postnatal year. The second aim of this study was to investigate whether maternal depression, substance abuse, child temperament, and inattentive vs. hyperactive/impulsive ADHD domains influence the relationship between adolescent mothers' prenatal ADHD symptoms and postnatal parenting abilities and infant maltreatment. We hypothesized that ADHD symptoms in adolescent mothers during pregnancy would be associated with a lower sense of competence and attachment to the child, poorer organization of the domestic environment, and a higher frequency of child maltreatment. We also predicted that maternal depression, substance abuse, and difficult child temperament would exacerbate the negative impact of maternal ADHD symptoms on parenting and child maltreatment.

Methods

Participants and study setting

The participants in this study were 80 pregnant adolescents who were taking part in a randomized controlled trial (clinicaltrials.gov: NCT02807818) designed to test the efficacy of a home visiting program (Primeiros Laços) for improving maternal care and promoting better child development among adolescent mothers living in poverty in Brazil. Pregnant adolescents were recruited from primary care units in the western region of São Paulo, Brazil, a region that is quite poor. The inclusion criteria were: age between 14 and 19 years, first pregnancy, between 8-16 weeks of gestation, residence in western São Paulo, and low socioeconomic classes (C, D, and E according to the Brazilian Criteria for Economic Classification [Critério de Classificação Econômica Brasil]).[44] The exclusion criteria were: a mental, visual, or hearing disorder that could interfere with participation in the study, a chronic disease associated with fetal development problems, and high-risk pregnancy. Participants were randomized to receive Primeiros Laços (n=40) or care as usual (n=40). Primeiros Laços is a nurse home visitation program for pregnant youth developed by our team based on bioecological,[45] self-efficacy,[46] and attachment theories.[47] Primeiros Laços was designed to improve the following domains: 1) child and maternal physical health – providing information about nutrition, hygiene, domestic care, common childhood diseases, immunization, accident prevention, and child development; 2) domestic and community environmental health – helping identify resources to ensure adequate living conditions, such as safe housing, access to kindergartens, schools, and health services; 3) life course – helping participants achieve personal goals, such as finishing high school, finding a job, planning the birth of further children, accessing social benefits; 4) parenting skills – promoting sensitive and responsive maternal care; 5) social support network mapping – encouraging family and friends to help with parenting functions. Nurse home visits began between the 8th and 16th week of gestation and continued until the infants reached 24 months of age. The program was designed for each mother-baby dyad to receive between 60 and 64 visits. The visits occurred weekly or biweekly by trained nurses, who received weekly supervision by the program developers. Adolescent mothers in the usual care group received the normal prenatal and child care offered by the National Health System (Sistema Único de Saúde, SUS).[48-50]

In the current report, we conducted analyses on the entire sample (n=80) of adolescent mothers while adjusting for group; the effects of the intervention are reported elsewhere.[51,52] The sample's characteristics are shown in Table 1. The mean age at baseline was 17.1 years (standard deviation [SD] = 1.2). The participants' socioeconomic status was low, they were living under adverse conditions, and had low education levels: 15% had completed less than 5 years of school, less than half (43.8 %) were currently attending school, 37.5% belonged to socioeconomic classes C and D (very poor), 17.5% had

a household income of less than 250 USD per month, and 26.3% were receiving some form of social benefits. In addition, 22.5% of the adolescents' own mothers were illiterate and nearly half (46.3%) had completed less than 5 years of school.

Measures

For the current analyses, we used measures administered at three time-points: baseline (8-16 weeks of gestation), 6 months after birth, and 12 months after birth. Evaluations took place at our community-based research center or, for assessments requiring direct observation of the domestic environment, at the mothers' homes. The participants were assessed by blinded trained psychologists who underwent 1 month of training about all measures used in our study and who pilot-tested the assessment protocol prior to beginning the clinical trial.[6,7]

Maternal psychopathology

ADHD symptoms were assessed using the Brazilian Portuguese version of the Adult Self-Report Scale (ASRS-v 1.1) Symptom Checklist.[53,54] The ASRS was developed by the World Health Organization to screen for ADHD symptoms in adults.[55] The Brazilian version was validated in a sample of 60 outpatients seen in adult ADHD programs at two major academic centers. It consists of 18 questions based on DSM-IV criteria for ADHD. The first nine assess inattention, while the last nine assess hyperactivity/impulsivity. Respondents rate the frequency of each symptom, resulting in total scores ranging from 0 to 72, which consist of an inattention score (0 to 36) and a hyperactivity/impulsivity score (0 to 36). The ASRS has a sensitivity of 56.3%, a specificity of 98.3%, a total classification accuracy of 96.2%, and a kappa of 0.58.[8] Total scores > 24 points are suggestive of ADHD.[9] A total of 48.8% of mothers scored > 24.[24] The sample's mean score for this instrument was 12, which was expected since this was not a clinical sample.

