Maternal-infant bonding and partner support during pregnancy and postpartum

de Waal, Noor; Boekhorst, M.G.B.M.; Nyklicek, I.; Pop, V.J.M.

Published in:
Infant Behavior and Development: An International and Interdisciplinary Journal

DOI:
10.1016/j.infbeh.2023.101871

Publication date:
2023

Document Version
Publisher's PDF, also known as Version of record

Infant Behavior and Development 72 (2023) 101871

Contents lists available at ScienceDirect

Infant Behavior and Development

journal homepage: www.elsevier.com/locate/inbede

Maternal-infant bonding and partner support during pregnancy and postpartum: Associations with early child social-emotional development

Noor de Waal [*,1], Myrthe G.B.M. Boekhorst, Ivan Nyklíček, Victor J.M. Pop

Center of Research on Psychological disorders and Somatic diseases (CoRPS), Department of Medical and Clinical Psychology, Tilburg School of Social and Behavioral Sciences, Tilburg University, Tilburg, the Netherlands

ARTICLE INFO

Keywords:
Maternal-infant bonding
Partner support
Pregnancy
Postpartum
Child
Social-emotional development

ABSTRACT

The first 1000 days after conception are considered critical for healthy development and well-being throughout life. Fundamental to health practices during pregnancy and positive parenting after birth is the development of maternal-infant bonding. Previous research has demonstrated the importance of having an involved partner during pregnancy and in parenting for optimal maternal-infant bonding. The current study examined maternal-infant bonding and partner support during pregnancy and the postpartum period, and their associations with early child social-emotional development. A total of 227 women completed the Pre- and Postnatal Bonding Scale (PPBS) and Tilburg Pregnancy Distress Scale (TPDS) during pregnancy (32 weeks of gestation) and at 8 months postpartum, assessing maternal-infant bonding and partner support. Additionally, a questionnaire on social-emotional behavior of the Bayley Scales of Infant and Toddler Development was administered to mothers to measure child development at 2 years of age. Path analyses revealed an indirect positive effect of prenatal maternal-infant bonding on child social-emotional development through postnatal maternal-infant bonding, as well as mediating effects of pre- and postnatal maternal-infant bonding on the association between pre- and postnatal partner support and child social-emotional development. Our findings support the notion that an emotional connection from mother to child originates in pregnancy and that experiencing positive feelings towards the fetus promotes positive maternal-infant bonding after birth and social-emotional capacities of the child. Additionally, having a supportive partner during pregnancy and postpartum, might be essential for the development of optimal maternal-infant bonding.

The first 1000 days after conception are considered critical for healthy development and well-being throughout life (Berg, 2016). In utero experiences and the quality of caregiving that is provided after birth, shape the way a child grows, learns, and thrives. For example, elevated levels of distress during pregnancy have been associated with emotional and behavioral problems in the offspring (Graignic-Philippe et al., 2014), as have mothers' insensitive parenting behaviors in early childhood (i.e., inadequate or late responses to infant signals; Behrendt et al., 2019). Fundamental to health practices during pregnancy (e.g., a sufficient amount of sleep,

* Correspondence to: Tilburg University, Department of Medical and Clinical Psychology, Room T417, Warandelaan 2, 5037 AB Tilburg, the Netherlands.
E-mail address: N.deWaal@tilburguniversity.edu (N. de Waal).
[1] ORCID: 0000-0002-2287-8426

https://doi.org/10.1016/j.infbeh.2023.101871
Received 10 June 2022; Received in revised form 18 July 2023; Accepted 30 July 2023
Available online 4 August 2023

refraining from harmful substances) and positive parenting after birth is the development of maternal-infant bonding (Lindgren, 2001; Medina et al., 2021), defined as the emotional tie that mothers feel towards their infant (Bicking Kinsey & Hupcey, 2013).

Maternal-infant bonding originates in pregnancy and evolves with gestation when fetal movements increase (Cannella, 2005; Guney & Ucar, 2019; Tichelman et al., 2019). The strength of prenatal bonding has been shown to be a robust predictor of bonding quality in early childhood (e.g., De Cock et al., 2016; De Cock et al., 2017; Le Bas et al., 2021; Tichelman et al., 2019). Previous research has associated postnatal bonding quality with early child social-emotional capacities. For example, Mason et al. (2011) found that stronger feelings of bonding in mothers at 2 months postpartum predicted better social-emotional development in their children at 6 months of age. Moreover, better maternal-infant bonding 6–8 months postpartum has been associated with fewer social-emotional and behavior problems (e.g., negative emotionality, withdrawal), as well as more social-emotional competencies (e.g., empathy, prosocial behavior) in 1-year-old children (Behrendt et al., 2019).

Although studies have emphasized the important implications of prenatal maternal-infant bonding for parenting competencies (Bicking Kinsey & Hupcey, 2013), research on associations with child social-emotional development is scarce. Le Bas et al. (2021) found positive correlations between bonding during each trimester of pregnancy and child social-emotional development at 12 months postpartum. Yet, for the main analyses, this study focused specifically on the unique contribution of postnatal bonding, as a previous meta-analysis showed stronger associations with infant development compared to mothers' prenatal bonding quality (Le Bas et al., 2020). In addition, meta-analytic research associated stronger prenatal bonding with an easier overall temperament and positive infant mood (Le Bas et al., 2020). A systematic review found similar results in some of the studies included, with associations between prenatal bonding and several temperamental dimensions (e.g., adaptability, intensity), but insignificant relations in other studies (Branjerdporn et al., 2017). It should be noted though that the number of studies that were included in this review were limited, and that some were of poor quality. Moreover, social-emotional development was not assessed in these studies. That is unfortunate because, despite being related to one another (Salley et al., 2013; Sanson, 2004), temperament and social-emotional development are distinct constructs (Liew, 2012; Sanson, 2004). The relatively small number of studies on prenatal bonding fail to provide a clear picture on its potentially unique effect on social-emotional development, as well as the potential mediating role of postnatal bonding in this association.

Literature has identified a variety of risk and protective factors for optimal maternal-infant bonding. For example, multiparity and mental health problems (e.g., depression) were found to have adverse effects on the quality of bonding, whereas an intended pregnancy and social support were associated with a stronger bond between mother and child (McNamara et al., 2019). Previous studies have also demonstrated the importance of having an involved partner during pregnancy and in parenting for the development of maternal-infant bonding. For example, women living without a partner and women who did not feel supported by their partner during pregnancy, experienced lower levels of bonding towards their fetus (da Rosa et al., 2021). Furthermore, mothers who were characterized as having a strong bond with their child at 6 and 24 months postnatally reported higher levels of partner support (De Cock et al., 2016). We previously demonstrated that partner support was one of the most important protective factors of maternal-infant bonding, both during pregnancy and in the postnatal period (Cuijlits et al., 2019).

Prenatal partner support has been associated with a variety of other positive outcomes, such as maternal health behaviors during pregnancy (e.g., less likely to drink alcohol; Cohen et al., 2016) and less maternal and infant distress after birth (Stapleton et al., 2012). To our knowledge, no studies have examined the relation between prenatal partner support and child social-emotional development. However, fathers' involvement in pregnancy has been positively associated with the paternal share in caregiving (Zvara et al., 2013), which has been studied in relation to child social-emotional development. Children who described their father as more supportive, also reported a greater sense of competence and social acceptance at 6 years of age (Dubowitz et al., 2001). Moreover, Dubeau et al. (2012) found in a rather small sample, that fathers who placed more emphasis on play interactions and spent more time on household tasks including childcare, more often had children who displayed fewer internalizing problems and more prosocial behavior at age 4. Another study, including a larger sample, found a positive effect of father involvement on peer relations in 7-year-olds, but no effects at younger ages (Flouri et al., 2016). Regarding pregnancy and the first years of life, little is known about the relation between partner support and child social-emotional capacities, or about the potential mechanisms that would explain such an association.

