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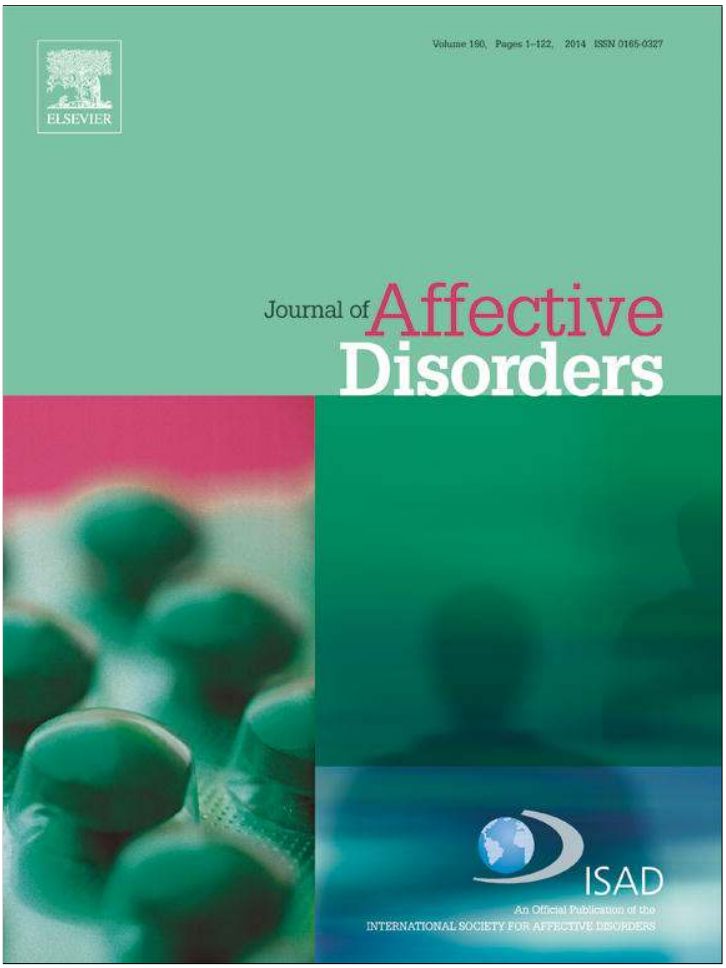

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Research report

Perinatal common mental disorders among women and the social and emotional development of their infants in rural Vietnam

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ABSTRACT

Background: Little is known about the effect of common mental disorders (CMD) among women in the perinatal period on infant development in low-income countries. The aim of this study was to examine the effect of exposures to maternal symptoms of ante- and post-natal CMD on infant social–emotional development in a low-income setting.

Methods: A prospective community-based investigation in which a cohort of pregnant women was recruited in rural northern Vietnam and followed until 6 months postpartum. Psychosocial and biological data were collected in four assessment waves. The outcome was 6-month old infants' scores on the Bayley Scales of Infant and Toddler Development Social–Emotional Questionnaire. Direct and indirect effects of maternal CMD on the outcome were tested simultaneously with path analysis.

Results: Complete data were available for 378 mother–infant dyads. There were no direct effects of ante- or post-natal CMD on infant Social–Emotional scores. However, there was an indirect pathway (path coefficient −1.11, 95% CI −1.79 to −0.42) in which antenatal CMD were associated with increased likelihood of postnatal CMD, which were associated with reduced parenting self-efficacy and less affectionate and warm parenting practices, which were associated with lower infant social–emotional scores. Parenting self-efficacy and practices also mediated the adverse effects of a woman being young or of high parity or experiencing poverty, intimate partner violence, a poor relationship with her own mother, non-economic life adversity and insufficient breastmilk, on infant social–emotional development.

Limitations: We acknowledge some limitations including (1) a moderate rate of attrition, (2) the use of a screening test for perinatal CMD, (3) the Bayley scales are not yet validated for use in Vietnam and (4) possible response bias in which maternal perceptions of their infants were influenced by their mood.

Conclusions: These data indicate that women's antenatal and postnatal mental health is a crucial but currently inadequately understood determinant of the social and emotional development of infants in low-income settings.

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1. Introduction

Brain development is rapid in the foetus and in the first three years of life (McCann and Ames, 2007). Both intrauterine and early life exposures determine early childhood neurodevelopment. Well-established risks include intrauterine iron and iodine deficiencies, foetal growth restriction and, in early life, premature birth, and lack of adequate nutrition, cognitive stimulation, and/or sensitive and responsive care. There is emerging evidence that maternal mental disorders have adverse impacts on both foetal and infant development (Field, 2011; Parsons et al., 2012; Talge et al., 2007).

Common mental disorders, including depression and anxiety among women during pregnancy or in the first postpartum year, are now recognised as a global public health problem. Prevalence

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is much higher in low- and lower-middle income than high-income countries and is highest in women living in the poorest rural communities (Fisher et al., 2012). Pregnant women with a common mental disorder can have chronically elevated levels of stress hormones, which have adverse effects on foetal development via alterations in the maternal–placental–foetal neuroendocrine axis (Wadhwa, 2005; Waxler et al., 2011; Weinstock, 2005). Postnatally, common mental disorders may diminish women's sensitivity, responsiveness and caregiving capabilities, which, in turn can compromise child development (Downey and Coyne, 1990; Lovejoy et al., 2000; Murray et al., 1996; Walker et al., 2011).

