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Maternal mental health is associated with child undernutrition and illness in Bangladesh, Vietnam and Ethiopia

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Abstract

Objective: We assessed associations of maternal common mental disorders (CMD) with undernutrition and two common illnesses in children aged 0–5 years.
Design: Cross-sectional survey. Maternal CMD was measured using the WHO Self-Reporting Questionnaire-20. Child undernutrition was defined as stunting, underweight or wasting. Child illnesses included diarrhoea and acute respiratory infections (ARI). Multivariate logistic regression was used to test these associations adjusting for confounders at child, maternal and household levels.
Setting: Bangladesh, Vietnam and Ethiopia.
Subjects: Mothers with children aged 0–5 years from 4400 households in Bangladesh, 4029 households in Vietnam and 3000 households in Ethiopia.
Results: The prevalence of maternal CMD was high, ranging from 31 % in Vietnam to 49 % in Bangladesh. Child undernutrition was more prevalent in Bangladesh and Ethiopia than in Vietnam. Symptoms of ARI and diarrhoea were also prevalent. In multivariate analysis, maternal CMD was associated with child stunting in Bangladesh (OR = 1·21; 95 % CI 1·03, 1·41) and with child underweight in Vietnam (OR = 1·27; 95 % CI 1·01, 1·61); no association was found with wasting. Maternal CMD was strongly associated with diarrhoea and ARI in all three countries.
Conclusions: Maternal CMD, which affected nearly half of women in Bangladesh and one-third in Vietnam, was an important determinant of child stunting and underweight, respectively. No such association was found in Ethiopia, although CMD affected 39 % of women. Maternal CMD was strongly associated with childhood illnesses in all three countries. Interventions to support maternal mental health are important for women's own well-being and could make important contributions to improving child health and nutrition.

Keywords
Bangladesh
Child undernutrition
Child illness
Ethiopia
Maternal mental health
Vietnam

Maternal characteristics such as education, health and nutrition knowledge, empowerment, and physical and mental health are critical resources for child survival, growth and development[1]. The recent *Lancet* series on maternal and child undernutrition highlighted maternal depression as a significant risk factor for poor child growth and recommended interventions to address the problem through maternal and child health and nutrition programmes[2]. Maternal behaviours and practices are important elements for translating resources for care, such as household food security and health-care resources, into child well-being[3,4]. Impaired mental health reduces a mother's ability to take adequate care of her child, which in turn can have negative effects on the child's growth and development[5–7]. Alternatively, the presence of a sick or poorly growing child could undermine a mother's well-being, thereby increasing her vulnerability to depressive symptoms due to the worry and stress of the additional effort required to take care of her child and the pressure of disappointment or even overt criticism expressed by family members or others[5].

Poor maternal mental health has been shown to be associated with suboptimal breast-feeding and complementary feeding practices[8], compromised parenting behaviours, reduced mother–child interactions and a higher prevalence of medical and emotional problems among children. Studies in India, Bangladesh and Pakistan demonstrated consistent associations between maternal common mental disorders (CMD) and child undernutrition[9–11]. Results from cross-country studies indicated that in India and Vietnam, mothers with CMD had higher likelihood of having a stunted and underweight child,

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respectively, compared with mothers who did not suffer from CMD. In Peru and Ethiopia, however, these associations were not statistically significant[12]. Studies in Latin America and Africa also revealed mixed results. Maternal mental health was associated with child nutrition in Brazil[13,14] and Malawi[15], but not in South Africa[16] and Ethiopia[17]. A recent meta-analysis of seventeen studies in eleven countries also provided evidence of the association between maternal depression and early childhood underweight and stunting in both cross-sectional and longitudinal studies[18].

Few studies have examined the association between maternal mental health and child illnesses. In a cohort study in Pakistan, pre- and postnatal depression were found to increase the risk of having diarrhoea in infants[19,20]. Results from a case study in Nigeria also showed that infants of depressed mothers were more likely to have episodes of diarrhoea and other infectious illnesses[21]. In a recent study in Ethiopia, infants of mothers with persistent perinatal CMD symptoms were at more than double the risk of having diarrhoea. However, such associations were not observed between perinatal CMD symptoms and fever or acute respiratory infection (ARI)[22].

In the present study, we examined the associations of maternal CMD with child undernutrition and illnesses in Bangladesh, Vietnam and Ethiopia. We proposed that maternal CMD would be associated with greater levels of undernutrition and common illnesses in children. Use of the same measurement tools and analytical techniques was useful to demonstrate the associations of maternal CMD with child undernutrition and illnesses across the three countries.

Materials and methods

Data source and study population

We used data from the baseline household survey of Alive & Thrive (A&T), which is an initiative funded by the Bill & Melinda Gates Foundation to reduce undernutrition and death caused by suboptimal infant and young child feeding (IYCF) practices in Bangladesh, Vietnam and Ethiopia over a period of six years (2008–2014). The Vietnam baseline survey covered 4029 households in forty communes in four provinces where the A&T project is being implemented[23]. The Bangladesh baseline survey covered 4400 households in twenty selected *upazilas* (sub-districts)[24]. The baseline survey in Ethiopia included a total of 3000 households from seventy-five enumeration areas[25]. All households with children aged 0–5 years and their mothers were included in the survey. There were no exclusion criteria except for those who refused to participate (refusal was minimal across the three countries). All three surveys received ethical approval from the Institutional Review Board of the designated countries and from the International Food Policy Research Institute.

Anthropometry

The first outcome in the present study was child undernutrition – stunting, underweight and wasting. Weight and height/length measurements were taken by trained fieldworkers using recommended protocols[26]. Weight of children and mothers was measured using electronic scales accurate to 100 g. Locally manufactured length/height boards, which were precise to 1 mm, were used to measure the recumbent length of children aged 0–24 months and the standing height of children aged ≥24 months and of mothers.

