

Perinatal depression as a risk factor for child developmental disorders: a cross-sectional study

La depressione perinatale, un fattore di rischio per lo sviluppo del bambino: uno studio caso-controllo

MELANIA MARTUCCI*, GIULIA FAVA¹, NICOLETTA GIACCHETTI², FRANCA ACETI², GIOVANNI GALEOTO³, MATTEO PANFILI², CARLA SOGOS¹

*E-mail: melania.martucci@uniroma1.it

¹Child Neuropsychiatry Unit, Department of Human Neuroscience, Sapienza University of Rome, Italy

²Post-Partum Disorders Unit, Department of Human Neuroscience, Sapienza University of Rome, Italy

³Department of Public Health and Infectious Diseases, Sapienza University of Rome, Italy

SUMMARY. Aims. The first aim of this study, has been to observe the differences in developmental profiles of children of depressed mothers in comparison with children of undepressed mothers in a period from 3 to 12 months after childbirth through a cross-sectional study. The second aim of the study has been to describe the differences of romantic attachment style, mother-child bond and parenting stress of depressed mothers in comparison with a control sample. **Material and methods.** The clinical sample examined consisted of 46 depressed mothers of the Perinatal Psychopathology of an hospital in Rome and their children aged between 3 and 12 months compared with a control sample of 28 mothers without PD and their children matched to cases by age. The children were evaluated by using Bayley Scales of Infant development III. Mothers assessment included Edinburgh Postnatal Depression Scale, Maternal Postpartum Attachment Scale, The Experience in Close Relationships-Revised and The short-form Parenting Stress Index. **Results.** Depressed mothers showed a lower score at the assessment of mother-child bond and an increased parental stress in comparison with the control sample. Children of depressed mothers had lower scores in all Bayley Scales, with statistically significant differences between two groups for all scales. **Conclusions.** Results leads to the importance of including maternal mental health into primary health care to treat depressed mothers and prevent consequences for child development.

KEY WORDS: child development, pregnancy, child care, perinatal depression.

RIASSUNTO. Obiettivi. L'obiettivo principale di questo studio è stato quello di osservare, mediante uno studio caso-controllo, le differenze nei profili di sviluppo dei figli di madri depresse rispetto ai figli di madri non depresse, in un periodo da 3 a 12 mesi dopo il parto. Il secondo obiettivo è stato quello comparare lo stile di attaccamento romantico, il legame madre-figlio e lo stress genitoriale di madri depresse rispetto a un campione di controllo. **Materiale e metodi.** Il campione clinico esaminato era costituito da 46 madri depresse seguite presso la Psicopatologia Perinatale di un ospedale di Roma e dai loro bambini di età compresa tra 3 e 12 mesi, confrontato con un campione di controllo di 28 madri non affette da depressione perinatale e i loro figli della stessa età. I bambini sono stati valutati mediante la somministrazione del test di sviluppo Bayley Scales of Infant Development III. La valutazione delle madri ha incluso la somministrazione dei seguenti test: Edinburgh Postnatal Depression Scale, Maternal Postpartum Attachment Scale, The Experience in Close Relationships-Revised, The short-form Parenting Stress Index. **Risultati.** Le madri depresse hanno mostrato un punteggio inferiore alla valutazione del legame madre-figlio (MPAS) e un aumento dello stress genitoriale (PSI) rispetto al campione di controllo. I figli di madri depresse hanno riportato punteggi inferiori in tutte le scale della Bayley, con differenze statisticamente significative tra i due gruppi per tutte le scale. **Conclusioni.** I risultati sottolineano l'importanza di includere la salute mentale materna nell'assistenza sanitaria di base, per curare le madri depresse e prevenire le conseguenze sullo sviluppo del bambino.

PAROLE CHIAVE: sviluppo del bambino, cura del bambino, depressione perinatale, gravidanza.

INTRODUCTION

Perinatal mental health is a topic of growing interest, with distinct clinical conditions that could affect mothers in such a period of high vulnerability.

Perinatal Depression (PD) is a frequent and debilitating mental disorder, which has become of significant public

health concern¹ especially in the Western developed countries, where it has a prevalence of 10 to 20 percent². PD is a non-psychotic depressive episode that occurs in women either in pregnancy or from 4 weeks to 3 months after childbirth³. Important risk factors for PD are represented by depression and/or anxiety during pregnancy or previous history of depression⁴; life stressors, lack of social support with

low quality of psychosocial support network and a problematic couple life⁵. Moreover, in the latest years the assessment of the quality of attachment has assumed a particular importance in the study of psychological risk factors that predispose the development of affective disorders⁶.

