


## ORIGINAL ARTICLE

# Women's dietary diversity in rural Bangladesh: Pathways through women's empowerment

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## Abstract

The relationship between women's empowerment and women's nutrition is understudied. We aimed to elucidate this relationship by quantifying possible pathways between empowerment and dietary diversity among women in rural Bangladesh. In 2015, we conducted a cross-sectional survey of 2,599 married women ages 15–40 (median: 25) living in 96 settlements of Habiganj District, Bangladesh, as a baseline for the Food and Agricultural Approaches to Reducing Malnutrition trial. We collected data on women's empowerment (highest completed grade of schooling and agency), dietary diversity, and demographic factors, including household wealth. We used exploratory factor analysis and confirmatory factor analysis on random split-half samples, followed by structural equation modelling, to test pathways from schooling, through domains of women's agency, to dietary diversity. Factor analysis revealed 3 latent domains of women's agency: social solidarity, decision-making, and voice with husband. In the adjusted mediation model, having any postprimary schooling was positively associated with voice with husband ( $\beta_{41} = .051, p = .010$ ), which was positively associated with dietary diversity ( $\beta_{54} = .39, p = .002$ ). Schooling also had a direct positive association with women's dietary diversity ( $\beta_{51} = .22, p < .001$ ). Neither women's social solidarity nor decision-making mediated the relationship between schooling and dietary diversity. The link between schooling and dietary diversity was direct and indirect, through women's voice with husband but not through women's social solidarity or decision-making. In this population, women with postprimary schooling seem to be better able to negotiate improved diets for themselves.

## KEYWORDS

agency, Bangladesh, dietary diversity, women's empowerment

## 1 | INTRODUCTION

In Bangladesh, 54% of women of reproductive age (10–49 years old) consume inadequately diverse diets (four or less of nine food groups in the prior 24 hr; Helen Keller International [HKI] & James P Grant School of Public Health, 2016). Dietary diversity has a consistent positive relationship with micronutrient adequacy cross-nationally and within Bangladesh (Arimond et al., 2010). A majority of women of reproductive age in Bangladesh are, therefore, likely to be consuming inadequate amounts of micronutrients, putting them at risk of deficiency and associated adverse health outcomes for themselves and their offspring (Arsenault et al., 2013).

Few studies have examined whether women's empowerment influences their dietary intake. One study in Bangladesh found a positive association between women's empowerment and household dietary diversity, but did not examine women's dietary diversity (Sraboni, Malapit, Quisumbing, & Ahmed, 2014). Other studies have assessed the relationships between women's empowerment and child nutrition in South Asia (Bhagowalia, Menon, Quisumbing, & Soundararajan, 2012; Cunningham, Ploubidis, et al., 2015; Cunningham, Ruel, Ferguson, & Uauy, 2015; Malapit, Kadiyala, Quisumbing, Cunningham, & Tyagi, 2015; Richards et al., 2013; Shroff, Griffiths, Adair, Suchindran, & Bentley, 2009). Otherwise, few studies have examined how women's empowerment may influence women's nutrition in Bangladesh or South Asia more generally.

We used Naila Kabeer's (1999) resources–agency–achievements framework to guide an analysis of the relationship between women's

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empowerment and their dietary diversity in Bangladesh. Kabeer (1999) describes empowerment as being composed of interrelated components, defining *enabling resources* as the “pre-conditions ... [that] enhance the ability to exercise choice,” *agency* as the “ability to define one’s goals and act upon them,” and *achievements* as the outcome resulting from the exercise of agency. Resources include material, human, and social resources and serve as the foundation for agency, which can include the active exercise of power, such as through decision-making and negotiation, as well as a woman’s self-concept and attitudes (Kabeer, 1999).

The aim of our study was to quantify associations between components of women’s empowerment (resources and agency) and dietary diversity among women in a rural area of Bangladesh. We identified schooling as a key resource for three domains of women’s agency: social solidarity, decision-making, and voice with husband (Gammage, Kabeer, & van der Meulen Rodgers, 2016). We hypothesized that women who had more schooling would have higher dietary diversity and that this relationship would be mediated by women’s agency.

