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The role of maternal depression symptoms and foeto-maternal attachment in predicting exclusive breastfeeding

Title: The role of maternal depression symptoms and foeto-maternal attachment in predicting exclusive breastfeeding: A multi-site prospective study

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Abstract

Background: Previous research shows that 61% of children younger than six months, in low- and middle-income countries (LMICs) are not exclusively breastfed. While data on the role of pre- and postnatal depression on breastfeeding exclusivity is mixed, foeto-maternal attachment might foster breastfeeding exclusivity. Thus, we tested the potential mediating role of foeto-maternal attachment and postnatal depression in the relationship between maternal prenatal depression and exclusive breastfeeding.

Methods: Data were collected as part of a prospective, cross-cultural project, *Evidence-for-Better-Lives-Study,* which enrolled N=1208 expectant mothers, in their third trimester of pregnancy across eight sites, from LMICs. Of the whole sample, N=1185 women (M_{age}=28.32, *SD*=5.77) completed Computer-Aided-Personal-Interviews on prenatal depressive symptoms, foeto-maternal attachment and socio-economic status. N=1054 women provided follow-up data at 3-6 months after birth, about postnatal depressive symptoms, exclusive breastfeeding and infant health indicators. Path analysis was used to assess parallel mediation.

Results: In the whole sample, the effect of prenatal depression on breastfeeding exclusivity was completely mediated by postnatal depression, while foeto-maternal attachment did not mediate the relationship. The full mediation effect was replicated individually in Pakistan and Sri Lanka.

Conclusion: The study results indicate that prenatal depression symptoms contributed to the development of depressive symptoms after birth, negatively affecting the probability of exclusive breastfeeding. Future research should explore this in early prevention interventions, increasing the chances of healthy child development in LMICs. Considering the mixed results around the sites, it is important to better understand the relationship between maternal depression, foeto-maternal attachment and breastfeeding behavior in each site's socio-cultural context.

Abbreviations: LMICs, low- and middle-income countries

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Introduction

The perinatal period is crucial for the long-term development and health of the infant, with maternal mental health factors playing direct and indirect roles in children's development and well-being. Pregnancy is often a time of emotional and psychological change:[1] distress is higher compared to other life phases and there are changes in hormone concentrations, which trigger psychological changes in expectant mothers.[2,3] These factors, together with social and economic precarities, contribute to prenatal stress and, depression, which in turn may have negative effects on children's physical and socio-emotional health.[4]

The prevalence rates of prenatal depression vary and are reported to be higher in many low-income countries(LMICs) compared to high income countries (HICs).[5] Globally, the prevalence rate ranges from 15% to 65% in low- and middle-income countries.[6] The risk of prenatal depression increases as the pregnancy progresses and clinical depressive symptoms are common during second (12.8%) and third trimester (12%).[7,8] This is problematic, as women with clinical prenatal depression are less likely to seek prenatal care and have been reported to have poorer overall physical health as well as psychological health during the prenatal period.[9] These changes may negatively impact physical and psychological health, with effects on foetal development.[4] Perinatal depression may impact foetal development via prolonged intrauterine exposure to stress hormones and affects the serotonergic system and maternal hypothalamic-pituitary-adrenal axis.[10-12] In terms of physical health, evidence suggests that prenatal stress and depression restrict intra-uterine growth and thus further impair weight gain postnatally.[13-15]

Fifty-four percent of women experiencing prenatal depression continue to have depressive symptoms postnatally[16] with the prevalence of postnatal depression ranging from 3.5% to 58.8% in LMICs.[6] Postnatal depression is also a risk factor for malnutrition and common infant diseases.[6] It has negative effects on mother-child attachment and interactions, which in turn have long term effects on the social, cognitive, and behavioral development of the child.[17] Besides this, postnatal depression has adverse effects on mother-caregiving behaviors,[18] one of them being breastfeeding.[16,19]

Maternal depression and breastfeeding

The benefits of exclusive breastfeeding are well-known for both mothers and children.[20-22] Appropriate breastfeeding practices decrease the risk of child morbidity due to diarrhoea,

respiratory infections, otitis media, sudden infant death syndrome, and obesity in the long term.[23-25] For mothers, breastfeeding has a protective effect on the risk of breast cancer ovarian cancer and diabetes.[25,26]

Recent studies have found a strong negative association between three-month exclusive breastfeeding duration and prenatal stressful life events of the mother.[27] Women who experienced stressful events at both 18 and 34 weeks of pregnancy were more likely than those who did not, to stop breastfeeding before the child turned four months old, independently of maternal biomedical factors and socio-demographic characteristics.[28-30] However, some systematic reviews (e.g. Dias & Figueiredo, 2015; Butler et al., 2021)[31,32] suggest that the relationship between prenatal depression and breastfeeding is less straightforward: while some studies show no significant association between prenatal depressive symptoms and breastfeeding duration,[33-34] others suggest that prenatal depressive symptoms predict shorter breastfeeding duration.[35-37]

Regarding breastfeeding exclusivity, the results are also mixed, with some studies showing that prenatal depression was associated with shorter duration of exclusive breastfeeding,[38,39] while others failed to find this positive association.[40,41] Arguably, there are other factors that contribute to exclusive breastfeeding as well, such as social and cultural norms.[42,43] Still, the impact of socio-economic adversities and lack of support for the mother continue to be strong factors associated with early cessation of breastfeeding, consistent with relatively lower rates of exclusive breastfeeding in LMICs compared to HICs[16,44,45] and among women with lower education attainment and lower socio-economic status(SES) compared to their more affluent counterparts.[46]

