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Maternal and Child Dietary Diversity Are Associated in Bangladesh, Vietnam, and Ethiopia[1,2]

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Abstract

Dietary diversity (DD) reflects micronutrient adequacy of the diet and is associated with better child growth. Emerging evidence suggests that maternal and child DD are associated. This could have measurement and programmatic implications. Data on mother-child (6–24 mo) dyads in Bangladesh, Vietnam, and Ethiopia were used to examine agreement and association between maternal and child DD and identify determinants of maternal and child DD. The DD scores were derived from a 24-h recall of intake of foods from 7 groups. Multivariable regression was used to examine for the association, adjusting for covariates at child, maternal, and household levels. There was mother/child agreement for staple foods across the 3 countries but disagreement for flesh foods, dairy, fruits, and vegetables. A strong positive association was seen between maternal and child DD; a difference of one food group in mother's consumption was associated with a difference of 0.29, 033, and 0.24 groups in child's consumption in Bangladesh, Vietnam, and Ethiopia, respectively. The odds of achieving minimum DD (≥4 groups) were higher among children whose mother consumed 4 groups compared with ≤3 food groups [Bangladesh: OR = 2.73 (95% CI: 1.76, 4.25); Vietnam: OR = 2.30 (95% CI: 1.45, 3.43); Ethiopia: OR = 5.11 (95% CI: 2.36, 11.04)]. Maternal education was associated with both maternal and child DD; food security and socioeconomic status were associated only with maternal DD. Given the disagreements in mother/child intake for nutrient-rich foods, both maternal and child DD should be measured in surveys. Behavior change communications should focus on promoting both mother and child DD and encouraging mothers to feed young children all family foods, not just a subset. J. Nutr. 143: 1176–1183, 2013.

Introduction

Nutrient-rich foods and diverse diets are key elements of optimal complementary feeding practices and are essential for children to meet their nutrient needs and support adequate growth during the critical period between 6 and 24 mo of age. International guidelines recommend that complementary foods be fed in small amounts several times per day and include a variety of foods from different groups daily, including nutrient-rich flesh foods or fortified foods (1).

Dietary diversity (DD)[9] is part of the set of indicators developed by the WHO (2) to assess infant and young child feeding practices. DD, defined as the simple count of foods and food groups consumed over the past 24 h, is a strong predictor of the micronutrient density adequacy of the diet in infants and young children (3,4). In adult women, a similar indicator validated through a multi-country study also found a strong association between DD and the micronutrient adequacy of the diet (5). DD is therefore being increasingly adopted as a proxy indicator of micronutrient density or adequacy of the diet in large surveys and other data collection exercises.

A recent study using demographic and health surveys from Cambodia, Ghana, and Haiti suggests that maternal and child DD are associated. Children whose mothers consumed >5 food groups (on a scale of 0–9 food groups) were 5–9 times more likely to achieve minimum DD compared with those whose mothers consumed <3 food groups (6). Other studies in developed countries also suggest that maternal dietary patterns influence children's diets (7–10). Typically, however, behavior change communication (BCC) strategies to improve complementary feeding practices focus on educating mothers about the importance of including a variety of foods in the child's diet (11–14) without necessarily emphasizing the importance of diversity in their own diet as well. If mothers' food choices and their access to food dictate both their diet and that of their child, BCC

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[9] Abbreviations used: BCC, behavior change communication; CMD, common mental disorder; DD, dietary diversity; SES, socioeconomic status.
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strategies should emphasize the importance of nutrient-rich foods for both mother and child. BCC should also address up front the potential cultural barriers and broader constraints that may prevent mothers from consuming certain nutritious foods that would provide key nutrients for them and their child during the first 1000 d (the period between conception and a child's second birthday), a period of peak nutritional vulnerability for both (15).

This study investigated the association between maternal and child DD in 3 countries with different food availability, culture, and dietary patterns: Bangladesh, Vietnam, and Ethiopia. The study had 2 main objectives: *1*) examine the agreement and association between maternal and child DD, both in terms of overall scores and consumption of specific food groups; and *2*) assess the similarities and differences in the determinants of maternal and child DD and identify household and maternal constraints that may need to be addressed to improve both. The information generated by this study has programmatic implications and will help guide efforts aimed at measuring and improving the diversity and micronutrient adequacy of diets of mothers and children. In addition, the study provides evidence regarding the household and maternal constraints that need to be addressed to achieve these goals.

Methods

Data source and study population

The data for the study were from baseline surveys conducted in Bangladesh, Vietnam, and Ethiopia as part of a large project (Alive andThrive) aimed at reducing undernutrition and death caused by suboptimal infant and young child feeding practices. The Bangladesh baseline survey included 4400 households in 20 selected subdistricts (upazila) (16). The Ethiopia baseline survey covered 3000 households from 75 enumeration areas in Tigray and Southern Nations Nationalities and Peoples Region (17). The Vietnam baseline survey included 4029 households in 40 communes from 4 provinces (18). For this study, we used data on children 6–24 mo old and their mothers. Data on food group intake were available for 1211, 1094, and 832 mother and child dyads in Bangladesh, Vietnam, and Ethiopia, respectively. Because >90% of children were breastfed, we did not stratify the sample on breastfeeding status. Ethical approval was obtained from the Institutional Review Boards of the designated countries and from the International Food Policy Research Institute.