Children's weight and length/height measurements were used to derive *Z*-scores by comparing each child's anthropometric measurements with the WHO child growth standards for his/her age and gender[27]. Three indicators were calculated using child's weight and length/height: length/height-for-age *Z*-score (HAZ), weight-for-age *Z*-score (WAZ) and weight-for-length/height *Z*-score (WHZ). Stunting was defined as HAZ <-2, underweight as WAZ <-2 and wasting as WHZ <-2[27]. Maternal weight and height were used to calculate BMI (kg/m^2). Maternal undernutrition was defined as BMI $<18{\cdot}5$ kg/m^2.

Child illness

The second outcome was child illness, which was measured through maternal recall of symptoms of diarrhoea and upper ARI in the two weeks prior to the survey. Diarrhoea was defined as three or more loose stools passed in a 24-h period[28] and ARI was defined as the presence of cough/cold with fever and/or fast breathing[29].

Maternal common mental disorders

Maternal CMD was measured using the WHO-recommended screening tool called the Self-Reporting Questionnaire-20 (SRQ-20) that includes twenty questions with a recall period of 30 d prior to the administration of the questionnaire[30]. The SRQ-20 measures several symptoms of depression, including headache, poor appetite, sleep disturbance, depressed mood, unhappiness, helplessness and psychomotor retardation. Each question is given a score of 0 or 1 depending on the 'no' or 'yes' response, respectively. The scores are added to generate an overall SRQ-20 scale, where higher scores indicate higher levels of maternal CMD and vice versa. This tool has been found to be reliable, valid and adaptable for screening mental disorders in the developing world[30] including Ethiopia[31] and Vietnam[32]. We used a cut-off of 7 to classify women with low or high level of CMD, as suggested by several validation studies[31,32].

Socio-economic status index

The socio-economic status (SES) index was constructed using principal components analysis. Variables that were included in the SES index were ownership of house and land, housing quality (e.g. house construction materials), access to services (water, electricity, gas and sanitation

services) and household assets (different types of durable goods, productive assets, animals and livestock)[33,34]. Factor scores derived from the first factor (which explained 47 %, 33 % and 39 % of the variance for Bangladesh, Vietnam and Ethiopia, respectively) were then used to characterize the SES of each household. Households were categorized into SES quintiles based on their individual SES index score.

Household food security

Household food security was measured using the Household Food Insecurity Access Scale[35] of the Food and Nutrition Technical Assistance Project/US Agency for International Development, which provides information on behaviour and perceptions related to household food insecurity – anxiety and uncertainty, insufficient quality of intake, insufficient food intake and its consequences. All the questions were asked for a reference period of 30 d preceding the survey. The households were categorized into four groups: food secure, mildly food insecure, moderately food insecure and severely food insecure[35]. These categories were then collapsed into two groups of households: food secure and food insecure (which included the mildly, moderately and severely food-insecure groups).

Infant and young child feeding practices

IYCF practice indicators were described using the WHO recommendation[36,37]. The six core IYCF indicators used in the present analysis were: (i) early initiation of breast-feeding (the proportion of children born in the last 24 months who were put to the breast within 1 h of birth); (ii) exclusive breast-feeding (the proportion of infants 0–5 months of age who are fed exclusively with breast milk); (iii) minimum dietary diversity (the proportion of children 6–23 months of age who receive foods from four or more food groups); (iv) minimum meal frequency (the proportion of breast-fed and non-breast-fed children 6–23 months of age who receive solid/semi-solid food, the minimum number of times or more); (v) minimum acceptable diet (the proportion of children 6–23 months of age who receive at least the minimum dietary diversity and the minimum meal frequency, apart from breast milk); and (vi) consumption of Fe-rich foods (the proportion of children 6–23 months of age who received an Fe-rich food or a food that was fortified with Fe).

Other variables

We collected information on the child's birth weight. Low birth weight was defined as birth weight <2500 g for Vietnam, and mother's perception that the child was very small or smaller than average for Bangladesh and Ethiopia. In addition, mother's and child's cleanliness was assessed based on a hygiene spot check[38] of the general appearance of the face, hands, hair and body/clothes. Each question was given a score of 0 or 1 depending on the 'dirty' or 'clean' observation, respectively. The scores were added to generate an overall hygiene scale (range: 0–4), where higher scores indicated higher levels of cleanliness. Women's education was measured as the years of schooling completed. As women's education levels varied across the three countries, different cut-offs were used for maternal education based on their suitability to the country's context. Whereas 'primary education' was used as the reference group in Vietnam, 'no schooling' was the reference group for Bangladesh and Ethiopia.

Statistical analysis

Descriptive analyses were used to report background characteristics of the study sample. Bivariate analysis was done to examine the association of maternal CMD with child undernutrition and child illness, and also with maternal and household characteristics, child feeding practices, hygiene and health-seeking behaviours, using the t test for continuous variables and the χ^2 test for categorical variables. Logistic regression models were used to examine the relationship of maternal CMD with child undernutrition and child illness, adjusting for several potential confounding factors at child (age, gender, low birth weight), maternal (age, height, BMI, education, mother as household head) and household levels (SES, food security). These models were also adjusted for mother's and child's cleanliness. The 'cluster' command in Stata was used to adjust for clustering effects at the sub-district level in Bangladesh, communes in Vietnam and region in Ethiopia. All statistical analyses were carried out using the statistical software package Stata version 11.

Results

Sample characteristics

Characteristics of the study population in Bangladesh, Vietnam and Ethiopia are presented in Table 1. Levels of undernutrition were high across the three countries. The prevalence of stunting was highest in Ethiopia (44 %) followed by Bangladesh (40 %) and Vietnam (17 %). Rates of underweight and wasting were highest in Bangladesh followed by Ethiopia and Vietnam (39 %, 24 % and 13 % for underweight and 18 %, 7 % and 5 % for wasting, respectively). A large number of children had symptoms of upper ARI during the previous two weeks (33 % in Bangladesh, 16 % in Vietnam and 20 % in Ethiopia). The prevalence of diarrhoea in Bangladesh (8 %) was lower than in the other two countries (9 % in Vietnam and 16 % in Ethiopia). Maternal CMD was high in all three countries, affecting nearly half of women in Bangladesh, 39 % of women in Ethiopia and 31 % of women in Vietnam.