In high-income countries maternal ante- and post-natal common mental disorders have been associated with compromised social–emotional development in infants, including increased difficulties in early social engagement (low alertness, high fussiness, low social initiation, delayed vocalisations, low gaze maintenance, and lack of positive affect), more difficult infant temperament and increased fearfulness (Bergman et al., 2008; Davis et al., 2007, 2011; Feldman et al., 2009; Josefsson and Sydsjo, 2007). Maternal antenatal anxiety and ante- and post-natal depression increases the risk of child behavioural/emotional problems at two and half and four years old (O'Connor et al., 2002). There is to date very little evidence available from low-income countries. A small set of investigations has examined the consequences of ante- and post-natal common mental disorders on infant cognitive and motor development in low- and lower-middle income countries (Nasreen et al., 2013; Servili et al., 2010), but as yet there have been no systematic investigations of the relationship between this exposure and the social and emotional development of infants.

Maternal micronutrient deficiencies and the social and economic environment are also relevant with risks accruing and being more common amongst people living in the least-resourced circumstances (Walker et al., 2007). However few studies have examined the interactions among all these risks, and their impact on the separate domains of early childhood development, in particular in the low-income countries where millions of children fail to reach their potential. In these settings most of the limited research that is available has focused on the relationship between individual risks and cognitive development, much less on social–emotional development (Walker et al., 2011).

The aim of this study was to examine the effects of ante- and post-natal common mental disorders symptoms on social–emotional development of 6-month old infants in rural Vietnam. We postulated that maternal antenatal common mental disorders symptoms would influence infant social–emotional development via both direct and indirect pathways (Fig. 1). The hypothesised direct pathway was that common mental disorders symptoms could cause adverse conditions in utero which would affect foetal neurodevelopment and lead, via 'programming' to lasting changes in social–emotional function. The hypothesised indirect pathways were first that maternal common mental disorders symptoms during pregnancy would have adverse effects on birthweight and infant weight; and second that postnatal common mental disorders symptoms, predicted by antenatal common mental disorders symptoms, compromises maternal caregiving and that these mediate effects on infant social–emotional development. Demographic characteristics, other psychosocial factors, infant birth order and sex, and maternal antenatal iron deficiency anaemia have been associated with both the exposure and the main outcome in low-income settings and therefore had to be controlled for as potential confounders.

2. Methods

2.1. Study design

A prospective population-based study of a cohort of pregnant women recruited and assessed before 20 gestational weeks (Wave 1, W1), at about 28 weeks gestation (Wave 2, W2), and, with their infants, at 6 weeks (Wave 3, W3) and 6 months (Wave 4, W4) postpartum.

2.2. Setting

The study was undertaken in Ha Nam, a rural province in the north of Vietnam. Ha Nam has a population of 0.8 million inhabitants most of whom live in lowland rural delta areas. Most women generate income from subsistence agriculture, principally rice farming, and can earn additional income through basket weaving, working in handicraft enterprises or in local industries. In 2011 the average annual per capita income was USD800 compared with USD1260 in the whole country. Pregnant women attend at least one antenatal health check and most give birth at a health service (Fisher et al., 2010).

2.3. Participants and recruitment

Participants were recruited through a two-stage sampling procedure (Fisher et al., 2011, 2013a). First, 50 of the 104 rural communes in the province were selected randomly from a list using the 'sample' command in Stata (StataCorp LP, College Station, Texas, United States of America) by an independent statistician. Second, all pregnant women between 12 and 20 weeks gestation

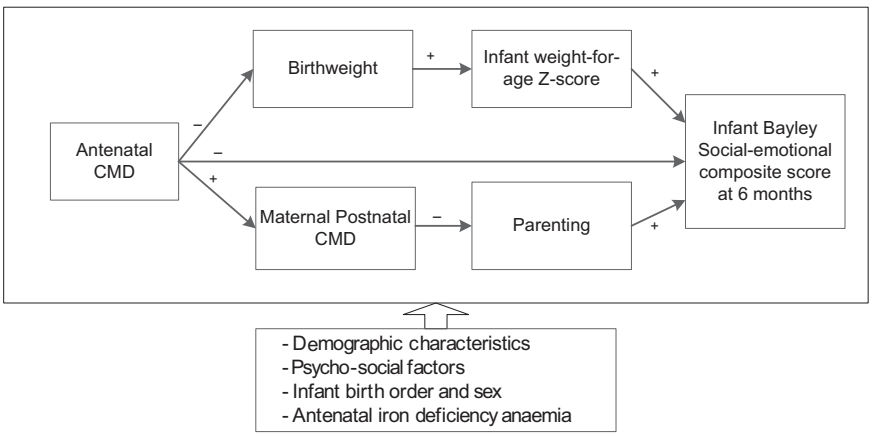

Fig. 1. Conceptual framework of the effect of ante- and post-natal common mental disorders symptoms (CMD) on infant Bayley social–emotional score at six months.

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and living in the selected communes during the enrolment period (December 2009 to January 2010) were eligible and invited to participate.

2.4. Measures

2.4.1. Infant social–emotional development

Social–emotional development was assessed in 6-month old infants (W4) by interviewing the mother using the Bayley Scales of Infant and Toddler Development Social–Emotional Questionnaire, 3rd Ed. (Bayley, 2006a) which was based on The Greenspan Social–Emotional Growth Chart for children from birth to 42 months of age (Greenspan, 2004). At this age, the questionnaire contains 15 items evaluating how infants engage in relationships (emotional expressions and purposeful motor acts in interactions with caregivers and others), and sensory processing, which is the way the infant responds to novel sensations including sights, sounds, touch, smells, movement, and tastes. Mothers rate their infant on each item using a 5-point Likert scale ranging from 1 'none of the time' to 5 'all of the time'. The original validation study demonstrated that the Bayley social–emotional scores distinguish significantly between clinical groups including infants with Down syndrome, Pervasive Developmental Disorder, Cerebral Palsy, Specific Language Impairment, or prenatal alcohol exposure and age-matched control groups (Bayley, 2006c). Alpha coefficients of at least 0.9 for social–emotional items and test-retest correlation coefficient of 0.96 indicate high internal consistency and test–retest reliability (Weiss et al., 2010).