The current study examined maternal-infant bonding and partner support during the pre- and postnatal period, as well as their associations with early child social-emotional development. Our hypothesis was that maternal-infant bonding during pregnancy and in the postpartum period would be positively associated with social-emotional development of children at 2 years of age, and that postnatal bonding would partially mediate the association between prenatal bonding and child social-emotional development. Furthermore, we hypothesized positive associations between pre- and postnatal partner support and child social-emotional development, either directly or mediated by maternal-infant bonding.

1. Method

1.1. Participants

The current study included a subsample of women who participated in the Holistic Approach to Pregnancy and the first Postpartum Year (HAPPY) study, a large longitudinal prospective cohort study for which the protocol has been described previously (Truijens et al., 2014). Pregnant women that were eligible for participation (i.e., Dutch speaking, Caucasian or third generation of other ethnic groups) were recruited via community midwife practices. Exclusion criteria included multiple pregnancies (or higher order pregnancies), the existence of an endocrine disorder, severe psychiatric disorder (schizophrenia, borderline personality disorder, or bipolar disorder), HIV, drug or alcohol addiction problems, or any other disease resulting in treatment with drugs that are potentially adverse

for the fetus. During their participation, women ($n = 2269$) were followed throughout pregnancy and in the first year postpartum. Only participants who were included between October 2013 and August 2014 received a questionnaire on maternal-infant bonding during pregnancy ($n = 1163$) of whom data were complete for 1050 women. Of those women, 793 also completed the questionnaire in the postpartum period. After completion of the cohort study, a subsample of 828 women was invited to participate in a follow up study (selected based on [1] elevated levels of depressive symptoms, [2] suboptimal thyroid function or thyroid dysfunction, and [3] healthy controls). A total of 485 women (59%) consented to participate. For the purpose of this study, only the participants were included that completed pre- and postnatal measures on maternal-infant bonding, as well as child social-emotional development at follow up ($n = 239$). Additionally, participants had to be married or co-habiting and information on partner support during pregnancy and postpartum had to be complete, resulting in a sample size of 227 participants (see Fig. 1 for an overview of enrollment). All participants gave informed consent for the cohort study and its follow up study.

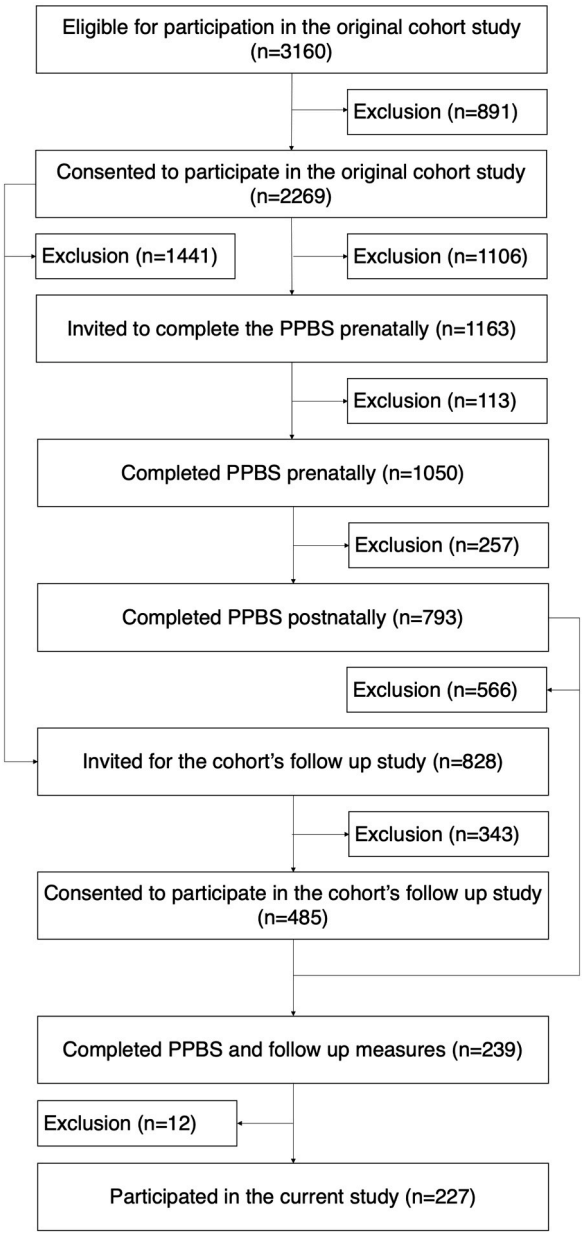

Fig. 1. *Enrollment of participants. Note.* PPBS = Pre- and Postnatal Bonding Scale.

1.2. Procedures

Data for the original cohort study were collected between January 2013 and September 2014. Participants received questionnaires via postal mail or email around 32 weeks of gestation and 8 months postpartum, assessing mother-to-infant bonding and partner support. Although not examined for the questionnaires that were used in the present study, previous research demonstrated that results for online and paper-and-pencil administration were comparable, both for self-rated (Luce et al., 2007) and parent-rated questionnaires (Bjornsdotter et al., 2013). Follow up data on child social-emotional development were collected between December 2016 and June 2018, when the child was approximately 2 years of age. Once more, women completed questionnaires that were sent by postal mail or were completed online. The study was approved by the Ethical Board of Tilburg University and has been evaluated by the Medical Ethical Committee of the Máxima Medical Centre Veldhoven. The follow up study was approved by the Medical Ethics Committee of the Máxima Medical Centre (protocol number NL54558.015.15). The study has been carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki).

1.3. Measures

1.3.1. Mother-to-infant bonding

Mother-to-infant bonding was measured with the Pre- and Postnatal Bonding Scale (PPBS), a self-rated questionnaire that was developed to assess maternal bonding during pregnancy and postpartum (Cuijlits et al., 2016). The PPBS holds an advantage over other measures that assess either prenatal or postnatal maternal-infant bonding (Wittkowski et al., 2020), and are therefore not well comparable and do not enable making a reliable assessment of bonding over time from pregnancy to postpartum (Cuijlits et al., 2016). In addition, the PPBS specifically focuses on the affectionate domain. Positive feelings and emotions towards the child generally arise during pregnancy (e.g., Tichelman et al., 2019) and, therefore, do not necessarily require a response from the child. Although interacting with the child after birth may enhance feelings of bonding (Cuijlits et al., 2016), parental affections and feelings of love is what defines bonding (Brandon et al., 2009), rather than parental behaviors that may or may not be associated with feelings of bonding. Finally, the PPBS is a short questionnaire with a user-friendly set-up (Cuijlits et al., 2016). Only positively worded items are included to prevent socially desirable answers and since previous research demonstrated that especially low scores on positive feelings reflected poor bonding or a disorganized relationship with the child (Brockington et al., 2006). For prenatal and postnatal administration, the PPBS demonstrated good psychometric properties and construct validity in a sample of 1050 pregnant women (Cuijlits et al., 2016). Moreover, the PPBS has previously been used in various other studies (e.g., Kommers et al., 2017) and a systematic review on parent-report measures of bonding indicated a sufficient structural validity and internal consistency (Wittkowski et al., 2020). The questionnaire consists of five items that describe positive feelings of bonding (e.g., "Loving", "Happy"). Women are asked whether these feelings reflect their own feelings towards their fetus or infant over the last four weeks on a 4-point Likert scale (0 = not at all, 1 = hardly, 2 = much, 3 = very much). For analyses, total scores were used that ranged from 0 to 15 with higher scores reflecting more positive mother-to-infant bonding. In the current study, reliability was good with $\alpha = 0.86$ and 0.78 for prenatal (32 weeks of pregnancy) and postnatal (8 months postpartum) administration, respectively.

