Changes in women's empowerment in the household, women's diet diversity, and their relationship against the background of COVID-19 in southern Bangladesh

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ABSTRACT

The COVID-19 pandemic in Bangladesh, associated public health measures, and people's reactions were projected to have caused job losses among women, a decline in women's empowerment and reduced women's diet diversity. Using a November 2020 telephone survey to re-interview adult female respondents of a November 2019 in-person survey, contrary to expectations we find that more women found than lost jobs, and women's diet diversity increased over the year partly marked by the COVID-19 pandemic. We did not find evidence of a decline in women's involvement in food purchase decisions, nor women's autonomy over use of household income. The change in women's outside employment is neither statistically related to changes in women's involvement in food purchase decisions, changes women's autonomy over use of household income, nor changes in women's diet diversity. Change in women's involvement in food purchase decisions is positively related with change in women's diet diversity and change in women's autonomy over income use is negatively related with change in women's diet diversity.

1. Introduction

Despite substantial recent improvements, Bangladesh faces high levels of undernutrition (USAID 2018). The COVID-19 pandemic and associated public health measures, which started in March 2020, are thought to have aggravated this problem due to supply constraints, increased price volatility, and reduced household purchasing power (Egger et al., 2021; Food and Agriculture Organization of the United Nations (FAO), 2020a, 2020b; Termeer, Brouwer, and de Boef, 2020). Vegetables, fruits, and protein-rich foods became relatively more expensive, and poor people are said to have increased the proportion of low-cost carbohydrates in their diets. As a consequence, nutritional deficiencies are projected to have deepened (Food and Agriculture Organization of the United Nations (FAO), 2020a, 2020b; Termeer et al., 2020; Ruszczyk et al., 2021). The scarce survey data also point at a negative effect of the pandemic on diets and nutrition. Based on a panel survey, Egger et al. (2021) conclude that early in the pandemic (April-May 2020)

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rural households were more likely to skip meals than a year before. Using cross-sectional data from both rural and urban areas, Kundu et al. (2020) conclude that, later in the pandemic (September 2020), diet quality, as measured by the number of food groups consumed, was negatively correlated with respondents reporting pandemic-related decreased monthly income, increased prices, and challenges with accessing the same food types and quantities as prior to the pandemic. In Myanmar, women in households that reported COVID-19 related income loss had lower diet diversity scores (Ragasa et al., 2021).

The pandemic, associated policies, and people's reactions to these have also been hypothesised to have had a negative effect on women's empowerment. Even before the pandemic, many women in rural Bangladesh lacked control over income and resources and were limited in mobility outside their home (Jayachandran, 2020; H. J. L. Malapit et al., 2019; Schuler & Rottach, 2010; Sraboni et al., 2014). While, to our knowledge, robust evidence is still missing, the pandemic and public health measures have been projected to have decreased women's empowerment even further (BRAC, 2020; Jaim, 2021; U.N. Women, 2020). First, women have had limited representation and voice in the design of COVID-19-related policies, and the policies have been largely gender blind (U.N. Women, 2020). Second, the limited share of women participating in the labour force is mainly employed in the informal sector, which was halted due to lockdowns or seriously hindered by other restrictions (Bahn, Cohen, & van der Meulen Rodgers, 2020; Sarker, 2020; U.N. Women, 2020). Third, in a rapid assessment by the Bangladesh Rural Advancement Committee (BRAC), more women than men reported not having received any COVID-19-related government support (BRAC, 2020). Fourth, school closures and restrictions that hindered people's ability to work outside the home implied heavier domestic and care work burdens for many women, who could not rely on household help during the pandemic (BRAC, 2020; Jaim, 2021; Seck et al., 2021; U.N. Women, 2020). Fifth, crises are often associated with an increase in gender-based violence (Mittal & Singh, 2020). Reasons include increased economic dependence of women, distorted intrahousehold power dynamics, limited ability to escape the perpetrator, reduced scrutiny from the wider community or police, and increased anxiety, frustration, and, in some cases, alcoholism among men when they lose their income earning ability. In the June 2020 review of a series of large-scale phone surveys conducted by the Manusher Jonno Foundation (MJF), more than 25 % of women reported being victims of violence in the month prior to the interview; in most cases, the violence was domestic. Twenty percent of those subjected to violence reported never having been subjected to violence before the pandemic (Manusher Jonno Foundation, 2020; Sifat, 2020).

Changes in women's empowerment and nutrition are likely to be interdependent. Limited women's empowerment and gender-related constraints, within and outside the household, hamper women's access to healthy diets in Bangladesh (Bhagowalia et al., 2012; H. J. L. Malapit et al., 2019; U.N. Women, 2020). As a result, women are more prone to nutritional deficiencies than men (HLPE, 2017; WHO, 2000). In Bangladesh, evidence is emerging that women's agency within households is positively correlated with household dietary diversity and per capita calorie availability (Sraboni et al., 2014) and with women's dietary diversity (Quisumbing et al., 2020; Sinharoy et al., 2018; Sraboni & Quisumbing, 2018). A lower empowerment gap between the primary female and male decision maker in the household is further associated with higher women's diet diversity (Quisumbing et al., 2020).

This study addresses the evidence gap related to changes in women's empowerment and women's diet diversity in rural Bangladesh during the COVID-19 pandemic. We specifically investigate potential changes in women's income earning abilities, women's decision-making power related to food purchases and use of income, and women's diet diversity between November 2019 and November 2020. Part of that year, which we will label the year with COVID-19, was marked by the COVID-19 pandemic and the subsequent implementation of public health measures, starting in early March 2020.[3] Our working hypothesis is that both women's empowerment and women's diet diversity have declined (Fig. 1, H1a and H1b). This study also assesses the nature of the relationships between these changes: how are changes in women's income earning abilities over the year with COVID-19 related to changes in their decision-making power; and how are changes in women's empowerment related to changes in diet diversity? Following Doss and Quisumbing (2020), we hypothesize that the loss of (informal) jobs or income-generating activities by women has reduced their outside options and bargaining power, with negative consequences for their control over the use of income in their households and their decision-making power about food purchases (Fig. 1, H2). Finally, in accordance with Sinharoy et al. (2018) and Quisumbing et al. (2020), we hypothesise that a reduction in women's empowerment in their households is associated with negative changes in women's diet diversity (Fig. 1, H3).

2. Methods

2.1. Ethics information

The study was granted ethical clearance by the Bangladesh Medical Research Council (registration number 348 11 10 2020), the International Food Policy Research Institute (IFPRI) Institutional Review Board (application approval number MTID-20–1140), and the Social Sciences Ethics Committee of Wageningen University & Research (12–11–2020). A pre-analysis plan was also registered (Lecoutere et al., 2020).