The questionnaire was translated from English into Vietnamese independently by two bilingual Vietnamese health researchers. The two translations were compared and reviewed by a group of clinical psychologists and research workers for meaning, comprehensibility and cultural appropriateness and back-translated to English for verification (Laungani, 2000). The Vietnamese version was pilot-tested in the study sites with a group of 30 mothers of 6-month infants. The results of pilot testing were used to reword and amend the scale before use in this study. Although comprehensible, feasible and acceptable, this scale has not yet been formally validated against a gold standard measure of child development in Vietnam.

The total raw scores of the Bayley Social–Emotional Scale were converted to composite scores based on the guidelines of the Bayley 3rd Edition Manual (Bayley, 2006b). Composite scores range from 55 to 145 with a mean of 100 and a standard deviation of 15 points in the reference population. This transformation allows for a measurement in standard deviation units of how far an infant's score is from the mean or average score at the infant's age $\pm$ 2 weeks.

2.4.2. Common mental disorders

Symptoms of common mental disorders were assessed by the Edinburgh Postnatal Depression Scale-Vietnam Validation (EPDS-V) (Cox et al., 1987; Tran et al., 2011) at all four waves. The EPDS-V includes ten fixed choice items scored from 0 to 3 which yield a total score from 0 to 30. The EPDS-V had been formally validated in a process in which it was translated from the English version, culturally verified and validated against psychiatrist-administered Structural Clinical Interviews for DSM IV diagnoses to establish local cut off scores for pregnant women and those who have recently given birth. Internal reliability is 0.75 (95% CI, 0.71–0.78) and scores $\geq$ 4 detect clinically significant symptoms of common mental disorders (CMD) with a sensitivity of 70% and specificity of 73% (Tran et al., 2011).

2.4.3. Parenting

Self-efficacy and parenting practices were assessed at W4 by interviewing the mother using the parenting measure from the Longitudinal Study of Australian Children (LSAC) Wave 1 Questionnaire for Infants' Parents (http://www.aifs.gov.au/growingup/studyqns/index.html). Those items were drawn by LSAC from The Child Rearing Questionnaire and The Early Childhood Longitudinal study, Birth Cohort 2000 in America (Weston et al., 2006).

Self-efficacy was measured by four items, including self-assessment of how skilled the woman felt at providing routine care, keeping her baby amused, engaged while she was doing housework and calming the baby when s/he was upset or crying. Responses to each of the statements are on a scale from 1 'Very bad' to 10 'Very good'. Parenting practices were assessed in two domains: the warmth and the hostility expressed by the mother towards her baby. Warmth was measured by six items about how often the woman expressed affection by hugging, kissing and holding her baby; hugging or holding her baby for no particular reason; telling the baby how happy s/he makes the mother; enjoying doing things with the baby; and feeling close to the baby when the baby is happy and when the baby is upset. Hostility was measured by five items about how often the woman has been angry with her baby; raised her voice with or shouted at her baby; found when the baby cried that s/he 'got on her nerves'; lost her temper with the baby; and left the baby alone when s/he was particularly irritable or upset. All of the items have three answers 'never/rarely', 'sometimes', and 'always' which were scored 0, 1 and 2 for warmth items and 2, 1, and 0 for hostility items.

In the original LSAC study, raw total scores were used for analyses, but they are more understandable as percentages. The total score of parenting self-efficacy was summed from the four items and divided by the maximum possible score (40) to convert it to a percentage. The total score of parenting practices was calculated by the total of scores of all 11 items divided by 22, the possible maximum score, to convert it into a percentage. Questions on self-efficacy and parenting practices have not yet been validated in Vietnam. However, those were carefully selected, translated and adapted by a group of experienced bilingual researchers and psychologists. Face validity was established in the pilot testing when participants found the items and response options understandable and meaningful.

Breastfeeding (W3 and W4) was assessed by study-specific structured questions including whether or not the infant was being breastfed and whether the mother thought that she had sufficient milk for the baby's needs.

2.4.4. Infant gestational age at birth, birth weight and infant growth (W3 and W4)

The gestational age at birth was calculated from women's reports of the first day of the last normal menstrual period (W1) and the date on which she gave birth (W3). Birth weights were collected by asking the mothers and verifying their reports against the birth certificate. Infant weight was measured by mother–infant scale (Seca 876). Infant weight-for-age *Z* score (WAZ) was calculated from infant's age, sex, and weight by WHO Anthro version 3.2.2 (World Health Organization, January 2011).

2.4.5. Sociodemographic, economic and other health factors (W1, W2, W3, and W4).

Current non-economic coincidental life adversity; quality of relationship with her mother and mother-in-law; family support with housework and in caring for the baby during the daytime and at nightime; reproductive health history including gravidity, parity, history of spontaneous abortions, foetal or neonatal deaths, parity; and whether or not the pregnancy was welcome were

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collected by study-specific questions which we have found in prior research are comprehensible and meaningful (Fisher et al., 2010; Tran et al., 2012b). Household economic status was assessed by the World Bank method which calculates a Household Wealth Index from information about 17 household characteristics, services and durable assets (Tran, 2004). The lower the index is the poorer the household is. Maternal age, marital status, educational level, and occupational status and security of income were collected by study-specific questions (Fisher et al., 2010). A family support index was summed from the three variables: having support in caring the infant during the day (1: yes; 0; no), during the night (1: yes; 0; no), and help with housework (1: yes; 0; no). The scores of family support ranged therefore from 0 (no support) to 3 (having all of the three kinds of support).