Therefore, it is crucial to study longitudinally the relationship between maternal depressive symptoms and breastfeeding practices. To the extent that prenatal depression is shown to impact breastfeeding exclusivity, it is also important to examine the possible mechanisms involved. One of these mechanisms, as suggested by previous research could be foeto-maternal attachment.[47]

Foeto-maternal attachment

Foeto-maternal attachment represents 'the unique and affectionate antenatal relationship that develops between a mother and the foetus'.[48] Though there is substantial individual and cultural variance, some evidence from HICs suggests that it beings to emerge around 18-25 weeks of gestation, intensifying in the 3rd trimester.[49] There is evidence that higher levels of foeto-

maternal attachment are associated with better parent-to-infant attachment during the post-partum period.[50] Longitudinally, foeto-maternal attachment predicts behavioral and emotional competencies, promotes development during early childhood and has positive effects on the health and wellbeing of both the mother and the child.[51,52] Higher quality of foeto-maternal attachment is also related to fewer depressive symptoms during the postnatal period.[53] Furthermore, foeto-maternal attachment has important positive implications for the transition to the mother role, the mother being better prepared for child caring.[54,55] It also motivates positive health behaviors as mothers with attachment approach orientations, such as positive views about the foetus tend to breastfeed longer and continue breastfeeding, even when they experience difficulties.[56]

Evidence thus suggests that breastfeeding exclusivity and foetal-maternal attachment foster the mothers' mental health and children's development; however the evidence on the role of maternal depression on breastfeeding exclusivity are mixed. Further research is needed to better understand these relationships. Thus, the present study sought to investigate whether and to what extent foetal-maternal attachment and postnatal depression are predicted by prenatal depression and whether they, in turn, influence breastfeeding exclusivity. Exploration of these relationships becomes particularly relevant for LMICs where depression prevalence is high,[6,57] while the breastfeeding exclusivity rates are relatively low.[25]

Moreover, there are relatively few studies that focus on the relationship between maternal depression, foetal-maternal attachment, and breastfeeding exclusivity in a longitudinal design. Additionally, since most of the studies on the relationship between prenatal depressive symptoms and breastfeeding were conducted in HICs, there is a particular need to focus our attention to LMICs.[32]

Therefore, the main aim of the present study is to test the potential mediating role of maternal-foetal attachment and postnatal depression in the relationship between prenatal depression and exclusive breastfeeding in mothers coming from eight LMICs around the world.

This research utilized the data from the Evidence for Better Lives Study (EBLS) birth cohort study, conducted in eight sites from LMICs with the aim of finding evidence to inform effective interventions to reduce violence against children and support psycho-social well-being for both mothers and children.[58]

Materials and Methods

Participants

EBLS included eight culturally different, medium-sized cities in LMICs across the world, namely (from West to East): Kingston (Jamaica), Koforidua (Ghana), Worcester (South Africa), Cluj-Napoca (Romania), Tarlai (Pakistan), Ragama (Sri Lanka), Hue (Vietnam) and Valenzuela (Philippines). A convenience sample of around 150 pregnant women in each study site ($N = 1208$ in total for baseline) was used. The first measurement wave was carried out in the third trimester of pregnancy, while the second one was done between 3 to 6 months after birth ($N = 1033$ for the follow-up). Pregnant women were recruited from local health centers and deemed eligible for the study if they met the following inclusion criteria: 1) expectant mothers were in the third trimester of their pregnancy for the first wave (i.e. weeks 28-40), 2) they were 18 years old or older, 3) had their main residence within the study area and were not planning to relocate (could be followed-up), 4) were able to give written, informed consent.

Procedure

The study aimed to achieve a sample that included diverse social backgrounds within the study area. Each local team targeted a specific number of local medical centers (family doctors' offices, obstetrics clinics). With the agreement and collaboration of the medical centers, the participants were recruited either by the medical staff, who briefly presented the study or asked the expectant mothers if they were willing to meet one of the research team members, or directly by the fieldworkers, trained for recruitment and data collection, in the medical setting where the mothers were attending prenatal check-ups. Pregnant women who were interested in the study were given more detailed information regarding the study and were screened to establish their eligibility for participation. Informed consent was collected from all eligible participants.

The eligible participants had the opportunity to continue the interview immediately after consent in a special room at the health unit or if they were not available at that time, the data collection interview was rescheduled. The questionnaires were administered using tablets via a mix of Computer-Aided Personal Interviews (CAPI) and Audio-supported computer- assisted self-interviewing (A-CASI) for sensitive information.. When children were between 3 to 6 months, the mothers were re-contacted for a brief interview which was conducted at a special unit or at

the mother's home. CAPI were also used at this time. All mothers received incentives for their participation at both measurement times.

All documents and questionnaires for baseline and follow up were translated and adapted into participants' native languages (WHO, 2014), using an internal standardized protocol.

The study was approved by the ethics committees of the University of Cambridge and the universities/research institutes in each country prior to data collection.