2.2. Data

Our study population resides in Patuakhali and Faridpur districts of southern Bangladesh (Fig. 2). From the start of the COVID-19

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[3] A list and timeline of key public health measures in Bangladesh is available as online supplementary material (OSM) in http://dx.doi.org/10.17632/hxf7nb964d.2.
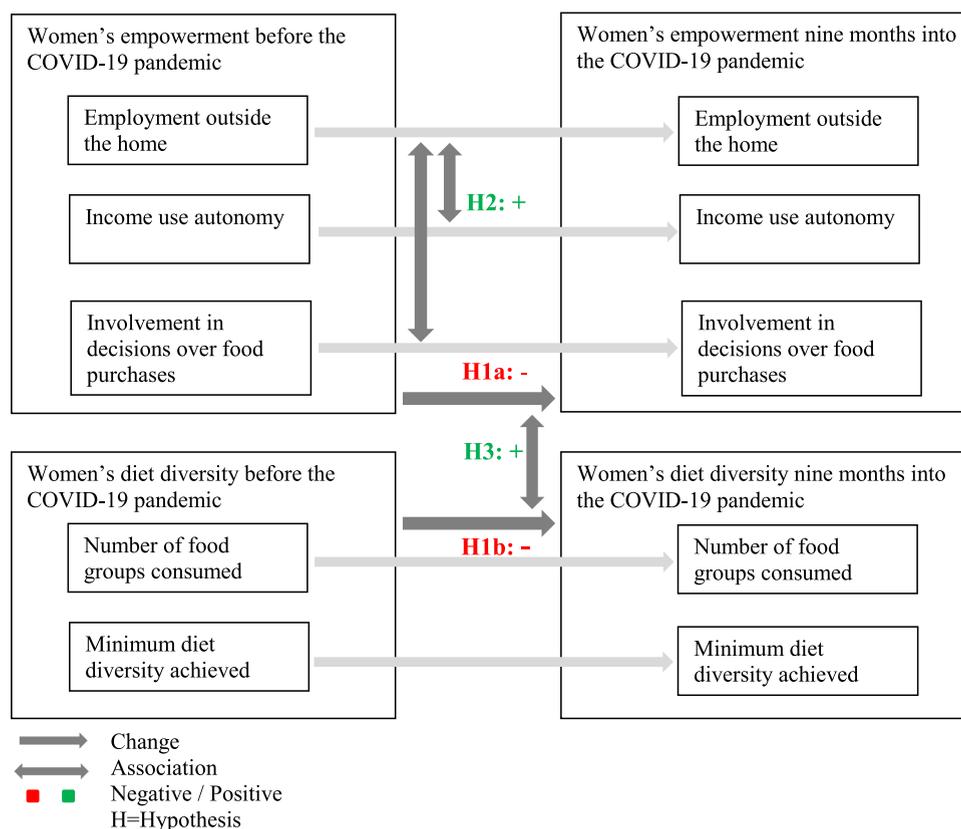
Fig. 1. Research hypotheses.

pandemic until just before the follow-up data collection began (23 November 2020), Bangladesh counted 449,760 confirmed COVID-19 cases and 6416 deaths (World Health Organization, 2020). Over that period, the number of cases over persons in the population at risk was 3406 in Faridpur and 865 in Patuakhali district. Up to mid-October 2020, test positivity was higher in Faridpur than Patuakhali district, but this flipped in November 2020.

Agriculture, livestock rearing, and fishing are still important ways to ensure a livelihood in rural Bangladesh, but their importance and their contribution to rural households' income is declining. Livelihoods are increasingly diversifying away from agriculture, toward relying on business and petty trade, remittances, non-farm wage labour, agro-industry, construction and transportation, and service delivery (Ahmed et al., 2015).

The study sample consists of 832 adult women between 19 and 50 years of age (at the time of the COVID-19 follow-up survey) who participated in an individual in-person survey conducted by the Feed the Future Bangladesh Nutrition Activity (BNA) between 30 October and 15 November 2019 and a follow-up survey using computer-assisted telephone interviews (CATI) conducted between 25 November and 8 December 2020. The phone survey was conducted by a team of female enumerators based in Dhaka, Bangladesh. The enumerators were instructed how to avoid – in a polite and culturally sensitive manner –other adult household members listening in during the phone interview.

For the 2019 individual in-person survey, BNA employed a two-stage cluster sampling design. In each of the three *upazilas* (sub-counties) in each district, nine standard enumeration areas (SEA) (villages) were randomly sampled probability proportional to size. Per SEA, 21 households were randomly selected based on a census of households with a woman of reproductive age (18–49 years) (Feed the Future Bangladesh Nutrition Activity (BNA), 2019).

To construct the COVID-19 follow-up sample, we started from the BNA baseline sample of 1127 adult women from households where the phone number of the household head (or another adult household member) was available. To reduce the risk of response bias (Hirvonen, Abate, & de Brauw, 2020), we used proportionate sample stratification by quintile of household wealth (measured at baseline using EquityTool, 2016) per age group of the adult woman per district combined with a replacement strategy per stratum. We first split the original sample of 1127 adult women by district, then into those younger than 26 years of age and those 26 years or older at the time of the BNA baseline, then into wealth quintile. Second, per stratum, we randomly selected a number of adult women proportionate to population size per stratum at baseline such that our main sample included 900 adult women. Third, if the enumerators were unable to reach an adult woman selected for the main sample within five attempts or the phone number was not connected, that respondent was replaced with another adult woman in the same stratum randomly selected from the remaining 227 women in the original sample.
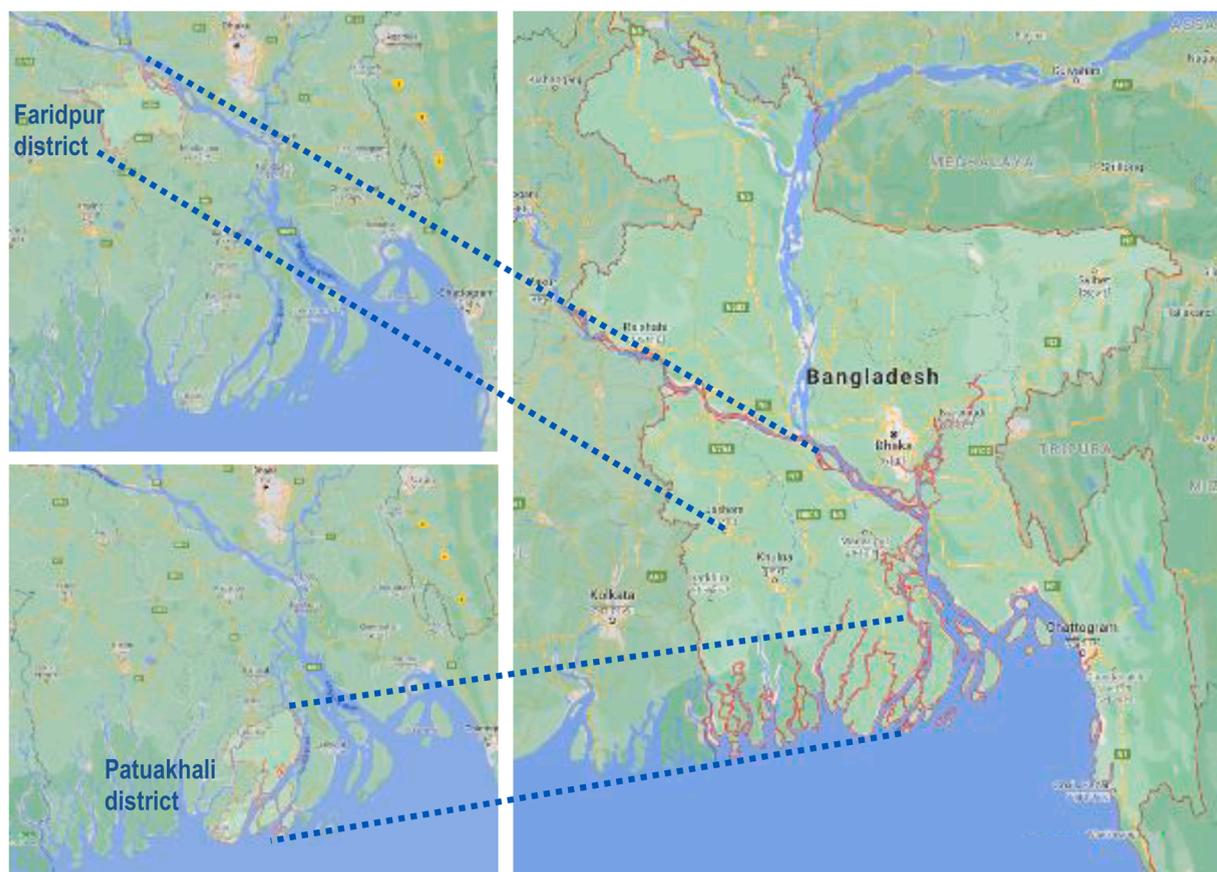
Fig. 2. Map of Bangladesh locating Patuakhali and Faridpur districts (dashed lines) (By authors using Google Maps).