Experiences of violence were assessed at W1 and W4 by section seven (Respondent and her partner) and section ten (Other experiences) of the WHO Multi-Country study on Domestic Violence survey (Garcia-Moreno et al., 2005). This instrument uses structured questions to assess women's lifetime experiences of intimate partner physical (1: yes; 0: no), sexual and emotional abuse (1: yes; 0: no) and childhood abuse (1: yes; 0: no) and any experiences of intimate partner violence since the giving birth (1: yes; 0: no). This questionnaire has been shown to be valid in resource-constrained settings (Garcia-Moreno et al., 2006) and in this setting (Fisher et al., 2013b).

Maternal serum ferritin concentration and haemoglobin concentration were assessed in W1 and W2. Maternal haemoglobin was evaluated in the field from a finger prick blood sample, using a haemoglobinometer (HemoCue AB, Angelholm Sweden). A 3-mL sample of venous blood was taken from pregnant women and centrifuged to harvest serum, frozen at −80 °C. Serum ferritin was evaluated by Chemiluminescent Microparticle ImmunoAssay performed on the Archicentre ci62000 instrument (Abbott, Illinois, USA) at Alfred Pathology Services, Alfred Health, Australia. Criterias for iron deficiency anaemia (IDA) were Hb < 11 g/dl and serum ferritin < 15 ng/mL as recommended by WHO, UNICEF, UNU (2001).

2.5. Procedure

Data were collected by face-to-face structured individual interviews conducted in private rooms at commune health centres between December 2009 and March 2011 by trained and supervised health research staff and psychologists of the Research and Training Centre for Community Development, Hanoi.

Approvals to conduct the study were provided by the Ha Nam Provincial Health Department Ethics Committee, the Vietnam Medical Association Ethics and Scientific Committee and the University of Melbourne's Health Sciences Human Ethics Committee. All participants were given an oral and written plain language description of the study and either signed a consent form, or those who could not write provided a thumbprint or verbal consent witnessed by an independent observer.

2.6. Data analysis

First, traditional models including multiple linear regressions and probit regressions were performed to check the possible contributing factors to each of main elements in the hypothesised model (Fig. 1) including Infant Bayley Social–Emotional scores at 6 months and the mediators, namely maternal postnatal CMD at 8 weeks, maternal self-efficacy, maternal parenting practices, birthweight, and WAZ scores. Second, the direct and indirect effects of maternal antenatal CMD on the infant Bayley Social–Emotional score were tested simultaneously by Path analysis.

The path model was estimated using weighted least-squares with pairwise deletion and the probit link function which are recommended for models combining binary and continuous outcomes. For continuous outcomes (i.e. Bayley social–emotional scores), the analyses produced linear regression coefficients, which can be interpreted as a relationship in which one unit increase in the predictor increases a coefficient unit in the outcome if the other predictors are kept constant. For binary variables (e.g. postnatal CMD), probit regression coefficients were produced. Probit regression coefficients represent the changes in probit index for unit changes in the predictors. The probit coefficients were converted to equivalent odds ratios for more straightforward interpretation (Long, 1997).

To assess the fit of the path model to the observed data, we used Chi-Square Test of Model Fit with p values greater than 0.05 indicating a good fit, Root Mean Square Error Of Approximation (RMSEA) with values less than 0.05 indicating a good fit, and Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) with values greater than 0.95 indicating a good fit (Kline, 2011). Univariate analyses were performed in Stata 11 (StataCorp LP, College Station, Texas, United States of America, 2011). Path analyses were carried out in Mplus Version 7 (Muthén & Muthén, Los Angeles, United States of America, 2012).

3. Results

3.1. Sample characteristics

In total 497/523 pregnant women agreed to participate in the study, a recruitment fraction of 97%. There were 119 (23.9%) women who did not provide complete data all of whom were lost at W2. Of those, two women had a multiple pregnancy and were excluded, nine withdrew, 39 refused to provide blood samples, 15 were not resident as they had returned to live with their families-of-origin to give birth, seven babies were stillborn and 47 had already given birth when the field team visited to collect W2 data. In total, 37 of these 47 women re-joined the study at W3, but as we did not have complete pregnancy data for them they could not be included in these analyses. Overall 378/497 (76.1%) participants provided data at all four surveys and were included in these analyses and their socio-demographic and psychological characteristics are presented in Table 1. The characteristics were identical to those in the previous studies of perinatal women in the same setting (Fisher et al., 2010). There were no significant differences in baseline characteristics including maternal age, education, occupation, reproductive history, economic status, haemoglobin and ferritin levels, and EPDS scores between women who did or did not provide complete data. Median of infant age at W3 was 7.9 weeks (ranging from 5.4 to 10.5 weeks) and at W4 was 6.5 months (ranging from 5.3 to 9.4 months).

3.2. Infant physical and social–emotional development and breastfeeding

Overall, 6.8% (95% CI, 4.3–9.4) of the 378 infants had a low birthweight and mean birthweight was 3.15 kg (SD of 0.40 kg). The mean gestational age at birth was 39.3 weeks (SD of 2.6) and 14.0% (95% CI, 10.1–18.0) of the infants were born before a gestational age of 37 complete weeks. Prevalence of infant underweight (WAZ < −2SD) was 2.3% at 8 weeks old. Infant Bayley Social–Emotional composite scores were distributed approximately normally at 6 months with a mean score of 95.8 (SD of 14.5), which was lower than the US normative mean of 100 ($p < 0.05$). Table 2 presents the mean score of each item in the Bayley Social–Emotional Scale.