Measures

Child DD. The key outcome variable was the child's DD score, which was constructed based on maternal recall of the child's intake of food groups in the past 24 h using a WHO-recommended questionnaire and country-specific adaptation guidance (2,3). Mothers were asked to list the foods her child ate and these foods were later categorized in 7 food groups: *1*) grains, roots, and tubers; *2*) legumes and nuts; *3*) dairy products (milk, yogurt, and cheese); *4*) flesh foods (meat, fish, poultry, and liver/organ meats); *5*) eggs; *6*) vitamin-A rich fruits and vegetables; and *7*) other fruits and vegetables. The response options were "consumed" (scored 1) and "not consumed" (scored 0). The DD indicator was the simple sum of scores to the 7 categorized food groups and thus ranged from 0 to 7. A minimally adequate DD was defined as children consuming ≥4 food groups based on a WHO indicator definition (2).

Maternal DD. The maternal DD score was also assessed via 24-h recall and used the same food groupings ($n = 7$) as the child DD to enable direct comparisons between maternal and child DD. The multi-country study for adult women found that indicators based on 8 alternative food groupings, ranging from 6 to 21 food groups, all showed a strong association with women's mean probability of adequacy for 11 micronutrients (5). Maternal DD was then re-categorized into mothers consuming ≤3, 4, 5, and ≥6 food groups for Bangladesh and Vietnam and ≤3, 4, and ≥5 food groups for Ethiopia (because very few mothers consumed 6 or more food groups in Ethiopia).

Covariates. We examined factors that could influence maternal and child DD. For child DD, these included child's age and gender and a series of maternal and household factors. For maternal DD, the models also included household factors as well as the mother's age and education. Different cutoffs were used for maternal education for the 3 countries, because education levels varied significantly. For example, in Vietnam, "primary education" was used as the reference group, because "no schooling" is very rare, whereas in Bangladesh and Ethiopia, "no schooling" was used as the reference group. In both mother and child models, we included maternal physical and mental health, nutrition knowledge, and control over income (including ability to earn money and use money to buy different types of foods). Maternal perceived physical health status was measured using a visual analogue scale that recorded maternal perception of her own health on a scale from 1 to 10, with 1 representing "poor health" and 10 "good health." Maternal common mental disorders (CMDs) were measured using the 20-item Self Reporting Questionnaire (19) scored as 0 or 1 depending on responses related to items on distress over the past 30 d. The scores were added to generate a scale, where high scores denote poor mental health. We used a cut-point of 7 to classify women with a low or high level of CMD, as suggested by several validation studies (20,21). Maternal knowledge of food diversity was measured by asking mothers to identify foods important for children to grow (assigning one score for each of the 7 food groups identified with a possible total score of 7). Maternal knowledge of general nutrition was measured by asking questions related to iron, vitamin A, and iodine (assigning one score for each correct response with a total possible score of 8).

At the household level, the models included household socioeconomic status (SES), food security, gender of household head, and number of children under 5 y. An SES index was constructed using principal components analysis with variables on 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) (22,23). Component scores derived from the first component (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. Household food security was measured using Food and Nutrition Technical Assistance/USAID's Household Food Insecurity Access Scale (24), which provides information on behavior and perceptions related to household food insecurity, anxiety and uncertainty, insufficient quality of intake, and insufficient food intake and its consequences. The households were then categorized into 4 groups (food secure and mild, moderately, and severely food insecure) based on the Household Food Insecurity Access Scale categorization (24). Households were categorized as increasingly food insecure as they responded affirmatively to more severe conditions and reported a greater frequency of experiencing the conditions.

Statistical analyses

Data were separately analyzed for each country using Stata version 11 (25). Descriptive analyses were conducted to examine the background characteristics of the study samples. Logistic regression was used to assess the association between maternal and child minimum DD. Multivariable linear regression was used to examine this association for all children and 2 age groups of children (6–11.9 and 12–23.9 mo) when treating child DD as a continuous variable. This model also allowed us to compare the similarities and differences in the determinants of maternal and child DD. Both logistic and linear regression models were adjusted for covariates at the maternal (age, education, nutrition knowledge, mental and physical health, and finance control), household (food security, SES, household head, and numbers of dependents), and child (age and gender) levels. Cluster effects that were defined as communes, upazilas, or enumeration areas were adjusted using a robust (i.e., sandwich) estimator of residual variance.