The ASRS was administered to the mothers in interview format by trained psychologists during the first trimester of pregnancy (at baseline). The inattention and hyperactivity/impulsivity scores were used in the analyses. The mothers were also asked about methylphenidate use previously in life, during pregnancy, or when the child was 6 or 12 months of age. None reported having used this medication.

Depression symptoms were assessed with the Brazilian Portuguese version of the Beck Depression Inventory,[49-51] a 21-item scale that assesses the presence and severity of depression symptoms in the last 2 weeks. Scores range from 0-63, with higher scores indicating more severe depression symptoms. The scores have a high correlation with clinical depression (r = 0.72), as well as adequate internal consistency in clinical (α = 0.86) and community (α = 0.81) samples.[56-58] The Beck Depression Inventory was administered to the mothers in interview format by trained psychologists during pregnancy and again at 6 and 12 months after birth.

We assessed alcohol and marijuana use by asking about the frequency of use in the period between each set of assessments, defined as weekly or less than weekly use. The participants answered questions about substance use at 6 and 12 months after delivery. Depression symptoms and substance use were measured jointly with the parenting assessments, rather than during the prenatal period. According to the literature, the immediate impact of these maternal psychopathologies on parenting is more significant and clearer than ADHD.[13,59,60] This is because these diseases are episodic, with periods of remission. In contrast, the clinical presentation of ADHD tends to be more stable.[61]

Parenting skills

We evaluated the mothers' perception of their competence and ability to bond with their infant, the adequacy of the home environment for child rearing, and disciplinary practices related to child maltreatment. All parenting dimensions were assessed at 6 and 12 months after birth using the instruments described below.

Maternal stress related to competence and attachment: the Parent Stress Index-IV[62] was administered to the mothers in interview format by trained psychologists. The Competence and Attachment subscale scores were used in the analysis to determine the level of maternal stress related to competence and attachment, respectively. Items in the competence subscale assess how much the mother considers herself unable to take proper care of her baby. Thus, it actually measures the opposite of maternal competence.[63] Items in the attachment subscale assess the mother's difficulty in achieving a sense of closeness with her child and to observe, understand, and respond appropriately to the child's needs. Scores on these scales range from 11-55 and 7-35, respectively, with higher scores indicating higher maternal stress related to competence and attachment. While the PSI has other subscales, only Competence and Attachment relate directly to the parenting abilities involved in our hypotheses.

Home environment: the Home Observation and Measurement of the Environment inventory (HOME)[16] was applied at the participants' residences. This direct observation instrument was designed to measure the quality of the home environment and mother-child interaction. We used the initial version of the inventory (Infant/Toddler HOME),[16,64-66] which consists of 45 items divided into the following subscales: I) Emotional and Verbal Responsiveness of the Mother; II) Acceptance of the Child; III) Organization of the Environment; IV) Learning Materials; V) Maternal Involvement with the Child; and VI) Variety in Experience. Scores range from 0-45, with higher scores reflecting a more favorable home environment for child development. Each HOME assessment was coded by one interviewer blinded to group allocation.

Maltreatment

Adolescent mothers responded to the Brazilian Portuguese version of the Parent-Child Conflict Tactics Scales,[67-69] which was administered in interview format by trained psychologists. The Parent-Child Conflict Tactics Scales measures child physical and psychological abuse and neglect by parents. It consists of 17 items describing the frequency of aggressive behaviors in the last year. Scores range from 0-34, with higher scores indicating higher levels of maltreatment. The original and Brazilian Portuguese versions of the scale have shown adequate indices of internal consistency and construct validity.[67,69] The Parent-Child Conflict Tactics Scales has been used in previous studies with infants as young as one month old.[70]

Infant temperament

Infant temperament was assessed using the Infant Behavior Questionnaire-Revised (Gartstein & Rothbart[11]). The questionnaire consists of 91 items describing infant behavior. The items are averaged to yield 14 temperament dimensions, which can be combined into three temperament factors: positive emotionality/surgency, negative affectivity, and orienting/regulation.[71] Higher positive emotionality/surgency scores reflect more positive behaviors (rapid approach/excitement toward pleasurable activities, pleasure in anticipating activities, smiling and laughter). Higher negative affectivity scores reflect greater negative emotions (fear, sadness, distress). Higher orienting/regulation scores reflect better attentional and regulatory abilities (longer attention span/better orientation to objects, greater soothability). This questionnaire was administered to the mothers 6 and 12 months after birth in interview format by trained psychologists.