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Table 1
Social–demographic, psychological and biological characteristics of 378 mothers who completely provide data in four waves, Ha Nam Province, Vietnam, 2010.

Characteristic	Values
Mother age (years), mean [SD]	26.2 [4.8]
Education level, No. (%)	
Partial or complete primary school (Grades 1–5)	68 (18.0)
Secondary school (Grades 6–9)	202 (53.4)
High school (Grades 10–12)	46 (12.2)
Any post-secondary education	62 (16.4)
Occupation, No. (%)	
Farmer	176 (46.6)
Factory, handcraft worker or retailer	115 (30.4)
Government or private officer	46 (12.2)
Not currently engaged in income-generating activity	41 (10.8)
Parity, No. (%)	
Primiparous	136 (36.0)
Second childbirth	169 (44.7)
Third and more childbirth	73 (19.3)
CMD[a], No. (%)	
Wave 1	147 (38.9)
Wave 2	106 (28.0)
Wave 3	41 (10.8)
Wave 4	47 (12.4)
Lifetime experience of Intimate partner physical or sexual violence, No. (%)	57 (15.1)
Intimate partner emotional abuse and controlling behaviour No. (%)	99 (26.2)
Iron deficiency anaemia, No. (%)	
Wave 1	147 (38.9)
Wave 2	106 (28)

[a] CMD: clinically significant symptoms of common mental disorders (EPDS-V score ≥ 4); Wave 1: 12–20 weeks of gestation; Wave 2: 32+ weeks of gestation; Wave 3: 8 weeks postpartum; Wave 4: 6 months postpartum.

Table 2
Mean scores of Bayley Social–emotional scale items.

Item	Mean score[a]	Standard deviation
1. Takes a calm and enjoyable interest in most sounds.	4.1	1.1
2. You can easily get your child's attention without having to be very dramatic.	4.2	1.0
3. Takes a calm and enjoyable interest in most sights, including colourful or bright things.	4.3	1.0
4. You can easily get your child to look at things without them being very bright or colourful.	3.6	1.3
5. Calmly enjoys touching or being touched by different things.	4.2	1.0
6. You can easily get your child to respond to your touch without having to touch your child firmly to get his or her attention.	4.1	1.1
7. Likes to be swung around, danced with while in your arms, or quickly lifted up in the air.	4.6	0.8
8. You can easily get your child's attention by approaching him or her, or moving him or her around slowly.	4.4	0.9
9. You can help your child to calm down.	4.5	0.8
10. Looks at interesting sights, such as your face or toy.	4.4	0.9
11. Looks at or turn toward interesting sounds.	4.5	0.9
12. Seems happy or pleased when he or she sees a favourite person.	4.6	0.8
13. Responds to people talking or playing with him or her by making sound or faces	4.3	1.0
14. Reaches or point at things, or make distinct sounds to show you what he or she wants.	3.7	1.3
15. Exchanges two or more smiles, other looks, sounds, or action with a favourite person.	4.2	1.1

[a] Score ranging from 1 'none of the time' to 5 'all of the time'

The internal consistency of Bayley Social–Emotional scale in this study assessed by Chronbach's alpha was good (0.76).

Almost all women breastfed their babies (376/378, 99.5%) and 96.5% (365/378) continued to provide babies with at least some breastmilk 6 months postpartum. In total 73.8% (279/378) women appraised their breastmilk supply as being sufficient for the baby's needs.

3.3. Models predicted infant social–emotional development

The multivariable regression model to examine the associations of the main variables collected during pregnancy and infant Bayley Social–Emotional scores at 6 months is presented in Table 3. The results of this model suggest that antenatal CMD was negatively associated with the infant outcome (coefficient = −3.30, 95% CI −6.32; −2.89). In the next step, the pathways of this association were examined through a path analysis.

The correlations among all variables included in the path analysis are listed in Table 4 and path models to predict infant Bayley Social–Emotional scores are presented in Table 5. The path model combines all traditional models to test simultaneously the direct and indirect paths leading from maternal antenatal micronutrient deficiencies and CMD to infant Bayley Social–emotional score at 6 months. The fit indices indicate that the path model fits the data very well, in that all were within the range of perfect fit

Table 3
Multivariable regression analysis of infant Bayley social–emotional scores at 6 months of age by antenatal factors, Ha Nam Province, Vietnam, 2010.

Parameter estimates	Coefficient	95% CI
Antenatal CMD	−3.30	−6.32; −2.89
Antenatal IDA	−1.20	−5.42;3.02
Primiparity	−3.15	−6.79;0.49
Child sex (Boy)	0.86	−2.17;3.89
Mother's low education level (up to grade 9)	−0.11	−1.57;1.35
Household wealth index	0.97	0.03;1.91
Mother age (year)	0.29	−0.05;0.62

(see Table 5). The significant relationships in the path analysis are shown in Fig. 2.

Maternal antenatal CMD and postnatal CMD have no direct significant associations with infant Social–Emotional Bayley Score at 6 months old. However, they have significant indirect associations with infant Social–Emotional Bayley Score at 6 months old in the Path analysis. Postnatal CMD influences the outcome adversely via maternal self-efficacy and parenting practices (path coefficient −1.11, 95% CI −1.79 to −0.42). Due to the association between