Bivariate associations between maternal common mental disorders and child undernutrition and illness

The prevalence of undernutrition and child illnesses by maternal CMD is shown in Fig. 1(a) and (b). Compared

Table 1 Baseline characteristics of the study population in Bangladesh, Vietnam and Ethiopia; baseline data from Alive & Thrive

	Bangladesh (*n* 4400)		Vietnam (*n* 4010)		Ethiopia (*n* 2962)	
	% or mean	SD	% or mean	SD	% or mean	SD
Dependent variables						
Child undernutrition						
Stunting (%)	40·0	–	16·8	–	44·4	–
Underweight (%)	38·8	–	13·2	–	23·8	–
Wasting (%)	18·4	–	4·8	–	6·7	–
HAZ	−1·65	1·37	−0·93	1·19	−1·69	1·65
WAZ	−1·68	1·14	−0·86	1·09	−1·12	1·30
WHZ	−1·04	1·21	−0·47	1·03	−0·22	1·26
Child illness during the last 2 weeks (%)						
Diarrhoea	7·5	–	9·1	–	15·8	–
Fever	42·8	–	27·7	–	26·8	–
Cold/cough	44·2	–	29·5	–	31·9	–
Upper ARI (including fever and cold/cough)	33·1	–	15·8	–	20·0	–
Independent variables						
Maternal characteristics						
CMD						
High CMD (≥7)	49·1	–	31·2	–	39·7	–
Low CMD (<7)	51·0	–	68·8	–	60·9	–
Age (years)	26·8	6·1	29·3	5·5	29·2	6·5
Education (%)						
No schooling	26·8	–	15·7	–	65·4	–
Primary school	29·1	–	–	–	27·6	–
Secondary school	41·7	–	51·5	–	7·0	–
High school	2·5	–	20·4	–	–	–
College or higher	–	–	12·4	–	–	–
Maternal height (cm)	150·8	5·5	153·0	5·3	156·5	8·6
Maternal undernutrition (BMI <18·5 kg/m^2) (%)	29·6	–	26·4	–	24·4	–
Child's characteristics						
Age (months)	22·3	14·4	24·7	17·8	24·4	17·0
Low birth weight (%)	24·0	–	5·1	–	31·1	–
Child gender (%)						
Male	51·6	–	52·6	–	51·5	–
Female	48·4	–	47·4	–	48·5	–
Household's characteristics						
SES in quintile (%)	20·0	–	20·0	–	20·0	–
Food security (%)						
Food insecure	32·1	–	38·4	–	65·5	–
Food secure	68·0	–	61·6	–	34·5	–
Mother is household head (%)	9·4	–	5·9	–	7·2	–
Hygiene spot score						
Child (range: 0–4)	2·9	1·6	3·2	1·12	2·4	1·6
Mother (range: 0–4)	3·3	1·3	3·2	1·05	2·5	1·5

HAZ, length/height-for-age *Z*-score; WAZ, weight-for-age *Z*-score; WHZ, weight-for-length/height *Z*-score; ARI, acute respiratory infections; CMD, common mental disorders; SES, socio-economic status.

with children of mothers with low CMD, children of mothers with high CMD had a significantly higher proportion of stunting, underweight and wasting in Bangladesh and Vietnam, and a higher proportion of underweight in Ethiopia. Similarly, children of mothers with high CMD also had more illnesses (both diarrhoea and ARI) than their counterparts across the three countries.

Multivariate analyses of the association between maternal common mental disorders and child undernutrition and illness

The results from logistic regression models on the association between maternal CMD and child undernutrition are presented in Table 2. The reference category was mothers with low CMD. When adjusting for child, maternal and household factors, mothers with high levels of CMD had significantly higher odds of having a stunted child compared with mothers with low levels of CMD in Bangladesh (adjusted OR = 1·21; 95% CI 1·03, 1·41), but not in Vietnam and Ethiopia. Similarly, mothers with high CMD were 1·27 times (95% CI 1·01, 1·61) more likely to have underweight children than mothers with low CMD in Vietnam. There was no significant association between maternal CMD and wasting in any of the countries when adjusting for confounding factors.

Among other factors, ARI was significantly associated with child undernutrition (stunting, underweight and wasting) in Bangladesh, but not in other two countries. Low birth weight was strongly associated with all three indicators of child undernutrition across the three countries.