Results

Description of the study samples

The study samples from Bangladesh, Vietnam, and Ethiopia shared similarities in maternal age, child age, proportion of male and female children, proportion of households headed by females, and number of children <5 y old in the household (**Table 1**). Major differences across the 3 countries were observed for maternal education and household food security. Whereas 27% of women in Bangladesh and about two-thirds in Ethiopia had no education, all the women in Vietnam had some education. More than 60% of the households were categorized as food secure in Bangladesh and Vietnam, but only 35% were food secure in Ethiopia (Table 1). Maternal knowledge on food diversity was better in Vietnam (mean score of 3.2) compared with Bangladesh (2.2) and Ethiopia (2.2). The proportion of mothers with CMDs was highest in Bangladesh (49%), followed by Ethiopia (38%) and Vietnam (31%). Maternal power to control finances (earning money and buying food) was high in Vietnam compared with Bangladesh and Ethiopia.

TABLE 1 Selected characteristics of the study sample in Bangladesh, Vietnam, and Ethiopia[1]

	Bangladesh (n = 1211)	Vietnam (n = 1094)	Ethiopia (n = 875)
Maternal DD			
Food groups consumed (range: 0–7)	4.1 ± 1.2	4.6 ± 1.1	2.8 ± 1.3
1–3 groups, %	31.0	17.4	74.8
4 groups, %	34.3	28.9	15.5
5 groups, %	22.5	31.3	9.7
6–7 groups, %	12.2	22.5	
Child DD			
Food groups consumed (range: 0–7)	2.9 ± 1.6	4.4 ± 1.6	1.7 ± 1.1
Achieved minimum DD,[2] %	31.1	74.8	6.3
Maternal characteristics			
Age, y	26.4 ± 6.0	28.8 ± 5.5	28.3 ± 6.1
Education, %			
No schooling	26.7	0.0	63.1
Primary school	28.7	13.0	30.2
Secondary school	41.5	49.6	6.7
High school	3.1	23.0	
College or higher		14.4	
Maternal knowledge			
Food diversity (range: 0–7)	2.2 ± 0.7	3.2 ± 1.4	2.2 ± 1.2
General nutrition (range: 0–8)[3]	2.7 ± 1.7	2.5 ± 1.4	2.4 ± 1.8
High CMD, %	49.3	30.9	38.4
Maternal self-perceived physical health, %			
Bad health	19.5	7.4	8.0
Normal	63.4	58.3	34.6
Good health	17.1	34.3	57.4
Mother can earn money, %	5.2	54.0	8.8
Mother can decide to buy foods (range: 0–8)[4]	3.2 ± 3.6	6.5 ± 2.8	5.6 ± 2.7
Child characteristics			
Age, %			
6–11.9 mo	33.7	42.1	37.1
12–23.9 mo	66.3	57.9	62.9
Female, %	49.3	46.8	48.6
Household characteristics, %			
Household food security			
Food secure	68.5	62.3	33.4
Mildly food insecure	6.7	16.4	16.8
Moderately food insecure	11.3	16.1	34.8
Severely food insecure	13.5	5.3	15.0
Female household head	9.5	5.4	7.1
Number of children <5 y			
1 child	75.7	82.9	48.5
2 children	22.5	16.5	48.9
≥3 children	1.7	0.6	2.6

[1] Values are means ± SDs or percentages. CMD, common mental disorder; DD, dietary diversity.
[2] Consumed ≥4 food groups.
[3] General nutrition knowledge is calculated based on mother's responses to questions related to iron, vitamin A, and iodine (assigning one score for each correct response with a total possible score of 8).
[4] Mother can decide to buy foods is calculated based on if she can decide herself or decide jointly with her husband to buy 8 different kinds of foods; each give one score.

Maternal and child DD patterns

The mean maternal DD was highest in Vietnam (4.6), followed by Bangladesh (4.1) and Ethiopia (2.8) (Table 1). Three-quarters of mothers in Ethiopia consumed only 1–3 food groups compared with 31% in Bangladesh and 17% in Vietnam. Similarly, the mean child DD was highest in Vietnam (4.4), followed by Bangladesh (2.9), and Ethiopia (1.7). About three-quarters of children in Vietnam had a minimum DD compared with only one-third in Bangladesh and 6% in Ethiopia.

There were close similarities between the diets of mothers and children in all 3 countries but also some clear distinctions (**Fig. 1**). As is common in developing countries, starchy staple foods were almost universally consumed by both mothers and children, whereas flesh foods, eggs, and dairy products were less likely to have been consumed in the previous 24 h, particularly in Ethiopia. Whereas in Vietnam, ~80% of both mothers and children had consumed animal-source foods the previous day, only 65% of mothers and 35% of children had done so in Bangladesh and as few as 9% of mothers and <2% of children consumed these foods in Ethiopia. Children from all 3 countries were more likely than their mothers to have consumed dairy products (1.4 times in Bangladesh, 3.2 times in Vietnam, and 1.5 times in Ethiopia). On the other hand, mothers were more likely to have consumed flesh food (1.9 times in Bangladesh and 5.8 times in Ethiopia) and vitamin A-rich fruit and vegetables as well as other fruits and vegetables in all 3 countries (3.9, 1.4, and 11.1 times in Bangladesh, Vietnam, and Ethiopia, respectively) (Fig. 1).