Measures

Prenatal and postnatal depression-The Patient Health Questionnaire (PHQ-9)

The PHQ-9 is the depression module included in The Patient Health Questionnaire[60] which is a self-administered diagnostic instrument for common mental disorders. It consists of 9 items, based on the DSM-IV criteria for depression diagnosis (e.g. "Feeling down, depressed or hopeless", "Little interest or pleasure in doing things"). The total score can range from 0 to 27, each of the 9 items having a four-point Likert scale rage answer, from 0 (not at all) to 3 (nearly every day). The possible total score ranges from 0 to 27. Cut-points of 5, 10, 15, and 20 represent "mild", "moderate", "moderately severe" and "severe depression". In the present study, the questionnaire has acceptable internal consistency scores, α =.76 (prenatal period), α =.73 (postnatal period) and test-retest reliability on average of r = .81. Further details on PHQ-9's psychometrics functions in the current sample are reported in Murray et al. (2022).[61]

Foeto-maternal attachment- The Prenatal Attachment Inventory-Revised (PAI-R)

The PAI-R[62] is an 18-item shortened version of the PAI[48], which was designed to measure the emotional affiliation developing between mother and unborn infant. It is divided in three subscales: "Anticipation" (e.g., pertaining to the mother's fantasies and future plans for the infant, ''I wonder what the baby looks like now''), "Interaction" (e.g., the mother's feelings towards her infant, "I enjoy feeling the baby move") and "Differentiation" (e.g., differentiation of self from the foetus, ''I think that my baby already has a personality''). Each item is scored on a 4-point Likert scale from 1 (almost never) to 4 (almost always). Higher scores indicate higher levels of prenatal attachment, the total score ranging from 0 to 72. Total PAI-R scores in the current study were found to have excellent internal consistency (α = .93).). Further details on PAI-R's psychometrics functions in the current sample are reported in Foley et al. (2021).[63]

Breastfeeding exclusivity- Questionnaire for breastfeeding mothers Unicef/WHO

For breastfeeding exclusivity one specific item from the Questionnaire for breastfeeding mothers was selected:[64] "How are you feeding your baby?" with four possible answers: "Breastfeeding exclusively", "Both breastfeeding and feeding breast-milk substitutes", "Feeding my baby breast-milk substitutes (not breastfeeding at all)", "Other: (please specify)".

Demographics and health status of children

We also collected demographic data about children, including sex, age, length (in centimeters), head circumference (in centimeters), and weight at birth (in kilograms), mode of delivery, health problems, and if they received intensive or other post-natal special healthcare.

Covariates

To improve the accuracy of the model and to adjust for key potential confounding factor, mothers' age, education, SES and child development aspects such as weight, length and head circumference of the children, measured at birth were included in the analysis as control variables. For SES we used a composite score of 15 items, which measured the household composition and household equipment, with lower aggregate scores indicating lower SES.

Statistical analyses

After excluding the participants who did not meet the inclusion criteria, data was analyzed using IBM SPSS v25 and IBM AMOS v20. Missing data was single imputed using the regression method. Descriptive analyses were conducted; means, standard deviations, internal consistencies and ranges were assessed for all the psychometric measures' scores. Correlations were run to investigate significant relationships between all measurement scores.

A path analysis in AMOS v20 using maximum likelihood estimation was employed to assess the proposed parallel mediation model, nested in two other models which included covariates. The model fit was evaluated based on Hu and Bentler (1995).[65] Direct and indirect effects were estimated using a bootstrapping procedure with 5000 bootstrap samples. An unconstrained multi-group mediation model, in which parameters were allowed to vary across sites was tested for the subgroup analysis. These models were fit first without covariates and then repeated with the covariates inserted into the model.

Results

The total baseline sample consisted of 1208 pregnant women. Data from 23 participants were excluded from the data set, for not meeting the inclusion criteria (they were 20-27 weeks

pregnant), leaving N =1185 (Mage = 28.32, SD = 5.77) participants in total. The follow up sample consisted of N = 1054 (89% of the initial sample).

Descriptive statistics

Table 1 presents the descriptive statistics of participants' age, weeks of pregnancy, education, socio-economic status and children age and developmental outcomes at follow up.

Prenatal depression ranged between 0 to 25 (M = 6.80, SD = 4.70), 428 (36.1%) mothers reported minimal depressive symptoms, 457 (38.6%) reported mild depressive symptoms, 183 (15.4%) reported moderate depressive symptoms, 78 (6.6%) reported moderately severe depressive symptoms and 22 (1.9%) severe depressive symptoms. The scores for postnatal depression ranged between 0 to 24 (M = 4.82, SD = 4.17), 428 (36.1%) mothers reported minimal depressive symptoms, 320 (30.3 %) mild depressive symptoms, 100 (9.4%) moderate depressive symptoms, 29 (2.7%) moderately severe depressive symptoms and 5 (0.4%) reported severe depressive symptoms, respectively.

 Foeto-maternal attachment comprised scores between 4 and 72 (M = 52.72, SD =11.41). Regarding the breastfeeding behavior, 605 (57.4%) mothers exclusively breastfed their children and 426 (40.4%) mothers fed their children with only milk substitutes, a mixed feeding method (breast milk and milk substitutes) or other feeding methods.

Correlations between key variables

Bivariate correlations were conducted between the key variable and the covariates, as shown in Table 2.

Mediation model

The path analysis using maximum likelihood estimation was employed to assess the proposed parallel mediation model. Acceptable model fit was evaluated based on Hu and Bentler (1995):[65] SRMR $\leq$ .08, RMSEA $\leq$ .06, CFI and TLI $\geq$ .95. The initial model (Figure 1.1) had a good data fit ($\chi2(1)$ = 1.36, p = .234, TLI = .99, CFI = 1.00, RMSEA = .02, 90%CI [.00, .08], SRMR = .01, AIC = 27.36)(Figure 1.2). Next, we tested a model which included the mother's education, age and SES. The model provided a good fit ($\chi2(1)$ = 2.40, p = .122, TLI = .96, CFI = 1.00, RMSEA = .03, 90% CI [.00, .09], SRMR = .01, AIC = 70.40)(Figure 1.3). Finally, we tested a model which also included the child's birth weight, length, and head circumference. The model fitted the data in an acceptable manner ($\chi2(1)$ = 1.87, p = .171, TLI = .96, CFI = 1.00, RMSEA = .03,

90%CI [.00, .09], SRMR = .004, AIC = 129.87)(Figure 1.4). All three models presented no out-of-range values, negative factor variances, negative indicator error variances or areas of ill fit. Both model 2 and 3 passed the χ2diff test.[66] However, controlling for additional variables did not change the strength of the relationships between our variables of interest. On this basis, alongside the AIC criterion, the initial model was considered to best fit the data.