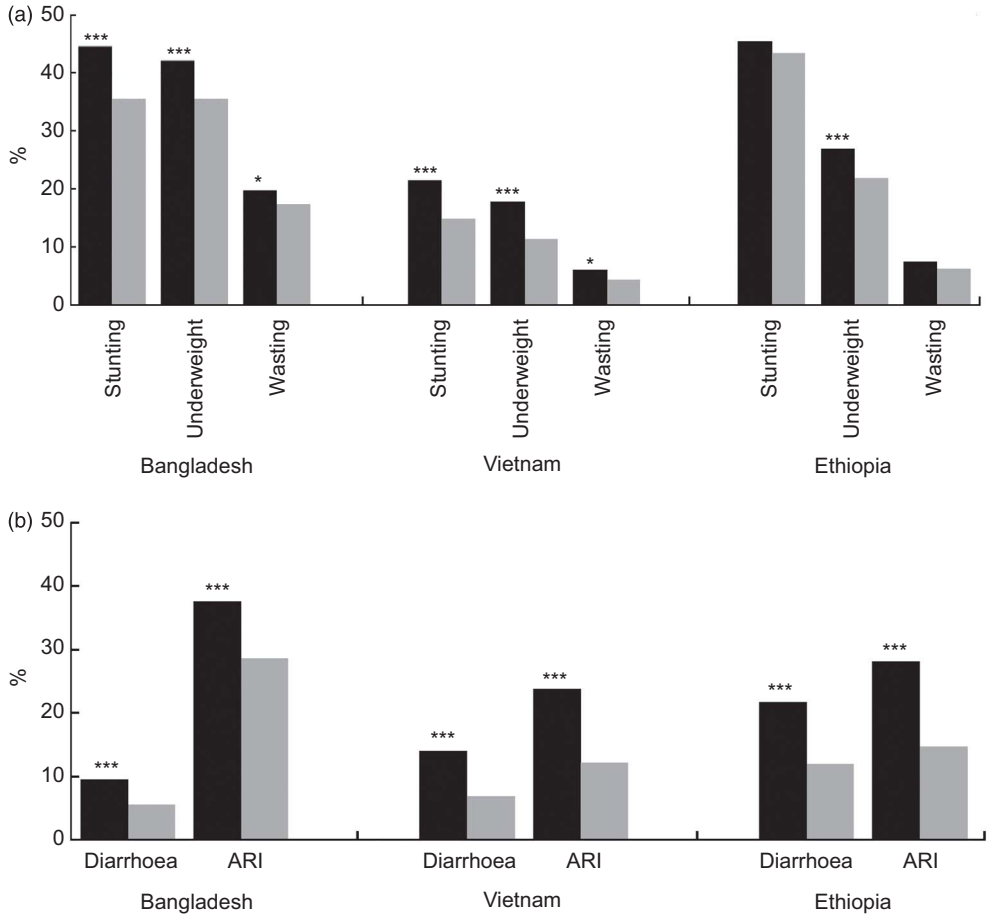

Fig. 1 Bivariate association of maternal common mental disorders (CMD) (■, high CMD; ■, low CMD) with (a) child undernutrition (stunting, underweight and wasting) and (b) child illnesses (diarrhoea and upper acute respiratory infections (ARI) in the past two weeks) in Bangladesh, Vietnam and Ethiopia; baseline data from Alive & Thrive. *$P < 0{\cdot}05$, ***$P < 0{\cdot}001$

Boys were more likely than girls to be wasted in all three countries, and were more likely to be stunted and underweight in Bangladesh and Ethiopia. As expected, lower household SES was associated with higher odds of child undernutrition in all three countries; and household food insecurity was associated with higher odds of stunting in Bangladesh and Ethiopia. Higher maternal education was associated with lower odds of stunting, and taller women had lower odds of having undernourished children in all three countries.

The results of multivariable logistic regression of the association between maternal CMD and child illness symptoms showed that maternal CMD was strongly associated with both child diarrhoea and upper ARI in all three countries (Fig. 1 and Table 3). Compared with children of mothers without CMD, those whose mothers had CMD had 1·67 (95 % CI 1·22, 2·25), 2·11 (95 % CI 1·61, 2·76) and 1·83 (95 % CI 1·47, 2·27) times higher odds of experiencing diarrhoea in the two weeks prior to the survey, and 1·41 (95 % CI 1·15, 1·73), 2·05 (95 % CI 1·61, 2·62) and 2·10 (95 % CI 1·72, 2·57) times higher odds of having had upper ARI, in Bangladesh, Vietnam and Ethiopia, respectively.

Associations between maternal common mental disorders and maternal and household characteristics, child feeding practices, hygiene and health-seeking behaviours

In an effort to characterize mothers with CMD, we examined the association between CMD and maternal and household characteristics (Table 4). The results showed that maternal CMD was more prevalent among older women, women with lower education level and those suffering from undernutrition (BMI $<18{\cdot}5\,kg/m^2$). Not surprisingly, women living in a food-insecure household or a household of lower SES were much more likely to have high CMD than women from more food-secure or wealthier households. These findings were consistent across all three countries.

When looking at the potential pathways by which maternal CMD might be associated with child health and nutrition, we found that maternal CMD was significantly associated with poorer hygiene practices (proxied by child's cleanliness or mother's cleanliness) and a lower likelihood of having attended prenatal care services (Table 5). These findings were true for all three countries. There was also a pattern of poorer IYCF practices among

Table 2 Results of multivariate analyses of the association between maternal CMD and child undernutrition in Bangladesh, Vietnam and Ethiopia†; baseline data from Alive & Thrive

	Stunting			Underweight			Wasting		
	Bangladesh (*n* 4219)	Vietnam (*n* 3542)	Ethiopia (*n* 2578)	Bangladesh (*n* 4284)	Vietnam (*n* 3546)	Ethiopia (*n* 2669)	Bangladesh (*n* 4228)	Vietnam (*n* 3543)	Ethiopia (*n* 2610)
High CMD (≥7) (ref. = low CMD (<7))	1·21*	1·09	0·89	1·09	1·27*	1·14	1·06	1·17	1·24
Child's characteristics									
Age (months)	1·16***	1·14***	1·12***	1·10***	1·03***	1·09***	1·04*	1·00	0·95***
Child illness									
Diarrhoea (ref. = no)	1·08	0·90	1·05	1·15	0·91	1·22	1·37(*)	1·39	1·19
Upper ARI (ref. = no)	1·26**	1·02	1·18	1·21*	1·08	1·18	1·18*	1·20	1·05
Low birth weight (ref. = no)	1·54***	3·71***	1·20*	1·95***	3·96***	1·41***	1·71***	3·61***	1·50*
Child gender (ref. = female)	1·21***	1·18	1·35***	1·12*	0·85	1·30**	1·22*	1·43*	1·45*
Maternal characteristics									
Age (years)	1·00	0·98	1·00	1·01	0·99	1·00	1·00	1·00	1·00
Education									
No schooling (ref. in Bangladesh, Ethiopia)	1·00	–	1·00	1·00	–	1·00	1·00	–	1·00
Primary school (ref. in Vietnam)	0·90	1·00	0·78*	1·03	1·00	0·87	0·92	1·00	0·86
Secondary school	0·82(*)	0·97	0·65*	0·93	1·12	0·66(*)	0·96	1·17	0·71
High school	0·52(*)	0·73	–	0·48**	0·96	–	0·61	1·32	–
College or higher	–	0·52*	–	–	0·77	–	–	1·22	–
Maternal height/BMI‡	0·91***	0·88***	0·98***	0·93***	0·91***	0·98**	0·98(*)	0·97*	1·00
Household characteristics									
SES									
Richest (ref.)	1·00	1·00	1·00	1·00	1·00	1·00	1·00	1·00	1·00
Richer	1·34*	1·59*	0·92	1·30**	1·60*	1·37*	1·13	1·58	1·59
Middle	1·72***	2·05***	1·06	1·44**	1·85**	1·29	0·98	1·85*	1·44
Poorer	1·77***	2·05***	1·03	1·64***	1·71*	1·37*	1·03	1·51	1·60(*)
Poorest	2·36***	1·72*	1·31(*)	2·26***	1·88**	1·80***	1·25*	2·01*	1·30
Food security									
Security (ref.)	1·00	1·00	1·00	1·00	1·00	1·00	1·00	1·00	1·00
Insecurity	1·18	1·24**	1·22*	1·15	1·39*	1·15	1·13(*)	0·97	0·99
Mother is household head (ref. = no)	1·02	0·97	1·21	1·03	0·78	1·22	1·01	1·09	0·90