1.3.2. Partner support

Partner support during pregnancy (32 weeks) was assessed using the partner involvement subscale of the Tilburg Pregnancy Distress Scale (TPDS; Pop et al., 2011). The TPDS has been found reliable and valid for administration during pregnancy, with good internal consistency for the subscale partner involvement (Boekhorst et al., 2020). To measure postnatal partner support (8 months postpartum), the Tilburg Postnatal Distress Scale (TPDS-2) was used. Items of the TPDS-2 were derived from the TPDS and assess partner support in the postpartum period. The TPDS-2 demonstrated good reliability in one of our previous studies using a larger subsample (Cuijlits et al., 2019). By means of five items, mothers are asked to indicate the extent in which they feel emotionally supported by their partner during pregnancy or in parenting (e.g., "The pregnancy/birth of the baby brought me and my partner closer together" and "I feel supported by my partner"). Items are answered on a 4-point (prenatal administration) or 5-point Likert scale (postnatal administration) ranging from 0 = very much to 3 or 4 = not at all, resulting in a subscale score between 0 and 15–20. For analyses, all items were reversed so that higher scores indicate more partner support. In the current study, internal consistency of the subscale partner support of the TPDS and TPDS-2 was good ($\alpha = 0.78$ and 0.83 for prenatal and postnatal administration, respectively).

1.3.3. Child social-emotional development

The parent-rated social-emotional questionnaire of the Bayley Scales of Infant and Toddler Development – Third Edition – NL (Bayley-III-NL; Van Baar et al., 2014) was used to assess child social-emotional development. The scale was designed to assess social-emotional milestones in children up to 42 months of age. Rather than measuring isolated skills or competencies, the scale gives rise to a broad representation of social-emotional behavior and accomplishments. The questionnaire, to be completed by the mother, has previously been validated and found reliable in a sample of 1845 Dutch mothers (Van Baar et al., 2014). Items assess different aspects of social-emotional development (e.g., self-regulation, interest in the world) by means of six answer categories (0 = don't know, 1 = never, 2 = sometimes, 3 = half of the time, 4 = often, 5 = always). Examples of items are "You can help your child calm down when that is necessary" and "Looks at interesting things like faces or toys". Total scores are converted into standardized index scores which range from 40 to 160, with higher scores indicating better social-emotional development of the child. Reliability of the questionnaire in the current study was excellent ($\alpha = 0.96$).

1.3.4. Covariates

Based on previous research that associated demographic factors, obstetric outcomes, and maternal mental health during pregnancy to the current study's variables (e.g., Johnson et al., 2018; Leis et al., 2014; McNamara et al., 2019), various confounders are included in the main analyses. First, mothers reported on their maternal age, level of education, and parity via an online questionnaire around 12 weeks of gestation. Second, obstetric measures (i.e., gestational age at birth and birth weight) were collected via obstetric records by a research midwife. Third, prenatal distress was assessed using the self-rated 11-item subscale negative affect of the TPDS (Pop et al., 2011), which demonstrated good validity and reliability in 1739 pregnant women (Boekhorst et al., 2020). Items concern worries about the pregnancy, upcoming delivery, and postpartum period (e.g., health of the baby, weight gain after pregnancy) and are rated on a 4-point Likert scale (0 = not at all, 1 = sometimes, 2 = often 3 = very much). Subscale scores range from 0 (no pregnancy

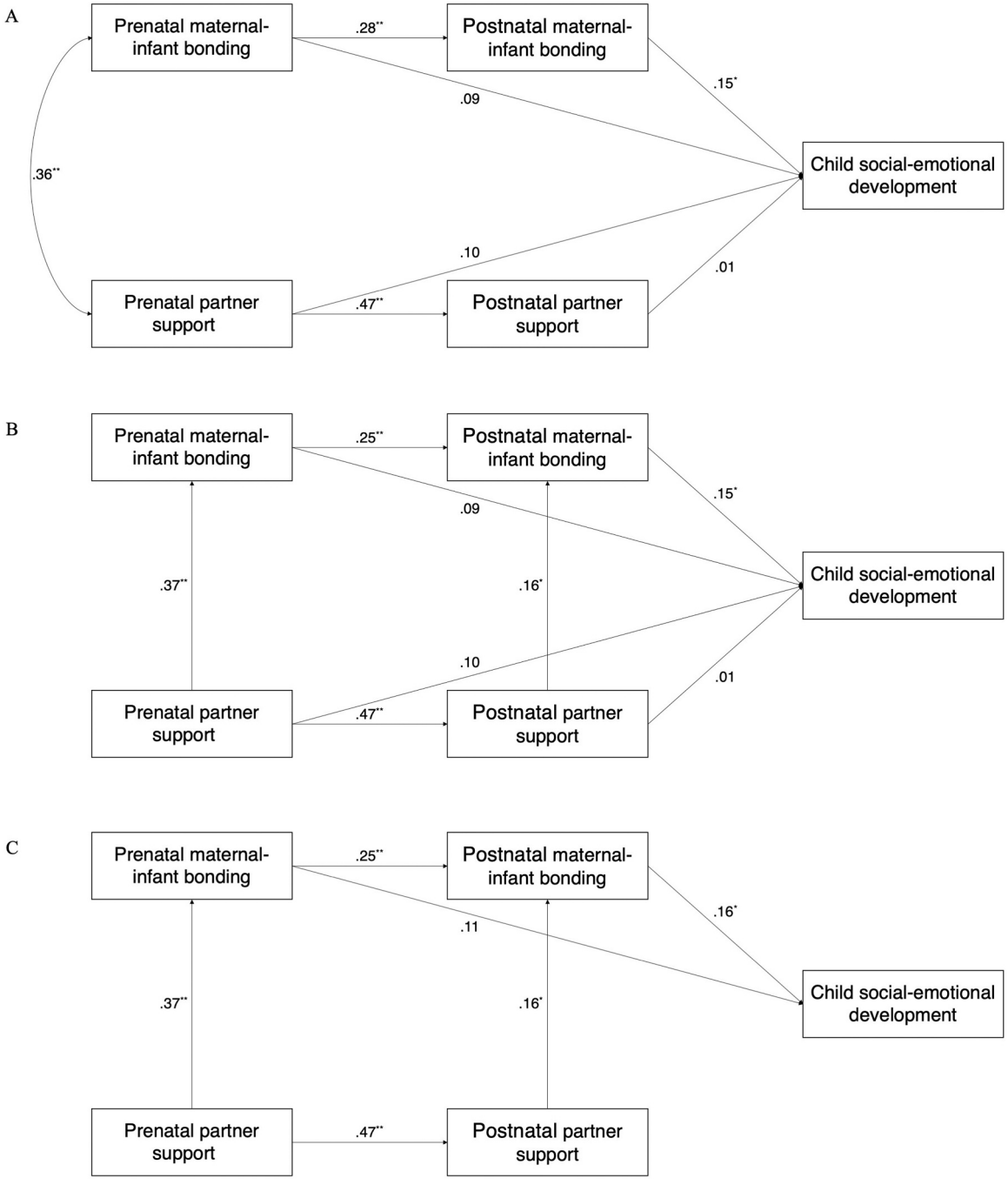

Fig. 2. Standardized coefficients of pathways in three theoretical models testing direct and indirect effects. *Note*. $^{*}p < .05$; $^{**}p < .01$.

distress) to 33 (much pregnancy distress). Reliability in the current study was good (α = 0.77). Fourth, depressive symptoms were assessed during pregnancy (32 weeks of gestation) and 2 years after childbirth with the self-rated 10-item Edinburgh Depression Scales (EDS-10; Cox et al., 1987). The Dutch version of the EDS was validated among pregnant women (Bergink et al., 2011) and was demonstrated to be a reliable measurement of depression in the postpartum period (Cox et al., 1987). Items (e.g., "I have been so unhappy that I have been crying") are rated on a 4-point scale ranging from 0 to 3. Total scores vary from 0 to 30 with higher scores reflecting more depressive symptoms. Scores ≥ 10 (prenatal administration) or ≥ 13 (postnatal administration) indicated clinically significant levels of depressive symptoms (Bergink et al., 2011; Cox et al., 1987). In the current study, reliability was good (α = 0.84 and 0.87 for administration during pregnancy and 2 years after birth, respectively).