Association between maternal and child DD

In all 3 countries, maternal DD was significantly associated with minimum child DD (consumption of ≥4 food groups) after adjusting for child, maternal, and household covariates (**Table 2**). The more food groups the mothers consumed, the more likely their child attained the minimum DD. Compared with children whose mothers consumed ≤3 food groups, children whose mothers consumed 4 food groups were more than twice as likely to achieve the minimum DD in Bangladesh [OR = 2.73 (95% CI: 1.76, 4.25)] and Vietnam [OR = 2.30 (95% CI: 1.45, 3.43)] and were 5 times more likely to achieve the minimum DD in Ethiopia [OR = 5.11 (95% CI: 2.36–11.04)]. These odds were even higher among children whose mothers consumed 5 food groups across the 3 countries [OR = 4.05 (95% CI: 2.64, 6.21) in Bangladesh, 2.43 (95% CI = 1.50, 3.92) in Vietnam, and 14.76 (95% CI = 6.34, 34.36) in Ethiopia]. Maternal education was also significantly associated with child minimum DD in Bangladesh and Vietnam, where children whose mothers had a high school education were 1.7 (in Vietnam) and 3.1 (in Bangladesh) times more likely to achieve the minimum DD than those with no schooling. Compared with the younger children (6–11 mo old), the older group (12–23 mo old) was more likely to achieve the minimum DD (OR = 5.3, 3.7, and 3.1 in Bangladesh, Vietnam, and Ethiopia, respectively).

Results of multiple linear regression, where both maternal and child DD are included as continuous variables, confirm the association between maternal and child DD (**Fig. 2**; **Table 3**). A difference of one food group in mother's consumption was associated with a difference of 0.29, 033, and 0.24 food groups in the

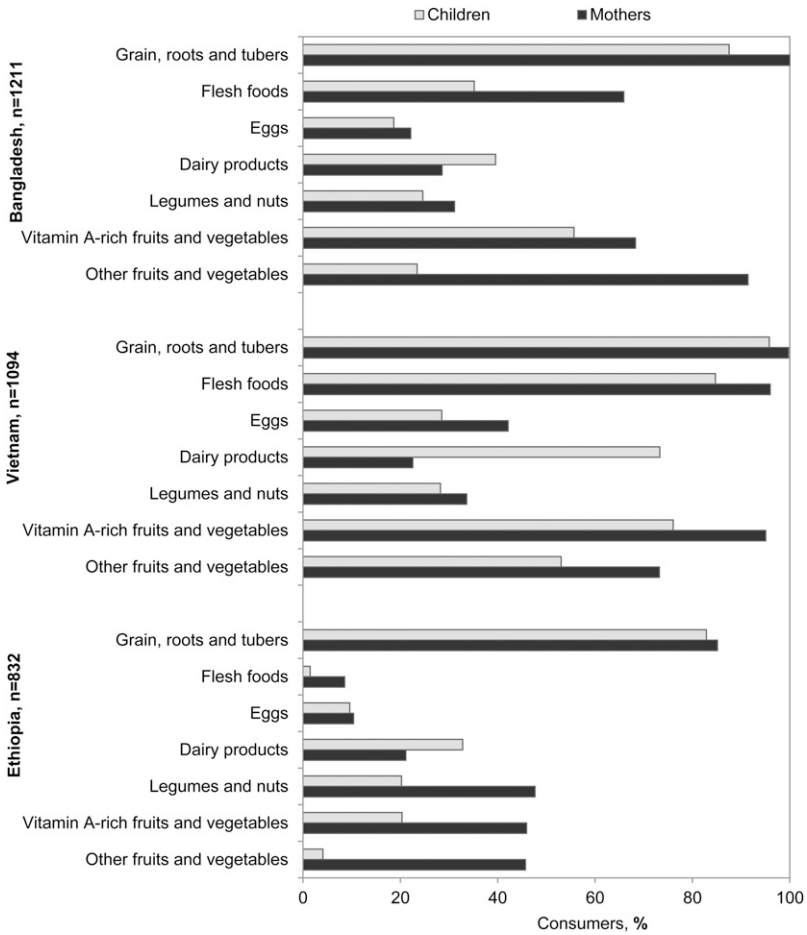

FIGURE 1 Percentage of mothers and children consuming different food groups during the past 24 h in Bangladesh, Vietnam, and Ethiopia.