CMD, common mental disorders; ref., referent category; ARI, acute respiratory infections; SES, socio-economic status.
(*)$P<0·10$, *$P<0·05$, **$P<0·01$, ***$P<0·001$.
†Results presented are odds ratios. Models were also adjusted for age squared and cluster effects.
‡Maternal BMI was used for the wasting model.

mothers with high CMD, but differences were statistically significant only for early initiation of breast-feeding in Vietnam and Ethiopia, and for minimum acceptable diet (a composite indicator of appropriate child feeding practices) in Vietnam.

Discussion and conclusions

The present paper indicates that maternal CMD is a considerable public health problem in Bangladesh, Vietnam and Ethiopia. It also corroborates that maternal CMD is associated with both child undernutrition and common illnesses. After adjusting for potential confounding factors, maternal CMD was associated with 1·21 higher odds of being stunted in Bangladesh and 1·27 higher odds of being underweight in Vietnam. For child illnesses, the associations were even higher and more consistent across countries: children whose mothers had high CMD were more than twice more likely to have upper ARI in Vietnam and Ethiopia (and 1·4 times more likely in Bangladesh); and for diarrhoea, the odds ranged from 1·67 times in Bangladesh to 2·11 times in Vietnam.

To our knowledge, only a few studies, conducted in Chile[39], Nigeria[21], Ethiopia[22] and Pakistan[20], have examined the association between maternal mental health and child illness. Our results showed a strong association between maternal CMD and both diarrhoea and upper ARI in three different countries. These findings suggest that a potential pathway for the relationship between maternal CMD and child undernutrition could be through child illness – as high levels of maternal CMD may hinder a mother's ability to take adequate care of her child, prevent illnesses and seek health care when the child is ill, hence leading to higher illness rates. The illness measurement was based on two-week recall and was similar to the method used in the Demographic and Health Survey. However, the duration and number of episodes of the illnesses were not captured and therefore were not included in the analysis. Other possible mechanisms linking maternal CMD to child growth and child illness include compromised parenting behaviour and non-responsive care-giving practices[40]. Our data also showed evidence of poorer hygiene practices, lower use of prenatal care services, and some trends towards poorer IYCF practices among mothers with high CMD. There was also evidence in our data that children's illness symptoms (upper ARI and diarrhoea) were associated with undernutrition, although the associations were statistically significant only in Bangladesh.

Table 3 Results of multivariate analyses of the association between maternal CMD and child illness in Bangladesh, Vietnam and Ethiopia†; baseline data from Alive & Thrive

	Diarrhoea			Upper ARI		
	Bangladesh (*n* 4318)	Vietnam (*n* 3557)	Ethiopia (*n* 2695)	Bangladesh (*n* 4318)	Vietnam (*n* 3557)	Ethiopia (*n* 2695)
High CMD (≥7) (ref. = low CMD (<7))	1·67***	2·11***	1·83***	1·41***	2·05***	2·10***
Child's characteristics						
Age (months)	1·30*	1·00	1·01	1·09	1·05***	1·00
Low birth weight (ref. = no)	1·06**	1·06	1·01	1·01	1·18	1·13
Child gender (ref. = female)	1·15(*)	1·17	1·23(*)	1·01	0·95	0·92
Maternal characteristics						
Age (years)	0·98	0·97***	1·00	0·99*	1·00	1·00
Education						
No schooling (ref. in Bangladesh, Ethiopia)	1·00	–	1·00	1·00	–	1·00
Primary school (ref. in Vietnam)	0·97	1·00	1·06	0·99	1·00	1·16
Secondary school	0·90	1·28	0·87	1·01	0·87	1·27
High school	0·33(*)	0·98	–	0·74	0·77(*)	–
College or higher	–	1·23	–	–	0·76	–
Household characteristics						
SES						
Richest (ref.)	1·00	1·00	1·00	1·00	1·00	1·00
Richer	0·65	0·82	1·22	1·08	1·11	1·08
Middle	0·76	0·86	1·11	1·17	1·09	1·86***
Poorer	0·68	0·78	1·51*	1·40*	0·88	1·62**
Poorest	0·59	0·84	1·65**	1·12	0·85	1·79***
Food security						
Security (ref.)	1·00	1·00	1·00	1·00	1·00	1·00
Insecurity	1·48**	1·62***	1·15	1·25**	1·33*	1·13
Mother is household head (ref. = no)	1·01	1·12	0·55*	1·24	0·77	0·81
Hygiene spot score						
Child's hygiene	0·95	0·91	0·96	1·01	1·00	0·95
Mother's hygiene	0·98	0·99	0·91*	0·98	0·97	0·97

CMD, common mental disorders; ref., referent category; ARI, acute respiratory infections; SES, socio-economic status.
(*)$P<0·10$, *$P<0·05$, **$P<0·01$, ***$P<0·001$.
†Results presented are odds ratios. Models were also adjusted for age squared and cluster effects.