## 2 | METHODS

### 2.1 | Participants and procedures

We conducted a secondary analysis of data from the baseline survey for a cluster-randomized controlled trial, called Food and Agricultural Approaches to Reducing Malnutrition (FAARM), in Habiganj District, north-eastern Bangladesh. FAARM is a 4-year trial (2015–2019) that aims to evaluate the impact of an enhanced homestead food production intervention on the nutritional status of women and their young children. The target population is young married women and their children under age 3.

The trial covers 96 rural settlements in 13 unions of Habiganj district. Settlements were selected by HKI based on suitability for homestead gardening (i.e., some dry land year-round). The team identified households in these settlements that matched the trial inclusion criteria: ownership of at least 40 m<sup>2</sup> of cultivable land, willingness to participate in a gardening programme, and inclusion of a married woman with self-reported age below 30 years on the first visit and whose husband stays overnight in the household at least once a year. We included a minimum of 10 and a maximum of 60 (median: 26) households per settlement.

The baseline survey took place in the hot dry (lean) season from March to May 2015. The survey covered household demographic and socio-economic characteristics, food security and dietary diversity, women’s agency, women’s and children’s health, and infant and young child feeding practices. We drafted the survey in English, HKI staff translated it into Bengali, and then a separate team at the University of Heidelberg independently back-translated it into English. Data collectors (19 female and 10 male) received a 2-week training, including two practice field visits, and an additional day of training after 1 week of data collection. The survey was pilot-tested before and during data collector training. Field teams, each consisting of two women and one man, administered the survey in Bengali with two to three field teams working under a survey supervisor. All 96 settlements were visited,

### Key messages

- We identified a positive association between women’s voice with husband and dietary diversity, which can inform programme design and implementation. Programmes may consider promoting intrahousehold communication with the aim of achieving improved nutrition outcomes.
- Women’s schooling is an important predictor of their dietary diversity. Working with the education and health sectors may thus contribute to improved nutrition outcomes.
- In our study, women’s agency did not strongly mediate the association between schooling and dietary diversity. Further research is needed to explore whether other enabling resources may influence women’s dietary diversity through women’s agency.
- Women’s decision-making and social solidarity were not associated with their dietary diversity. Further research is needed on the domains of women’s agency that may be important for women’s nutrition.

and all 2,895 eligible women were targeted for inclusion in the study. In total, 2,624 women (91%) were found at home (at repeat visits), consented to participate, and were enrolled. A total of 2,599 enrolled women (90% of the 2,895 eligible women) completed the household and women’s sections of the survey.

### 2.2 | Variables

The achievement or outcome of interest was women’s dietary diversity, measured by asking the woman about her food consumption in the previous day through open recall followed by list-based probes, categorizing diets into 21 food categories. When women reported consuming a food item, data collectors asked whether she had consumed more or less than a spoonful, in order to assess whether she had consumed at least 15 g of the food throughout the day. We then aggregated the responses into a continuous score derived from a standard 10-Food Group Indicator (FGI-10R; Food and Agriculture Organization, 2014). FGI-10R captured starches (e.g., grains and white roots or tubers), pulses, nuts and seeds, dairy, flesh foods (e.g., meat, poultry, fish, including organ meats), eggs, dark green leafy vegetables, vitamin-A-rich fruits and vegetables, other fruits, and other vegetables that were consumed in a quantity greater than 15 g. Among women of reproductive age, consumption of five or more of the 10 food groups is associated with a higher likelihood of achieving micronutrient adequacy (Food and Agriculture Organization & FHI 360, 2016).

Women’s resources were operationalized as their completed grades of schooling, based on previous research identifying education as a contemporary resource for empowerment in Bangladesh (Head, Yount, Hennink, & Sterk, 2015). We dichotomized schooling to represent zero to five completed years of primary schooling compared with

any completed postprimary years. The dichotomization corresponds to a threshold with important theoretical and policy implications, based on previous evidence. For example, a cross-country analysis of Demographic and Health Survey (DHS) data from 58 countries found that schooling was an important determinant of women's agency and noted that secondary schooling was of particular importance in Bangladesh (Hanmer & Klugman, 2016). Another study in Bangladesh found having any secondary schooling to be inversely associated with early marriage (Bates, Maselko, & Schuler, 2007). Thus, secondary schooling in particular is considered an important resource for agency in this context.