Statistical analysis

We used multilevel linear regression for longitudinal data to assess the effects of maternal inattention and hyperactive-impulsive symptoms and covariates (intervention or usual care group, maternal depression symptoms, maternal use of alcohol and marijuana [binary variables], and infant temperament factors) on parenting skills and infant maltreatment. For each outcome variable (maternal competence and attachment, home environment, and maltreatment), we first fitted a random intercept regression model to calculate the initial intraclass correlation (ICC). The initial ICC estimate indicates the percentage of variance in the outcome variable that can be explained by predictor variables (in this study, maternal inattention and hyperactive-impulsive symptoms, and covariates). A separate model was used for each outcome measure (nine in total). Maternal depression symptoms, alcohol and marijuana use, and infant temperament could assume different values (time variant) at each timepoint (6 and 12 months), while other variables assumed fixed values (time invariant) for each participant (intervention group and maternal ADHD symptoms). Next, using the backward stepwise method, variables with the highest p-value were excluded from the model at each step. We repeated this procedure until only variables that significantly predicted outcome variables ($p < 0.05$) remained in the model. We included the intervention group in all models, regardless of p-value. Sociodemographic variables were not included as covariates in the models because our

sample was homogeneous in terms of low socioeconomic status and education level.

We calculated the residual ICC of the final model, which represents the percentage of variance in the outcome variable that can be explained by predictor variables with p < 0.05. Thus, the model's residual ICC is always lower than its initial ICC, and the difference between initial and residual ICC indicates the proportion of variance that the remaining variables can explain. Additionally, this difference presents a clearer idea of how much maternal inattention and hyperactive-impulsive symptoms influence the main outcomes. We assumed that variables with p < 0.05 in the final models were statistically significant predictors. Pearson correlation coefficients between variables in 6- and 12-month infants are presented in the online-only supplementary material.

Data were collected via REDCap, an electronic tool for research data management and storage.[72] Statistical analyses were performed with STATA (version 13.0), using the meglm command. The maximum likelihood estimation method was used to account for missing data, and default model specifications for multilevel linear regressions (Gaussian family, identity link, and the mvaghermite integration method with seven integration points). For all regression coefficients, 95% confidence intervals (95%CI) are reported. Data were assumed to approximate normal distribution, considering the central limit theorem.[73]

Ethics statement

Adolescents wishing to participate provided written informed consent; if they were under 18 years of age, their legal guardians also signed the consent form. The study was approved by the ethical review boards of Faculdade de Medicina, Universidade de São Paulo (ref: 052/15), and the Secretaria Municipal de Saúde de São Paulo.

This study has been approved by the appropriate ethics committee and was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments.

Results

Sample characteristics: maternal psychopathology

Means and SD for maternal psychopathology are summarized in Table 1. Briefly, mean scores for prenatal inattention and hyperactivity/impulsivity symptoms were 12.0 and 12.4, respectively. The mean Beck Depression Inventory score was 12.3 during pregnancy, and 8.7 at 6 and 12 months after birth (Table 1). At baseline, 38.8 and 17.5% of the sample reported weekly use of alcohol or marijuana, respectively, at some point in life. The frequency of use of these substances in the last 6 and 12 months, however, was much lower (4.3 and 6.2%, respectively, for alcohol, and 1.5 and 1.6%, respectively, for marijuana). There were no differences in inattention symptoms (t = -0.42; p = 0.677), hyperactivity/impulsivity symptoms (t = -0.28; p = 0.782), and total ASRS scores (t = -0.39; p = 0.699) between the intervention and control groups at baseline.