Attachment in childhood can address the ways in which the subject will establish a relationship and build emotional bonds with partners in adulthood (romantic attachment). Thus, individuals who grow up with supportive and responsive parents develop secure attachments. In contrast, insecure attachments are characterized by high levels of Anxiety and/or Avoidance⁷; high levels of discomfort and mistrust of others as reliable attachment figures drive both. Transition to parenthood can be considered a stressful life event that activates the attachment system⁸. Hence, for these reasons we assessed in our sample the quality of attachment to the child and partner, in order to make a comparison between clinical and control sample. Moreover, considering pregnancy as an important life stressor in which there are many transformations from physical, psychological, and relational points of view⁸, we have hypothesized a higher Parental Stress Index in our clinical sample compared with the control sample. Regarding this topic, Rollè et al.⁹ suggested the full mediation effect of mental health between parenting stress and dyadic adjustment. Hence, the comparison between clinical and control sample is useful to provide information about the influence of perinatal depression on stress in childcare.

Furthermore, PD is not only a pathology of the mother but also of the mother-child relationship, considering the consequences of maternal depression on child development.

Depressed mothers present withdrawn and inhibited or intrusive and hyper-controlling behavior. They also often exhibit poor physical and visual contact and difficulty in interpreting child's needs¹⁰.

There are several studies about PD and the consequences on child's psychomotor development, starting from the neonatal age.

Numerous studies showed that the children of mothers with postpartum depression had a higher risk, compared to controls, for the early onset of emotional development disorders and lower emotion recognition at ten years^{11,12} possible neuropsychological or cognitive deficits¹³⁻¹⁵ internalizing and externalizing behavioral disorders¹¹, sleep disturbances^{10,11}, persistent lower growth¹⁶. Several results suggested that maternal depression was related to a characteristic temperament in toddlers¹⁷.

Thus, early difficulties in the mother-child relation may be connected to a negative temperament in the toddler phase, with long-term consequences on the child and adolescent mental health^{17,18}. Wall-Wieler et al.¹⁹, report that children exposed to maternal depression before age 5 have a 17% higher risk of having at least 1 developmental vulnerability at school entry than children not exposed to maternal depression before age 5.

There are currently few studies evaluating children in a period from 3 to 12 months after childbirth. The first year after childbirth is very important if we consider that adequate mother-child interaction influences psychological and emotional development of the child in a period characterized by myelination of the limbic system and maturation of the right hemisphere, with impact also on the cortical areas²⁰.

Currently, there are no studies evaluating the correlations between the variables measured in our study.

Hence, the first aim of this study has been to observe the differences in developmental profiles of children of depressed mothers in comparison with children of undepressed mothers in a period from 3 to 12 months after childbirth through a cross-sectional study. The second aim of the study has been to describe the differences of romantic attachment style, mother-child bond and parenting stress of depressed mothers in comparison with a control sample of mothers with children between 3 and 12 months. The third aim has been to verify if the presence and the severity of PD are related to any particular pattern of attachment, higher parental stress index or lower Bayley scores in children.

MATERIALS AND METHODS

The drafting of the cross-sectional study has been realized according to the guidelines for reporting observational studies: Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement. The current study, initiated in March 2016, is a part of a larger clinical project-intervention conducted by the Perinatal Psychiatry Unit in collaboration with the Child Neuropsychiatry Unit of the Human Neuroscience and Mental Health Department in a hospital in Rome²¹⁻³⁰. The project focus on primary, secondary prevention and treatment of maternal depression to sustain a child-mother relationship in the first years after childbirth.

Participants

The clinical sample examined consisted of a group of patients followed at the Perinatal Psychopathology Service of the Department of Neuroscience and Mental Health of a hospital in Rome, enrolled according to the following inclusion criteria: women with a clinical diagnosis of PD, carried out by a psychiatrist in accordance with the DSM-5³¹ diagnostic criteria, who had a child between 3 and 12 months of age. The exclusion criteria were as follows: the refusal to provide an informed consent, less than 18 years of age, the presence of a diagnosis of mental retardation or schizophrenia spectrum disorder, a poor knowledge of the Italian language or other limitation in verbal communication which compromised the patient's ability to perform the research protocol, diagnosis of chronic or genetic diseases in the child.