TABLE 2 Multivariable logistic regression models for the association between maternal DD and children's minimum DD in Bangladesh, Vietnam, and Ethiopia[1]

	OR (95% CI)		
	Bangladesh	Vietnam	Ethiopia
Maternal DD			
1–3 groups	Reference	Reference	Reference
4 groups	2.73*** (1.76, 4.25)	2.30*** (1.54, 3.43)	5.11*** (2.36, 11.04)
5 groups	4.05*** (2.64, 6.21)	2.43*** (1.50, 3.92)	14.76*** (6.34, 34.36)
6–7 groups	5.97*** (3.44, 10.36)	3.92*** (2.26, 6.79)	
Mother's age	0.99 (0.96, 1.02)	0.99 (0.97, 1.02)	1.02 (0.96, 1.08)
Maternal education			
No schooling	Reference	Reference	Reference
Primary school	1.05 (0.75, 1.47)		1.11 (0.54, 2.27)
Secondary school	1.34 (0.78, 2.29)	1.51 (0.98, 2.34)	1.03 (0.31, 3.40)
High school	3.11** (1.42, 6.81)	1.69 (0.87, 3.27)	
College or higher		1.97 (0.95, 4.10)	
Maternal knowledge			
Food diversity	1.10 (0.92, 1.32)	1.06 (0.95, 1.18)	1.20 (0.90, 1.61)
General nutrition	1.08 (0.98, 1.19)	1.06 (0.94, 1.19)	1.35** (1.11, 1.65)
Maternal mental health	1.08 (0.81, 1.46)	1.17 (0.84, 1.63)	1.49 (0.71, 3.09)
Maternal self-perceived physical health			
Bad health	Reference	Reference	Reference
Normal	0.79 (0.54, 1.16)	1.12 (0.61, 2.07)	1.57 (0.19, 13.28)
Good health	1.14 (0.68, 1.91)	1.36 (0.67, 2.73)	3.10 (0.38, 25.40)
Mother can earn money	0.64 (0.31, 1.30)	1.16 (0.83, 1.63)	0.79 (0.29, 2.16)
Mother can decide to buy foods	1.00 (0.95, 1.04)	1.08*** (1.03, 1.13)	1.06 (0.92, 1.21)
Food security			
Severely food insecure	Reference	Reference	Reference
Moderately food insecure	0.90 (0.55, 1.48)	0.67 (0.26, 1.75)	2.80 (0.58, 13.57)
Mildly food insecure	0.73 (0.35, 1.54)	0.84 (0.34, 2.08)	3.15 (0.62, 15.96)
Food secure	0.85 (0.55, 1.30)	0.87 (0.37, 2.03)	3.47 (0.72, 16.72)
SES			
Poor	Reference	Reference	Reference
Average	0.91 (0.67, 1.24)	0.98 (0.69, 1.39)	1.16 (0.50, 2.71)
Rich	1.24 (0.82, 1.85)	1.33 (0.84, 2.12)	0.92 (0.37, 2.25)
Mother as household head	0.56* (0.34, 0.92)	0.86 (0.49, 1.51)	1.17 (0.34, 4.00)
Number of children <5 y	0.70* (0.51, 0.05)	0.69 (0.46, 1.06)	1.21 (0.66, 2.21)
Child age			
6–11.9 mo	Reference	Reference	Reference
12–23.9 mo	5.28*** (3.60, 7.75)	3.72*** (2.67, 5.18)	3.08** (1.40, 6.76)
Child sex			
Female	Reference	Reference	Reference
Male	0.96 (0.70, 1.32)	1.13 (0.82, 1.55)	1.30 (0.68, 2.49)
Area under ROC curve	0.77	0.75	0.86

[1] *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$. DD, dietary diversity; ROC, receiver operating characteristic; SES, socioeconomic status.

child's consumption in Bangladesh, Vietnam, and Ethiopia, respectively (Table 2). A similar result was found for both age groups in Vietnam and Ethiopia (Vietnam: $\beta = 0.23$ and 0.41 for children 6–11.9 and 12–23.9 mo, respectively; Ethiopia: $\beta = 0.24$ and 0.26) (Fig. 2). In Bangladesh, a significant association was found only in children 12–23.9 mo old ($\beta = 0.35$).

Determinants of maternal and child DD

Aside from maternal DD that was strongly associated with child DD, only child's age (being older) was positively and significantly associated with greater child DD in all 3 countries (Table 3). When using child age as a continuous variable, we found that for each month increase in age, child food group will increase by 0.13 (95% CI: 0.12, 0.15) in Bangladesh, 0.10 (95% CI: 0.08, 0.12) in Vietnam, and 0.07 (95% CI: 0.05, 0.08) in Ethiopia (results not shown). Greater maternal education was associated with higher child DD and higher number of children in the family was associated with lower child DD in Bangladesh and Vietnam, but not in Ethiopia. Other determinants such as maternal knowledge of food diversity (Ethiopia) and ability to decide on buying food (Vietnam) were significantly associated with child DD (Table 3). With maternal DD in the model, food security and SES were not significantly associated with child DD in any of the 3 countries.

By contrast, food security and SES were positively associated with maternal DD in all 3 countries. Similar to the results for child DD, maternal education was positively associated with maternal DD in Bangladesh and Vietnam (Table 3). Other determinants differed between countries, but maternal perceived physical health status was an important determinant of maternal DD in Bangladesh and Ethiopia.