Prediction of parenting skills and infant maltreatment

Maternal competence

The final regression model (Table 2) indicated that maternal inattention (β = 0.36, 95%CI 0.16-0.57, p = 0.001) and hyperactivity (β = -0.19, 95%CI -0.35 to -0.02, p = 0.029) symptoms in the first trimester of pregnancy, as well as postnatal maternal depression symptoms (β = 0.14, 95%CI 0.01-0.27, p = 0.036), significantly predicted maternal stress related to competence at 6 and 12 months after birth. Higher levels of inattention and depressive symptoms predicted a lower sense of maternal competence, while higher levels of hyperactivity symptoms predicted better competence. Substance use and child temperament did not predict sense of maternal competence. The residual ICC for this model was 0.50 (SD = 0.10, 95%CI 0.30-0.69).

Attachment

The final model for maternal stress related to attachment showed that prenatal symptoms of maternal inattention and hyperactivity were the only significant predictors of poorer maternal attachment ratings at 6 and 12 months after birth (Table 2). Higher inattention symptoms predicted higher maternal stress levels related to attachment to the child (β = 0.18, 95%CI 0.05-0.32; p = 0.008). In contrast, higher maternal hyperactivity symptoms were predictive of lower attachment-related stress (β = -0.13, 95%CI -0.24 to -0.02; p = 0.026). The model's residual ICC was 0.48 (SD = 0.11, 95%CI 0.28-0.69).

Maltreatment

Maternal inattention symptoms were the only significant predictor of the frequency of infant maltreatment (Table 2). Inattention levels predicted a higher frequency of infant maltreatment (β = 0.17, 95%CI 0.07-0.26; p = 0.001; residual ICC = 0.11, SD = 0.12, 95%CI 0.01-0.59).

Home environment

Total raw HOME inventory scores ranged from 16 to 41. The mean scores at 6 and 12 months after birth were 31.17 (SD = 4.41) and 32.76 (SD = 5.63), respectively. Higher maternal inattention symptoms significantly predicted lower scores for the "maternal involvement" (β = -0.04, 95%CI = -0.08-0.01; p = 0.024; residual ICC = 0.07, SD = 0.14, 95%CI 0.00-0.82) and "opportunity for variation in daily stimulation" (β = -0.04, 95%CI -0.07-0.01; p = 0.009; residual ICC = 0.34, SD = 0.12, 95%CI 0.15-0.59) HOME inventory subscales (Table 3). Thus, higher levels of prenatal maternal inattention predicted lower involvement with the baby and poorer ability to provide the baby with a variety of experiences at 6 and 12 months after birth. Although inattention symptoms had a similar effect on total HOME scores, it was not significant (β = -0.15, 95%CI = -0.30-0.00; p = 0.053). Inattention symptoms did not have a significant effect on the other HOME subscales (Table 3). Hyperactivity symptoms did not predict HOME inventory scores, nor did any of the covariates (Table 3).

Table 1 Maternal demographic characteristics and mental health problems stratified by intervention and control group

	Baseline[†]	6 months	12 months
Age, mean (SD)	17.1 (1.2)		
Control	17.9 (0.3)		
Intervention	17.5 (0.2)		
Education level			
Illiterate	1 (1.3)		
Control	1 (2.5)		
Intervention	0 (0.0)		
Some elementary	11 (13.8)		
Control	3 (7.5)		
Intervention	8 (20.0)		
Primary – complete	60 (75.0)		
Control	32 (80.0)		
Intervention	28 (70.0)		
Secondary – complete	8 (10.0)		
Control	4 (10.0)		
Intervention	4 (10.0)		
Still in school	35 (43.8)		
Control	19 (47.5)		
Intervention	16 (40.0)		
Maternal grandmother's education level			
Illiterate	18 (22.5)		
Control	9 (22.5)		
Intervention	9 (22.5)		
Some primary	19 (23.8)		
Control	12 (30.0)		
Intervention	7 (17.5)		
Primary – complete	17 (21.3)		
Control	6 (15.0)		
Intervention	11 (27.5)		
Secondary – complete	23 (28.8)		
Control	11 (27.5)		
Intervention	12 (30.0)		
Higher education	3 (3.8)		
Control	2 (5.0)		
Intervention	1 (2.5)		
Monthly family income (USD)			
0-250	14 (17.5)		
Control	16 (40.0)		
Intervention	15 (37.5)		
⩾ 250	59 (73.8)		
Control	21 (52.5)		
Intervention	21 (52.5)		
Unknown	7 (8.8)		
Control	3 (7.5)		
Intervention	4 (10.0)		
Family SES, very poor (class D, E)	30 (37.5)		
Control	7 (17.5)		
Intervention	8 (20.0)		
Access to social benefits	21 (26.3)		
Control	6 (15.0)		
Intervention	9 (22.5)		
ASRS, mean (SD)			
Total score	24.4 (11.5)		
Control	23.9 (1.5)		
Intervention	24.9 (2.1)		
Inattention score	12.0 (6.1)		
Control	11.7 (0.8)		
Intervention	12.3 (1.1)		