The control sample concerned mothers with children aged between 3 months and 12 months recruited by pediatricians.

Exclusion criteria were as follows: the refusal to provide an informed consent, less than 18 years of age, the presence of a diagnosis of PD, mental retardation or schizophrenia spectrum disorder, a poor knowledge of the Italian language or other limitation in verbal communication which compromised the patient's ability to perform the research protocol, diagnosis of chronic or genetic diseases in the child.

Procedure

The study was approved by the local ethics committee and was conducted in accordance with the standards ethics in force on the basis of the Helsinki Declaration of 1964 and subsequent amendments. Mothers were enrolled only after they had given informed consent. Infants were only included if the mother and

Perinatal depression as a risk factor for child developmental disorders: a cross-sectional study

father had given informed consent. The mothers who participated in the study have completed at the time of the first psychiatric visit a semi-structured interview in order to obtain information about sociodemographic aspects, previous medical or psychiatric disorders of the patient or family members, any psychiatric treatments carried out, presence of stressful life events, quality of social support subjectively perceived, presence of maltreatment/neglect in developmental age and abuse and the Edinburgh Postnatal Depression Scale (EPDS)³². At the time of the second visit they have completed mothers psychiatric assessment and at the time of the third visit, children were involved in the evaluation.

Measures

Mothers assessment

The presence of depressive symptoms during the period of pregnancy and postpartum was evaluated using the Edinburgh Postnatal Depression Scale (EPDS)³², a self-assessment questionnaire, consisting of 10 items, which explores the presence of depressive symptoms during the period of pregnancy and postpartum. The recommended cut-off is 12; a score equal to or higher than 12 is considered indicative of moderate or severe major depression. The style of attachment and the way of experiencing relationships in adults was assessed using:

The *Experience in Close Relationships-Revised* (ECR-R)³³, a self-administered questionnaire consisting of 36 questions. The dimension of Anxiety was assessed using 18 items, indicating the presence of concern for romantic relationships, in particular the fear of refusal and abandonment by the partner. The Avoidance dimension, also assessed using 18 items, related to the presence of difficulties and discomfort in relying on and depending on others. From the combination of scores obtained in the two dimensions, it is possible to derive four categories or styles of 'romantic attachment': safe (low anxiety, low avoidance); worried (high anxiety, low avoidance); avoidant (low anxiety, high avoidance); and fearful-avoidant (high anxiety, high avoidance).

The *Maternal Postpartum Attachment Scale* (MPAS) was used as a qualitative indicator of the mother-child bond during the first year of life. This is a self-administered scale consisting of 19 items. The scoring of the items is on a 5-point Likert-type scale (Very often= 1; Never= 5) The emerging range is 19-95. The normative score, which takes into consideration a good mother-child bond in the first year of life, is 81.4³⁴.

The short-form *Parenting Stress Index* (PSI), a test for the early identification of stressful parent-child relational systems, was administered. The Italian version³⁵ exists only in the short form of 36 items, divided into 3 subclasses: parental distress (PSI PD), which measures anxiety and discomfort in the role of parent; dysfunctional parent-child interaction (PSI P-CDI), which highlights the possible negative perception of the child as not meeting expectations; difficult child (PSI DC), who takes into account the child's behavioral characteristics that make them easy or difficult to manage and care for. Some questions enable evaluation of the 'defensive response' (DIF) of the parent: a score ≤ 10 must be interpreted as a failure to recognize or a failure by the parent to admit the ongoing discomfort.

Child development

Child development was assessed by using Bayley Scales of Infant Development – Third Edition (Bayley-III)³⁶ a measure of

infant development between 1 and 42 months. The Bayley scales are built based on the concept that the measure of a certain skill, at a given moment of growth, is not predictive of the subsequent development of the same skill, because the structures underlying the skill itself change qualitatively over time. Bayley-III, consists of five main scales. Three scales (cognitive, motor, language) are administered directly to the child; two scales (socio-emotional and adaptive behavior) are questionnaires for parents. The normative value is 100 ± 15 SD. Cognitive scale includes items that evaluate the sensorimotor development, the memory, the exploration and manipulation of objects, the formation of concepts. Motor scale includes two subtests: fine motor, which assesses visual tracking, the handling of objects, the taking and response to tactile information; gross motor, which evaluates movements related to rolling, crawling, sitting or standing, walking, running and jumping, grasping, imitation, and dynamic movement. Language scale includes receptive communication, which assesses preverbal behavior, vocabulary development and verbal comprehension and expressive communication, which assesses preverbal communication, vocabulary development and morpho-syntactic development. Emotional and social developmental scale evaluates the ability of the child to express and regulate emotional functionality, communication needs, the ability to relate to others, to use emotions in an interactive and targeted way and the use of emotional signals to solve problems. Adaptive behavior evaluates the child's daily functional skills, measuring what the child actually does, beyond what he is able to do (communication, play, personal care, self-control, preschool skills, home life, sociability, activities of movement and exploration in the environment).