Prenatal depression significantly predicted postnatal depression (B = .399, S.E. = .021, p < .001) and attachment (B = -.361, S.E. = .069, p < .001) but not breastfeeding exclusivity (B = -.006, S.E. = .003, p = .100). Postnatal depression significantly predicted breastfeeding exclusivity (B = -.013, S.E. = .004, p = .002) while attachment did not significantly predict breastfeeding exclusivity (B = .001, S.E. = .002, p = .641). The standardized direct effect of prenatal depression on breastfeeding exclusivity was not statistically significant (β = -.054, p = .100, 95% CI [-.119, .009]) while the standardized indirect effect was statistically significant (β = -.049, p = .005, 95% CI [-.081, -.017]). Therefore, the effect of prenatal depression on breastfeeding exclusivity is totally mediated by postnatal depression.

An unconstrained multi-group mediation model, in which parameters were allowed to vary across sites was tested. The data provided a good fit for the model (χ2(8) = 10.35, p = .241, TLI = .95, CFI = .99, RMSEA = .02, 90%CI [.00, .04], SRMR = .05). In all 8 sites prenatal depression predicted postnatal depression Ghana (β = 0.520, p < .001, Jamaica (β = 0.448, p < .001), Pakistan (β = 0.550, p < .001), Philippines (β = .392, p < .001), Romania (β = .438, p < .001), South Africa (β = 402, p = .001), Sri Lanka (β = 386, p < .001), and Vietnam (β = .237, p = .002). Prenatal depression predicted the foeto-maternal attachment in Philippines (β = -.261, p = .001), South Africa (β = -.245, p = .007) and Sri Lanka (β = -.258, p = .005). In turn, foeto-maternal attachment predicted breastfeeding exclusivity in Romania only (β = -.0281, p = .001). Postnatal depression predicted breastfeeding exclusivity in Pakistan (β = -.249, p = .014). No direct effect of prenatal depression on breastfeeding exclusivity was identified in any of the sites. An indirect effect of prenatal depression via postnatal depression on breastfeeding exclusivity was observed in Pakistan (β = -.145, p = .009, 95%CI [-.269, -.039]) and Sri Lanka (β =-.077, p = .035, 95% CI [-.192, -005]) (Table 3)

Discussion

Maternal mental health and childcare practices, such as breastfeeding, are important for child development and health.[67] The present study sought to investigate whether and how perinatal maternal depression can influence breastfeeding behavior. Our study showed that prenatal depression had a significant effect on breastfeeding exclusivity. This relationship was fully mediated by postnatal depression. This indicates that prenatal depression symptoms contributed to the development of depressive symptoms after birth, which, in turn, negatively affected the probability to exclusively breastfeed. These results are consistent with previous studies linking postnatal depression with low rates of exclusive breastfeeding.[68,69]

In contrast, foeto-maternal attachment did not have a significant effect on breastfeeding exclusivity and it did not mediate the relationship between prenatal depressive symptoms and the probability of exclusive breastfeeding, indicating that prenatal mental health and the attitudes toward the foetus do not influence breastfeeding exclusivity.

There are numerous mechanisms that might account for the relationship between postnatal depressive symptoms and breastfeeding exclusivity, as indicated by previous research. Depressive symptoms might impact mothers' self-efficacy towards breastfeeding and is associated with low self-esteem.[70] Additionally, depressive symptoms might affect the mother-child interaction and her interpretation of the infant's hunger/sleep/distress cues.[71] All these are sensible explanations for the observed relationship between postnatal depression and exclusivity of breastfeeding.

Our results regarding prenatal depression are consistent with those of a recent review showing that prenatal depression has negative effects on foeto-maternal attachment.[50] It is possible that prenatal depressive symptoms influence the mothers' feelings, making them feel less confident that they will be able to fulfil their future role as mothers and further their ability to develop attachment to the foetus.[72-74]

Our findings also suggested some cross-context variations in the relations among pre- and post-natal depression, foeto-maternal attachment and breastfeeding practices.

In line with the overall sample analysis, there was no direct effect of prenatal depression on breastfeeding exclusivity in any of the eight sites; however, the full mediation effect of the postnatal depression was observed only in Pakistan and Sri Lanka, replicating the result from the whole sample. In all eight sites prenatal depressive symptoms predicted the postnatal depressive symptoms and in the Philippines, South Africa and Sri Lanka has a further detrimental effect on

foeto-maternal attachment, showing the importance of early detection of signs of depression in LMICs, where mental health problems have higher prevalences.[6] Interestingly, foeto-maternal attachment predicted the breastfeeding exclusivity in Romania while postnatal depression also predicted breastfeeding exclusivity in Pakistan. Given these mixed results around the eight sites, it would be important to better understand each country's socio-cultural context, for example how the family and community attitudes and support may influence these relationships.[19]

Our study found evidence consistent with the idea that postnatal depression is the mechanism by which prenatal depression affects breastfeeding exclusivity. Prenatal depressive symptoms alone are cues that the expectant mothers need help and resources, but they also are indicators that these problems might continue after birth and have detrimental effects on childcare practices, which in the long term can negatively affect the mothers' mental health, child development and their interaction. These findings highlight the importance of identifying at-risk women and screening for depressive symptoms, as early as possible in order to provide psychological interventions and prevent postpartum depression. Even if breastfeeding is recommended and its advantages are known, breastfeeding can be challenging for women. Some of them encounter problems with milk supply, pain or breastfeeding that may exert a negative mental or physical toll on the mother.[75] Thus, sometimes the balance of benefits might be in favor of choosing not to breastfeed. The community, family and health services that can have a role in this kind of decision-making should support women to choose what is individually best for their situation.[76]