1.4. Statistical analyses

All statistical analyses were conducted in Statistical Package for the Social Sciences (IBM SPSS version 28.0). First, independent samples t-test and Chi Square tests were conducted to identify any differences in demographics and study variables between the subsample of women in the current study and a sample of women who completed questionnaires on maternal-infant bonding in the original cohort study, but did not participate in the cohort's follow up study. Significant differences with small-to-medium effect sizes of Cohen's $d > 0.30$ or Cramer's $V > 0.20$ were considered as clinically relevant. Second, missing values in the data were inspected. Information on gestational age at birth and birth weight was missing for respectively two and three participants (1%). Further data were complete. Little's Missing Completely at Random (MCAR) Test was not significant ($\chi^2(321) = 326.15$, $p = .41$), indicating that the data were missing completely at random. Power analyses in the software program G*Power identified a minimum sample size of 109 participants for an effect size of $f^2 = .15$, alpha of.05, and power of.80. Based on the random and small proportion of missingness, resulting in a minimum loss of power and generalizability, cases with missing values were listwise deleted. Third, Pearson's *r* correlation coefficients were calculated between pre- and postnatal maternal-infant bonding, pre- and postnatal partner support, child social-emotional development, and covariates.

For the main analyses, path analysis was conducted by using the IBM SPSS Amos version 28.0 (Arbuckle, 2014). As an extended version of regression analyses, path analysis allows for testing more complex models that include multiple variables or paths, as well as comparing different theoretical models (Streiner, 2005). Three models were analyzed to see which model provided the best fit for the data. All three models included prenatal partner support as an exogenous variable (not influenced by other variables), and postnatal bonding, postnatal partner support, and child social-emotional development as endogenous variables, whereas for prenatal bonding this differed for each model. Based on findings in earlier literature, in all three models, direct paths were set up from pre- to postnatal bonding, pre- to postnatal partner support, and pre- and postnatal bonding to child social-emotional development. Additional paths varied for each model as earlier research was either absent or ambiguous. In the *first model*, prenatal bonding was included as an exogenous variable and additional direct paths were set up from pre- and postnatal partner support to child social-emotional development, leading to the following indirect paths: (1) prenatal bonding to child social-emotional development mediated by postnatal bonding and (2) prenatal partner support to child social-emotional development mediated by postnatal partner support (see Fig. 2. A).

Table 1
Demographics and descriptive statistics of women participating in the current study and the original cohort.

	Study sample ($n = 227$)				Original cohort ($n = 566$)			
	N (%)	*M (SD)*	Min	Max	*N (%)*	*M (SD)*	t / χ^2	d / V
Demographics and covariates								
Maternal age		31.07 (3.48)	22	42		30.35 (3.62)	2.54*	.20
Maternal education[a]	178 (78)				342 (62)		19.21	0.16
Parity[b]	87 (38)				284 (52)		17.30**	.15
Gestational age at start in weeks		32.17 (0.94)	30	41		32.22 (0.81)	-0.76	0.06
Gestational age at birth in weeks		39.83 (1.25)	35	42		39.80 (1.36)	-1.32	0.02
Birth weight in grams		3604 (519)	1800	5366		3469 (475)	2.05**	.27
Child age at follow up in months		24.40 (0.61)	23	26				
Child sex[c]	114 (51)				271 (49)		0.58	0.02
Prenatal distress		6.62 (4.44)	0	20		5.71 (3.88)	2.19*	.22
Prenatal depressive symptoms		5.76 (4.53)	0	21		4.47 (3.79)	3.78**	.31
Maternal depressive symptoms		5.16 (4.16)	0	21				
Study variables								
Prenatal maternal-infant bonding		11.24 (2.54)	5	15		12.77 (2.22)	-7.96**	.64
Postnatal maternal-infant bonding		12.83 (2.04)	6	15		14.03 (1.57)	-7.96**	.66
Prenatal partner support		9.81 (2.76)	2	15		10.66 (2.81)	-3.87**	.31
Postnatal partner support		15.50 (3.50)	4	20		16.51 (3.22)	-3.88**	.30
Social-emotional development		96.94 (10.76)	70	119				

Note. The original cohort includes participants who completed questionnaires on maternal-infant bonding but did not participate in the follow up.
[a] Reference category is higher vocational education or university degree.
[b] Reference category is primiparous.
[c] Reference category is boy.
* $p < .05$;
** $p < .01$.

To test potential other mediating effects of postnatal bonding, the *second model* included prenatal bonding as an endogenous variable and paths were set up from prenatal partner support to prenatal bonding, and from postnatal partner support to postnatal bonding. This led to two additional indirect paths that were analyzed: (1) prenatal partner support to child social-emotional development through postnatal partner support and pre- and postnatal bonding, and (2) postnatal partner support to child social-emotional development through postnatal bonding (see Fig. 2. B). In the *third model*, direct paths from pre- and postnatal partner support to child social-emotional development were omitted to test whether the model fit would improve when only indirect paths from partner support to child social-emotional development were included (see Fig. 2. C).

To assess the overall model fit, the following criteria were used: a nonsignificant chi-square, a Comparative Fit Index (CFI) and Goodness of Fit Index (GFI) close to 1, and root mean square error of approximation (RMSEA) < 0.05. In order to determine which model demonstrated the relatively best fit, Chi Square difference tests were performed to compare the "full" model including all parameters (model 2) with the "smaller" models (model 1 and 3) with fewer parameters and more degrees of freedom. An insignificant Chi Square value (CMIN) indicated that the smaller model was to prefer over the full model. In addition, the Akaike Information Criterion (AIC) was assessed. The model with the smallest AIC value was concluded to be the best fit for the data (Kline, 2010). Additionally, standardized coefficients were assessed for each separate path, as well as direct and indirect effects. To assess significance of direct and indirect effects, bootstrapping was performed with 5000 samples and 95% confidence intervals (Kline, 2010). Maternal age, maternal education, parity, gestational age at birth, birth weight, maternal depressive symptoms during pregnancy, and pregnancy distress of the mother were included as covariates.

2. Results

2.1. Preliminary analyses

Demographics are presented in Table 1, as are participants' average scores on depressive symptoms. Of the women who participated in the follow up study, scores on depressive symptoms were equal to or greater than the clinical cutoff for 41 women (18%; assessed at 32 weeks of gestation) and 11 women (5%; assessed 2 years after childbirth). Independent samples t-tests and Chi-Square tests revealed significant differences between the subsample of women as used in the current study ($N = 227$) and women who completed maternal-infant bonding questionnaires during pregnancy and postpartum but did not participate in the cohort's follow up study ($N = 566$), see Table 1. Women in the current study were slightly older, more often highly educated, and more often multiparous than women in the original cohort (however all differences showed small effect sizes). No significant differences were found for gestational age at the start of participation or child sex. Regarding the study variables, women in the current sample showed significantly lower levels of maternal-infant bonding and indicated less partner support during pregnancy and postpartum than women in the original cohort. In addition, depressive symptoms and distress during pregnancy were higher in the current sample, and birth weight was lower. Differences in pre- and postnatal bonding, pre- and postnatal partner support, and depressive symptoms were clinically relevant (with Cohen's *d* ranging from 0.30−0.66). Bivariate correlations between maternal-infant bonding, partner support, child social-emotional development, and covariates are presented in Table 2. Prenatal maternal-infant bonding was positively associated to postnatal maternal-infant bonding and prenatal partner support was positively associated to postnatal partner support. In addition, a positive correlation was found between maternal-infant bonding and partner support, both prenatally and postnatally. Child social-emotional development was positively associated with pre- and postnatal maternal-infant bonding, as well as with prenatal partner support, but not with postnatal partner support.

Table 2
Bivariate correlations.

		1	2	3	4	5	6	7	8	9	10	11	12
Study variables													
1	Prenatal maternal-infant bonding												
2	Postnatal maternal-infant bonding	0.27**											
3	Prenatal partner support	0.36**	.18**										
4	Postnatal partner support	0.19**	.24**	.48**									
5	Social-emotional development	0.16*	.19**	.15*	.12								
Covariates													
6	Maternal age	-0.08	-0.02	-0.14*	.04	0.02							
7	Maternal education	-0.22**	-.07	-0.09	0.06	0.10	0.34**						
8	Parity	0.00	-0.07	-0.29**	-.11	0.09	0.37**	.19**					
9	Gestational age at birth in weeks	-0.08	0.01	-0.03	-0.01	0.07	0.14*	.13*	.14*				
10	Birth weight in grams	-0.10	-0.08	-0.08	-0.10	-0.00	0.14*	.10	0.34**	.52**			
11	Prenatal distress	-0.08	-0.13*	-.21**	-.21**	-.13	-0.07	-0.22**	-.12	-0.09	0.06		
12	Prenatal depressive symptoms	-0.19**	-.13*	-.46**	-.30**	-.12	-0.01	0.02	0.10	-0.03	0.08	0.41**	
13	Maternal depressive symptoms	-0.04	-0.20**	-.19**	-.24**	-.08	0.03	0.03	0.02	-0.09	0.01	0.44**	.45**

Note. *$p < .05$; **$p < .01$. Prenatal determinants were assessed at 32 weeks of gestation; postnatal determinants were assessed 8 months postpartum; social-emotional development and maternal depressive symptoms were assessed at 2 years of the child's age.