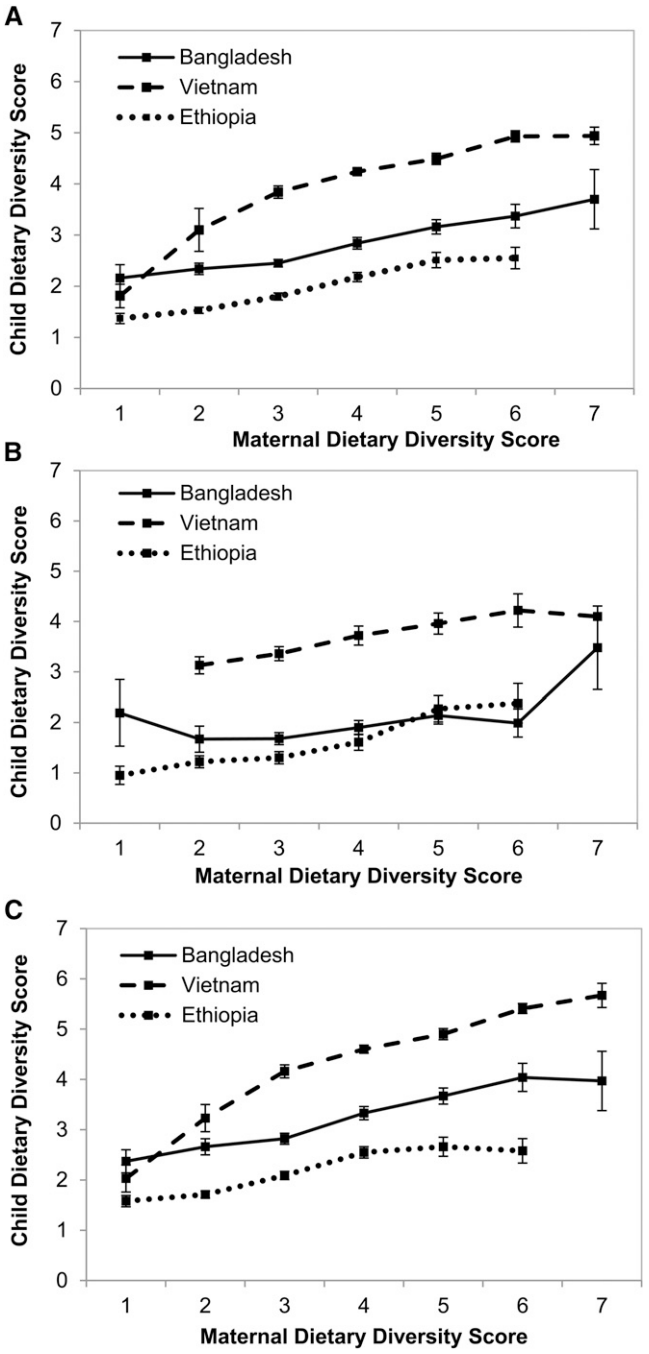

FIGURE 2 DD score for children 6–23.9 mo (*A*) and for 2 age subgroups, 6–11.9 mo (*B*) and 12–23.9 mo (*C*), by maternal DD in Bangladesh, Vietnam, and Ethiopia. Values are adjusted means ± SEMs, $n = 1121$ (Bangladesh), 1094 (Vietnam), and 832 (Ethiopia). Data points representing fewer than 15 observations were not included. Model adjusted for maternal factors (age, education, nutrition knowledge, mental and physical health, and finance control), household factors (food security, SES, household head, numbers of dependents), and child's gender. For all children, $\beta = 0.29$ (95% CI: 0.17, 0.41) for Bangladesh, 0.33 (95% CI: 0.25, 0.42) for Vietnam, and 0.24 (95% CI: 0.19, 0.30) for Ethiopia. For children 6–11.9 mo: $\beta = 0.15$ (95% CI: −0.01, 0.32) for Bangladesh, 0.23 (95% CI: 0.07, 0.38) for Vietnam, and 0.24 (95% CI: 0.14, 0.36) for Ethiopia. For children 12–23.9 mo: $\beta = 0.35$ (95% CI: 0.22, 0.49) for Bangladesh, 0.41 (95% CI: 0.33, 0.49) for Vietnam, and 0.26 (95% CI: 0.19, 0.32) for Ethiopia. DD, dietary diversity; SES, socioeconomic status.

Discussion

Maternal DD is strongly associated with child DD in all 3 countries studied despite the heterogeneity in local cultures and types of foods consumed. Child DD increases as maternal DD increases, as does the likelihood of children achieving the minimum DD in models that adjusted for child, maternal, and household characteristics. These results are consistent with the existing literature showing that maternal DD is associated with children's dietary intake among preschool (26) and school-aged children (27,28) and among children <24 mo in developed countries (7–10). Our study is one of the few that examined the association between maternal and child DD and their determinants in developing countries and builds upon previous findings from Cambodia, Ghana, and Haiti (6). Regarding the pathways of influence and their implications for programming, the literature suggests that parents may play an important role in shaping their children's eating habits by dictating variety and quantity of foods available to their child (29) or through parents' own food-related behaviors and parental feeding styles (10).