Table 4 Bivariate association of maternal CMD with maternal and household characteristics in Bangladesh, Vietnam and Ethiopia; baseline data from Alive & Thrive

	Bangladesh		Vietnam		Ethiopia	
	High CMD	Low CMD	High CMD	Low CMD	High CMD	Low CMD
Maternal characteristics						
Age (years)	27·52***	26·16	29·83***	29·05	30·21***	28·48
Education (%)						
No schooling	58·69***	41·31	44·25***	55·75	41·17***	58·83
Primary school	49·61	50·39	–	–	37·78	62·22
Secondary school	43·61	56·39	31·04	68·96	23·79	76·21
High school	30·56	69·44	27·66	72·34	–	–
College or higher	–	–	21·57	78·43	–	–
BMI (%)						
BMI<18·5 kg/m^2	55·02***	44·98	36·39***	70·67	43·75**	56·25
BMI ≥ 18·5 kg//m^2	46·60	53·40	29·33	63·61	37·37	62·63
Household characteristics						
SES (%)						
Poorest	61·25***	38·57	41·77***	58·23	50·42***	49·58
Poorer	53·64	46·36	33·54	66·46	41·65	58·35
Middle	47·95	52·05	33·29	66·71	33·95	66·05
Richer	43·86	56·14	25·19	74·81	33·78	66·22
Richest	38·52	61·48	22·32	77·68	35·47	64·53
Food security (%)						
Food insecure	65·25***	34·75	50·00***	50·00	46·11***	53·89
Food secure	41·40	58·60	19·54	80·46	25·78	74·22

CMD, common mental disorders; SES, socio-economic status.
**$P<0·01$, ***$P<0·001$.

Table 5 Bivariate association of maternal CMD with child feeding practices, hygiene and health-seeking behaviours in Bangladesh, Vietnam and Ethiopia; baseline data from Alive & Thrive

	Bangladesh		Vietnam		Ethiopia	
	High CMD	Low CMD	High CMD	Low CMD	High CMD	Low CMD
	%	%	%	%	%	%
Child feeding practices						
Early initiation of breast-feeding	64·86	63·02	53·93**	60·25	62·86*	69·00
Exclusive breast-feeding	47·61	51·67	17·87	18·51	68·98	74·36
Minimum dietary diversity (≥4 food groups)	30·15	31·92	73·96	75·13	5·65	6·68
Minimum meal frequency†	37·69	41·53	77·51	82·41	42·86	47·31
Minimum acceptable diet‡	14·07	15·47	49·41***	60·32	3·87	5·01
Consumption of Fe-rich foods§	34·67	37·62	83·43	86·51	1·79	2·23
Child illness						
Fever symptoms	47·41***	38·31	37·22***	23·42	36·30***	20·50
Cough/cold symptoms	47·87***	40·68	40·81***	24·40	39·33***	26·87
Fast breathing symptoms	12·14***	5·89	8·55***	2·54	14·43***	6·15
Diarrhoea symptoms	9·55***	5·58	14·06***	6·89	21·78***	12·02
Health-seeking behaviour						
Consultation health professional during last pregnancy	75·63**	79·08	50·72***	56·27	62·83*	66·76
Mother takes Fe supplements	60·79**	65·19	86·64	93·40	27·23	29·26

	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Hygiene spot score												
Child's cleanliness	2·73***	1·67	3·03	1·58	3·01***	1·21	3·29	1·06	2·17***	1·62	2·53	1·54
Mother's cleanliness	3·23***	1·32	3·43	1·24	3·07***	1·12	3·26	1·01	2·26***	1·48	2·59	1·44

CMD, common mental disorders.
*$P<0·05$, **$P<0·01$, ***$P<0·001$.
†Minimum meal frequency is defined as 2 times/d for breast-fed infants aged 6–8 months; 3 times/d for breast-fed children aged 9–23·9 months; 4 times/d for non-breast-fed children aged 6–23·9 months. 'Meals' include both meals and snacks and frequency is based on mother's report.
‡Acceptable diet is defined as at least the minimum dietary diversity and the minimum meal frequency during the previous day.
§Fe-rich or Fe-fortified foods include flesh foods, commercially fortified foods especially designed for infants and young children that contain Fe, or foods fortified in the home with a micronutrient powder containing Fe.

The lack of an association between maternal CMD and child undernutrition in Ethiopia is consistent with recent findings from a prospective cohort study in Ethiopia. The latter study showed that maternal CMD was associated with child underweight at 12 months in a bivariate analysis, but the association did not remain after adjusting for maternal characteristics or household characteristics[17].

The variability in findings among the three countries, especially regarding the association between maternal CMD and child undernutrition, may be explained by socio-cultural differences in care and feeding practices, differences in maternal resources such as education, knowledge or time, or in household food insecurity and wealth[18]. In our data, the two variables that were most different among the three countries were maternal education (with 65·4% of women in Ethiopia having no schooling compared with 26·8% of women in Bangladesh and 15·7% of women in Vietnam) and household food insecurity (the prevalence of food insecurity was twice as high in Ethiopia as it was in Bangladesh and Vietnam). We examined whether the association between maternal CMD and child nutrition outcomes in Ethiopia differed by maternal education, household SES or food insecurity, but we did not find evidence of such interactions (results not shown). It is possible, therefore, that the variability in the associations across countries could be attributable to broader socio-cultural issues, including potential differences in access to social support mechanisms or social networks within communities for women with high CMD.