2.2. Path analyses

Path analysis demonstrated an overall good fit of the first model that included direct paths from pre- and postnatal bonding and partner support to child social-emotional development (χ^2 (3) = 5.93, p = .115, CFI = 0.99, GFI = 1.00), although RMSEA = 0.066. The second model, including additional paths from partner support to bonding, showed a good fit as well (χ^2 (2) = 0.52, p = .770; CFI = 1.00; GFI = 1.00; RMSEA = 0.00), as did the third model where direct paths from partner support to child-social emotional development were omitted and only indirect effects of partner support were tested (χ^2 (5) = 2.98, p = .703, CFI = 1.00, GFI = 1.00, RMSEA = 0.00). Chi Square differences tests comparing the second with the first and third model demonstrated that the smaller first (CMIN (2) = 3.42, p = .181) and third models (CMIN (2) = 1.55, p = .461) were to prefer over the full second model. The AIC demonstrated the relatively best fit for the third model (AIC = 174.98), compared to the first and second model (AIC = 181.93 and 178.52, respectively). Standardized coefficients of separate paths in each model are presented in Fig. 2. The statistics in the text are derived from the third model, as this model demonstrated the best fit. Paths from pre- to postnatal bonding (β = 0.25, SE = 0.07, CI [0.11–0.38], p = .001) and from pre- to postnatal partner involvement were significant (β = 0.47, SE = 0.06, CI[0.34–0.59] p = .001), i.e., higher levels of bonding and partner support during pregnancy were associated with higher levels of bonding and partner support postpartum. In addition, maternal-infant bonding and partner support were positively related, both during pregnancy (β = 0.37, SE = 0.07, CI[0.22–0.50], p < .001) and in the postpartum period (β = 0.16, SE = 0.08, CI[0.00–0.30], p = .048). To statistically compare the strength of the associations between partner support and bonding in the pre- and postnatal period, we used a z-test in which the difference in the regression coefficients was divided by the root of the average squared standard errors. Results indicated that the association was significantly stronger in the prenatal period compared to the association as found in the postnatal period (z = 3.23, p = .001). Only postnatal bonding was directly associated with child social-emotional development (β = 0.16, SE = 0.07, CI [0.03–0.29], p = 020). Stronger maternal-infant bonding in the postpartum period, predicted better social-emotional capacities in early childhood.

Prenatal bonding was not directly related to child social-emotional development, but indirect effects as mediated by postnatal bonding were significant (β = 0.04, SE = 0.02, CI[0.01–0.09]). Thus, stronger prenatal bonding was associated with better social-emotional development of children at 2 years of age through stronger postnatal bonding. Prenatal partner support was not directly related to child social-emotional development, but an indirect effect was found through postnatal partner support and pre- and postnatal bonding (β = 0.07, SE = 0.03, CI[0.01–0.14]). This indirect effect of prenatal partner support was only significant in the third model, which included no direct paths from pre- and postnatal partner support to child social-emotional development. Further, an indirect effect was found of postnatal partner support on child social-emotional development, but only indirect though postnatal bonding (β = 0.03, SE = 0.02, CI[0.00–0.08]).

Concerning the covariates, maternal education was negatively associated with prenatal bonding ($\beta = -0.21, p = .001$). Parity was positively associated with prenatal bonding (β = 0.20, p = .011) and prenatal partner support ($r = -0.29$, $p < .001$). In addition, maternal age was negatively related to prenatal partner support ($r = -0.15, p = .020$), as were prenatal distress ($r = -0.21, p = .001$), and depressive symptoms during pregnancy ($r = -0.47$, $p < .001$) and 2 years after childbirth ($r = -0.20, p = .004$). Gestational age at birth and birth weight were unrelated to any of the study variables and none of the covariates was associated with child social-emotional development. Overall, conducting the analyses without covariates yielded similar results, apart from demonstrating a poorer fit for the first model with a significant Chi Square (χ^2 (3) = 8.46, p = .037).

3. Discussion

The current study examined maternal-infant bonding and partner support during pregnancy and postpartum, and their associations with early child social-emotional development. Analyses revealed that maternal-infant bonding during pregnancy was positively related to maternal-infant bonding in the postpartum period, and that both were associated with better social-emotional development in 2-year-old children. More specifically, stronger prenatal maternal-infant bonding was related to better social-emotional capacities, but only indirectly as mediated by postnatal maternal-infant bonding. In addition, more partner support during pregnancy was associated with more partner support postpartum, and both were positively related to pre- and postnatal maternal-infant bonding. Furthermore, more partner support during pregnancy and postpartum was positively associated to better social-emotional development of the child at 2 years of age, although only indirectly through maternal-infant bonding.

As hypothesized, feelings of prenatal maternal-infant bonding were positively associated to maternal-infant bonding in the postpartum period. This was in line with a systematic review that found the strength of prenatal bonding to be predictive of maternal-infant bonding in early childhood (Tichelman et al., 2019). Also, the effect sizes found in the present study were similar to other studies that examined associations between maternal-infant bonding during pregnancy and 6–24 months postpartum (De Cock et al., 2016; De Cock et al., 2017; Le Bas et al., 2021). Our findings support the notion that an emotional connection from mother to child originates in pregnancy and that experiencing positive feelings towards the fetus promotes positive maternal-infant bonding after birth.

In addition, we found that maternal-infant bonding was positively associated with child social-emotional development. For prenatal bonding, only an indirect effect was found through postnatal bonding quality. Thus, stronger maternal-infant bonding during pregnancy was related to stronger bonding in the postpartum period and subsequently to better social-emotional capacities of children at 2 years of age. Furthermore, we found a direct association between postnatal mother-infant bonding and better social emotional development. These findings were in line with our hypotheses, as well as with previous studies that associated prenatal maternal-infant bonding with positive social-emotional outcomes (Branjerdporn et al., 2017; Le Bas et al., 2021; Le Bas et al., 2020) and demonstrated stronger feelings of bonding 2–8 months postpartum to predict more social-emotional competencies 6–12 months after birth (Behrendt

et al., 2019; Mason et al., 2011). Presumably, mothers who feel emotionally connected to their child are more motivated to provide adequate caregiving and engage in interaction, which would promote parental sensitivity and subsequently social-emotional capacities of the child (Behrendt et al., 2019; Medina et al., 2021). Poor bonding on the other hand, has been associated with maternal depression, both in earlier research (Faisal-Cury et al., 2020; Rolle et al., 2020) as bivariate in the current study. In turn, depression is a known risk factor for insensitive parenting behavior (Bernard et al., 2018; Coyne et al., 2007) and social-emotional difficulties in early childhood (Junge et al., 2017; Mason et al., 2011). Although the current study assessed postnatal bonding in terms of maternal feelings towards the child and not bonding-related parenting behavior, the fact that only indirect effects of prenatal bonding on child social-emotional development were found, may further suggest that parental behavior in the postpartum period can be an important mechanism in explaining the relation between maternal-infant bonding and child development, at least in the current sample. Alternatively, mothers with higher levels of bonding might also have more positive relationships with other individuals, which may be indicative for having adequate communication skills in social interactions, as well as emotion regulation capacities (Behrendt et al., 2019; Lopes et al., 2011). As such, these mothers may provide a better role model for their children (Morris et al., 2007).