During the COVID-19 follow-up survey, we tried to contact a total of 1088 adult women and managed to interview 832 adult women, amounting to 74.6 % (Table 1). This percentage is higher than the average 63 % of connected per attempted numbers from in-person baseline surveys reported in Innovations for Poverty Action (IPA)'s review (IPA, 2020). Out of the 832 adult women who were interviewed both at baseline and follow-up, 422 reside in Patuakhali district, 410 in Faridpur district; 624 are between 27 and 50 years of age at follow-up, 208 younger than 27.

The main reasons for attrition from the sampled respondents that were called to those finally interviewed in the COVID-19 follow-up survey include an unconnected phone number, a working phone number that was not picked up on any of the five call attempts, and no consent. Proportions of respondents per stratum in the interviewed sample are not significantly different from proportions per stratum in the main and reserve sample. We formally tested for attrition bias and found no evidence of significant imbalance in key baseline characteristics and baseline measures of the dependent variables after adjusting p-values for multiple hypotheses testing.[4]

The informed consent process was verbal. After being informed, the female respondent was asked for her consent to participate in the phone survey and instructed to answer by "Yes, I agree" or "No, I do not agree" (Kopper & Sautmann, 2020). The answer was recorded, with the respondent's awareness. After the interview, female respondents received an incentive equivalent to about US $1.30, sent to their preferred mobile money number.

The structured electronic questionnaire for the COVID-19 follow-up phone survey included 36 questions, 26 of which were the same as in the 2019 BNA survey. The repeated questions enabled us to measure the key dependent and explanatory variables, including women's autonomy regarding the use of household income, women's involvement in decision making about food purchases,[5] women's employment outside the home, and women's diet diversity, in a consistent way at baseline and follow-up. The other questions were about changes in husbands' employment and income, changes in husbands' and women's labour contributions to household production, changes in total monthly household income, and households' challenges with food access as compared to the same period the

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[4] This analysis, along with raw data, meta-data, replication code, as well as tests for attrition bias, additional specifications, and analyses of heterogeneity by age group and by district, are publicly available in a data repository at http://dx.doi.org/10.17632/hxf7nb964d.2.

[5] The indicators of women's empowerment used in this study are based on survey questions used for measuring a project-level women's empowerment in agriculture index (Pro-WEAI) nutrition and health module (piloted by BNA). We were not able to measure all Pro-WEAI nutrition and health aspects as we needed to limit the number of questions in the follow-up phone survey.

Table 1
Sample and attrition.

	Sampled	Called	Attrition	Interviewed
Main sample for COVID-19 follow-up survey	900	898	198	700
Reserve list	227	190	58	132
Total	1127	1088	256	832

year before.

2.3. Empirical approach

First, we tested if changes over the year with COVID-19 (i.e., change from baseline to follow-up) are significantly different from zero for a set of empowerment and diet quality indicators (ΔY), while controlling baseline individual and household characteristics (Z_0) (Eq. 1):

$$\Delta Y_i = \alpha_0 + \quad \alpha_1 Z_{i0} + \varepsilon_i \tag{1}$$

Our parameter of interest in Eq. 1 is α_0. If α_0 is statistically significantly different from zero and smaller than zero, this provides support for our hypotheses that empowerment and dietary diversity declined over the year with COVID-19 (H1a, H1b). In case of women's involvement in food purchase decisions, we exclude women who did not have any children at baseline.[6] In case of diet quality indicators, we exclude women whose reported consumption concerned a fasting day at baseline and/or follow-up.

We operationalised women's empowerment with three indicators: women's *income use autonomy,* women's involvement in *food purchase decisions,* and women's income-generating capacity as measured by whether she *works outside the home* (Table 2). The variable women's *income use autonomy* is based on the vignettes included in the pro-WEAI survey questions. We used the associated weighting scheme (H. Malapit et al., 2019:681) and applied an additional weighting depending on the reported similarity of the respondent to the person described in the vignette (ranging from 0 for completely different, 0.33 for somewhat different, 0.66 for somewhat the same, and 1 for completely the same). Most negative values of the indicator point to external motivation for the way to use the income; slightly negative values point to introjected motivation; 0 signifies having no alternative; and positive values point to autonomous motivation. The second empowerment indicator, women's involvement in *food purchase decisions*, is measured by the proportion (out of five) of food purchase decisions in which the female respondent declared herself to be either the only member or one of the household members normally making the decision.[7] The change over the year with COVID-19 in both empowerment indicators is measured by taking the difference between the follow-up and the baseline value. Finally, the change in a woman's *work outside the home* takes the value of 1 if she works outside the home at follow-up but not at baseline, the value − 1 if she did so at baseline but not at follow-up, and the value 0 if her status of employment outside the home remained unchanged between baseline and follow-up.