We used 22 items to capture four domains of agency: freedom of movement, women's social solidarity, decision-making, and voice with husband (Table S1). In previous programmes, HKI had observed that cultural restrictions on women's freedom of movement created barriers to participation, potentially reducing programme impact. We therefore hypothesized that this domain could be an important mediator between women's resources and nutrition outcomes. To measure freedom of movement, we used a set of questions from previous HKI programme evaluations. The question asked respondents whether they had left their homestead alone or with only their children in the last month and, if so, asked them if they had visited any one of seven types of locations. We defined leaving the homestead as visiting any place outside the homestead, with no further criteria related to distance or time. We created seven dichotomous variables representing each type of place.

We included questions on women's social solidarity as a variation on women's group membership, which has been shown to be associated with dietary diversity in Bangladesh (Sraboni et al., 2014). We expected formal group membership to be low in our target population, and we therefore aimed to measure whether women were meeting with other women in a broader context. The questions on social solidarity came from a module that was developed and tested by HKI and other organizations for use in agriculture–nutrition projects (Harris et al., 2016; Olney et al., 2016). We measured women's social solidarity by asking respondents whether they usually met with other women in their community to discuss five types of issues, which were listed individually in the questionnaire with dichotomous (yes or no) response options (Table S1).

Decision-making is commonly measured in studies of women's empowerment (Kabear, 1999). For this domain, we used five questions that were taken from or modelled on the DHS standard woman's questionnaire. We expanded the response options to allow women to list all individuals in the household who were involved in the decision. We then dichotomized the responses according to whether the respondent woman was involved or not involved.

Voice has long been considered an important component of agency, especially in the field of economics (Gammage et al., 2016). It has been defined as “the right and ability to enter into the household bargaining process” (Katz, 1997) and “the ability to articulate practical needs and strategic interests” (Gammage et al., 2016). Within the household, voice may take many forms, including conversation, negotiation, and argument. We measured this concept using questions that, along with the questions on social solidarity, were tested by HKI and other organizations (Harris et al., 2016; Olney et al., 2016). The questions asked respondents how often they talked with their husband

about five topics, which were listed individually in the questionnaire with response options of never, sometimes (monthly), or often (weekly; Table S1).

For all 22 questions, we recoded variables to ensure that a higher value indicated higher agency. The Cronbach's alpha coefficient in our sample for the set of variables representing each domain was .21, .77, .69, and .70 for freedom of movement, social solidarity, decision-making, and voice with husband, respectively (Table S1).

To control for potential confounding by socio-economic status, we created a household asset index using standard DHS techniques (Rutstein & Johnson, 2004). We applied principal component analysis to variables representing ownership of 23 assets, including household goods, livestock, and land, as well as seven attributes of the housing structure, such as latrine type, water source, house size, and materials used in house construction. Other covariates were household structure (joint vs. nuclear) and the woman's height, age at first marriage, and age at the time of the survey. Woman's height was included as a potential proxy for deprivation, as adult height below 145 cm may result from chronic undernutrition and could therefore represent a long-term lack of resources (Dewey & Begum, 2011). Age at first marriage and age at the time of the survey were included because younger ages for both variables may contribute to lower agency in traditional patriarchal households (Head et al., 2015).

### 2.3 | Statistical analyses

We calculated descriptive statistics, as well as tetrachoric and polychoric correlations for dichotomous and ordinal variables, respectively.

Of the 22 items used to measure women's agency, the majority had been developed recently, and their structure had not been extensively studied, nor had the full set of items been analysed together. Therefore, we used exploratory factor analysis (EFA) to explore the structure of the constructs being measured (Bandalos & Finney, 2010). We ran sequential two- to six-factor EFA models on a random split-half sample ( $n = 1,300$ ) using means and variance-adjusted weighted least squares estimators, which are appropriate for categorical variables (Kline, 2011). We interpreted the results after geomin rotation. This rotation produces oblique factors, which allow correlation between dimensions of the construct under study (Bandalos & Finney, 2010). After each estimation, we removed items one at a time based on low pattern coefficients, high multidimensionality (i.e., cross-loadings ( $>|0.300|$ ) on two or more factors), or significant negative pattern coefficients. We also dropped items that loaded on factors for which only one or two items had significant pattern coefficients, because factors with fewer than three loading items are considered weak (Costello & Osborne, 2005). After removing an item, we reran the analysis with the remaining variables until a satisfactory factor structure was achieved. We interpreted model fit based on the following indices: root mean squared error of approximation (RMSEA), comparative fit index (CFI), Tucker–Lewis index (TLI), and standardized root mean squared residual (SRMR).  $RMSEA < 0.08$ ,  $CFI > 0.95$ ,  $TLI > 0.95$ , and  $SRMR < 0.08$  were considered good fit (Hooper, Coughlan, & Mullen, 2008).