In all 3 countries, foods from some groups tended to be consumed equally by mothers and children (e.g., starchy staples and eggs), while some food groups were more likely to be consumed by the mother (e.g., meat and fruits and vegetables) and others by the child (e.g., dairy). In all 3 countries, fruits and vegetables (vitamin A-rich or other) were the food groups that had the lowest agreement between mother and child and where consumption was markedly lower among children than mothers. Previous research in Vietnam (30) and Ethiopia (31) indicated that mothers believe that vegetables are difficult to digest and therefore can cause stomach illness or abdominal pain. In Bangladesh, although fruits and vegetables are well accepted as children's food, lack of familiarity with certain vegetables and the perception that food preparations with chili are too spicy for young children prevent mothers from feeding several family foods, including traditionally prepared vegetables, to their children (32). Discrepancies were also found for flesh food and dairy products. The percentage of children having consumed milk during the previous day was higher than the percentage of mothers. This finding is plausible, given that milk is generally considered a special food for children across cultures. Except for staple foods and dairy products, our data provide evidence that mothers may select a subset of family foods to feed their child, which results in low diversity and probably inadequate micronutrient density of the diet. BCC should therefore focus on messages promoting that infants and young children, even as young as 8–12 mo, be given all the family foods, not just a subset, and that animal-source foods should be consumed daily or as often as possible by both mother and child. This latter message would be particularly important for Ethiopia, where only 9% of mothers and 2% of children in our sample had consumed meat, chicken, or fish in the previous 24 h.

These findings suggest that although there is a definite and strong association between maternal and child DD, mother-child agreement in intake of different food groups may not be high enough to allow using maternal DD to characterize the child's DD. Given that mother-child agreement tends to be lower for food groups rich in micronutrients (e.g., dairy, flesh foods, and fruits and vegetables), it would be unwise to use maternal intake from such food groups to characterize the child's intake. This could be particularly misleading for food groups such as dairy, where the mother's low prevalence of intake does not necessarily correspond to a similarly low prevalence of intake in her child.

TABLE 3 Multivariable linear regression models for the determinants of maternal and child DD in Bangladesh, Vietnam, and Ethiopia[1]