Limitations and future research

The current study has several limitations. Firstly, the study is based on convenience sampling with participants being motivated and interested to participate in a birth cohort study. It is difficult to extrapolate the present findings to more heterogenous populations in terms of ethnicity, psychosocial needs, and backgrounds. Secondly, possible maternal health problems or other factors that might interfere with milk supply were not assessed and might impact breastfeeding practices non-uniformly. Future research should control for such problems). Thirdly, possible maternal health problems or other factors that might interfere with milk supply were not assessed and might impact breastfeeding practices non-uniformly. Fourthly, the PHQ-9 scale is not specific for the prenatal period, some of the items might be confounded with somatic symptoms of pregnancy (i.e. troubled sleeping, increased or decreased appetite). Future research

would benefit from the use of clinician-administered, criterion-standard diagnostic interviews for the assessment of pre- and postnatal depression.

Conclusions

The study found evidence that prenatal depression symptoms contributed to the development of depressive symptoms after birth, which, in turn, negatively affected the probability of exclusive breastfeeding, while foeto-maternal attachment din not influence the relationship. Future research should explore maternal mental health in early prevention interventions, increasing the chances of healthy child development in LMICs. Considering the variations in the results around the eight sites, it is important to better understand the relationship between maternal depression, foeto-maternal attachment and breastfeeding behavior in each site's socio-cultural context.

Authors' contribution

Madalina Ruxandra Costin: Conceptualization(equal); writing – original draft(lead); methodology(equal); formal analysis(equal); investigation(equal); resources(equal)

Diana Taut: Conceptualization (equal); writing – review & editing; methodology(equal); formal analysis(equal); investigation(equal); resources(equal)

Adriana Baban: Resources(equal), project administration(lead); funding acquisition(lead); writing – review & editing(equal)

Thea Ionescu: Supervision; resources(equal); writing – review & editing(supporting)

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Eugen Secara: Formal analysis(equal)

Sara Valdebenito: Data curation(lead); Writing – review & editing(equal)

Manuel P. Eisner: Resources(lead), project administration(lead); funding acquisition(lead); writing – review & editing(equal)

Conflict of Interest

All authors have no conflicts of interest to disclose.

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Table 1.

Demographic characteristics of Participants at Baseline and Follow up

		Baseline		Follow up	
		n	**%**	**n**	**%**
Country	Jamaica	152	12.8	143	13.5
	Sri Lanka	152	12.8	141	11.8
	Ghana	145	12.2	119	10.0
	Pakistan	134	11.3	121	10.2
	Philippines	154	13.0	141	11.8
	Romania	150	12.7	114	9.6
	South Africa	148	12.5	127	10.7
	Vietnam	150	12.7	148	12.4
	Missing			131	11.0
Education	No/incomplete primary education	91	7.8		
	Primary school educated	83	7.1		
	Secondary school educated	563	48.0		
	Vocational/technical school educated	86	7.3		
	University educated	247	21.0		
	Other	102	8.7		
	Missing	13	.60		
Mother's age	18 – 24	322	27.2		
	25 – 34	687	57.9		
	35 – 44	172	14.5		
	45+	4	4		
	Missing	0	0		

Weeks of pregnancy	28 – 30	316	26.6		
	31 – 33	333	28.1		
	34 - 36	308	26.0		
	37 – 39	195	16.4		
	40+	33	2.8		
	Missing	0	0		
Household possessions	1-5	103	8.7		
	6-10	609	51.4		
	11-15	426	36.0		
	Missing	47	4		
Birth weight (kg)	1.1-2			13	1.1
	2.01-3			428	35.6
	3.02-4			535	44.5
	4.02 +			34	2.8
	Missing			191	15.9
Birth body length (cm)	29.97-40			6	0.5
	41-50			387	32.2
	50.04-61			329	27.3
	Missing			481	40
Child head circumference (cm)	26-30			72	6
	31-40			633	52.6
	42-50			4	0.4
	53 +			3	0.3

Missing	491	40.8

Table 2.

Correlations between Study Variables

Variable	1	2	3	4	5	6	7	8	9	10
1. Prenatal depression	-									
2. Postnatal depression	.473**	-								
3. Foeto-maternal attachment	-.149**	-.041	-							
4. Mother's education	-.136**	-.097**	.310**	-						
5. Mother's age	-.059*	-.120**	-.029	-.007	-					
6. Socio-economic status	-.162**	-.123**	.165**	.393*	.123**	-				
7. Birth weight	-.046	-.119**	-.014	-.029	.134**	.109**	-			
8.Birth body length	-.072*	-109**	.164**	.344**	.063*	.313**	-.002	-		
9. Birth head circumference	.107**	.149**	.056	-.033	.009	-.014	.009	-.024	-	
10.Breastfeeding exclusivity	-103**	-.126**	.026	.043	.011	.072*	-.031	.041	-.093*	-

Significant coefficients: *p < .05. ** p < .01.

Table 3.