We followed a standard two-phase structural equation modelling approach, with a measurement model followed by a structural model. To establish the measurement model, we used confirmatory factor analysis (CFA) on the remaining random split-half sample to test the structure that was identified in the EFA. We used the same fit indices and criteria described above to assess model fit.

We added the final measurement model identified in the EFA and confirmed using CFA to a structural model with schooling modelled as an independent variable; women's social solidarity, decision-making, and voice with husband modelled as latent mediator variables; and the FGI-10R dietary diversity score as a continuous outcome variable. We identified confounders based on bivariable analyses, defining a confounder as any variable that was associated with both the outcome and the exposure variables, and not on the causal path between the exposure and the outcome. On the basis of these analyses, the path from schooling to decision-making was adjusted for woman's height; the paths from schooling and decision-making to dietary diversity were adjusted for woman's age at first marriage; the paths from schooling to all three latent variables were adjusted for woman's age at the time of the survey; and the paths from decision-making and voice with husband to dietary diversity were adjusted for household structure and household wealth. We used estimation with cluster-adjusted robust standard errors for the structural equation model to account for any effects of clustering, with settlement defined as a cluster. We report standardized results for the structural model.

We used MPLUS version 7.2 for the EFA and CFA and STATA version 14.0 for the descriptive statistics and structural model. We performed complete-case analysis as missing data were minimal ( $n = 25$ ).

## 2.4 | Ethics

This secondary analysis was conducted as part of a cluster-randomized trial, FAARM, for which the protocol was reviewed and approved by the ethics committees of the Bangladesh Medical Research Council, the James P Grant School of Public Health at BRAC University in Bangladesh, and Heidelberg University in Germany. FAARM is registered with ClinicalTrials.gov (NCT02505711). Written informed consent was obtained from all study participants before interview. The analysis presented here used deidentified secondary data, and additional human subjects review was not required.

## 3 | RESULTS

### 3.1 | Descriptive statistics

Table 1 shows descriptive statistics for women in the study. Women consumed a mean of 3.9 (robust  $SE = 0.045$ ) of 10 possible food groups in the 24-hr period prior to the survey. The dietary diversity score was approximately normally distributed, with a range of 0 to 9 and a median of 4. A majority of women (69%) had inadequately diverse diets, defined as less than five of the 10 food groups. High percentages of women reported consuming starches (100%), flesh foods (82%), and other vegetables (69%). The high percentage of women consuming flesh foods was primarily due to high fish consumption (80%, data

not shown). For the other seven food groups, percentages were below 30% (data not shown).

A minority (39%) of women had any postprimary schooling. With respect to women's freedom of movement, 69% of women said that they had not left their homestead in the previous 30 days. For those women who reported that they had left their homestead, the father's and relative's house were the most frequently reported destinations (15% and 8%, respectively).

The items on women's social solidarity had the smallest range (5–10%), with most women reporting that they did not typically meet with women in their community to discuss any of the listed topics. Of the five topics, the largest percentage of respondents (10%) reported that they met with other women to discuss problems of women. With respect to decision-making, with the exception of daily food preparation, a minority of women reported being involved in the decisions. The percentage of women who said that they could make the decision either alone or jointly ranged from 15% (for visits to their family or relatives) to 66% (for daily food preparation). Responses to the questions about voice with husband indicated that a majority of women talked with their husbands about all five topics at least monthly, if not weekly. The percentage of women who said that they talked about a given subject with their husband on a weekly basis ranged from 18% (for what happens in your community or area) to 59% (for your work or agricultural activities).