Statistical analysis

All statistical analyses were conducted using the SPSS statistical social software science version 25 for Windows. The data were reported as averages and standard deviations for continuous variables and as frequencies (and percentages) for discrete variables. The ANOVA test at one via (one-way analysis of variance) was used to analyze differences between groups (of mothers and children) in continuous variables. The X² test was used to evaluate differences in frequency distributions of discrete variables between groups. The correlation coefficient test *r* of Pearson has been employed to evaluate possible associations of maternal variables and child and to evaluate different associations of the variables examined for mothers. Analyses of correlation were carried out separately for the two groups (clinical and control group). Differences between clinical and control sample have been considered statistically significant with a $p < 0.05$.

RESULTS

Sample characteristics

Of the approximately 150 outpatients who made the first visit in the time frame taken into consideration, only 46 of them met inclusion criteria and agreed to participate in the study. This final sample has been compared with a control sample of 28 undepressed mothers recruited by pediatricians.

The characteristics of the sample are presented in Table 1.

Table 1. Characteristics of the clinical and control sample.

	Clinical mother-child dyads	Control mother-child dyads	P
N	46	28	
Maternal age in years			
Mean (range)	36 (20-49)	34 (20-42)	0.348**
Infant age in months			
Mean (range)	8,7 (5-12)	8,2 (6-12)	0.412**
Infant gender (♂: ♀)	27; 19	18;10	
Employment (%)	55	60	0.340**
Family psychiatric anamnesis (%)	61.4	17.3	0.001*
Stressful events (%)	85.3	27.6	0.001*
Absence of Social support (%)	46.6	13.2	0.001*
Socioeconomic problems (%)	14.7	3.9	0.039*
No partner (%)	8.5	0	0.012*
Abuse/Neglect (%)	13	7	0.320**
Desired Pregnancy (%)	88.4	97.4	0.035*
*statistically significant differences			
**not significant differences			

Mothers assessment

All variables of mothers' assessment showed statistically significant differences between clinical and control sample, exception given for PSI DIF (mean). EPDS showed positive scores in all patients with a score over ten. ECR reported statistically significant differences between the clinical and the control sample in anxiety and avoidance. The clinical sample showed higher anxiety and avoidance compared with the control sample. MPAS showed a subthreshold score in the clinical sample. PSI showed higher scores in all patients compared with the control sample. Results are in Table 2.

Child assessment

Bayley Scales: children of depressed mothers had lower scores in all Bayley Scales, particularly those that assess the adaptive and socio-emotional level, with statistically significant differences between the clinical and the control sample. Results are in Table 3.

Correlations

Correlations have been useful to evaluate possible associations of maternal variables and child developmental scales and to evaluate different associations of the variables examined for mothers.

The study of the correlations between variables within the two groups has highlighted several significant relationships within the clinical group.

The EPDS correlated directly with ECR anxiety dimension ($r=0.441$, $p=0.027$) and ECR avoidant dimension ($r=0.553$, $p=0.003$). The avoidance assessed at the ECR cor-

Table 2. Variables of mothers' assessment. Data represent mean (SD).

Variable	Clinical Sample N=46	Control Sample N=28	p
EPDS mean (SD)	14.80 (6.66)	6.08 (4.07)	0.001*
ECR Anxiety mean (SD)	66.04 (19.49)	48.04 (14.24)	0.001*
ECR Avoidance mean (SD)	50.38 (24.95)	29.22 (7.623)	0.001*
MPAS mean (SD)	71.08 (12.13)	82.33 (9.081)	0.001*
PSI PD mean (SD)	35.65 (9.12)	25.26 (5.702)	0.001*
PSI P-CDI mean (SD)	29.65 (15.96)	17.30 (5.882)	0.001*
PSI DC mean (SD)	27.96 (12.95)	21.56 (7.924)	0.034*
PSI DIF mean (SD)	16.19 (9.191)	14.67 (3.563)	0.436**
PSI Total Stress mean (SD)	93.19 (32.07)	64.04 (17.017)	0.001*
*statistically significant differences			
**not significant differences			

relates inversely with the attachment to the child ($r=-0.531$, $p=0.006$).