We used two indicators for diet quality: the change in the number of *food groups* consumed, and achievement of adequate *diet diversity*. During baseline and follow-up, female respondents were asked whether they consumed a food belonging to each of ten food groups the day prior to the interview (24-hour recall, from morning until going to sleep).[8] The variable *food groups* measures the difference in number of food groups consumed between baseline and follow-up. The change in *diet diversity* takes a value of 1 if the female respondent achieved minimum diet diversity (i.e., consumed food items from five or more food groups the day prior to the interview) at follow-up but not at baseline, takes the value − 1 if she did so at baseline but not at follow-up, and takes the value 0 if (not) achieving minimum diet diversity remained unchanged between baseline and follow-up.

After we assessed changes in women's empowerment and diet quality, we used a first difference approach to test the relationship between these changes. We first related the change in women's employment outside the home (ΔX) to the changes in the other empowerment indicators (ΔE), in some specifications controlling for selected other changes over time (ΔC) and baseline

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[6] While the BNA baseline questionnaire indicated a restriction to ask questions about decisions over food purchases for the woman herself and her child only if the female respondent had a child less than 2 years of age, the questions were asked to all respondents, regardless of having children and regardless of having a young child (< 2 years). But because the questions pertain to food purchase decisions for the female respondent herself and her child, we excluded women who reported not to have any children at baseline in the analyses where women's involvement in decision-making about food purchases is an (in)dependent variable.

[7] Decisions include whether or not to purchase 1) small amounts of food, for example smaller than 5 kg; 2) larger amounts of food, for example larger than 5 kg; 3) eggs; 4) Milk or milk products; and 5) (organ) meat, poultry or fish.

[8] Food groups include: 1) meat, poultry, fish; 2) eggs; 3) dairy; 4) pulses; 5) nuts and seeds; 6) dark green leafy vegetables; 7) vitamin A-rich fruits and vegetables; 8) other vegetables; 9) other fruits; and 10) grains and tubers.

Table 2

Descriptive statistics.

Indicators	Baseline					COVID-19 follow-up					Change over the year with COVID-19				
	N	Avg	S.D.	Min	Max	N	Avg	S.D.	Min	Max	N	Avg	S.D.	Min	Max
Income use autonomy	832	-0.023	0.279	-0.67	0.67	832	-0.019	0.25	-0.67	0.67	832	0.004	0.371	-1.34	1.34
Food purchase decisions *(excluding women without children at baseline)*	759	0.667	0.38	0	1	759	0.618	0.355	0	1	759	-0.049	0.473	-1	1
Food groups *(excluding fasting women)*	829	4.329	1.372	0	9	805	5.426	1.753	1	10	802	1.12	1.968	-5	7
No husband (dummy)	832	0.085	0.28	0	1	832	0.1	0.3	0	1	832	0.014	0.119	0	1
Market challenges (dummy)											832	0.564	0.496	0	1
											N	Value	Freq.	Percent	
Diet diversity *(excluding fasting women)*	829	0.405	0.491	0	1	805	0.665	0.472	0	1	802	-1	92	11.47	
												0	405	50.50	
												1	305	38.03	
Work outside the home	832	0.075	0.263	0	1	829	0.162	0.368	0	1	829	-1	29	3.50	
												0	699	84.32	
												1	101	12.18	
Husband's income	756	0.643	0.479	0	1	756	0.114	0.318	0	1	756	-1	490	64.81	
												0	180	23.81	
												1	86	11.38	
Household income	808	0.988	0.782	0	2	808	0.132	0.396	0	2	808	-2	242	29.95	
												-1	314	38.86	
												0	162	20.05	
												1	73	9.04	
												2	17	2.10	
Age						832	34.448	8.827	19	50					
Number of children in the household	832	1.656	1.23	0	12										
Number of children of woman respondent	821	1.868	1.069	0	8										
Faridpur (dummy)	832	0.493	0.5	0	1										
Lowest wealth quintile (dummy)	832	0.321	0.467	0	1										
(Wife of) household head (dummy)	832	0.865	0.342	0	1										
Education beyond primary school (dummy)	832	0.459	0.499	0	1										

characteristics (Z_0). (Eq. 2).

$$\Delta E_i = \beta_0 + \beta_1 \Delta X_i + \beta_2 \Delta C_i + \beta_3 Z_{i0} + \varepsilon_i \tag{2}$$

Second, we addressed the relationship between changes in empowerment (including outside employment) ($\Delta E'$) and changes in women's diet diversity (ΔD) (Eq. 3). Again, we included specifications in which we control for selected other changes over time ($\Delta C'$) and baseline characteristics (Z_0).[9]

$$\Delta D_i = \gamma_0 + \gamma_1 \Delta E_i' + \gamma_2 \Delta C_i' + \gamma_3 Z_{i0} + \varepsilon_i \tag{3}$$

We ran separate regressions for each combination of indicators. Our parameters of interest in Eqs. 2 and 3 are β_1 and γ_1 respectively. If β_1 is statistically significantly different from zero and larger than zero, this provides support for the hypotheses that a reduction (increase) in women's employment outside the home is associated with a reduction (increase) in the other indicators of women's empowerment (H2). If γ_1 is statistically significantly different from zero and larger than zero, this provides support for the hypothesis that reduced (increased) women's empowerment is associated with a negative (positive) change in women's diet diversity (H3).

The baseline control variables (Z_0) include the female respondent's *age*; a dummy variable indicating the female respondent is the (*wife of the*) *household head*[10]; the number of resident *children* up to 17 years of age within the *household*; the number of living *children of the female respondent*; a dummy variable with value 1 if the female respondent was in the *lowest wealth quintile* in her age group by district; and a dummy variable with value 1 if she resided in *Faridpur* district at baseline (as opposed to Patuakhali district).[11]

When estimating relationships between changes in women's employment outside the home and changes in women's empowerment (ΔE), we included regression specifications where we control for changes in having a *husband* and *husband's income* to check the influence of a potentially altered balance between husbands' and wives' outside options (ΔC).[12] If the female respondent changed from having a husband at baseline to not having one at follow-up,[13] the variable *husband* takes the value 1, else 0. The change in the *husband's income* is based on questions asked at follow-up. The questions asked the female respondent to compare her husband's income from the week prior to the interview to his income in a typical week in the same period one year before. The change in *husband's income* takes the value 1 if the female respondent reported her husband's income to have increased since a year before, takes the value -1 if she reported it decreased or was zero at follow-up, and takes the value 0 if she reported it unchanged.

When estimating relationships between changes in women's empowerment and changes in women's diet quality (ΔD), we included specifications in which we control for whether there is a change in having a *husband,* changes in *household income* and a dummy for experiencing *market access challenges*[14] in the week prior to the interview to check if there is a change in a household's purchasing power or market access intervenes ($\Delta C'$).[15] The change in *household income* takes the value 1 (resp. 2) if the female respondent reported it to have increased (resp. increased a lot); it takes the value -1 (resp. -2) if it decreased (resp. decreased a lot); and takes the value 0 if it did not change over time.