### 3.2 | Factor analyses

We dropped all items for freedom of movement from the EFA due to low pattern coefficients, high multidimensionality, significant negative pattern coefficients, and/or two or less items loading onto one factor. The first three items for women's social solidarity (discussing problems of the community, education, and health) loaded onto one factor, with pattern coefficients ranging from .82 to .94. The first three items for decision-making (daily food preparation, major household purchases, and daily household purchases) loaded onto one factor, with pattern coefficients ranging from .78 to .94. All five items relating to voice with husband loaded onto a third factor, with pattern coefficients ranging from .60 to .75. Each of these three factors was modelled as latent (mediator) variables. Pattern coefficients for the three factors were similarly high in the CFA (.96–1.00, .99–1.00, and .82–1.00, respectively). Fit was acceptable for the final EFA model (RMSEA = 0.074, CFI = 0.98, TLI = 0.95, SRMR = 0.034) and exceeded minimum thresholds for the final CFA model (RMSEA = 0.057, CFI = 0.97, TLI = 0.96).

### 3.3 | Latent variable structural equation models

Figure 1 shows the measurement and structural models together in unadjusted and adjusted mediation models, using standard symbols for the representation of structural equation models (Kline, 2011). Both models had good fit (unadjusted: RMSEA = 0.042, CFI = 0.95, TLI = 0.93, SRMR = 0.041; adjusted: RMSEA = 0.040). Postprimary schooling showed a strong direct association with dietary diversity in both the unadjusted model ( $\beta_{51} = .44, p < .001$ ) and the adjusted model ( $\beta_{51} = .22, p < .001$ ).

In the unadjusted model, strong inverse relationships exist between schooling and decision-making and between decision-making

**TABLE 1** Descriptive statistics of participant women in the FAARM study, Habiganj district, Bangladesh

Characteristic	Percentage or mean (SE), N = 2,561		
Dietary diversity score, mean (robust SE)	3.87	(0.045)	
Inadequate dietary diversity (<5 food groups in previous day)	69.5		
Any completed years of postprimary schooling	39.2		
Age at first marriage	18.1	(0.11)	
Age at the time of the survey	24.7	(0.13)	
Woman's height, mean in cm (robust SE)	150.5	(0.015)	
Nuclear household structure	32.2		
Freedom of movement			
In the last month, what are all of the places you have been to alone or just with your children outside the homestead?			
1. Market		2.9	
2. Health facility		7.3	
3. Community meeting		1.2	
4. Father's house		15.1	
5. Relative's house		7.9	
6. Friend's house		0.6	
7. Other		4.1	
Women's social solidarity			
Do you usually meet with other women in your community to discuss the following issues?			
1. Problems of the community		5.0	
2. Education problems		7.2	
3. Health problems		7.6	
4. Problems of women		9.8	
5. To receive information on health and nutrition		8.7	
Decision-making		Woman is involved in the decision	
Who usually makes decisions about...			
1. What food is prepared every day?		66.4	
2. Making major household purchases?		22.3	
3. Making purchases for daily household needs?		44.7	
4. Your visits to your family or relatives?		14.8	
5. Health care for yourself?		20.5	
How frequently do you talk with your husband about the following subjects			
Voice with husband	Weekly	Monthly	Never
1. Your work activities or agricultural activities?	59.0	33.0	8.0
2. What happens at home?	43.9	46.5	9.6
3. Your expenditures?	48.7	43.9	7.5
4. What happens in your community or area?	17.9	58.1	24.0
5. Your own health?	57.0	38.8	4.3

and dietary diversity. After adjusting for woman's height, age at first marriage, age at the time of the survey, household structure, and household wealth, we observed a positive association between schooling and decision-making ( $\beta_{31} = .034, p = .018$ ) but not between decision-making and dietary diversity ( $\beta_{53} = .023, p = .88$ ).

Schooling was also positively associated with voice with husband ( $\beta_{41} = .051, p = .010$ ) in the adjusted model, but not with the latent variable for women's social solidarity ( $\beta_{21} = -.0025, p = .36$ ). Voice with husband was positively associated with dietary diversity ( $\beta_{54} = .39, p = .002$ ). Women's social solidarity was not associated with dietary diversity ( $\beta_{52} = -.26, p = .39$ ).