Unconstrained multi-group mediation model with parameters free to vary across countries

Country	a1	a2	b1	b2	Direct effect		Indirect effect	
	β	β	β	β	β	95% CI	β	95% CI
Ghana	0.522**	-0.157	-0.087	-0.009	-.114	-.303; .075	-.044	-.151; .070
Jamaica	0.448**	-0.109	-0.012	0.011	.011	-.167; .189	-.006	-.088; .080
Pakistan	0.555**	0.081	-0.249*	-0.096	.060	-.135; .247	-.145*	-.269; -.039
Philippines	0.392**	-0.261**	0.067	-0.006	-.085	-.262; .098	.028	-.051; .125
Romania	0.438**	-0.075	-0.079	-0.281**	.024	-.165: .215	-.013	-.103; .094
South Africa	0.402**	-0.245*	-0.056	0.044	.000	-.174; .173	-.032	-.131; .051
Sri Lanka	0.386**	-0.258*	-0.141	0.088	.108	-.067; .277	-.077*	-.192; -.005
Vietnam	0.237*	-0.074	-0.06	0.092	-.054	-.234; .108	-.021	-.081; .019

Note. Path a1 is the effect of prenatal depression on postnatal depression

Path a2 is the effect of prenatal depression on postnatal foeto-maternal attachment

Path b1 is the effect of postnatal depression on breastfeeding exclusivity

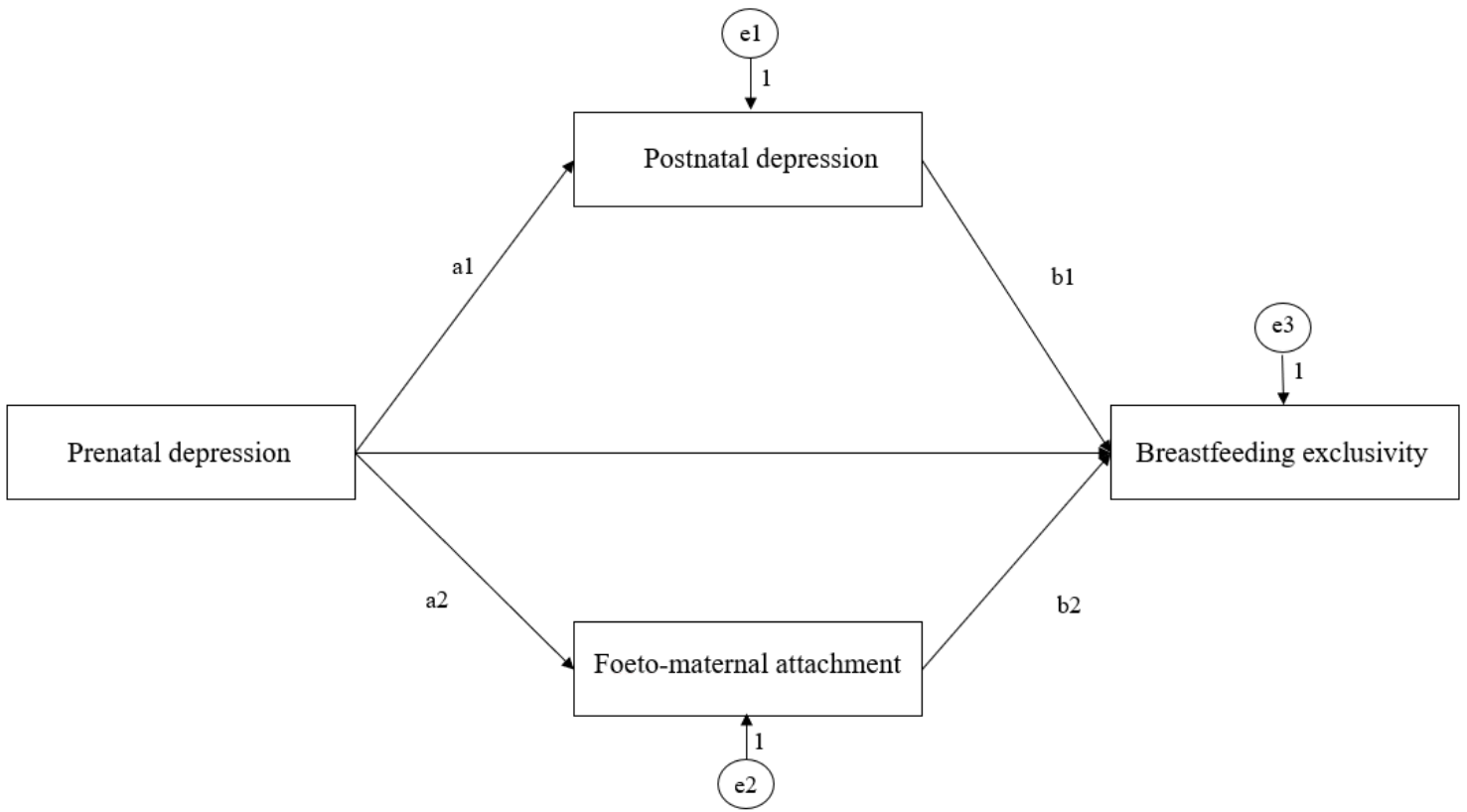Path b2 is the effect of foeto-maternal attachment on breastfeeding exclusivity