We estimated Eqs. (1), (2) and (3) using Ordinary Least Squares with robust standard errors for continuous dependent variables and Ordered Probit regression with robust standard errors for the case of (ordered) categorical dependent variables. In cases of categorical dependent variables, we additionally estimated probabilities for Eq. (1) and average marginal effects of the explanatory variable of interest on the probability of each of the categories of the dependent variable for Eqs. (2) and (3) to facilitate interpretation of results.

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[9] In the pre-analysis plan (Lecoutere et al., 2020), we intended to also examine the extent to which changes in women's empowerment and diet diversity related to changes in women's labor contributions to household production. As women's labor contributions to household production are expected to have weaker implications for women's empowerment and we needed to rely on recall questions for measurement of its change we use these results as robustness checks (available as OSM in http://dx.doi.org/10.17632/hxf7nb964d.2).Furthermore, not only the district where women reside but also women's age can be a source of heterogeneity in changes over the year with COVID-19 since women's empowerment, women's diet diversity and the relationships between these could have evolved differently among women at different life cycle stages. Analyses of heterogeneity by age group and district are available as OSM in http://dx.doi.org/10.17632/hxf7nb964d.2.

[10] As opposed to being the brother/sister, brother/sister-in-law, parent, parent-in-law, son/daughter, son/daughter-in-law, other relation of the head of household.

[11] We decided not to use women having an education level beyond primary education as a control variable because it significantly and strongly correlates with women's age, lowest wealth quintile, being (wife of) the head of household, and living without the presence of a husband.

[12] Changes over time in women's outside employment and changes in having a husband and husband's income are not statistically significantly correlated.

[13] i.e., if at baseline, female respondent reported to be married living with her spouse and by follow-up, her husband was reported to have died, left, or divorced from.

[14] Market access challenges include difficult access to food markets due to public health-related restrictions to mobility or market closure, or due to shortages or high prices of food in markets.

[15] Indicators of changes over time in women's empowerment and changes in household income, having a husband and market challenges are not statistically significantly correlated.

We applied the method by Anderson (2008) to calculate False Discovery Rate (FDR) q-values to correct p-values for multiple hypothesis testing, adjusting for testing 29 hypotheses (McKenzie, 2020).[16]

3. Results

3.1. Change in women's empowerment over the year with COVID-19

We find mixed evidence regarding the change in women's empowerment over the year with COVID-19. While a loss of outside employment was expected, the share of women working outside the home increased significantly (Table 3, Column 1) from 7.5 % to 16.2 % (Table 2), which is suggestive of increased empowerment. While the employment status of most women remained unchanged, 12.2 % gained employment and 3.5 % lost employment outside the home.

There is no evidence, however, that women's income use autonomy changed over the year with COVID-19 (Table 3, Column 2). On average, both at baseline and follow-up, the measure is close to zero, which means women's beliefs about their autonomy remained between having no alternatives and introjected motivations for such decisions (Table 2). Neither is there evidence that women's involvement in decisions over food purchases has declined (Table 3, Column 3). Women remained involved in approximately two thirds out of five food purchasing decisions (Table 2). Hence, while a decline in women's empowerment was anticipated, this is not confirmed by our data.

3.2. Change in women's diet diversity over the year with COVID-19

We reject the hypothesis that diet diversity decreased over the year with COVID-19; in fact, we find that women's diet diversity significantly increased. The number of food groups consumed by non-fasting women increased by 1.28 food groups (Table 3, Column 4). Descriptive statistics show that, on average, women consumed 4.33 (sd *1.37*) food groups at baseline, and 5.43 (sd *1.75*) at follow-up (Table 2). In particular other fruits, eggs, and dairy were more likely to be consumed at follow-up than at baseline.[17] Relatedly, women are more likely to achieve minimum diet diversity at follow-up (Table 3 Column 5). More specifically, 38.0 % of women moved from not achieving minimum diet diversity at baseline to achieving it at follow-up, whereas only 11.5 % moved from achieving to non-achieving adequate diet diversity. Overall, the likelihood of achieving minimum diet diversity was 40.5 % at baseline and 66.5 % at follow-up (Table 2).

3.3. Relationship between change in women's employment outside the home and change in women's income use autonomy and decision-making power over food purchases

We reject the hypothesis that a change in women's employment outside the home is negatively associated with a change in women's income use autonomy and decision-making power over food purchases. We find no relation between the loss of a job and a change in income use autonomy (Table 4, Column 1). A change in women's employment outside the home does not have a statistically significant relationship with women's involvement in food purchase decisions either (Table 4, Column 3). Controlling for other changes over time including changes in husband's income and the presence of a husband does not make a difference for the relationships between changes in women's outside employment and indicators of women's empowerment (Table 4, Columns 2 and 4).

3.4. Relationship between change in women's empowerment and change in women's diet diversity

Our results provide mixed evidence regarding our hypothesis that changes in women' empowerment and diet diversity are positively correlated.

Changes in working outside of the home are not significantly associated with either of the indicators of change in diet diversity (Table 5, Columns 1 and 3). Controlling for other changes over time including changes in household's income, market access challenges and the presence of a husband does not make a difference (Table 5, Columns 2 and 4).

Contrary to expectations, we find a negative, statistically significant relationship between change in women's income use autonomy and change in the number of food groups consumed by women (Table 6, Column 1). However, controlling for changes in household income, market access challenges, and the presence of a husband turns the relationship statistically insignificant (after correcting for multiple hypotheses testing). In particular, (positive) changes in household income seem to dampen the negative relationship between change in women's income use autonomy and number of food groups (details not shown here). There is no statistically significant relationship between the change in women's income use autonomy and change in achieving minimum diet

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[16] We test five hypotheses of changes over the year with COVID-19 in five empowerment and diet quality indicators (Eq. 1). We test hypotheses of i) correlation between change in two empowerment indicators and change in women's employment outside the home, which has two categories (Eq. 2); ii) correlation between two diet quality indicators and change in women's employment outside the home, which has two categories (Eq. 3); iii) correlation between two diet quality indicators and two empowerment indicators (Eq. 3). We run each of the four tests in i), ii), and iii) once controlling for baseline characteristics (Z) and once additionally controlling for other changes over time ($\Delta C + Z$), adding up to a total of 24 hypotheses tested.

[17] More detailed analysis is available at http://dx.doi.org/10.17632/hxf7nb964d.2.

Table 3
Change over the year with COVID-19 in women's work outside the home, women's empowerment, and women's diet diversity.