The ECR anxiety dimension correlated inversely proportional with the children scores on the Motor ($r=-0.432$, $p=0.035$) and Language ($r=-0.482$, $p=0.017$) Bayley scales.

DISCUSSION AND CONCLUSIONS

The results of our study partly confirm data from the literature, but also suggest new considerations.

Perinatal depression as a risk factor for child developmental disorders: a cross-sectional study

Table 3. Bayley Scales in the clinical and control sample.

Variable	Clinical sample (mean)	Control sample (mean)	p	Clinical sample (%) subthreshold score (≤ 85)	Control sample (%) subthreshold score (≤ 85)
Bayley Cognitive scale	85.91 (13.26) SD	100.93 (6.70) SD	0.001*	54,3	0
Bayley Language scale	88.41 (17.31) SD	97.71 (6.31) SD	0.002*	37	0
Bayley Motor scale	81 (18.89) SD	96.07 (10.6) SD	0.001*	74	14.3
Bayley Socioemotional scale	76.41 (34.13) SD	111.43 (17.04) SD	0.001*	52	3.6
Bayley Adaptive Behavior	48.1 (30.2) SD	97.93 (25.60) SD	0.001*	91	32

Above all, literature underlines a past history of depression, anxiety, or bipolar disorders, as well as psychosocial factors, such as ongoing conflict with partner, poor social support, and ongoing stressful life events, as risk factors for perinatal depression^{37,38}. Consistent with these evidences, we can note a highest presence in our clinical sample of psychological distress in mothers' personal anamnesis and psychiatric problems in their families' clinical history. Socioeconomic problems and absence of social support were more represented in the clinical sample. Hence, most depressed mothers described the perinatal period as a traumatic experience characterized by fatigue and solitude.

Data from romantic attachment style are consistent with evidences suggested by a previous study. Meuti et al.⁸ found that the ECR showed a prevalence of "Fearful-Avoidant" attachment style in depressed mothers (29.2% versus 1.1%, $p < 0.001$); additionally, the EPDS average score increases with the increasing of ECR dimensions (Avoidance and Anxiety).

Mothers of our clinical sample had a diagnosis of moderate/severe PD, assessed by EPDS. Results demonstrated a prevalence of insecure attachment in the clinical sample (63%), assessed by ECR. In particular 44% had a fearful avoidant attachment style (high anxiety, high avoidance), 11% of mothers showed an avoidant style (high avoidance, low anxiety) and 8% of the clinical sample had a worried attachment style (high anxiety, low avoidance). Regarding controls, 85% of the sample had a secure attachment (low anxiety, low avoidance).

MPAS demonstrated a low quality of mother-child bond in the clinical sample, qualitatively evidenced by the mother-child interaction, characterized by poor affective exchanges and eye contact. Moreover, the correlations between anxiety, avoidance, EPDS score and Bayley score provide interesting new information about the relationship between variables concerning the mother and those concerning the child. Anxiety assessed by ECR correlated inversely proportional with the children scores of motor and language scales. Moreover, the EPDS score correlated with anxiety and avoidance assessed by ECR. Hence, increased depressive symptoms were associated to an insecure attachment style and anxiety, in turn, was associated with lower scores at Bayley developmental scales. It seems to suggest a dysfunctional mother-child interaction, in the clinical sample, with consequences on the developmental profiles of the children.

The aforementioned results evidence the vulnerability of depressed mothers and of mother-child relationship, in a period of higher request of tuning with the child's needs. Consequently, childcare seems to be very stressful for depressed mothers. This was demonstrated in the first year after child birth by the results of the Parental Stress Index, where the clinical mothers had higher parental stress scores than the control group mothers.

Several studies, however, analyzed the relationship between perinatal depression and the risk of socio-emotional and psycho-motor developmental delay of the children^{39,40}, but few studies assessed child developmental profile in the first year after childbirth⁴¹. In particular, Sacchi et al.⁴² reported that as maternal depression heightened, a risk for impaired motor development emerged for infants who had high negative emotionality, in the first two years after childbirth.

These data appear interesting if we consider that, in the period in question, the first year of the infant's life, development is mostly determined by the relationship that seems to widely influence and interact with genetically-determined factors.

The relevant literature⁴³ emphasized the importance of a facilitating environment, of a tuned and responsive mother who can facilitate the development of potential and hereditary tendencies of the infant.