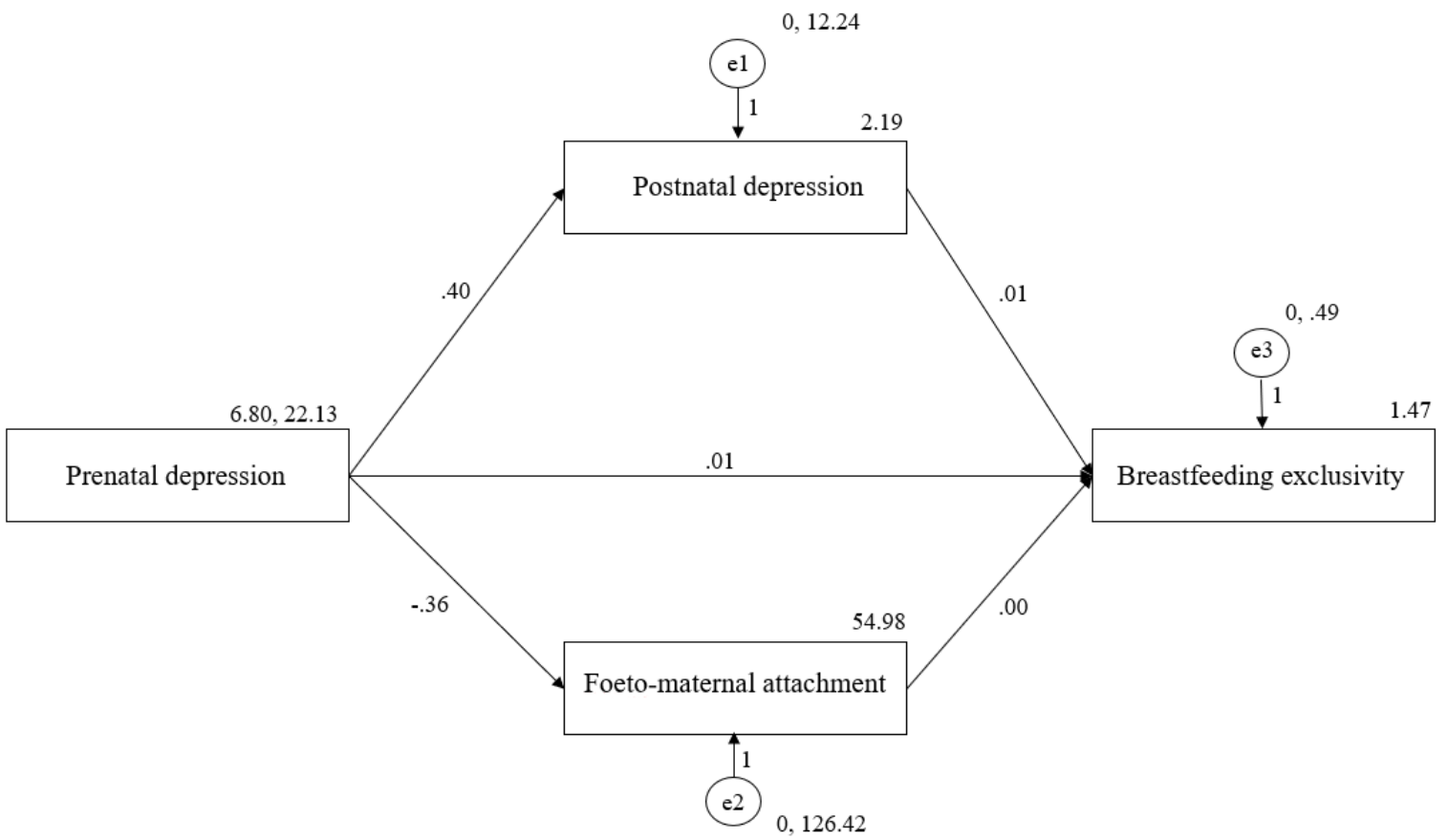**Figure 1.1** Mediation model of key variables

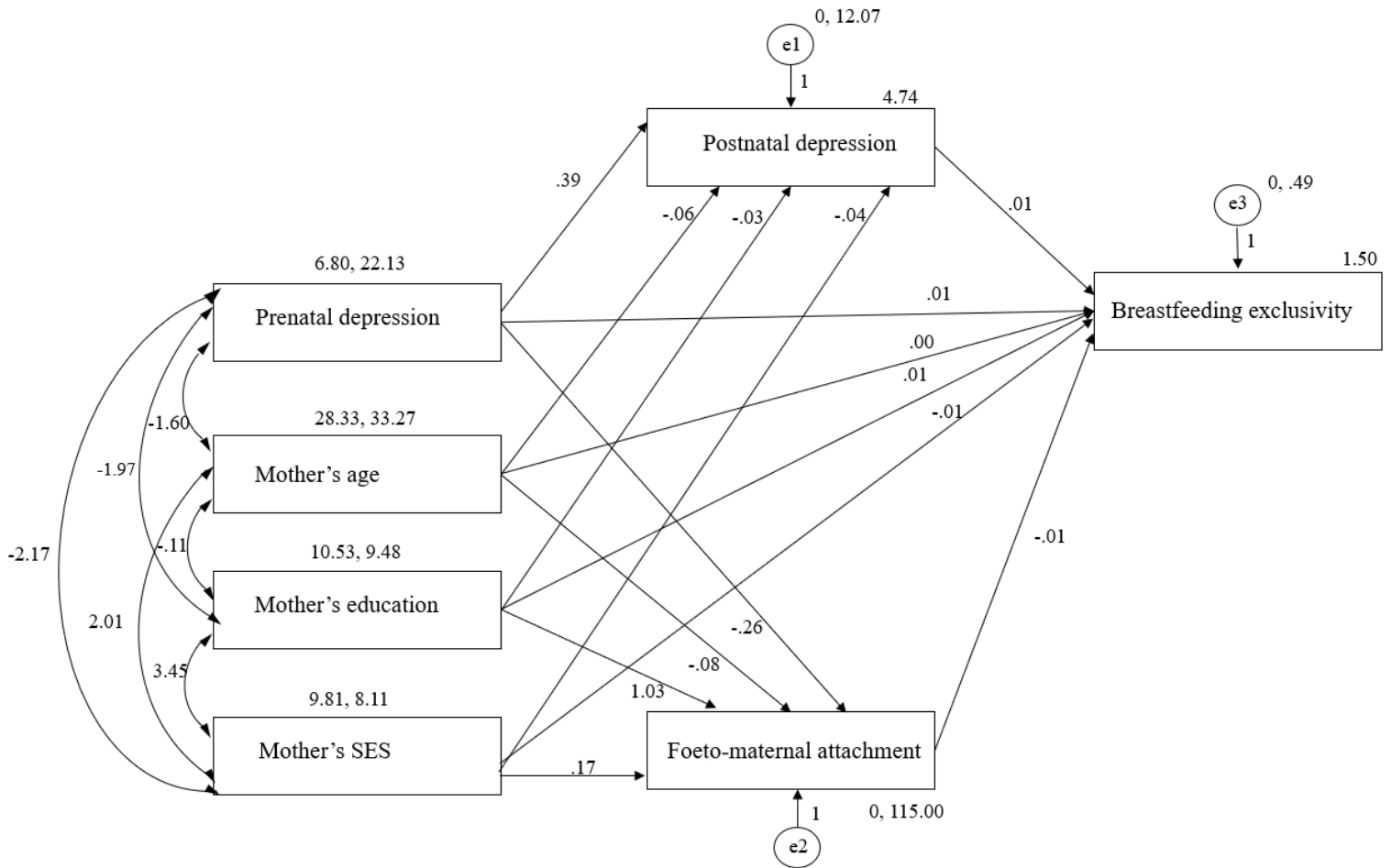**Figure 1.2** Tested mediation model between key variables