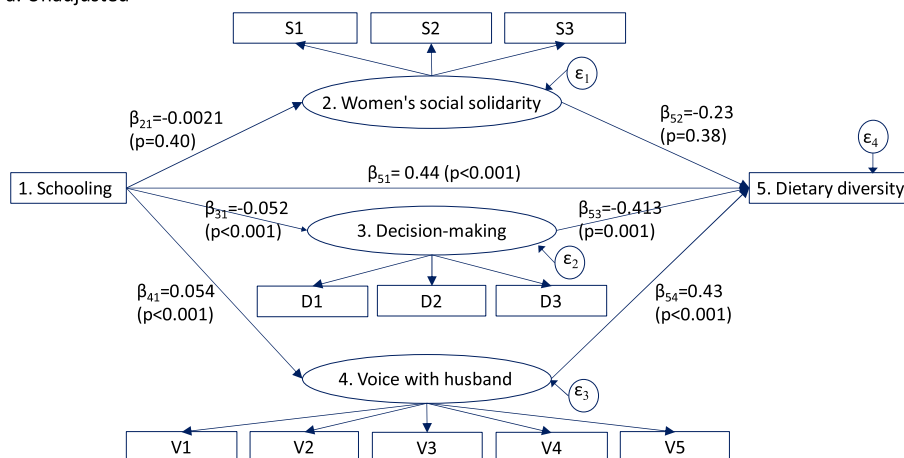
Thus, we observed a positive direct association between schooling and dietary diversity as well as an indirect association, mediated by

voice with husband. Neither social solidarity nor decision-making was an important mediator of the relationship between schooling and dietary diversity. In examining our hypothesis that women with higher agency would have higher dietary diversity, we rejected the null hypothesis of no association for one domain of women's agency (voice with husband) and failed to reject the null hypothesis for the other two domains (women's social solidarity and decision-making).

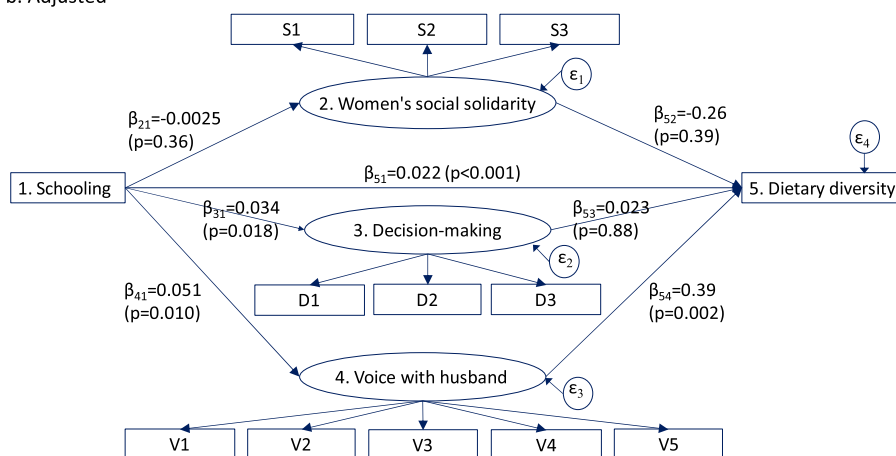
## 4 | DISCUSSION

This is the first study to use the resources–agency–achievements framework to examine women's nutrition outcomes in Bangladesh.

## a. Unadjusted



## b. Adjusted



**FIGURE 1** Mediation of the relation between schooling and dietary diversity through women's social solidarity and voice with husband. The figures use standard symbols for the representation of structural equation models (Kline, 2011). Note.  $\beta_{31}$  is adjusted for women's height;  $\beta_{31}$  and  $\beta_{53}$  are adjusted for age at first marriage;  $\beta_{21}$ ,  $\beta_{31}$ , and  $\beta_{41}$  are adjusted for age at the time of the survey;  $\beta_{53}$  and  $\beta_{54}$  are adjusted for household structure; all are adjusted for household wealth and clustering

We observed that having any completed years of postprimary schooling was positively associated with voice with husband, which was positively associated with dietary diversity. Schooling also was directly positively associated with dietary diversity. Prior studies from Bangladesh found positive direct associations between women's schooling and child nutrition, as well as between domains of women's agency and child nutrition (Bhagowalia et al., 2012; Semba et al., 2008). This study is novel in that we examined pathways to women's nutrition.