Table 1 (*continued*)

	Baseline[†]	6 months	12 months
Hyperactivity score	12.4 (6.8)		
Control	12.2 (1.0)		
Intervention	12.6 (1.2)		
BDI – total score, mean (SD)	12.3 (7.9)	8.7 (7.8)	8.7 (6.6)
Control	11.7 (7.1)	8.4 (7.3)	8.7 (6.7)
Intervention	13.0 (8.7)	8.6 (8.1)	8.6 (6.7)
Alcohol use – lifetime[†]	31 (38.8)		
Control	12 (30.0)		
Intervention	19 (47.5)		
Marijuana use – lifetime[†]	14 (17.5)		
Control	6 (15.0)		
Intervention	8 (20.0)		
Alcohol use[‡]		3 (4.3)	4 (6.2)
Control		1 (2.9)	3 (8.8)
Intervention		2 (5.9)	1 (3.2)
Marijuana use[‡]		1 (1.5)	1 (1.6)
Control		1 (2.9)	1 (3.1)
Intervention		0 (0.0)	0 (0.0)

Data presented as n (%), unless otherwise specified.
ASRS = Adult Self-Report Scale; BDI = Beck Depression Inventory; SD = standard deviation; SES = socioeconomic status.
[†] At least once a week for some period of time.
[‡] At least once a week.

After applying a Bonferroni correction for multiple comparisons (i.e., the nine statistical comparisons), only the effects of inattention on Competence and Maltreatment remained significant.

Discussion

In our sample, maternal inattention symptoms occurring early in pregnancy negatively impacted several parenting abilities of adolescent mothers measured in the first postnatal year. These included the mothers' sense of maternal competence, attachment and involvement with the baby, maltreatment rates, and organization of the home environment. These associations were present regardless of the effect of maternal depression symptoms, alcohol and marijuana use, and infant temperament. To our knowledge, this is the first study to investigate how maternal ADHD symptoms affect parenting abilities and maltreatment rates in vulnerable teenage mothers. Our findings indicate the crucial importance of assessing and treating ADHD symptoms in this population. The most consistent scientific evidence currently suggests the use of medications (mainly psychostimulants) and behavioral therapy to treat ADHD.[74]

Our findings may be relevant for understanding the effects of maternal ADHD symptoms on parenting abilities more generally. Specifically, although more studies are investigating the impact of ADHD symptoms on parenting, few have investigated the impact of inattention and hyperactivity/impulsivity dimensions separately.[37] Our results suggest that maternal inattention symptoms have

Table 2 Initial and final regression models identifying the best longitudinal models for dimensions of maternal care

Independent variables	I Stress related to maternal competence				II Stress related to attachment				III Child maltreatment			
	Initial		Final		Initial		Final		Initial		Final	
	Coefficient (95%CI)	p-value	Coefficient (95%CI)	p-value	Coefficient (95%CI)	p-value	Coefficient (95%CI)	p-value	Coefficient (95%CI)	p-value	Coefficient (95%CI)	p-value
Mother												
ASRS – Inattention score	0.38 (0.17-0.59)	**<0.001**	0.36 (0.16-0.57)	**0.001**	0.18 (0.04-0.32)	**0.011**	0.18 (0.05-0.32)	**0.008**	0.14 (0.03-0.25)	**0.017**	0.17 (0.07-0.26)	**0.001**
ASRS – Hyperactivity score	-0.13 (-0.30-0.04)	0.136	-0.19 (-0.35 to -0.02)	**0.029**	-0.12 (-0.24 to 0.01)	**0.034**	-0.13 (-0.24-0.02)	**0.026**	-0.01 (-0.11-0.08)	0.794	variable excluded	variable excluded
BDI – Total score	0.15 (0.02-0.28)	**0.024**	0.14 (0.01-0.27)	**0.036**	0.05 (-0.04-0.14)	0.254	variable excluded	variable excluded	0.09 (0.01-0.17)	**0.025**	variable excluded	variable excluded
Alcohol use†	-0.69 (-3.97-2.58)	0.677	variable excluded	variable excluded	-0.43 (-2.65-1.79)	0.703	variable excluded	variable excluded	0.65 (-1.77-3.08)	0.597	variable excluded	variable excluded
Marijuana use†	0.09 (-7.92-8.10)	0.982	variable excluded	variable excluded	0.13 (-5.18-5.44)	0.963	variable excluded	variable excluded	-3.79 (-8.04-0.46)	0.080	variable excluded	variable excluded
Child												
Infant surgency	-1.15 (-2.88-0.58)	0.194	variable excluded	variable excluded	-0.73 (-1.88-0.42)	0.212	variable excluded	variable excluded	-0.36 (-1.27-0.58)	0.466	variable excluded	variable excluded
Infant negativity	0.15 (-1.19-1.49)	0.831	variable excluded	variable excluded	0.41 (-0.49-1.30)	0.372	variable excluded	variable excluded	0.66 (-0.07-1.36)	0.077	variable excluded	variable excluded
Infant regulation	0.92 (-0.58-2.43)	0.230	variable excluded	variable excluded	0.42 (-0.57-1.42)	0.404	variable excluded	variable excluded	0.24 (-0.57-1.05)	0.564	variable excluded	variable excluded
Intervention	0.53 (-1.48-2.54)	0.605	0.81 (-1.13-2.76)	0.413	0.06 (-1.27-1.40)	0.925	0.32 (-1.02-1.67)	0.638	-0.45 (-1.53-0.63)	0.415	0.27 (-0.87-1.40)	0.646