	Δ Work outside the home (1) Ord Prob	Δ Income use autonomy (2) OLS	Δ Food purchase decisions (3) OLS	Δ Food groups (4) OLS	Δ Diet diversity (5) Ord Prob
Constant (α_0)	1.467***	-0.107	0.146	1.276***	1.152***
S.E.	0.217	0.063	0.093	0.359	0.205
p-value	0.000	0.092	0.113	0.000	0.000
FDR q-value	0.001	0.171	0.193	0.001	0.001
2nd cut point	1.534				0.357
S.E.	0.215				0.202
Prob pr($\Delta Y = -1$)	0.035				0.115
S.E.	0.006				0.011
p-value	0.000				0.000
Prob pr($\Delta Y = 0$)	0.843				0.505
S.E.	0.013				0.018
p-value	0.000				0.000
Prob pr($\Delta Y = 1$)	0.122				0.380
S.E.	0.011				0.017
p-value	0.000				0.000
Control variables	Z	Z	Z	Z	Z
N	829	832	759	802	802
R^2		0.008	0.009	0.005	
Pseudo R^2	0.008				0.001
Log pseudo lkh	-425.463				-769.897

Note: Models (1–2) with dependent variable Δ Work outside the home and models (9–10) with dependent variable Δ Diet diversity estimated using ordered Probit (Ord Prob), with Prob predicted probability per category of ΔY; Models with dependent variables Δ Income use autonomy (3–4), resp. Δ Food purchase decisions (5–6), and Δ Food groups (7–8) estimated using OLS; S.E. robust standard error; False Discovery Rate (FDR) q-value correcting for multiple hypotheses testing; Control variables Z = {Age, Lowest wealth quintile, (Wife of) household head, Nbr of children in the household, Faridpur} Model (3) exclude women without children at baseline; Models (4–5) exclude women whose reported consumption concerned a fasting day at baseline and/or follow-up; * ** , * *, * significance of coefficient of interest α_0 at 1, 5, and 10 % based on FDR q-value.

Table 4
Relationship between change over the year with Covid-19 in women's empowerment and change in women's work outside the home.

	Δ Income use autonomy		Δ Food purchase decisions	
	(1) OLS	(2) OLS	(3) OLS	(4) OLS
β_1 Δ Work outside the home $= -1$	-0.041	-0.056	-0.052	-0.004
S.E.	0.067	0.070	0.099	0.102
p-value	0.542	0.426	0.602	0.971
FDR q-value	0.612	0.503	0.671	0.883
β_1 Δ Work outside the home $= 1$	-0.081	-0.077	-0.018	-0.006
S.E.	0.039	0.042	0.049	0.053
p-value	0.040	0.068	0.713	0.910
FDR q-value	0.105	0.148	0.703	0.835
Constant	-0.103	-0.089	0.149	0.156
S.E.	0.063	0.070	0.093	0.107
p-value	0.104	0.202	0.107	0.145
Control variables	Z	ΔC + Z	Z	ΔC + Z
N	829	753	756	686
R^2	0.013	0.016	0.009	0.017

Note: Models with dependent variable Δ Income use autonomy (1–2), resp. Δ Food purchase decisions (3–4), estimated using OLS with coefficient ß1 estimated for different categories of Δ Work outside the home; S.E. robust standard error; False Discovery Rate (FDR) q-value correcting for multiple hypotheses testing; Control variables ΔC= { Δ No husband, Δ Husband's income}, Z = {Age, Lowest wealth quintile, (Wife of) household head, Nbr of children in the household, Faridpur}; Models (3–4) exclude women without children at baseline; * **, **, * significance of coefficient of interest ß$_1$ at 1, 5, and 10 % based on FDR q-value.

diversity (Table 6, Columns 3 and 4).

In contrast, the change in women's involvement in food purchase decisions is positively and statistically significantly associated with the change in the number of food groups consumed by women (Table 6, Column 5) and the change in achieving minimum diet diversity (Table 6, Column 7). More particularly, increasing involvement in food purchase decisions makes moving from not achieving to achieving minimum diet diversity more likely and the opposite less likely. These statistically significant relationships are robust to controlling for changes in household income, market access challenges, and the presence of a husband (Table 6, Columns 6 and 8).

Table 5

Relationship between change over the year with COVID-19 in women's diet diversity and change in women's work outside the home.

	Δ Food groups		Δ Diet diversity	
	(1)	(2)	(3)	(4)
	OLS	OLS	Ord Prob	Ord Prob
γ_1 Δ **Work outside the home** $= -1$	0.158	0.092	0.117	0.072
S.E.	0.346	0.354	0.185	0.191
p-value	0.649	0.794	0.527	0.707
FDR q-value	0.703	0.747	0.612	0.703
γ_1 Δ **Work outside the home** $= 1$	0.215	0.174	0.187	0.164
S.E.	0.213	0.216	0.120	0.121
p-value	0.315	0.420	0.119	0.173
FDR q-value	0.420	0.503	0.193	0.262
Constant	1.263	1.136	-1.140	1.002
S.E.	0.359	0.381	0.205	0.220
p-value	0.000	0.003	0.000	0.000
2nd cut point			0.368	0.515
S.E.			0.203	0.219
Δ **Work outside the home** $= -1$				
AME pr(ΔD=−1)			-0.022	-0.014
S.E.			0.032	0.036
p-value			0.500	0.708
AME pr(ΔD=0)			-0.023	-0.014
S.E.			0.040	0.036
p-value			0.560	0.706
AME pr(ΔD=1)			0.045	0.027
S.E.			0.072	0.072
p-value			0.532	0.707
Δ **Work outside the home** $= 1$				
AME pr(ΔD=−1)			-0.033	-0.031
S.E.			0.020	0.023
p-value			0.091	0.176
AME pr(ΔD=0)			-0.039	-0.031
S.E.			0.028	0.023
p-value			0.158	0.171
AME pr(ΔD=1)			0.072	0.062
S.E.			0.047	0.045
p-value			0.124	0.172
Control variables	Z	ΔC' + Z	Z	ΔC' + Z
N	800	778	800	778
R^2	0.006	0.015		
Pseudo R^2			0.003	0.008
Log pseudo lkh			-767.266	-740.973

Note: Models (1–2) with dependent variable Δ Food groups (3–5) estimated using OLS with coefficient γ1 estimated for different categories of Δ Work outside the home; Models (3–4) with dependent variable Δ Diet diversity estimated using ordered Probit (Ord Prob), with AME average marginal effect of each category of explanatory variable of interest ΔE' (Δ Work outside the home) on the probability of each of the categories of ΔD; S.E. robust standard error; False Discovery Rate (FDR) q-value correcting for multiple hypotheses testing; Control variables ΔC'= {Δ No husband, Δ Household income, Market challenges}, Z = {Age, Lowest wealth quintile, (Wife of) household head, Nbr of children in the household, Faridpur}; Models (1–4) exclude women whose reported consumption concerned a fasting day at baseline and/or follow-up; ***, **, * significance of coefficient of interest γ1 at 1, 5, and 10 % based on FDR q-value.