Similar to maternal-infant bonding, the level of prenatal partner support was positively related to the level of partner support in the postpartum period. Thus, a partner who was perceived as more supportive during pregnancy, was also perceived as more supportive after birth. These results were consistent with our hypothesis, as well as with earlier work that found paternal involvement during pregnancy to be related to fathers' engagement in postnatal caregiving (Zvara et al., 2013). Given the positive child outcomes that are related to father involvement in early childhood (Wilson & Prior, 2011), our findings emphasize the importance of encouraging fathers to actively participate in their partners' pregnancies and to include them in prenatal health care.

In accordance with our hypothesis and previous work (Cuijlits et al., 2019; da Rosa et al., 2021; De Cock et al., 2016), partner support was positively associated with maternal-infant bonding, both during pregnancy and in the postpartum period. In the transition to parenthood, women are particularly vulnerable to develop mental health problems such as depression and anxiety (Parfitt & Ayers, 2014), which may reflect negatively on their perceptions of the fetus or child (Cornish et al., 2006). Having a partner who provides emotional support and who is understanding, might protect against developing such mental health problems (Pilkington et al., 2016; Stapleton et al., 2012) and subsequently promote positive feelings towards the child, perhaps even more so in a sample of women with heightened levels of depression. Our results demonstrated that the association between partner support and maternal-infant bonding in pregnancy was stronger compared to this relation in the postpartum period. Possibly, this can be explained by the fact that the current study assessed partner support as perceived by mother, rather than actual involvement in terms of engagement in pregnancy activities or hours spent on childcare tasks. Pregnancy can be a stressful period and being able to share any uncertainties or concerns, for example regarding fetal growth, the upcoming delivery, or future parenting qualities, might be crucial (Darvill et al., 2010), whereas in early parenthood, mothers might benefit more from practical support (i.e., involvement in terms of actual hours spent with the child) to unburden them from childcare tasks (Kirova & Snell, 2019).

Our assessment of mothers' perception of partner support (i.e., whether mothers felt supported by their partner) rather than actual involvement, might also explain why this was only indirectly related to social-emotional development of the child through maternal-infant bonding, while no direct association was found. Earlier studies that found an association between paternal involvement and children's social-emotional capacities, included the amount of hours that fathers reported they spent with their child or on childcare tasks (Dubeau et al., 2012; Flouri et al., 2016), fathers' perception of parental roles (e.g., how much importance they attribute to play-interactions with the child; Dubeau et al., 2012), or paternal support as rated by the child itself (Dubowitz et al., 2001). The various measures of father involvement were also found to be differently related to child outcomes. For example, fathers' time spent on household and childcare tasks was related to prosocial behavior of the child, whereas paternal availability and presence in the home was not (Dubeau et al., 2012), further suggesting that the type of involvement measure plays a role. Furthermore, there seems to be a discrepancy in maternal and paternal ratings of father's involvement in childcare. For example, fathers have been found to report a greater frequency of involvement compared to mothers' rating of their partners' engagement (Mikelson, 2008), potentially explaining the inconsistent findings. Moreover, mothers' emotional perception of the support provided by her partner might affect maternal mental health and behavior specifically, whilst partner involvement as measured in the previous studies can potentially have a more direct effect on child development. It should be noted that the selection of the current sample may also play a role, as this was, in part, based on elevated levels of depression which are known to influence how interactions with others are perceived and interpreted (Kupferberg et al., 2016). Nevertheless, we demonstrated that partner support was indirectly associated with social-emotional development of the child through maternal-infant bonding, emphasizing the importance of having a supportive partner throughout pregnancy and after birth.

Strengths of the present study are the longitudinal design with assessments during pregnancy and the postpartum period, as well as a follow up at 2 years after childbirth. In contrast to earlier studies, maternal-infant bonding and partner support were assessed both pre- and postnatally, which enabled analyses of different pathways and direct and indirect effects on social-emotional development in early life. In addition, maternal-infant bonding during pregnancy and the postpartum period were assessed using the same questionnaire, allowing for a reliable assessment of bonding throughout the transition into parenthood. Furthermore, we controlled for various potential confounders in the analyses, enabling us to examine the independent contribution of maternal-infant bonding and partner support on child development. However, this study also has limitations. First, women participating in the current study were overall highly educated and few had an ethnic minority background, which may limit generalizability to the general population. Second, clinically relevant differences were found between the current sample and women participating in the original cohort (e.g., lower levels of maternal-infant bonding). This was not unexpected since one of the selection criteria for the follow up study was elevated levels of depression during pregnancy and/or postpartum, which have been associated with, among others, impaired maternal-infant bonding. These selection criteria may have had an impact on our results in an unknown way and further limit

generalizability of the current findings, since we included a relatively high-risk sample that was potentially characterized by lower levels of bonding. This may be particularly relevant for prenatal bonding since this represent thoughts and fantasies on the child, which may be more strongly affected by feelings of depression. Third, mothers self-reported on their feelings towards their child and perceived partner support, as well as on their children's social-emotional capacities, which might potentially bias the results. However, we controlled for maternal depressive symptoms during pregnancy and at times of completing the questionnaire on child social-emotional development, taking potential bias due to depression into account.

Future research might consider examining the role of parenting behavior (e.g., parental sensitivity) and maternal social competencies in relation to maternal-infant bonding and child development. Partner involvement could be assessed in terms of hours spent on childcare tasks, specifically using diary studies or experience sampling methods, for example. In addition, it would be interesting to include partner involvement alongside perceived partner support to examine associations with maternal-infant bonding, as well as potentially more direct effects on child development. Finally, facets of social-emotional development could be separated and examined individually, as different patterns of relations with bonding and partner support could emerge. The present study contributed to the literature by examining different pathways from maternal-infant bonding and partner support to social-emotional development of the child. Complementary to earlier work, pre- and postnatal measures were included, and direct and indirect effects were tested. Our results confirm earlier findings that an emotional bond from mother to child develops during pregnancy and that this lays a foundation for positive maternal-infant bonding after birth and social-emotional capacities in early childhood. Additionally, having a supportive partner during pregnancy and postpartum, might be essential for the development of optimal maternal-infant bonding. Our results emphasize the importance of monitoring maternal-infant bonding quality during pregnancy and postpartum, and actively involving partners in pregnancy and prenatal health care.

Ethical approval

The HAPPY study was approved by the Ethical Board of Tilburg University and has been evaluated by the Medical Ethical Committee of the Máxima Medical Centre Veldhoven. The follow up study was approved by the Medical Ethics Committee of the Máxima Medical Centre (protocol number NL54558.015.15). The study has been carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Funding

This work was supported by Stichting de Weijerhorst.

CRediT authorship contribution statement

Noor de Waal: Conceptualization, Methodology, Formal analysis, Writing – original draft. **Myrthe G.B.M. Boekhorst:** Conceptualization, Methodology, Supervision, Writing - review & editing. **Ivan Nyklíček:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Victor J.M. Pop:** Conceptualization, Methodology, Writing – review & editing, Supervision.

Declarations of interest

None.

Data Availability

Data will be made available on request.

Acknowledgements

The authors thank all midwife practices for their support in recruitment and all women for their participation in the study. In addition, the authors thank all the researchers for their contribution to the data collection.

References

Arbuckle, J.L. (2014). *Amos (Version 23.0)*. In IBM SPSS.