Consistent with these data, the results of our study revealed in children of depressed mothers a relevant risk for the areas of motor and cognitive development and, secondarily, of language. Most children in our clinical sample had lower scores on the motor scale (74%) than the control group (14.3%); as well, they had developmental profiles at risk.

This can be explained if we consider that, in this early stage of life, intersubjectivity drives the motor area of development. This, in turn, leads to the development of the self and mind of the baby, especially in the first seven months, precisely because it is through movement that, in the first year, the child experiences his/her cognitive and relational dimension.

These risky situations can evolve differently over time, also depending on the treatment and taking charge. The persistence of an insufficient or inadequate stimulation can transform a reversible functional fact into an irreversible alteration, connected to the failure to activate and organize specific functional activities. In fact, the literature states that

the initial difficulties in the cognitive use of the motor act and the perceptive act can interfere with the development of praxic, symbolic, and communicative skills⁴⁴. Visual interaction, in particular, seems to be very important at the beginning, because it is the basis of sharing and reciprocity, which constitute the platform for building communication and language⁴⁵.

In the baby observation of our research, one of the central clinical features was the observation that these mothers looked at their babies rarely and in a mirroring and painful way; consequently, the babies seemed to avoid eye contact with their mothers. Consistent with this consideration, the mothers of our clinical sample had great difficulty filling out questionnaires about adaptive and socio-emotional level. Hence, children of our clinical sample had lower scores in all Bayley Scales, and particularly in those that assessed the adaptive (91%) and socio-emotional level (51%). Subthreshold scores at these scales, the only ones compiled by the mothers, describe an high risk for child development but these data also reflect the difficulty of depressed mothers to represent the real competencies of their children.

These evidences are consistent with literature but also provide new suggestions regarding the mental state dynamics of women during pregnancy and their influence on children developmental profiles in the first year of life⁴⁶⁻⁴⁹. Moreover, these considerations address to the importance of an early recognition of dysfunctional parenting styles. Actually, if the risk of a delay in child socioemotional and psychomotor development is early identified, immediate planning of the most appropriate intervention becomes possible.

Our results, expanding upon the extant literature, highlight the importance of considering PD as a pathology of the mother-infant relationship and point out that specific mother-infant care should be assumed as an essential primary prevention in mental health.

Limits and future perspectives

Among the limits of the study there is certainly the low sample size. Many mothers did not agree to participate likely for fear of stigma or for intense feelings of guilt towards the child. Future goals include follow-up of mother and child at 24 months. One could also extend the follow-up to the preschool age. This could be the way to take care of the mother-baby bond, as therapy for the dyad.

Author contribution statement. Conceptualization: NG, FA, CS; data curation: MM, GF, MP; investigation: MM, GF, NG, FA, CS, MP; methodology: NG, FA, CS, GG; project administration: NG, FA, CS, GG; formal analysis: GG, CS; writing-original draft: MM, GG, MP; supervision: FA, CS; writing-review & editing: all authors.

All authors contributed to manuscript revision, read, and approved the submitted version.

Conflicts of interest: the authors have no conflict of interests to declare.

Funding: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical statement: the study was approved by the ethic committee of Sapienza University of Rome (Rif.CE:5406) and was conducted in

accordance with the standards ethics in force on the basis of the Helsinki Declaration of 1964 and subsequent amendments.