4. Discussion

In Bangladesh, as in other low- and middle-income countries, the COVID-19 pandemic and public health measures to contain it have had substantial effects on people's lives and livelihoods. It should not be surprising that intrahousehold relationships may have also been affected. In this study, which focuses on rural southern Bangladesh, we investigate changes over the course of one year, part of which includes the COVID-19 pandemic. We examine changes in women's employment outside their homes, women's empowerment regarding income use and food purchase decisions, and women's diet diversity. We do so by assessing change in indicators of each of these measured in November 2019 using data collected through an in-person survey conducted among adult women, and data collected in a follow-up phone survey conducted among the same women in November 2020. As such, our study helps provide evidence about how measures related to the evolution of women's empowerment changed in the context of the pandemic. Fig. 2 summarises our main findings. Fig. 3.

We found mixed results for the changes in women's empowerment. Several rapid assessments projected that the COVID-19 pandemic and public health measures would have reduced employment opportunities for women (Hypothesis H1a) (Bahn et al., 2020; Sarker, 2020; U.N. Women, 2020). In our study population, however, employment status outside the home appeared to have improved, as 12.2 % of women found employment over the course of the year with COVID-19, and only 3.5 % exited the labour force. UN Women's Rapid Gender Assessments conducted among random samples of cell phone users between March and June 2020 show

Table 6
Relationship between change over the year with COVID-19 in women's diet diversity and change in women's empowerment.

	Δ Food groups		Δ Diet diversity		Δ Food groups		Δ Diet diversity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	Ord Prob	Ord Prob	OLS	OLS	Ord Prob	Ord Prob
γ_1 Δ *Income use autonomy*	-0.423*	-0.384	-0.036	-0.013				
S.E.	0.190	0.194	0.107	0.109				
p-value	0.026	0.048	0.737	0.902				
FDR q-value	0.078	0.113	0.703	0.835				
γ_1 Δ *Food purchase decisions*					0.373**	0.398**	0.243**	0.270**
S.E.					0.150	0.152	0.086	0.088
p-value					0.013	0.009	0.005	0.002
FDR q-value					0.046	0.038	0.026	0.014
Constant	1.225	1.080	-1.147	1.009	1.315	1.161	-1.044	0.878
S.E.	0.358	0.381	0.207	0.222	0.383	0.412	0.228	0.243
p-value	0.001	0.005	0.000	0.000	0.001	0.005	0.004	0.000
2nd cut point			0.361	0.509			0.446	0.629
S.E.			0.204	0.221			0.226	0.243
AME pr(ΔD=−1)			0.007	0.003			-0.045	-0.053
S.E.			0.021	0.021			0.016	0.018
p-value			0.737	0.902			0.005	0.003
AME pr(ΔD=0)			0.007	0.003			-0.043	-0.048
S.E.			0.020	0.021			0.015	0.016
p-value			0.737	0.902			0.003	0.002
AME pr(ΔD=1)			-0.014	-0.005			0.088	0.101
S.E.			0.041	0.041			0.030	0.033
p-value			0.737	0.902			0.003	0.002
Control variables	Z	ΔC' + Z	Z	ΔC' + Z	Z	ΔC' + Z	Z	ΔC' + Z
N	802	780	802	780	731	711	731	711
R^2	0.011	0.020			0.014	0.025		
Pseudo R^2			0.001	0.007			0.006	0.014
Log pseudo lkh			-769.842	-743.283			-705.046	-678.946

Note: Models (1–2, resp. 5–6) with dependent variable Δ Food groups are estimated using OLS; Models (3–4, resp. 7–8) with dependent variable Δ Diet diversity estimated using ordered Probit (Ord Prob), with AME average marginal effect of explanatory variable of interest ΔE' on the probability of each of the categories of ΔD; S.E. robust standard error; False Discovery Rate (FDR) q-value correcting for multiple hypotheses testing; Control variables ΔC'= {Δ No husband, Δ Household income, Market access challenges}, Z = {Age, Lowest wealth quintile, (Wife of) household head, Nbr of children in the household, Faridpur}; Models (1–8) exclude women whose reported consumption concerned a fasting day at baseline- and/or follow-up, models (5–8) additionally exclude women without children at baseline; ***, **, * significance of coefficient of interest γ_1 at 1, 5, and 10 % based on FDR q-value.

that in Bangladesh, the likelihood of women losing their job and reducing work hours in the informal sector remained limited at about 25 % (Seck et al., 2021).[18] The unexpected gain in outside employment for some women raises the question whether this was women's choice or distress employment to make up for loss of household income during the period with lockdowns and restrictions. Local sources confirm the latter is most plausible. But the fact women were still employed after the most stringent restrictions had been abandoned could signify that women working outside the home has become more acceptable. Besides, labour shortage, following intra- and inter-district travel restrictions, may have created job opportunities for women, according to local sources.

Women's empowerment was expected to decline against the background of the COVID-19 pandemic (H1a) (BRAC, 2020; Jaim, 2021 Koning, Anderson, & Bin-Humam, 2020; U.N. Women, 2020). In our study population, however, neither women's involvement in food purchase decisions nor in women's autonomy in the use of income from agricultural and non-agricultural activities statistically significantly changed over the year with COVID-19. Hence, there is no evidence of a decline in women's empowerment in our study population.

Contrary to expectations, we found that women's diet diversity increased over time (H1b). More specifically, we found that the number of food groups consumed by non-fasting women increased by 1.28 food groups on average over the year with COVID-19. Our average of consuming 5.43 food groups (out of 10) in the follow-up survey is in line with Kundu et al. (2020), who found an average of 6.22 food groups (out of 12) consumed by any household member of their sample respondents (with 60 % rural households). An early study in India reported a reduction in fruit, fish, and meat consumption (Harris et al., 2020). A panel study in economically weaker districts in East India found small but significant reductions in women's diet diversity, but no change in minimum diet diversity achievement between May 2019 and May 2020 (Gupta et al., 2021). Other studies, focused on India (Ceballos, Kannan, & Kramer, 2020), Ethiopia (Hirvonen, de Brauw, & Abate, 2021), and Kenya (Janssens et al., 2021), showed limited changes in diets later in the pandemic. Reasons for limited effects on food consumption and diets put forward by Hirvonen et al. (2021) include reduced non-food consumption, entertainment or services that are no longer available, or relying on savings or credit. Such coping strategies were observed in small cities in southwestern Bangladesh as well (Ruszczyk et al., 2021). Ragasa et al. (2021) point out that diet diversity