Behrendt, H. F., Scharke, W., Herpertz-Dahlmann, B., Konrad, K., & Firk, C. (2019). Like mother, like child? Maternal determinants of children's early social-emotional development. *Infant Mental Health Journal, 40*(2), 234–247. https://doi.org/10.1002/imhj.21765

Berg, A. (2016). The importance of the first 1 000 days of life. *Journal of Child & Adolescent Mental Health, 28*(2), iii–vi. https://doi.org/10.2989/17280583.2016.1223803

Bergink, V., Kooistra, L., Lambregtse-van den Berg, M. P., Wijnen, H., Bunevicius, R., van Baar, A., & Pop, V. (2011). Validation of the Edinburgh Depression Scale during pregnancy. *The Journal of Psychosomatic Research, 70*(4), 385–389. https://doi.org/10.1016/j.jpsychores.2010.07.008

Bernard, K., Nissim, G., Vaccaro, S., Harris, J. L., & Lindhiem, O. (2018). Association between maternal depression and maternal sensitivity from birth to 12 months: a meta-analysis. *Attachment & Human Development, 20*(6), 578–599. https://doi.org/10.1080/14616734.2018.1430839

Bicking Kinsey, C., & Hupcey, J. E. (2013). State of the science of maternal-infant bonding: a principle-based concept analysis. *Midwifery, 29*(12), 1314–1320. https://doi.org/10.1016/j.midw.2012.12.019

Bjornsdotter, A., Enebrink, P., & Ghaderi, A. (2013). Psychometric properties of online administered parental strengths and difficulties questionnaire (SDQ), and normative data based on combined online and paper-and-pencil administration. *Child and Adolescent Psychiatry and Mental Health, 7*(1), 40. https://doi.org/10.1186/1753-2000-7-40

Boekhorst, M., Beerthuizen, A., Van Son, M., Bergink, V., & Pop, V. J. M. (2020). Psychometric aspects of the Tilburg Pregnancy Distress Scale: Data from the HAPPY study. *Archives of Women's Mental Health, 23*(2), 215–219. https://doi.org/10.1007/s00737-019-00974-4

Brandon, A. R., Pitts, S., Denton, W. H., Stringer, C. A., & Evans, H. M. (2009). A history of the theory of prenatal attachment. *Journal of Prenatal & Perinatal Psychology & Health, 23*, 201–222.

Branjerdporn, G., Meredith, P., Strong, J., & Garcia, J. (2017). Associations between maternal-foetal attachment and infant developmental outcomes: A systematic review. *Matern Child Health J, 21*(3), 540–553. https://doi.org/10.1007/s10995-016-2138-2

Brockington, I. F., Fraser, C., & Wilson, D. (2006). The postpartum bonding questionnaire: A validation. *Archives of Women's Mental Health, 9*(5), 233–242. https://doi.org/10.1007/s00737-006-0132-1

Cannella, B. L. (2005). Maternal-fetal attachment: an integrative review. *Journal of Advanced Nursing, 50*(1), 60–68. https://doi.org/10.1111/j.1365-2648.2004.03349.x

Cohen, K., Capponi, S., Nyamukapa, M., Baxter, J., Crawford, A., & Worly, B. (2016). Partner involvement during pregnancy and maternal health behaviors. *Maternal and Child Health Journal, 20*(11), 2291–2298. https://doi.org/10.1007/s10995-016-2048-3

Cornish, A. M., McMahon, C. A., Ungerer, J. A., Barnett, B., Kowalenko, N., & Tennant, C. (2006). Maternal depression and the experience of parenting in the second postnatal year. *Society for Reproductive and Infant Psychology, 24*, 121–132. https://doi.org/10.1080/02646830600644021

Cox, J. L., Holden, J. M., & Sagovsky, R. (1987). Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry, 150*, 782–786. https://doi.org/10.1192/bjp.150.6.782

Coyne, L. W., Low, C. M., Miller, A. L., Seifer, R., & Dickstein, S. (2007). Mothers' empathic understanding of their toddlers: Associations with maternal depression and sensitivity. *Journal of Child and Family Studies, 16*, 483–497. https://doi.org/10.1007/s10826-006-9099-9

Cuijlits, I., van de Wetering, A. P., Endendijk, J. J., van Baar, A. L., Potharst, E. S., & Pop, V. J. M. (2019). Risk and protective factors for pre- and postnatal bonding. *Infant Mental Health Journal, 40*(6), 768–785. https://doi.org/10.1002/imhj.21811

Cuijlits, I., Van de Wetering, A. P., Potharst, E. S., M., T. S. E, Van Baar, A. L., & Pop, V. J. M. (2016). Development of a pre- and postnatal bonding scale (PPBS). *Psychology & Psychotherapy, 6*(5). https://doi.org/10.4172/2161-0487.1000282

da Rosa, K. M., Scholl, C. C., Ferreira, L. A., Trettim, J. P., da Cunha, G. K., Rubin, B. B., Martins, R. D. L., Motta, J., Fogaca, T. B., Ghisleni, G., Pinheiro, K. A. T., Pinheiro, R. T., Quevedo, L. A., & de Matos, M. B. (2021). Maternal-fetal attachment and perceived parental bonds of pregnant women. *Early Human Development, 154*, Article 105310. https://doi.org/10.1016/j.earlhumdev.2021.105310

Darvill, R., Skirton, H., & Farrand, P. (2010). Psychological factors that impact on women's experiences of first-time motherhood: A qualitative study of the transition. *Midwifery, 26*(3), 357–366. https://doi.org/10.1016/j.midw.2008.07.006

De Cock, E. S., Henrichs, J., Vreeswijk, C. M., Maas, A. J., Rijk, C. H., & van Bakel, H. J. (2016). Continuous feelings of love? The parental bond from pregnancy to toddlerhood. *Journal of Family Psychology, 30*(1), 125–134. https://doi.org/10.1037/fam0000138

De Cock, E. S. A., Henrichs, J., Klimstra, T. A., Janneke, B. M. M. A., Vreeswijk, C., Meeus, W. H. J., & van Bakel, H. J. A. (2017). Longitudinal associations between parental bonding, parenting stress, and executive functioning in toddlerhood. *Journal of Child and Family Studies, 26*(6), 1723–1733. https://doi.org/10.1007/s10826-017-0679-7

Dubeau, D., Coutu, S., & Lavigueur, S. (2012). Links between different measures of mother/father involvement and child social adjustment. *Early Child Development and Care, 183*, 791–809. https://doi.org/10.1080/03004430.2012.723442

Dubowitz, H., Black, M. M., Cox, C. E., Kerr, M. A., Litrownik, A. J., Radhakrishna, A., English, D. J., Schneider, M. W., & Runyan, D. K. (2001). Father involvement and children's functioning at age 6 years: a multisite study. *Child Maltreatment, 6*(4), 300–309. https://doi.org/10.1177/1077559501006004003

Faisal-Cury, A., Bertazzi Levy, R., Kontos, A., Tabb, K., & Matijasevich, A. (2020). Postpartum bonding at the beginning of the second year of child's life: the role of postpartum depression and early bonding impairment. *Journal of Psychosomatic Obstetrics & Gynecology, 41*(3), 224–230. https://doi.org/10.1080/0167482X.2019.1653846

Flouri, E., Midouhas, E., & Narayanan, M. K. (2016). The relationship between father involvement and child problem behaviour in intact families: A 7-year cross-lagged study. *Journal of Abnormal Child Psychology, 44*(5), 1011–1021. https://doi.org/10.1007/s10802-015-0077-9

Graignic-Philippe, R., Dayan, J., Chokron, S., Jacquet, A. Y., & Tordjman, S. (2014). Effects of prenatal stress on fetal and child development: a critical literature review. *Neuroscience & Biobehavioral Reviews, 43*, 137–162. https://doi.org/10.1016/j.neubiorev.2014.03.022

Guney, E., & Ucar, T. (2019). Effect of the fetal movement count on maternal-fetal attachment. *Japan Journal of Nursing Science, 16*(1), 71–79. https://doi.org/10.1111/jjns.12214

Johnson, S., Waheed, G., Manktelow, B. N., Field, D. J., Marlow, N., Draper, E. S., & Boyle, E. M. (2018). Differentiating the preterm phenotype: Distinct profiles of cognitive and behavioral development following late and moderately preterm birth. *The Journal of Pediatrics, 193*, 85–92 e81. https://doi.org/10.1016/j.jpeds.2017.10.002

Junge, C., Garthus-Niegel, S., Slinning, K., Polte, C., Simonsen, T. B., & Eberhard-Gran, M. (2017). The impact of perinatal depression on children's social-emotional development: A longitudinal study. *Maternal and Child Health Journal, 21*(3), 607–615. https://doi.org/10.1007/s10995-016-2146-2

Kirova, K., & Snell, T. (2019). Women's experiences of positive postnatal partner support. *Journal of Reproductive and Infant Psychology, 37*(2), 206–218. https://doi.org/10.1080/02646838.2018.1542120

Kline, R. B. (2010). *Principles and Practice of Structural Equation Modeling.* The Guilford Press.