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Table 4
Correlation matrix of all variables in the path analysis.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Bayley social–emotional score																
2 Infant WAZ at 8 weeks	0.04															
3 Antenatal CMD	−0.10[a]	−0.10[a]														
4 Antenatal IDA	−0.02	0.05	0.06													
5 Urine iodine concentration at late pregnancy	−0.06	0.07	−0.02	0.10												
6 Infant birthweight	0.04	0.70[a]	−0.09[a]	0.05	0.01											
7 Primiparity	−0.06	−0.21[a]	0.01	−0.09	−0.07	−0.19[a]										
8 Child sex (boy)	0.01	−0.01	−0.05	0.03	0.01	0.05	−0.07									
9 Mother's low education level (up to grade 9)	0.04	0.05	0.10[a]	0.02	0.03	0.08	0.14[a]	0.03								
10 Household wealth index	0.01[a]	0.11	−0.03	−0.01	−0.01	0.11[a]	0.06	−0.01	0.43[a]							
11 Mother age (year)	0.09[a]	0.02	−0.04	−0.08	−0.02	0.04	−0.41[a]	0.07	−0.09[a]	−0.04						
12 Maternal postnatal CMD	−0.08	−0.01	0.30[a]	−0.07	−0.01	0.01	0.14[a]	−0.05	−0.01	−0.01	−0.07					
13 Family support after childbirth	−0.01	0.08	0.03	−0.06	0.01	0.04	−0.17	−0.09	−0.09	−0.05	0.17[a]	0.13[a]				
14 Experience of Intimate partner violence after childbirth	−0.01	−0.11	0.17[a]	0.05	−0.04	−0.10[a]	0.05	−0.03	0.01	−0.02	−0.07	−0.26[a]	−0.01			
15 Self-efficacy	0.33[a]	0.06	−0.10[a]	−0.05	−03	0.06	−0.10[a]	0.04	0.01	0.07	0.02	−0.14[a]	−0.02	−0.01		
16 Parenting practices	0.24[a]	0.09	−0.17[a]	−0.04	−03	0.04	−0.01	−0.03	0.01	0.11[a]	0.14[a]	−0.29[a]	−0.08	−0.14[a]	0.31[a]	
17 Mother perceiving she has sufficient milk for infant's requirements	0.09[a]	0.21[a]	−0.04	−0.05	−02	0.17[a]	−0.01	−0.06	−0.03	−0.01	−0.11[a]	−0.01	0.01	−0.02	0.15[a]	0.07

[a] Statistically significant ($p < 0.05$); CMD: clinically significant symptoms of common mental disorders (EPDS-V score ≥ 4); IDA: iron deficiency anaemia; WAZ: weight-for-age Z score.

antenatal CMD and postnatal CMD, the indirect pathway from antenatal CMD to infant Social–Emotional Bayley Score via postnatal CMD was tested in the path model and it was significant (path coefficient −0.61, 95% CI −1.17 to −0.04). Maternal self-efficacy and parenting practices were the mediators not only of the effect of ante- and post-natal CMD but also of low household wealth, poor quality of a woman's relationship with her own mother, low parity, low maternal age, breastfeeding difficulties, and the mother experiencing intimate partner violence and non-economic life adversity after child birth.

4. Discussion

This was a rigorous prospective investigation, which examined the effects of maternal ante- and post-natal common mental disorders on infant social–emotional development in a resource-constrained setting taking biological and psychosocial risks into account. Path analysis, which was used in this study, allows complete and simultaneous testing of direct and indirect effects of multiple covariates on the outcome of interest. We acknowledge the limitation of a moderate rate of attrition, but most was explicable and there were no differences in the characteristics of women who did or did not provide complete data.

The EPDS screening tool although formally validated against the gold standard of diagnostic psychiatric interviews in rural Vietnam, does not yield diagnoses of depression and anxiety. The clinical cut-off score of EPDS that we used has a sensitivity of 70% and a specificity of 73% to detect CMD, which while moderately high, could lead to some misclassification. In this study, we used the local cut-off ≥ 4 of EPDS-V to detect ante- and post-natal CMD; this cut-off value is lower than that usually used in high-income countries (Cox et al., 1987). The reasons for the choice of the low cut-off score, in brief, are: first, there is generally low emotional literacy in this setting and that people with a limited emotional lexicon, perhaps answer no if the emotional state is not one that they can name; and second, in general expression of any negative emotions is socially proscribed and so there is shame associated with acknowledging them, this shame is possibly related to the history of being a communist state in which the wellbeing of the collective is of much higher importance than the needs or experiences of individuals (Tran et al., 2012a).

Another limitation is that this study also used some assessment tools that are were yet to be formally validated for local use. However, we have carefully carried out the formal process of translation, back-translation, reviewing by local experts, and pilot testing of the scales before using them in this study. The topic of this study, infant social–emotional development, is new in low- and middle-income countries. To our knowledge, there has been no scale assessing infant social–emotional development including the Bayley Social–Emotional Scale having been validated in a low- and middle-income setting. The Bayley Social–Emotional Scale is yet to be formally validated against an external assessment of social and emotional development in young children in Vietnam. Comparisons between the scores of infants in this study and other populations of infants can therefore only be made with caution. The most substantial normative data available for the Bayley Scales are those provided by the test developers from children in the USA. The Cronbach's Alpha value for our data was good (=0.76) indicating that there was high internal consistency in responses to items on the scale. The lower overall mean score in the rural Vietnamese compared with the US sample may be explained by caregiving practices. In the first months of life the experiences of infants in Vietnam are significantly different to those of infants in high-income settings like America. For the first 6 months rural Vietnamese infants are thought to be vulnerable to 'wind', which in the traditional cultural belief system is regarded as the main cause of common illnesses. They are therefore kept inside, often in a darkened room, to avoid 'wind'. These beliefs and practices reduce the baby's chance to acquire new knowledge through exploring the environment, and interacting with people outside their families. It is possible that these caregiving practices limit infants' early social and emotional development.