I: ICC = 0.62, SD = 0.08, 95%CI 0.45-0.77/ICC residual = 0.50, SD = 0.10, 95%CI 0.30-0.69.
II: ICC = 0.54, SD = 0.10, 95%CI0.35-0.72/ICC residual = 0.48, SD = 0.11, 95%CI 0.28-0.69.
III: ICC = 0.18, SD = 0.12, 95%CI% 0.04-0.53/ CC residual = 0.11, SD = 0.12, 95%CI 0.01-0.59.
Bold type denotes statistical significance.
95%CI = 95% confidence interval; ASRS = Adult Self-Report Scale; BDI = Beck Depression Inventory; ICC = intraclass correlation; SD = standard deviation.
† At least once a week.

Table 3 Initial and final regression models identifying the best longitudinal models for HOME subscales

Independent variables	I Maternal Responsivity				II Acceptance of Child				III Organization of the Environment			
	Initial		Final		Initial		Final		Initial		Final	
	Coefficient (95%CI)	p-value	Coefficient (95%CI)	p-value	Coefficient (95%CI)	p-value	Coefficient (95%CI)	p-value	Coefficient (95%CI)	p-value	Coefficient (95%CI)	p-value
Mother												
ASRS – Inattention score	-0.05 (-0.13-0.02)	0.175	0.36 (0.16-0.57)	variable excluded	0.00 (-0.04-0.04)	0.900	variable excluded	variable excluded	-0.01 (-0.05-0.03)	0.593	variable excluded	variable excluded
ASRS – Hyperactivity score	0.02 (-0.04-0.08)	0.539	-0.19 (-0.35 to -0.02)	variable excluded	-0.00 (-0.04-0.03)	0.829	variable excluded	variable excluded	0.00 (-0.03-0.03)	0.846	variable excluded	variable excluded
BDI – Total score	-0.04 (-0.08-0.01)	0.139	-0.04 (-0.08-0.01)	0.117	0.00 (-0.03-0.03)	0.838	variable excluded	variable excluded	0.00 (-0.03-0.02)	0.865	variable excluded	variable excluded
Alcohol use[†]	1.04 (-0.18-2.26)	0.095	variable excluded	variable excluded	0.13 (-0.72-0.97)	0.772	variable excluded	variable excluded	-0.32 (-1.08-0.45)	0.421	variable excluded	variable excluded
Marijuana use[†]	0.02 (-2.78-2.82)	0.987	variable excluded	variable excluded	-0.41 (-1.89-1.06)	0.584	variable excluded	variable excluded	0.46 (-0.98-1.89)	0.535	variable excluded	variable excluded
Child												
IBQ – Surgency	0.59 (-0.02-1.20)	0.056	0.47 (0.05-0.86)	0.029	0.13 (-0.20-0.45)	0.438	variable excluded	variable excluded	-0.17 (-1.15-0.48)	0.301	0.28 (0.06-0.49)	**0.012**
IBQ – Negativity	0.22 (-0.25-0.69)	0.352	variable excluded	variable excluded	-0.18 (-0.43-0.07)	0.153	variable excluded	variable excluded	0.00 (-0.24-0.25)	0.975	variable excluded	variable excluded
IBQ – Regulation	-0.26 (-0.78-0.27)	0.337	variable excluded	variable excluded	-0.27 (-0.55-0.01)	0.062	-0.21 (-0.40 to -0.01)	**0.036**	0.12 (-0.16-0.39)	0.400	variable excluded	variable excluded
Intervention	0.79 (0.09-1.50)	**0.028**	0.81 (0.10-1.52)	**0.025**	0.23 (-0.16-0.61)	0.227	0.19 (-0.17-0.56)	0.304	0.01 (-0.35-0.38)	0.946	-0.07 (-0.44-0.29)	0.704