The high prevalence of maternal CMD among women in the three countries and the associated risk of high CMD for child undernutrition and child illness suggest that interventions to address maternal mental well-being, and the factors that influence mental well-being, could make important contributions to improving the health and nutrition of children. Several environmental and poverty-related factors were associated with CMD in our analyses (lower education, living in a food-insecure or a lower-SES household), which suggests that attempts to relieve some of these constraints (e.g. through poverty reduction, social protection, women's empowerment programmes) may be necessary to help improve maternal mental well-being. In the context of behaviour change interventions which aim at reducing undernutrition and death in children by improving IYCF practices, CMD might be an important factor that prevents mothers either from participating in the programme or from adopting recommended practices[6,41]. Further, programme interventions focused on the creation of women's groups and health committees to discuss maternal and child health problems and formulate approaches to deal with them based on methods learned within these group settings have also shown to be successful in improving maternal mental health and breast-feeding practices, indicating that

interventions centred around improving maternal CMD can be an important aspect to consider[42]. It would therefore be important to examine the role of maternal mental well-being in relation to participation in public health programmes and adoption of public health recommendations that require behaviour change.

The strengths of the present study include the large samples of mother–child dyads in the three countries and the use of the same questionnaire and survey methodology, which allowed for a valid comparison across countries. The instrument used to capture maternal CMD was validated for use in developing countries[30] and was locally adapted by taking cultural and social factors into consideration. Finally, the availability of data on a wide range of child, maternal and household factors in the surveys allowed us to control for a range of potentially confounding factors and isolate the association between maternal CMD and child undernutrition and illness.

Two limitations of the study merit further discussion. First, data were collected based on maternal recall of their emotional distress in the last four weeks (for CMD) and of their children's symptoms of illness in the two weeks prior to the interview. Maternal recall has its limitations and can result in either under- or over-reporting of information. We do not have evidence, however, to suggest that maternal CMD could adversely affect recall and assume, therefore, that recall biases for CMD and illness are randomly distributed across the sample. The cut-off point used to categorize the level of high and low maternal CMD was supported by one validation study[32] and it is possible that the cut-off itself is not uniformly applicable across countries. However, analyses with the continuous variables for CMD yielded similar results. Second, the cross-sectional nature of the data used for the present analysis did not allow us to establish the causal relationship of maternal CMD with child undernutrition and illness. The potential of reverse causality cannot be ruled out as children's poor growth or illness may cause maternal stress or mental distress, which in turn may impede the ability of mothers to take adequate care of their children and lead to compromised growth and increased prevalence of infections[5]. Several studies support this hypothesis. Preterm birth and failure to thrive among children have been found to be associated with postnatal depression[18,43,44]. Additionally, there is evidence from intervention trials showing that interventions targeted to the child, through early child stimulation activities, have positive effects on reducing maternal depression[45]. This further suggests reverse causality of the relationship between CMD and child undernutrition.

The results from the present study contribute to the growing evidence of the potential negative effects of maternal mental health on child undernutrition and illness. The findings underscore the importance of identifying ways to prevent, detect and address maternal mental health in the context of programmes aimed at improving child health and nutrition in these countries and in similar settings elsewhere.

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References

1. World Health Organization (2004) *The Importance of Caregiver–Child Interactions for the Survival and Healthy Development of Young Children: A Review*. Geneva: WHO.
2. Bhutta ZA, Ahmed T, Black RE *et al.* (2008) What works? Interventions for maternal and child undernutrition and survival. *Lancet* **371**, 417–440.
3. Engle PL & Lhotska L (1999) The role of care in programmatic actions for nutrition: designing programmes involving care. *Food Nutr Bull* **20**, 121–135.
4. UNICEF (1998) *The State of the World's Children 1998*. New York: Oxford University Press.
5. Stewart RC (2007) Maternal depression and infant growth: a review of recent evidence. *Matern Child Nutr* **3**, 94–107.
6. Rahman A, Patel V, Maselko J *et al.* (2008) The neglected 'm' in MCH programmes – why mental health of mothers is important for child nutrition. *Trop Med Int Health* **13**, 579–583.
7. Walker SP, Wachs TD, Gardner JM *et al.* (2007) Child development: risk factors for adverse outcomes in developing countries. *Lancet* **369**, 145–157.
8. Patel P, Wheatcroft R, Park RJ *et al.* (2002) The children of mothers with eating disorders. *Clin Child Fam Psychol Rev* **5**, 1–19.
9. Patel V, DeSouza N & Rodrigues M (2003) Postnatal depression and infant growth and development in low income countries: a cohort study from Goa, India. *Arch Dis Child* **88**, 34–37.
10. Black MM, Baqui AH, Zaman K *et al.* (2009) Maternal depressive symptoms and infant growth in rural Bangladesh. *Am J Clin Nutr* **89**, issue 3, 951S–957S.