Women in our study population had low dietary diversity scores. This is in line with earlier findings, which concluded that micronutrient inadequacy due to low dietary diversity is widespread among women in rural Bangladesh (Arsenault et al., 2013). Women in this population are therefore likely to be at risk of micronutrient malnutrition. Other consequences of their low dietary diversity may extend to their children: Women's nutrition can affect their infants and young children through pregnancy and breastfeeding as well as through the strong association between maternal and child diets (Black et al., 2013; Nguyen et al., 2013). Women's dietary diversity also has broader implications beyond health as a proxy for women's functioning and

capabilities (Sen, 1990). Additional research is needed to explore these potential consequences.

Our results may represent several mechanisms through which secondary schooling affects dietary diversity. More schooling may equip women with higher literacy, including health and nutrition literacy, and a concurrent ability to understand and act upon health information (Wachs, 2008). In this way, schooling may translate directly into improved dietary behaviours leading to higher dietary diversity. Especially in larger families, women with postprimary schooling may also have higher status in their households, which may entitle them to better food, thereby directly affecting their dietary diversity.

Having postprimary schooling may also indirectly lead to greater dietary diversity by increasing women's bargaining power in the household, enabling them to negotiate improved diets for themselves. In the field of family economics, both cooperative and noncooperative models of the household acknowledge the importance of the relative bargaining power of each household member (Agarwal, 1997; Doss, 2013; Lundberg & Pollak, 1996). Voice with husband acted as a proxy in our study for women's relative bargaining power. In this context, social norms about the value of education may contribute to increased

bargaining power for women with postprimary schooling, making these women better able to pursue their desired outcome of improved diets. Women with more schooling also may be more articulate and better able to bargain for themselves (Wachs, 2008).

We observed an association between schooling and decision-making, but not between decision-making and dietary diversity, in our adjusted model. Decision-making is considered an important domain of women's agency as well as a potentially important contributor to household nutrition in South Asia (Malapit et al., 2015; Sraboni, Malapit, Quisumbing, & Ahmed, 2014). No research exists, to our knowledge, on relationships between women's decision-making and women's dietary diversity in South Asia. Still, the lack of an association between decision-making and dietary diversity in our sample is surprising. It may be that our tool for measurement of decision-making lacked sensitivity and that questions focusing more specifically on decisions around food and diet may yield different results. Additional work is needed to refine these measurement tools and explore the role of decision-making in this context.

Schooling was not associated with women's social solidarity. Little evidence exists globally of relationships between women's social solidarity and schooling or any health and nutrition outcomes. In our study, the lack of an association between social solidarity and dietary diversity may have several explanations. First, it may be that our measures did not adequately capture social solidarity or that other measures of social capital may have been more appropriate. Second, the scope for women to engage in any form of solidarity or activism is limited in our study setting, given that a minority of women reported leaving their homestead in the previous 30 days. Third, it may be that social solidarity is not related to dietary diversity because, as has been noted, women's agency in public spheres "does not necessarily spill over to agency in other domains such as the household" (Gammage et al., 2016). In one study in Bangladesh, Kabeer noted that although women may have been vocal about injustice in the public sphere, they were more acquiescent in the private sphere (Kabeer, 2011). Thus, it may be that social solidarity is important for other types of achievements, but not for women's nutrition.

The questions on freedom of movement were dropped from the EFA. Their Cronbach's alpha coefficient of .21 suggests that the items are not highly correlated and that a scale composed of these items would have poor reliability. EFA analyses the shared variance across variables (Bandalos & Finney, 2010), and the relative lack of variability in responses to these questions may explain their failure to load together. For populations with limited freedom of movement, such as our study population, questions with longer recall periods and a greater number of response options may yield different results. Additional research is needed to examine the utility of including women's freedom of movement as a domain of agency in this population.

Few other studies have examined women's empowerment and women's nutrition in Bangladesh. The Bangladesh Integrated Household Survey (BIHS) examined women's empowerment and household dietary diversity, using the Women's Empowerment in Agriculture Index tool to measure empowerment (Sraboni et al., 2014). Results from the BIHS indicated that household dietary diversity was most strongly associated with women's ownership

and rights over productive capital, with household dietary diversity measured using a 7-day recall with foods grouped into 12 categories (Sraboni et al., 2014). This is in contrast to our analysis, which focuses on the relationship between women's agency and their own diets.