Figure 1.3 Mediation model including mother's age, education and SES as covariates
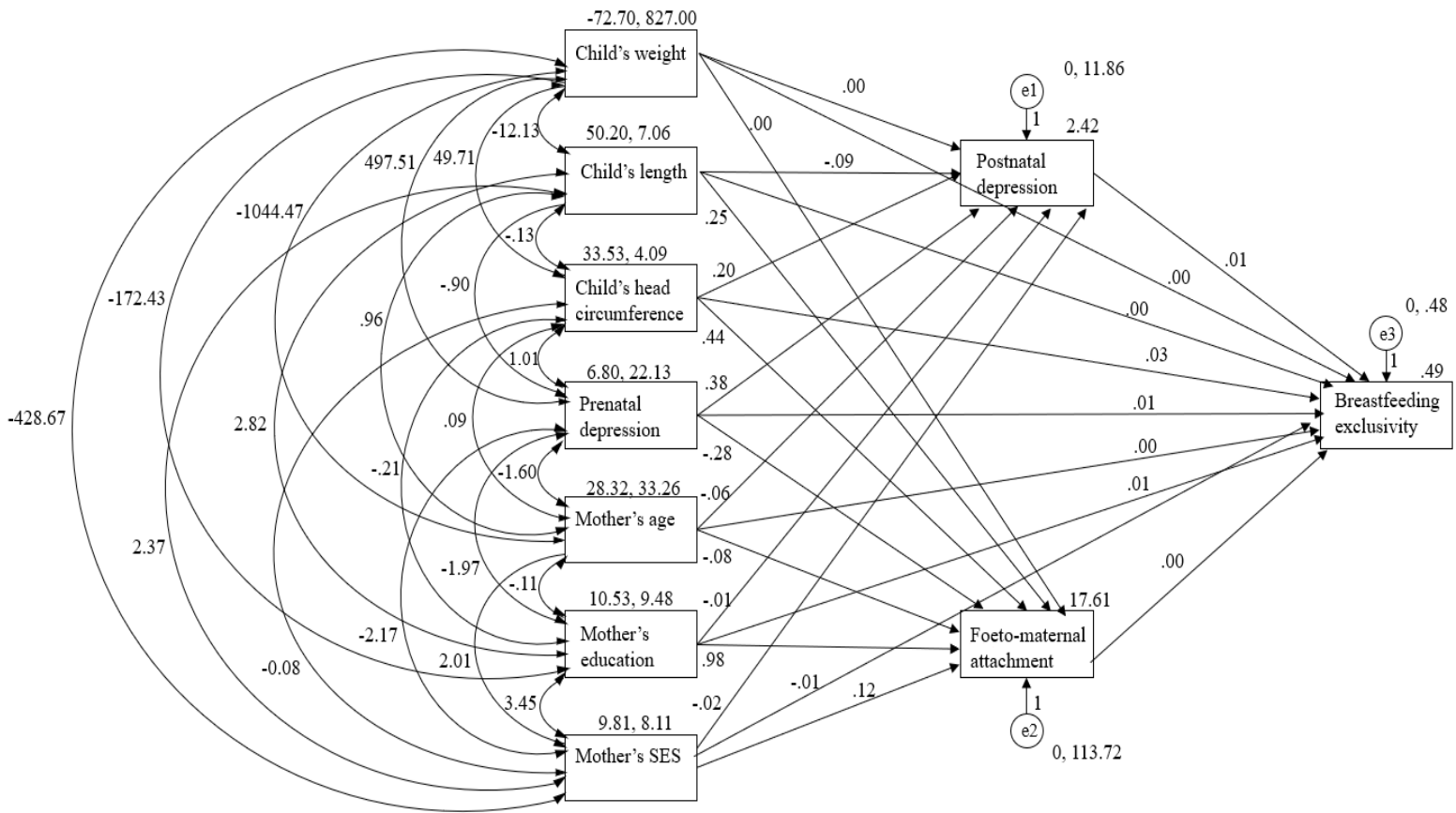
Abbreviations: SES, socioeconomic status

Figure1.4 Mediation model including mother's age, education, SES and child's weight, body length and head circumference at birth as covariates

Abbreviations: SES, socioeconomic status