11. Rahman A, Lovel H, Bunn J *et al.* (2004) Mothers' mental health and infant growth: a case–control study from Rawalpindi, Pakistan. *Child Care Health Dev* **30**, 21–27.
12. Harpham T, Huttly S, De Silva MJ *et al.* (2005) Maternal mental health and child nutritional status in four developing countries. *J Epidemiol Community Health* **59**, 1060–1064.
13. Surkan PJ, Kawachi I, Ryan LM *et al.* (2008) Maternal depressive symptoms, parenting self-efficacy, and child growth. *Am J Public Health* **98**, 125–132.
14. Santos DS, Santos DN, de Cassia Ribeiro Silva R *et al.* (2010) Maternal common mental disorders and malnutrition in children: a case–control study. *Soc Psychiatry Psychiatr Epidemiol* **46**, 543–548.
15. Stewart RC, Umar E, Kauye F *et al.* (2008) Maternal common mental disorder and infant growth – a cross-sectional study from Malawi. *Matern Child Nutr* **4**, 209–219.
16. Tomlinson M, Cooper PJ, Stein A *et al.* (2006) Post-partum depression and infant growth in a South African peri-urban settlement. *Child Care Health Dev* **32**, 81–86.
17. Medhin G, Hanlon C, Dewey M *et al.* (2010) The effect of maternal common mental disorders on infant undernutrition in Butajira, Ethiopia: the P-MaMiE study. *BMC Psychiatry* **10**, 32.
18. Surkan PJ, Kennedy CE, Hurley KM *et al.* (2011) Maternal depression and early childhood growth in developing countries: systematic review and meta-analysis. *Bull World Health Organ* **89**, 608–615.
19. Rahman A, Iqbal Z, Bunn J *et al.* (2004) Impact of maternal depression on infant nutritional status and illness: a cohort study. *Arch Gen Psychiatry* **61**, 946–952.
20. Rahman A, Bunn J, Lovel H *et al.* (2007) Maternal depression increases infant risk of diarrhoeal illness: – a cohort study. *Arch Dis Child* **92**, 24–28.
21. Adewuya AO, Ola BO, Aloba OO *et al.* (2008) Impact of postnatal depression on infants' growth in Nigeria. *J Affect Disord* **108**, 191–193.
22. Ross J, Hanlon C, Medhin G *et al.* (2011) Perinatal mental distress and infant morbidity in Ethiopia: a cohort study. *Arch Dis Child Fetal Neonatal Ed* **96**, F59–F64.
23. Nguyen PH, Manohar S, Mai LT *et al.* (2010) *Viet Nam Baseline Survey Report. Alive and Thrive Project.* Washington, DC: International Food Policy Research Institute.
24. Saha KK, Bamezai A, Khaled A *et al.* (2010) *Bangladesh Baseline Survey Report. Alive and Thrive Project.* Washington, DC: International Food Policy Research Institute.
25. Ali D, Tedla M, Subandoro A *et al.* (2010) *Ethiopia Baseline Survey Report. Alive and Thrive Project.* Washington, DC: International Food Policy Research Institute.
26. Cogill B (2003) *Anthropometric Indicators Measurement Guide. Food and Nutrition Technical Assistance Project.* Washington, DC: Academy for Educational Development.
27. World Health Organization (2010) The WHO Child Growth Standards. http://www.who.int/childgrowth/standards/en/ (accessed July 2012).
28. UNICEF/World Health Organization (2009) *Diarrhoea: Why Children are Still Dying and What Can be Done.* Geneva: WHO.
29. World Health Organization (2007) *Infection Prevention and Control of Epidemic- and Pandemic-Prone Acute Respiratory Diseases in Health Care. WHO Interim Guidelines.* Geneva: WHO.
30. World Health Organization (1994) *A User's Guide to Self-Reporting Questionnaires.* Geneva: Division of Mental Health, WHO.
31. Hanlon C, Medhin G, Alem A *et al.* (2008) Detecting perinatal common mental disorders in Ethiopia: validation of the self-reporting questionnaire and Edinburgh Postnatal Depression Scale. *J Affect Disord* **108**, 251–262.
32. Giang KB, Allebeck P, Kullgren G *et al.* (2006) The Vietnamese version of the Self Reporting Questionnaire 20 (SRQ-20) in detecting mental disorders in rural Vietnam: a validation study. *Int J Soc Psychiatry* **52**, 175–184.
33. Vyas S & Kumaranayake L (2006) Constructing socio-economic status indices: how to use principal components analysis. *Health Policy Plan* **21**, 459–468.
34. Gwatkin D, Rutstein S, Johnson K *et al.* (2007) Socio-economic differences in health, nutrition, and population within developing countries: an overview. *Niger J Clin Pract* **10**, 272–282.
35. Coates J, Swindale A & Bilinsky P (2007) *Household Food Insecurity Access Scale (HFIAS) for Measurement of Household Food Access: Indicator Guide (v. 3).* Washington, DC: Food and Nutrition Technical Assistance Project, Academy for Educational Development.
36. Daelmans B, Dewey K & Arimond M (2009) New and updated indicators for assessing infant and young child feeding. *Food Nutr Bull* **30**, 2 Suppl., S256–S262.
37. World Health Organization (2008) *Indicators for Assessing Infant and Young Child Feeding Practices: Conclusions of a consensus meeting held 6–8 November 2007 in Washington, DC, USA.* Geneva: WHO.
38. Ruel MT & Arimond M (2002) Spot-check observational method for assessing hygiene practices: review of experience and implications for programmes. *J Health Popul Nutr* **20**, 65–76.
39. Humphreys D, Araya M, Cruchet S *et al.* (1996) Maternal neurotic symptoms and infants' risk of developing persistent diarrhoea. *Rev Saude Publica* **30**, 213–217.
40. Rahman A, Harrington R & Bunn J (2002) Can maternal depression increase infant risk of illness and growth impairment in developing countries? *Child Care Health Dev* **28**, 51–56.
41. Field T (2010) Postpartum depression effects on early interactions, parenting, and safety practices: a review. *Infant Behav Dev* **33**, 1–6.
42. Tripathy P, Nair N, Barnett S *et al.* (2010) Effect of a participatory intervention with women's groups on birth outcomes and maternal depression in Jharkhand and Orissa, India: a cluster-randomised controlled trial. *Lancet* **375**, 1182–1192.
43. Vigod SN, Villegas L, Dennis CL *et al.* (2010) Prevalence and risk factors for postpartum depression among women with preterm and low-birth-weight infants: a systematic review. *BJOG* **117**, 540–550.
44. Drewett R, Blair P, Emmett P *et al.* (2004) Failure to thrive in the term and preterm infants of mothers depressed in the postnatal period: a population-based birth cohort study. *J Child Psychol Psychiatry* **45**, 359–366.
45. Baker-Henningham H, Powell C, Walker S *et al.* (2005) The effect of early stimulation on maternal depression: a cluster randomised controlled trial. *Arch Dis Child* **90**, 1230–1234.