Also, in contrast to the BIHS, we chose not to use the Women's Empowerment in Agriculture Index modules as our primary measurement of women's empowerment. We included questions on decision-making in agricultural production in our survey, but these questions were skipped for women who did not participate in agriculture. Therefore, we have not included them in this analysis and have focused instead on questions that measured domains of agency that were applicable to all women. Thus, we have excluded questions relating specifically to agriculture as well as those that only apply to women with children.

As Kabeer notes, achievements have to be "materially possible" and then have to be "conceived to be within the realms of possibility" before becoming reality (Kabeer, 1999). In rural Bangladesh, the achievement of an adequately diverse diet may not be materially possible for many women. Bangladesh produces only 22% of the fruits and vegetables necessary for the population to meet dietary guidelines (Siegel, Ali, Srinivasiah, Nugent, & Narayan, 2014), and economic constraints may prevent women from accessing certain foods. In a situation of limited availability of nutritious foods, the idea of prioritizing women's nutrition may not be something that women themselves would conceive to be in the realm of possibility, as this would be contrary to the traditional patriarchal norms underlying most Bangladeshi households. They also may choose to prioritize children over themselves, or they may have self-serving reasons for favouring others in the household, given their dependence on family members (Agarwal, 1997).

Projects aiming to improve women's dietary diversity may consider strengthening agricultural production of micronutrient-rich foods while also addressing women's agency based on the resources-agency-achievement framework. Projects may also seek out opportunities for intersectoral work to increase girls' school attainment, and those working with married women may aim to work with the women and their husbands to strengthen their bargaining and negotiation skills. Finally, nongovernmental organizations implementing projects in rural Bangladesh should conduct formative and evaluation research to examine intrahousehold bargaining and other possible pathways to improved dietary diversity, including through other dimensions of women's agency.

Our study has several limitations. Our measure of dietary diversity was based on self-reported consumption in the previous day, which may not accurately reflect usual intake, thus adding measurement error. Also, our survey was implemented in the lean season, and results for women's dietary diversity may differ at other times of year. For example, women may have a greater ability to use their agency to achieve higher dietary diversity during the harvest season, when foods are accessible and available in greater variety. In addition, we chose to dichotomize our schooling variable, which may have resulted in a loss of information and power. However, we conducted a sensitivity analysis with schooling as a continuous variable, and the results remained approximately the same. Similarly, we

chose to categorize the decision-making variables according to whether the woman had any involvement in decision-making. We conducted a sensitivity analysis to assess whether having sole decision-making power produced different results, and again, the results remained approximately the same.

Another limitation relates to our measurement of women's resources and agency. Certain measures of women's resources and agency that could be important for women's dietary diversity were not included in this analysis, such as women's asset ownership, women's employment, nongovernmental organization membership, and the quality of family relationships (Allendorf, 2012; Crandall, VanderEnde, Cheong, Dodell, & Yount, 2016; Doss, 2013; Gammage et al., 2016; Head et al., 2015). Additionally, several items measuring women's agency were dropped from the EFA and subsequently excluded from the mediation models, including all items on freedom of movement. As a result, it therefore is possible that some important relationships remained unobserved.

## 5 | CONCLUSION

In our study population of women in Bangladesh, having any postprimary schooling was positively associated with women's voice with husband and in turn with women's dietary diversity. Schooling was also directly positively associated with women's dietary diversity. This association was not mediated by women's social solidarity or decision-making. Research is needed to examine intrahousehold communication and other possible pathways to improve dietary diversity, including through other domains of women's agency.

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## CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

## CONTRIBUTIONS

SSS, RH, KMY conceptualized the research question and analysis plan. SG, JLW, AW conceptualized and manage the FAARM study. SG, AW, JLW designed the questionnaires, with contributions from SSS and led data collection. JLW was responsible for data management, with involvement of SG, AW, SSS, RH and KMY were responsible for statistical analysis. All authors contributed to interpretation of results. SSS wrote the first and subsequent drafts of the article. All authors contributed to critically revising the article and gave final approval of the version to be published.

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## SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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