	β (95% CI)					
	Maternal DD			Child DD		
	Bangladesh	Vietnam	Ethiopia	Bangladesh	Vietnam	Ethiopia
Maternal DD	NA	NA	NA	0.29*** (0.17, 0.41)	0.33*** (0.25, 0.42)	0.24*** (0.19, 0.30)
Mother's age	0.00 (−0.01, 0.01)	0.00 (−0.01, 0.01)	−0.01 (−0.03, 0.01)	−0.01 (−0.02, 0.02)	0.00 (−0.02, 0.01)	−0.01 (−0.02, 0.01)
Maternal education						
No schooling	Reference	Reference	Reference	Reference	Reference	Reference
Primary school	0.14 (−0.04, 0.33)		0.14 (−0.06, 0.34)	0.11 (−0.08, 0.30)		−0.08 (−0.25, 0.08)
Secondary school	0.24* (0.06, 0.43)	0.21** (0.06, 0.36)	−0.14 (−0.50, 0.22)	0.20 (−0.13, 0.52)	0.39* (0.07, 0.71)	−0.08 (−0.37, 0.21)
High school	0.66** (0.26, 1.07)	0.38*** (0.17, 0.60)		0.80*** (0.39, 1.22)	0.35 (−0.04, 0.75)	
College or higher		0.84*** (0.54, 1.14)			0.44* (0.04, 0.83)	
Maternal knowledge						
Food diversity	0.26*** (0.15, 0.37)	0.04+ (−0.01, 0.09)	0.03 (−0.05, 0.11)	0.06 (−0.04, 0.17)	0.04 (−0.03, 0.11)	0.07* (0.01, 0.13)
General nutrition	0.01 (−0.03, 0.05)	0.09** (0.03, 0.15)	−0.01 (−0.06, 0.05)	0.04 (−0.02, 0.10)	0.06 (−0.01, 0.13)	0.85 (0.04, 0.13)
Maternal mental health	0.11 (−0.03, 0.26)	0.08 (−0.06, 0.21)	0.01 (−0.20, 0.21)	−0.03 (−0.24, 0.19)	−0.01 (−0.19, 0.19)	0.04 (0.13, 0.21)
Maternal self-perceived physical health						
Bad health	Reference	Reference	Reference	Reference	Reference	Reference
Normal	0.18* (−0.01, 0.36)	0.12 (−0.15, 0.38)	0.13 (−0.23, 0.48)	−0.17 (−0.41, 0.08)	−0.05 (−0.44, 0.34)	0.27 (−0.02, 0.56)
Good health	0.26** (0.07, 0.45)	0.24 (0.05, 0.52)	0.41* (0.04, 0.77)	−0.06 (−0.40, 0.29)	0.10 (−0.32, 0.52)	0.26 (−0.04, 0.56)
Mother can earn money	−0.14 (−0.50, 0.23)	−0.01 (−0.15, 0.14)	0.26 (−0.05, 0.57)	−0.10 (−0.36, 0.16)	0.11 (−0.11, 0.33)	−0.06 (−0.31, 0.19)
Mother can decide to buy foods	0.00 (−0.02, 0.02)	0.02 (−0.01, 0.04)	−0.01 (−0.04, 0.02)	−0.01 (−0.04, 0.02)	0.05*** (0.02, 0.09)	−0.02 (−0.05, 0.01)
Food security						
Severely food insecure	Reference	Reference	Reference	Reference	Reference	Reference
Moderately food insecure	0.08 (−0.14, 0.31)	0.10 (−0.22, 0.43)	0.16 (−0.12, 0.44)	−0.10 (−0.42, 0.23)	0.01 (−0.52, 0.53)	0.03 (−0.19, 0.26)
Mildly food insecure	0.18 (−0.09, 0.46)	0.35 (−0.03, 0.73)	0.54*** (0.22, 0.86)	0.01 (−0.37, 0.38)	0.14 (−0.37, 0.65)	0.08 (−0.18, 0.34)
Food secure	0.31* (0.08, 0.54)	0.51** (0.17, 0.84)	0.43** (0.14, 0.72)	0.04 (−0.21, 0.30)	0.18 (−0.28, 0.64)	0.15 (−0.09, 0.39)
SES						
Poor	Reference	Reference	Reference	Reference	Reference	Reference
Average	0.19 (0.00, 0.38)	0.15 (−0.03, 0.33)	0.29* (0.07, 0.51)	0.03 (−0.14, 0.21)	0.07 (−0.15, 0.30)	0.03 (−0.15, 0.20)
Rich	0.67*** (0.39, 0.95)	0.45*** (0.26, 0.63)	0.49*** (0.26, 0.72)	0.22 (−0.05, 0.49)	0.07 (−0.17, 0.31)	0.01 (−0.18, 0.19)
Mother as household head	0.05 (−0.18, 0.28)	−0.08 (−0.34, 0.19)	0.25 (−0.10, 0.61)	−0.28 (−0.58, 0.03)	−0.28 (−0.59, 0.03)	0.04 (−0.25, 0.33)
Number of children <5 y	0.07 (−0.08, 0.22)	−0.12* (−0.23, −0.01)	0.10 (−0.06, 0.26)	−0.35*** (−0.53, −0.17)	−0.30* (−0.53, −0.07)	−0.03 (−0.16, 0.11)
Child age	NA	NA	NA			
6–11.9 mo				Reference	Reference	Reference
12–23.9 mo				1.35*** (1.16, 1.54)	0.97*** (0.73, 1.20)	0.64*** (0.49, 0.78)
Child sex	NA	NA	NA			
Female				Reference	Reference	Reference
Male				0.02 (−0.18, 0.22)	0.10 (−0.08, 0.28)	0.03 (−0.11, 0.17)
R^2	0.19	0.22	0.09	0.29	0.22	0.20

[1] *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$. DD, dietary diversity; NA, not applicable; SES, socioeconomic status.

Our comparison of the determinants of maternal and child DD showed interesting similarities and differences. Maternal education is important for both maternal and child DD and was significant in child DD models that included maternal DD in Bangladesh and Vietnam, suggesting that the effect of maternal education on child DD was independent of its effect through maternal DD. This was not true for household-level factors such as food security and SES, which were significantly associated with child DD only when maternal DD was excluded from the models (results not shown). Previous studies reported that child diet quality is influenced by SES (33) and food security (34), but maternal DD was not included in the analyses. Children's age was a significant determinant of child DD, where older children had a higher mean DD than the younger age group. This is expected, because children gradually consume a greater variety and quantity of foods from 6 mo onwards, and in developing countries, they are likely to transition to family foods during their second year (35). A recent study in Bangladesh also showed that a child's age determined the types of foods given to children (32).

Our findings have 3 important implications. First, from a measurement point of view, the lack of mother-child agreement in some key nutrient-rich food groups prevents the use of information on mothers' food group intake to characterize child intake. It is therefore important to continue to measure both maternal and child DD in large surveys to get accurate information on both maternal and child dietary patterns. Second, from a programmatic point of view, our findings support the focus of many maternal and child health and nutrition programs on the mother-child dyad. Because maternal DD is strongly associated with child DD, diverse diets should be promoted for both mother and child during the entire span of the first 1000 d. In addition, BCC strategies should emphasize the importance of feeding the child all family foods available, starting as early as 8–9 mo of age, to maximize the micronutrient adequacy of their diet. Third, household factors such as food security and SES are

determinants of maternal DD in all 3 countries. Programs to promote healthy and more diverse diets for mothers and children should therefore consider incorporating actions to address some of the underlying constraints to improving diet quality so that improved knowledge can translate into long-term behavior change and benefits for both mother and child.

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