Finally, infant social–emotional development was assessed by mother's ratings and it is possible that response bias meant that women with CMD reported their parenting practices and observations of their infant's social–emotional development differently from the reports of women without CMD. This bias could lead to over or under-estimation of the effect size of the association

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Table 5
Full path analysis of infant Bayley social–emotional scores at 6 months of age, Ha Nam Province, Vietnam, 2010.

Parameter estimates	Estimate	95% CI
Infant Bayley social–emotional score[a] (*estimate*: *regression coefficient*)		
Infant WAZ at 8 weeks	0.63	−1.62; 2.88
Antenatal CMD	−2.23	−6.27; 1.81
Antenatal IDA	−1.26	−5.47; 2.95
Infant birthweight (kilogram)	−0.54	−4.7; 3.62
Primiparity	−3.00	−6.9; 0.9
Child sex (Boy)	0.69	−2.35; 3.73
Mother's low education level (up to grade 9)	−0.56	−4.73; 3.61
Household wealth index	0.55	−0.45; 1.55
Mother age (year)	0.23	−0.1; 0.56
Maternal postnatal CMD	−0.12	−2.33; 2.09
Family support after childbirth	−0.06	−2.35; 2.23
Experience of Intimate partner violence after childbirth	3.40	−3.89; 10.69
Self-efficacy	0.37	0.25; 0.49
Parenting practices	0.28	0.08; 0.48
Mother having sufficient milk for infant's demand	2.96	−0.78; 6.7
Maternal self-efficacy[b] (*estimate: regression coefficient*)		
Maternal postnatal CMD	−1.70	−3.11; −0.29
Experience of Intimate partner violence after childbirth	4.09	−2.52; 10.7
Primiparity	−0.99	−4.2; 2.22
Mother's low education level (up to grade 9)	−0.84	−4.64; 2.96
Mother age (year)	0.10	−0.19; 0.39
Household wealth index	0.75	−0.09; 1.59
Affectionate relationship with her own mother	−2.58	−6.09; 0.93
Affectionate relationship with mother-in-law	−1.32	−4.26; 1.62
Family support after childbirth	0.68	−1.44; 2.8
Child sex (boy)	0.75	−1.88; 3.38
Welcome pregnancy	−1.57	−6.04; 2.9
Mother having sufficient milk for infant's demand of breastfeeding	4.30	0.2; 8.4
Parenting practices[b] (*estimate: regression coefficient*)		
Maternal postnatal CMD	−1.74	−2.62; −0.86
Experience of Intimate partner violence after childbirth	−2.70	−6.37; 0.97
Experience of childhood abuse	−1.05	−3.52; 1.42
Primiparity	3.04	0.83; 5.25
Mother's low education level (up to grade 9)	−1.74	−4.21; 0.73
Mother age (year)	0.36	0.11; 0.61
Household wealth index	0.63	0.04; 1.22
Affectionate relationship with her own mother	−3.17	−5.31; −1.03
Affectionate relationship with mother-in-law	0.25	−1.63; 2.13
Family support after childbirth	−0.42	−1.99; 1.15
Child sex (boy)	−0.98	−2.65; 0.69
Welcome pregnancy	−0.66	−3.62; 2.3
Mother having sufficient milk for infant's demand	−0.24	−3.08; 2.6
Maternal postnatal CMD (*estimate: probit coefficient*)		
Antenatal CMD at any point	0.99	0.5; 1.48
Non-economic co-incidental life adversity	0.80	0.25; 1.35
Primiparity	0.68	0.21; 1.15
Mother's low education level (up to grade 9)	−0.46	−1.05; 0.13
Mother age (year)	0.01	−0.03; 0.05
Affectionate relationship with her own mother	−0.24	−0.73; 0.25
Affectionate relationship with mother-in-law	0.23	−0.2; 0.66
Experience of Intimate partner violence after childbirth	1.12	0.34; 1.9
Experience of childhood abuse	0.48	−0.01; 0.95
Household wealth index	0.07	−0.07; 0.21
Family support after childbirth	0.23	−0.04; 0.5
Infant WAZ at 8 weeks	0.09	−0.13; 0.31
Child sex (boy)	−0.15	−0.54; 0.24
Antenatal IDA at any point	−0.50	−0.81; −0.2
Infant weight-for-age Z score at 8 weeks (*estimate*: *regression coefficient*)		
Mother having sufficient milk for infant's demand	0.40	0.16; 0.64
Mother's low education level (Up to grade 9)	0.01	−0.17; 0.19
Primiparity	−0.19	−0.37; −0.01
Household wealth index	0.06	0.02; 0.10
Mother age (year)	0.01	−0.01; 0.03
Antenatal IDA	−0.04	−0.24; 0.16
Antenatal CMD	−0.06	−0.20; 0.08
Family support after childbirth	0.06	−0.1; 0.22
Infant birthweight (kilogram)	1.12	0.98; 1.26
Child sex (boy)	0.02	−0.16; 0.2
Infant birthweight - in kilogram (*estimate*: *regression coefficient*)		
Household wealth index	0.03	−0.01; 0.07
Primiparity	−0.19	−0.29; −0.09
Mother's low education level (up to grade 9)	0.01	−0.11; 0.13
Mother age (year)	−0.01	−0.03; 0.01
Antenatal IDA	0.03	−0.11; 0.17
Antenatal CMD	−0.05	−0.13; 0.03
Self-efficacy correlated with parenting practices (*estimate*: *covariance*)	22.5	12.8; 32.2
Indirect effect (*estimate*: *regression coefficient*)		
Maternal postnatal CMD on social–emotional scores via self-efficacy and parenting practices	−1.11	−1.79; −0.42
Maternal antenatal CMD on social–emotional scores via maternal postnatal CMD	−0.61	−1.17; −0.04
Fit indices	**Estimates**	
χ^2/df (p-value)	57.5/62 (0.64)	
RMSEA (Probability RMSEA < =0.05)	< 0.00 (0.99)	
CFI	1.00	
TLI	1.00	

CMD: clinically significant symptoms of common mental disorders (EPDS-V score ≥ 4); CFI: Comparative Fit Index; IDA: iron deficiency anaemia; RMSEA: root mean square error of approximation; TLI: Tucker–Lewis index.