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[18] The authors further show that, in the formal sector, there was no job loss but significant reductions in work hours due to lockdowns.
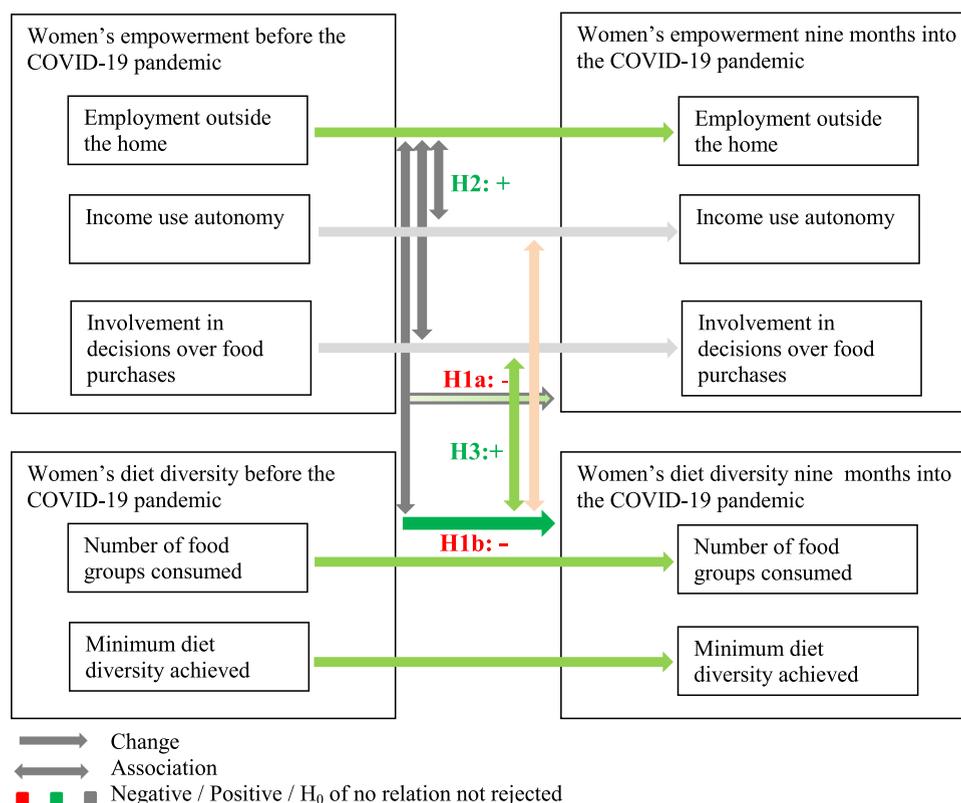
Fig. 3. Research findings.

only captures one aspect of diet quality and that people may also change quantities of food groups consumed. In rural Bangladesh, another reason why women's diet diversity was not negatively affected may relate to reduced marketing opportunities of own production during the pandemic. Markets for eggs, for instance, suffered from false beliefs that poultry products spread the coronavirus and markets for perishable products, such as milk and fruit, suffered from transport challenges (Food and Agriculture Organization of the United Nations (FAO), 2020a, 2020b; Ruszczyk et al., 2021; Termeer et al., 2020). Households may have consumed rather than sold own production of these food items. According to local sources, people in rural areas may have spent more time and effort in home production when faced with mobility restrictions and school closure. Besides, from the start of the pandemic, there have been intensive communication campaigns, by government and NGOs, about the importance of a diversified diet, to boost one's immunity.

While we expected a reduction of women's employment outside the home would be associated with a decline in women's empowerment (H2), we did not find a statistically significant relationship between these two changes. We also do not find a statistically significant relationship between changes in women's employment and changes in women's income use autonomy.

We expected a decline in women's empowerment to be associated with a deterioration of women's diet diversity (H3). The relationship between changes in women's empowerment and changes in diet diversity, however, appeared to depend on the specific women's empowerment indicator under consideration. With increasing involvement in food purchase decisions, women consumed more food groups and were more likely to gain achievement of minimum diet diversity. In contrast, an increase in women's income use autonomy was associated with a decrease in the number of food groups consumed. But other changes over time appeared to play a mediating role in this relationship. In particular, (positive) changes over time in household income temper this relationship. We found no significant relationship between changes in income use autonomy and achievement of minimum diet diversity. There is no evidence of a statistically significant relationship between change in women's employment outside the home and change in women's diet quality.

Our study has several implications. First, during a crisis, it is important not to assume that specific changes in opportunities and outcomes for women are taking place; rather, data collection is necessary. We found unexpected gains in women's employment outside the home, and perhaps similarly one might not have expected women's diet diversity to increase.

Second, it is important to realise that the COVID-19 pandemic was a shock that intersected the trajectory of changes taking place in women's agency over time in Bangladesh. Prior to the pandemic women's empowerment in their households, in general, seemed to have been improving, albeit slowly (Feed the Future, 2015; Kabeer, 2011; Quisumbing et al., 2020). While we did not observe changes in indicators of women's agency in our study population, nonetheless, the COVID-19 pandemic and related public health measures may have had negative consequences for women's agency we could not capture in our phone surveys. Then again, the increase in women's outside options could be associated with changes in women's agency in the longer term. Further study will be necessary in the

future to observe how the pandemic has affected the trajectory that women's agency had been on in the past. Likewise, following up on women's diet diversity will be needed to understand if the observed positive change will be sustained, for instance, because people realise the importance of a healthy diet.

Third, we should remain conscious of the study's limitations. The changes over the year are not necessarily only attributable to the COVID-19 pandemic, the measures to avert its spread, and people's reactions to these measures. For example, the cyclone Amphan hit the area in May 2020. There have also likely been changes in households, communities, and livelihoods that we did not capture, some of which might have occurred prior to the pandemic. Further, despite running the baseline and follow-up surveys at approximately the same time of year to avoid issues of seasonality, we cannot exclude small local atypical seasonal timing of harvests, availability or prices of different grains, pulses, fruits or vegetables, not necessarily related to the pandemic. Our results are not automatically representative of the adult female population in the rural districts of Faridpur and Patuakhali, Bangladesh. Particularly, adult women without access to mobile phones were excluded from our study population. Although that percentage was small in the original BNA baseline sample (2.6 % in Patuakhali and none in Faridpur), our study may still overestimate (changes in) women's outside employment, empowerment, or diet diversity, if these tend to be positively associated with access to a mobile phone. Finally, as the follow-up survey was collected through telephone interviews and the baseline data through in-person interviews, there may have been some inconsistency in measurement, different feelings of trust and privacy by respondents vis-a-vis interviewers, and higher risks of unnoticed reduced attention, as well common challenges of repeated data collection such as panel effect and differential interviewer bias (IPA, 2020; Van der Zouwen & Van Tilburg, 2001).

Conflict of interest

The authors, Els Lecoutere, Marrit van den Berg and Alan de Brauw declare that there is no conflict of interest.

Data Availability

Data will be made available on request. Raw data, meta-data, and replication code are openly available in Mendeley Data at http://dx.doi.org/10.17632/hxf7nb964d.2.

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