REFERENCES

1. Wisner KL, Chambers C, Sit DK. Postpartum depression: a major public health problem. *JAMA* 2006; 296: 2616-8.
2. Lee DTS, Chung TKH. Postnatal depression: an update. *Best Pract Res Clin Obstet Gynaecol* 2007; 21: 183-91.
3. Reck C, Hunt A, Fuchs T, et al. Interactive regulation of affect in postpartum depressed mothers and their infants: an overview. *Psychopathol* 2004; 37: 272-80.
4. Ryan D, Milis L, Misri N. Depression during pregnancy. *Can Fam Physician* 2005; 18: 32.
5. McMahon C, Barnett B, Kowalenko N, Tennant C. Psychological factors associated with persistent postnatal depression: past and current relationships, defence styles and the mediating role of insecure attachment style. *J Affect Disord* 2005; 84: 15-24.
6. Ainsworth MDS, Blehar MC, Waters E, Walls S. Pattern of attachment: a psychological study of the strange situation. Hillsdale, NJ, USA: Erlbaum, 1978.
7. Brennan KA, Clark CL, Shaver PR. Self-report measures of adult attachment: an integrative overview. New York, NY, USA: Guilford Press, 1998.
8. Meuti V, Aceti F, Giacchetti N, et al. Perinatal depression and patterns of attachment: a critical risk factor? *Depress Res Treat* 2015; 2015: 105012.
9. Rollé L, Prino LE, Sechi C, et al. Parenting stress, mental health, dyadic adjustment: a structural equation model. *Front Psychol* 2017; 8: 839.
10. Campbell SB, Cohn JF, Meyers T. Depression in first-time mothers: mother-infant interaction and depression chronicity. *Dev Psychol* 1995; 31: 349-57.
11. Gelfand DM, Teti DM. The effects of maternal depression on children. *Clin Psychol Rev* 1990; 10: 329-53.
12. Priel A, Djalovski A, Zeev-Wolf M, Feldman R. Maternal depression impairs child emotion understanding and executive functions: the role of dysregulated maternal care across the first decade of life. *Emotion* 2020; 20: 1042-58.
13. Van der Waerden J, Bernard JY, De Agostini M, et al.; EDEN Mother-Child Cohort Study Group. Persistent maternal depressive symptoms trajectories influence children's IQ: The EDEN mother-child cohort. *Depress Anxiety* 2017; 34: 105-17.
14. Junge C, Garthus-Niegel S, Slinning K, Polte C, Simonsen TB, Eberhard-Gran M. The impact of perinatal depression on children's social-emotional development: a longitudinal study. *Matern Child Health J* 2017; 21: 607-15.
15. Hay DF, Pawlby S, Sharp D, Asten P, Mills A, Kumar R. Intellectual problems shown by 11-year-old children whose mothers had postnatal depression. *J Child Psychol Psychiatry* 2001; 42: 871-89.
16. Pearson J, Tarabulsy GM, Bussières EL. Foetal programming and cortisol secretion in early childhood: a meta-analysis of different programming variables. *Infant Behav Dev* 2015; 40: 204-15.
17. Prenoveau JM, Craske MG, West V, et al. Maternal postnatal depression and anxiety and their association with child emotional negativity and behavior problems at two years. *Dev Psychol* 2017; 53: 50-62.
18. Whelan YM, Leibenluft E, Stringaris A, Barker ED. Pathways from maternal depressive symptoms to adolescent depressive symptoms: the unique contribution of irritability symptoms. *J Child Psychol Psychiatry* 2015; 56: 1092-100.

Perinatal depression as a risk factor for child developmental disorders: a cross-sectional study