Continued on next page

Table 3 (*continued*)

| | IV Learning Materials | | | | V Maternal Involvement | | | | VI Variety in Experience | | | |
| | Initial | | Final | | Initial | | Final | | Initial | | Final | |
	Coefficient (95%CI)	p-value	Coefficient (95%CI)	p-value	Coefficient (95%CI)	p-value	Coefficient (95%CI)	p-value	Coefficient (95%CI)	p-value	Coefficient (95%CI)	p-value
Mother												
ASRS–Inattention score	-0.09 (-0.17 to -0.01)	**0.031**	-0.05 (0.16-0.01)	0.081	-0.04 (-0.09-0.00)	0.061	-0.04 (-0.08 to -0.01)	**0.024**	-0.04 (-0.08 to -0.00)	**0.037**	-0.04 (-0.07 to -0.01)	**0.009**
ASRS–Hyperactivity score	0.03 (-0.03-0.10)	0.341	variable excluded	variable excluded	0.01 (-0.02-0.05)	0.460	variable excluded	variable excluded	0.01 (-0.02-0.04)	0.586	variable excluded	variable excluded
BDI – Total score	-0.01 (-0.06-0.05)	0.899	variable excluded	variable excluded	-0.02 (-0.05-0.01)	0.260	variable excluded	variable excluded	0.01 (-0.02-0.03)	0.644	variable excluded	variable excluded
Alcohol use[†]	1.00 (-0.70-2.70)	0.249	variable excluded	variable excluded	0.18 (-0.72-1.08)	0.691	variable excluded	variable excluded	-0.09 (-0.77-0.59)	0.792	variable excluded	variable excluded
Marijuana use[†]	4.26 (1.27-7.25)	**0.005**	4.51 (1.58-7.45)	**0.003**	0.00 (-1.62-1.62)	0.998	variable excluded	variable excluded	1.35 (-0.11-2.81)	0.069	variable excluded	variable excluded
Child												
IBQ – Surgency	0.32 (-0.33-0.98)	0.336	variable excluded	variable excluded	0.32 (-0.04-0.67)	0.081	0.29 (-0.03-0.62)	0.080	-0.08 (-0.40-0.23)	0.610	variable excluded	variable excluded
IBQ – Negativity	-0.20 (-0.70-0.31)	0.447	variable excluded	variable excluded	-0.11 (-0.39-0.16)	0.415	variable excluded	variable excluded	-0.10 (-0.35-0.14)	0.412	variable excluded	variable excluded
IBQ – Regulation	-0.28 (-0.85-0.29)	0.334	variable excluded	variable excluded	-0.26 (-0.57-0.04)	0.094	-0.25 (-0.55-0.04)	0.093	0.22 (-0.05-0.50)	0.114	variable excluded	variable excluded
Intervention	0.74 (-0.02-1.51)	0.057	0.70 (-0.04-1.44)	0.063	0.28 (-0.14-0.69)	0.191	0.22 (-0.19-0.63)	0.296	0.43 (0.06-0.80)	**0.023**	0.30 (-0.06-0.66)	0.098

Bold type denotes statistical significance.
95%CI = 95% confidence interval; ASRS = Adult Self-Report Scale; BDI = Beck Depression Inventory; HOME = Home Observation and Measurement of the Environment; IBQ = Infant Behavior Questionnaire; ICC = intraclass correlation; SD = standard deviation.
† At least once a week.

a stronger influence on parenting abilities, which remained significant even when adjusting for maternal depression symptoms and infant temperament.