[a] Infant Bayley social–emotional: scores range from 55 to 145.

[b] Maternal self-efficacy and parenting practices: score range from 0 to 100.

between CMD and the infant outcome. However, it would be more likely overestimated because women with CMD could tend to report the development of their infants as being worse than reality. These data extend the observations in high-income countries of an association between antenatal CMD in women and compromised social and emotional development of their infants (Bergman et al., 2008; Carter et al., 2001; Davis et al., 2007; Feldman et al., 2009; O'Connor et al., 2002). However, the statistical methods used in these prior studies could not distinguish indirect and direct effects and therefore they were unable to disaggregate the impact of ante- and post-natal CMD (Bergman et al., 2008; Carter et al., 2001; Davis et al., 2007). Our data, using path analysis, are the first to elucidate these relationships. We found that antenatal CMD did not have a direct effect on the social and emotional domain of infant development. Rather there is an indirect link in which maternal antenatal CMD are associated with increased likelihood of postnatal CMD, which then adversely affect parenting practices that influence the social and emotional development of infants in the first 6 months of life in Vietnam.

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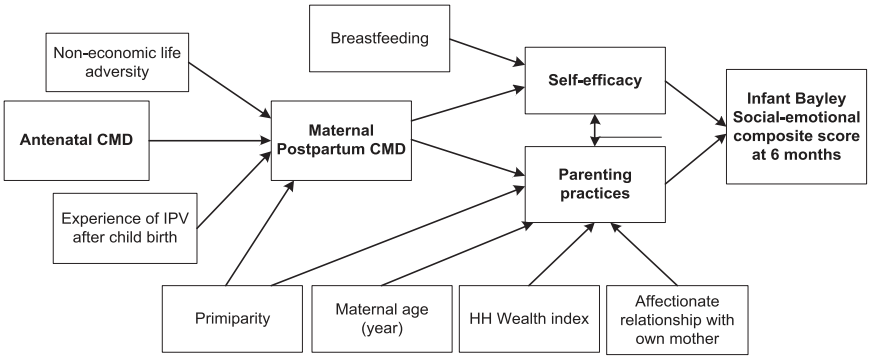

Fig. 2. Significant pathways of the factors of infant Bayley Social-emotional scores at 6months of age, Ha Nam province, Vietnam, 2010. Only significant paths were shown, formore details see Table 3.

- Single-headed solid arrows represent statistically significant directional paths (coefficients in italics are probit coefficients and the converted odds ratios in parentheses (i.e. the coefficients for variables with direct relationships with Maternal Postnatal CMD)).
- Bold path coefficients are the linear regression coefficients (i.e. the coefficients for variables with direct relationships with self-efficacy, parenting practices, and infant Baley social–emotional score).
- The double-headed arrow indicates the variables that are assumed to be correlated (the underlined coefficient is a covariance and its converted correlation coefficient).
- IPV: intimate partner violence; CMD: clinically significant symptoms of common mental disorders (EPDS-V score ≥ 4); HH: household.

The roles of parenting in child growth and development are vital and importantly, potentially modifiable through parenting education (Walker et al., 2011). These data confirm the importance of parenting in infant development from birth (Maughan et al., 2007; Murray et al., 2001; Valenzuela, 1997). In this setting, low parenting self-efficacy and absence of warm parenting were found to mediate the adverse effects of exposures to other hazards to development. Specifically, mothers′ with high parenting self-efficacy and warm affectionate parenting protected the baby against the potential adverse impacts of ante- and post-natal CMD, household poverty, low maternal age, insufficient breast-milk, and poor history of support from their own mother. It is argued that the impacts of parenting factors vary with traditional beliefs and cultural practices. These data indicate to the contrary that the benefits of warm affectionate parenting and the hazards of hostile parental behaviours are universal and affect the social and emotional development of infants in the same way regardless of the setting.

The findings of this study suggest that the caregiving milieu, which is governed by psychosocial factors may be the predominant determinant of infant social–emotional development in low-income settings. These findings have serious implications for researchers, professionals and policy makers who aim to improve infant development in low- and low-middle-income countries. This evidence indicates that interventions to promote early childhood development should include screening for CMD in women during pregnancy and the early postpartum period to identify those who are currently symptomatic and require additional assistance. Evidence-informed and well-evaluated psycho-educational programs for women during the perinatal period including modules to reduce risk factors for ante- and post-natal CMD, improve women′s knowledge about infant development and sensitive, responsive caregiving practices, and foster mutually gratifying interactions with her baby are warranted (Rahman et al., 2013). The greatest benefit is likely to accrue from stepped programs which offer integrated universal programs and more intense targeted strategies for high risk groups including women suffering CMD, who are poor, younger or older than the average age of parturient women, primiparous, and who have difficulties in their relationships with their partners or their own mothers.

Our study confirms that maternal ante- and post-natal mental health problems, which are now more widely recognised in low- and low-middle-income countries (Fisher et al., 2012), are prevalent in rural Vietnam. They lead to adverse indirect effects on social and emotional development which is fundamental to the formation of interpersonal relationships and capacity to participate in society. Future studies using developmental psychology laboratories to assess infant social–emotional development are warranted to confirm the findings of this study.

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Conflict of interest

We declare that we have no conflicts of interest.

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