19. Wall-Wieler E, Roos LL, Gotlib IH. Maternal depression in early childhood and developmental vulnerability at school entry. *Pediatrics* 2020; 146: e20200794.
20. Burck AM. Book Review: Louis J. Cozolino, *The Neuroscience of Psychotherapy: Healing the Social Brain* (2nd ed.). Fam. J. New York, NY: Norton, 2010.
21. Auletta AF, Cupellaro S, Abbate L, et al. SCORS-G and card pull effect of TAT stories: a study with a nonclinical sample of children. *Assessment* 2020; 27: 1368-77.
22. Manti F, Giovannone F, Sogos C. Parental stress of preschool children with generalized anxiety or oppositional defiant disorder. *Front Pediatr* 2019; 7: 415.
23. Catino E, Di Trani M, Giovannone F, et al. Screening for developmental disorders in 3- and 4-year-old Italian children: a preliminary study. *Front Pediatr* 2017; 5: 181.
24. D'Alvia L, Pittella E, Fioriello F, et al. Heart rate monitoring under stress condition during behavioral analysis in children with neurodevelopmental disorders. 2020 IEEE International Symposium on Medical Measurements and Applications (MeMeA) [Internet]. IEEE 2020, p. 1-6. Available from: <https://bit.ly/3C8jFnv> [accessed 11/11/2021].
25. Pittella E, Fioriello F, Maugeri A, et al. Wearable heart rate monitoring as stress report indicator in children with neurodevelopmental disorders. 2018 IEEE International Symposium on Medical Measurements and Applications (MeMeA) 2018, Rome 1-5. Available from: <https://bit.ly/3c4xxEN> [accessed 11/11/2021].
26. Levi G, Colonnello V, Giacchè R, Piredda ML, Sogos C. Building words on actions: verb enactment and verb recognition in children with specific language impairment. *Res Dev Disabil* 2014; 35: 1036-41.
27. Fioriello F, Maugeri A, D'Alvia L, et al. A wearable heart rate measurement device for children with autism spectrum disorder. *Sci Rep* 2020; 10: 18659.
28. Sperati V, Özcan B, Romano L, et al. Acceptability of the transitional wearable companion "+me" in children with autism spectrum disorder: a comparative pilot study. *Front Psychol* 2020; 11: 951.
29. Levi G, Colonnello V, Giacchè R, Piredda ML, Sogos C. Grasping the world through words: from action to linguistic production of verbs in early childhood. *Dev Psychobiol* 2014; 56: 510-6.
30. Levi G, Sogos C, Mazzei E, Paolesse C. Depressive disorder in preschool children: patterns of affective organization. *Child Psychiatry Hum Dev* 2001; 32: 55-69.
31. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders, DSM-5*. Washington, DC: American Psychiatric Association, 2013.
32. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *Br J Psychiatry* 1987; 150: 782-6.
33. Picardi A, Vermigli P, Toni A, D'Amico R, Bitetti D, Pasquini P. Il questionario «Experiences in Close Relationships» (ECR) per la valutazione dell'attaccamento negli adulti: ampliamento delle evidenze di validità per la versione italiana. *J Psychopathol* 2002; 8: 282-94.
34. Scopesi A, Viterbori P, Sponza S, Zucchinetti P. Assessing mother-to-infant attachment: the Italian adaptation of a self-report questionnaire. *J Reprod Infant Psychol* 2004; 22: 99-109.
35. Abidin R. *The Parenting Stress Index Short Form*. Charlottesville: Pediatric Psychology Press, 1990.
36. Bayley N. *Bayley scales of infant and toddler development*. Third edition. San Antonio, TX: Harcourt Assessment, 2006.
37. O'Hara MW, Wisner KL. Perinatal mental illness: definition, description and aetiology. *Best Pract Res Clin Obstet Gynaecol* 2014; 28: 3-12.
38. Joseph GF Jr. Perinatal depression. *Best Pract Res Clin Obstet Gynaecol* 2014; 28: 1.
39. Urizar GG Jr, Muñoz RF. Role of maternal depression on child development: a prospective analysis from pregnancy to early childhood. *Child Psychiatry Hum Dev* 2021. doi: 10.1007/s10578-021-01138-1.
40. Tuovinen S, Lahti-Pulkkinen M, Girchenko P, et al. Maternal depressive symptoms during and after pregnancy and child developmental milestones. *Depress Anxiety* 2018; 35: 732-41.
41. Wang H, Zhou H, Zhang Y, Wang Y, Sun J. Association of maternal depression with dietary intake, growth, and development of preterm infants: a cohort study in Beijing, China. *Front Med* 2018; 12: 533-41.
42. Sacchi C, De Carli P, Vieno A, Piallini G, Zoia S, Simonelli A. Does infant negative emotionality moderate the effect of maternal depression on motor development? *Early Hum Dev* 2018; 119: 56-61.
43. Tronick EZ, Weinberg MK. Depressed mothers and infants: failure to form dyadic states of consciousness. In: Murray L, Cooper PJ (eds). *Postpartum depression and child development*. New York, NY, USA: Guilford Press, 1997.
44. Tsao CY. *Motor development in children*, edited by Ermellina Fedrizzi, Giuliano Avanzini, and Paolo Crenna. London: Libbey, 1995.
45. Stern DN. Mother and infant at play: the dyadic interaction involving facial, vocal, and gaze behaviors. In: Lewis M, Rosenblum LA. *The effect of the infant on its caregiver*. Hoboken, NJ: Wiley-Interscience, 1974.
46. Aceti F, Carluccio GM, Meuti V, et al. [Parental care and postpartum depression: a case report]. *Riv Psichiatri* 2012; 47: 221-5.
47. Meuti V, Marini I, Grillo A, et al. MMPI-2: cluster analysis of personality profiles in perinatal depression: preliminary evidence. *Scientific World Journal* 2014; 2014: 964210.
48. Giacchetti N, Roma P, Pancheri C, Williams R, Meuti V, Aceti F. Personality traits in a sample of Italian filicide mothers. *Riv Psichiatri* 2019; 54: 67-74.
49. Martucci M, Aceti F, Giacchetti N, Sogos C. The mother-baby bond: a systematic review about perinatal depression and child developmental disorders. *Riv Psichiatri* 2021; 56: 223-36.