The fact that hyperactivity/impulsivity symptoms had no negative effects agrees with previous studies on adult mothers, which have also shown that inattention symptoms have a more deleterious effect on parenting skills than hyperactive-impulsive symptoms.[29] One explanation for this may be that raising young children places heavy demands on attention and related executive functioning. For instance, having to structure routines, organize the home environment, perform tasks on time and remember commitments (among other everyday parenting tasks) will require well-coordinated use of several attentional and executive functions, including selective and sustained attention, working memory, and cognitive flexibility. ADHD inattention symptoms are known to be associated with impairments in these attentional and executive processes, while hyperactive-impulsive symptoms are reportedly less strongly associated with difficulties in executive functioning.[75,76] This information is particularly important in the context of adolescent motherhood, since executive functions are still developing at this age[77] and are negatively affected by poverty and other psychosocial risk factors to which many adolescent mothers are exposed.[78]

In terms of effects on child maltreatment, previous research has indicated that maternal ADHD symptoms increase the risk of child maltreatment in the first year after birth, although they did not include repeated measurements of maltreatment over time and did not assess the role of infant temperament.[32,79] Our findings indicate that maternal inattention symptoms were associated with increased rates of infant maltreatment that persisted throughout the first year or life, independently of infant temperament. This is important considering that increased maltreatment rates are known to be associated with adolescent motherhood.[80] The current findings suggest that elevated maternal inattention symptoms may be a key contributor to an increased risk of infant maltreatment in this population. This information could be incorporated in intervention programs for these young mothers. In particular, our findings may indicate that maternal inattention is an important target for intervention programs.

Our study has limitations. Most of the instruments we used are based on self-report, which may have inflated associations between measures. Future studies should aim to replicate our findings with objective or multi-informant measures. However, we used validated self-report instruments with well-known properties, suggesting clinical validity. We assessed ADHD symptoms through self-report with the ASRS scale, which was developed for adults rather than adolescents, although the scale has shown adequate validity in adolescent samples.[81,82] We did not assess sleep, anxiety, or stress in general, factors that can contribute to inattention. This study did not include measures of cognitive or executive functioning, which have been shown to play a role in the parenting abilities in adolescent mothers and may have mediated

the associations we found between maternal ADHD and parenting abilities.[16] We used a high psychosocial risk sample from a randomized controlled clinical trial. This is problematic since some outcomes of interest (i.e., parenting abilities) are targets of the intervention. We were unable to stratify our analyses of associations by intervention group due to the modest sample size. Thus, the associations we found between maternal ADHD symptoms and parenting behaviors must be interpreted within the context of the intervention. The generalizability of our study's findings to the wider population of adolescent mothers may be limited by the fact that our sample of adolescent mothers were participating in a clinical trial and could therefore be considered "help-seeking". Generalizability to the wider population of mothers with ADHD is also limited by the fact that we used a high psychosocial risk sample. The effect sizes for our results are small, indicating that maternal ADHD symptoms and other predictors explained only a small percentage of variance in the parenting outcomes, though this is consistent with the results of other studies investigating parenting impairments due to ADHD.[35] Furthermore, our modest sample size may have reduced the probability of finding that other psychopathology measures, such as alcohol and marijuana use, had a significant effect on outcomes. To elucidate the impact of inattention and hyperactivity/impulsivity on maternal care, we treated these dimensions as different predictors in the statistical models, as well as infant temperament dimensions. Because these ADHD domains are highly related constructs, as are the infant temperament factors, their inclusion as separate predictors in the models may have led to type II errors.[83] After applying a Bonferroni correction for the nine statistical comparisons, only inattention had a significant effect on Competence and Maltreatment. However, this should be considered an exploratory study; future studies with larger samples are needed to replicate and clarify these findings.

Nevertheless, our study has several strengths, among which we highlight that longitudinal designs can deal with constructs that vary over time (as often occurs in psychopathology), as well as better infer cause and effect than cross-sectional designs. No studies to date have investigated the relationship between maternal ADHD and the household environment in terms of routines, the availability of learning materials, noise, crowding, and stimulation using a structured observational measure. Our sample is representative of many settings in Brazil as well as in other developing countries.[68,84] According to a 2018 UNICEF report, there are approximately 300 million children worldwide living in slums.[85] In such populations, socioeconomic factors and maternal mental health problems are intrinsically associated and have a role in child development.[86,87] Our study documented the specific impact of maternal inattention symptoms during the first year of life in a highly vulnerable population. The results suggest that inattention may be systematically addressed in routine clinical care and prevention programs, and future studies should further investigate its impact on child development.

Acknowledgements

Disclosure

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