Kommers, D. R., Truijens, S. E. M., Oei, S. G., Bambang Oetomo, S., & Pop, V. J. M. (2017). Antenatal mother-infant bonding scores are related to maternal reports of infant crying behaviour. *Journal of Reproductive and Infant Psychology, 35*(5), 480–492. https://doi.org/10.1080/02646838.2017.1354360

Kupferberg, A., Bicks, L., & Hasler, G. (2016). Social functioning in major depressive disorder. *Neuroscience & Biobehavioral Reviews, 69*, 313–332. https://doi.org/10.1016/j.neubiorev.2016.07.002

Le Bas, G. A., Youssef, G. J., Macdonald, J. A., Mattick, R., Teague, S. J., Honan, I., McIntosh, J. E., Khor, S., Rossen, L., Elliott, E. J., Allsop, S., Burns, L., Olsson, C. A., & Hutchinson, D. M. (2021). Maternal bonding, negative affect, and infant social-emotional development: A prospective cohort study. *Journal of Affective Disorders, 281*, 926–934. https://doi.org/10.1016/j.jad.2020.11.031

Le Bas, G. A., Youssef, G. J., Macdonald, J. A., Rossen, L., Teague, S. J., Kothe, E. J., McIntosh, J. E., Olsson, C. A., & Hutchinson, D. M. (2020). The role of antenatal and postnatal maternal bonding in infant development: A systematic review and meta-analysis. *Social Development, 29*, 3–20. https://doi.org/10.1111/sode.12392

Leis, J. A., Heron, J., Stuart, E. A., & Mendelson, T. (2014). Associations between maternal mental health and child emotional and behavioral problems: Does prenatal mental health matter? *Journal of Abnormal Child Psychology, 42*(1), 161–171. https://doi.org/10.1007/s10802-013-9766-4

Liew, J. (2012). Effortful control, executive functions, and education: Bringing self-regulatory and social-emotional competencies to the table. *Child Development Perspectives, 6*(2), 105–111. https://doi.org/10.1111/j.1750-8606.2011.00196.x

Lindgren, K. (2001). Relationships among maternal fetal attachment, prenatal depression, and health practices in pregnancy. *Research in Nursing & Health, 24*, 203–217.

Lopes, P. N., Nezlek, J. B., Extremera, N., Hertel, J., Fernandez-Berrocal, P., Schutz, A., & Salovey, P. (2011). Emotion regulation and the quality of social interaction: does the ability to evaluate emotional situations and identify effective responses matter? *Journal of Personalized Medicine, 79*(2), 429–467. https://doi.org/10.1111/j.1467-6494.2010.00689.x

Luce, K. H., Winzelberg, A. J., Das, S., Osborne, M. I., Bryson, S. W., & Taylor, C. B. (2007). Reliability of self-report: paper versus online administration. *Computers in Human Behavior, 23*, 1384–1389. https://doi.org/10.1016/j.chb.2004.12.008

Mason, Z. S., Briggs, R. D., & Silver, E. J. (2011). Maternal attachment feelings mediate between maternal reports of depression, infant social–emotional development, and parenting stress. *Journal of Reproductive and Infant Psychology, 29*, 382–394. https://doi.org/10.1080/02646838.2011.629994

McNamara, J., Townsend, M. L., & Herbert, J. S. (2019). A systemic review of maternal wellbeing and its relationship with maternal fetal attachment and early postpartum bonding. *PLoS One, 14*(7), Article e0220032. https://doi.org/10.1371/journal.pone.0220032

Medina, N. Y., Edwards, R. C., Zhang, Y., & Hans, S. L. (2021). A longitudinal investigation of young mothers' prenatal attachment, depressive symptoms, and early parenting behaviour. *Journal of Reproductive and Infant Psychology*, 1–16. https://doi.org/10.1080/02646838.2021.1886257

Mikelson, K. S. (2008). He said, she said: Comparing mother and father reports of father involvement. *Journal of Marriage and Family, 70*(3), 613–624. ⟨https://www.jstor.org/stable/40056355⟩.

Morris, A. S., Silk, J. S., Steinberg, L., Myers, S. S., & Robinson, L. R. (2007). The role of the family context in the development of emotion regulation. *Social Development, 16*(2), 361–388. https://doi.org/10.1111/j.1467-9507.2007.00389.x

Parfitt, Y., & Ayers, S. (2014). Transition to parenthood and mental health in first-time parents. *Infant Mental Health Journal, 35*(3), 263–273. https://doi.org/10.1002/imhj.21443

Pilkington, P. D., Whelan, T. A., & Milne, L. C. (2016). Maternal crying and postpartum distress: the moderating role of partner support. *Journal of Reproductive and Infant Psychology, 34*(1), 64–76. https://doi.org/10.1080/02646838.2015.1067884

Pop, V. J. M., Pommer, A. M., Pop-Purceleanu, M., Wijnen, H. A., Bergink, V., & Pouwer, F. (2011). Development of the tilburg pregnancy distress scale: The TPDS. *BMC Pregnancy Childbirth, 11*, 80. https://doi.org/10.1186/1471-2393-11-80

Rolle, L., Giordano, M., Santoniccolo, F., & Trombetta, T. (2020). Prenatal attachment and perinatal depression: A systematic review. *International Journal of Environmental Research and Public Health, 17*(8). https://doi.org/10.3390/ijerph17082644

Salley, B., Miller, A., & Bell, M. A. (2013). Associations between temperament and social responsiveness in young children. *Infant and Child Development, 22*(3), 270–288. https://doi.org/10.1002/icd.1785

Sanson, A. (2004). Connections between temperament and social development: A review. *Social Development, 13*(1), 142–170.

Stapleton, L. R., Schetter, C. D., Westling, E., Rini, C., Glynn, L. M., Hobel, C. J., & Sandman, C. A. (2012). Perceived partner support in pregnancy predicts lower maternal and infant distress. *Journal of Family Psychology, 26*(3), 453–463. https://doi.org/10.1037/a0028332

Streiner, D. L. (2005). Finding our way: an introduction to path analysis. *The Canadian Journal of Psychiatry, 50*(2), 115–122. https://doi.org/10.1177/070674370505000207

Tichelman, E., Westerneng, M., Witteveen, A. B., van Baar, A. L., van der Horst, H. E., de Jonge, A., Berger, M. Y., Schellevis, F. G., Burger, H., & Peters, L. L. (2019). Correlates of prenatal and postnatal mother-to-infant bonding quality: A systematic review. *PLoS One, 14*(9), Article e0222998. https://doi.org/10.1371/journal.pone.0222998

Truijens, S. E., Meems, M., Kuppens, S. M., Broeren, M. A., Nabbe, K. C., Wijnen, H. A., … Pop, V. J. (2014). The HAPPY study (Holistic Approach to Pregnancy and the first Postpartum Year): design of a large prospective cohort study. *BMC Pregnancy Childbirth, 14*, 312. https://doi.org/10.1186/1471-2393-14-312

Van Baar, A. L., Steenis, L. J. P., Verhoeven, M., & Hessen, D. J. (2014). Bayley-III-NL. Technische handleiding. *Pearson Assessment and Information, B V*.

Wilson, K. R., & Prior, M. R. (2011). Father involvement and child well-being. *Journal of Paediatrics and Child Health, 47*(7), 405–407. https://doi.org/10.1111/j.1440-1754.2010.01770.x

Wittkowski, A., Vatter, S., Muhinyi, A., Garrett, C., & Henderson, M. (2020). Measuring bonding or attachment in the parent-infant-relationship: A systematic review of parent-report assessment measures, their psychometric properties and clinical utility. *Clinical Psychology Review, 82*, Article 101906. https://doi.org/10.1016/j.cpr.2020.101906

Zvara, B. J., Schoppe-Sullivan, S. J., & Dush, C. M. (2013). Fathers' involvement in child health care: Associations with prenatal involvement, parents' beliefs, and maternal gatekeeping. *Family Relations, 62*(4), 649–661. https://doi.org/10.1111/fare.12023