*Public Health Nutrition: 25(10), 2886–2896* doi:10.1017/S1368980022001252

# Remittances and food security in Bangladesh: an empirical country-level analysis

Sylvia Szabo[1], Sayem Ahmed[2,3,4,*], Arkadiusz Wiśniowski[5], Malay Pramanik[6], Rashadul Islam[7], Ferdousi Zaman[7,8] and John KM Kuwornu[9]

[1]Department of Social Welfare and Counseling, College of Future Convergence, Dongguk University, Seoul, South Korea: [2]Health Economics and Health Technology Assessment, Institute of Health and Wellbeing, University of Glasgow, 1 Lilybank Gardens, Glasgow, G12 8RZ, UK: [3]Centre for Tropical Medicine and Global Health, Nuffield Department of Medicine, University of Oxford, Oxford, UK: [4]Mathematical Modelling Group, Oxford University Clinical Research Unit (OUCRU), Ho Chi Minh City, Vietnam: [5]Social Statistics Department, University of Manchester, Manchester, UK: [6]Department of Development and Sustainability, Asian Institute of Technology, Pathum Thani, Thailand: [7]International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b), Dhaka, Bangladesh: [8]World Health Organization, Dhaka, Bangladesh: [9]Department of Agricultural Economics, Agribusiness and Extension, University of Energy and Natural Resources, Sunyani, Ghana

Submitted 4 March 2021: Final revision received 28 February 2022: Accepted 12 May 2022: First published online 26 May 2022

**Abstract**

*Objective:* To examine the association between remittances and food security in Bangladesh, controlling for other key factors.

*Design:* The secondary data analysis was performed on the most recent (2016) nationally representative Household Income and Expenditure Survey. We used logistic regression models to measure the association between food security of the household and remittances received. The household food security was measured based on expenditure on food items and the energy intake of the household members. The key explanatory variables included the receipt of remittances by the household and household-level socio-economic characteristics.

*Setting:* Bangladesh.

*Participants:* Totally, 45 977 households across seven divisions of Bangladesh.

*Results:* Findings suggested that remittances have a significant positive effect on food security. Further, the households with female heads were significantly more likely to be food insecure. The wealth status and geographical locations were significantly associated with food security status in Bangladesh.

*Conclusions:* The findings highlight the importance of considering remittance as one of the key factors, while stakeholders implement nutritional interventions in Bangladesh and other low-income settings. Future research should consider this as an important determinant while further examining food security in such settings.

**Keywords**
Bangladesh
Food security
Migration and development
Remittances
Vulnerability

Globally, in 2020, the officially recorded remittance flows to low and middle-income countries were estimated at $540 billion and the total remittance flows, including high-income countries, were estimated at $702 billion[(1)]. The volume of remittances continues to be higher than the official development aid, although their level is projected to decline due to the present economic crisis in many developing nations[(2)]. The relationship between migration and human development has been investigated in different geographical settings. At the macro-level, Giuliano and Ruiz-Arranz (2009)[(3)] showed that remittances have a positive effect on countries' economic growth and financial development. At the household level, existing studies showed that remittances have a positive effect on both subjective and objective well-being[(4–6)].

Overall, there has been mixed evidence regarding the impact of migration and remittances on food security. While some studies[(4,5)] found that a positive association existed between migration and nutritional outcomes[(6)], it has been suggested that migration might negatively affect the quality of diet. Numerous studies have examined the food security status of farm households and coping strategies and the effect of off-farm work on food security[(7–10)]. However, to the best of the authors' knowledge, there is no

*Corresponding author: Email sayem.ahmed@glasgow.ac.uk

recent comprehensive country-level quantitative analysis on the associations between remittances and food security in Bangladesh. Our study aims to fill this gap by statistically analysing the most recent (2016) Household Income and Expenditure Survey data.

Examining the association between remittances and food security is particularly critical in high out-migration regions, such as South Asia. This region experiences comparatively a high level of out-migration accompanied by large remittances flows[1]. According to the most recent World Bank data[11], South Asia continued to experience considerable remittance growth despite the pandemic[11]. In the current US dollar (USD) terms, in 2020, India was amongst the top five recipients of remittances. Pakistan and Bangladesh were sixth and seventh, respectively, with Bangladesh receiving USD22 billion in 2020. While the pandemic negatively affected the remittance flow in some countries, this was not the case for Bangladesh and Pakistan[11]. A survey conducted by Bangladesh Bank in 2014 found that 55·6 % of remittances from expatriates were utilised to different types of expenditures (e.g. 33·6 % food and clothing, 11·5 % education and health care, 3·5 % durable goods and 7·0 % other expenses) and 44·4 % is utilised in different types of investment (e.g. 18·9 % real estate, 77·8 % small and medium enterprises and 7·7 % financial investment)[9].

In South Asian countries, the number of studies examining the link between remittance flows and food security to provide policy recommendations for development is limited. Bangladesh has a long history of migration, which has shaped and continues to shape Bangladeshi society[12]. According to an International Organization for Migration report (2005)[12], 75 % population migrating from rural to urban areas is internal migration, while the remaining individuals are international migrants[12]. In many cases, internal and international migrations are intertwined. Many international migrants, for example, had first settled in the country before venturing abroad[12]. The majority of Bangladeshi nationals who emigrated from the country reside in Saudi Arabia and India[13]. Only 2 % of migrants are classified as 'professional,' while 48 % are classified as 'low skilled'[14]. Remittances have played a significant role in poverty reduction, maintaining balance of payment, enriching foreign currency reserve and contributing to the Gross Domestic Product of the country[12].

Bangladesh is one of the top receivers of remittances from migrants globally, as attested by the contribution of remittances to the Gross Domestic Product. According to the most recent World Bank estimates, they account for equivalent to 5·8 % of the country's Gross Domestic Product and almost 20 % of foreign exchange earnings[10]. High rates of out-migration, both in terms of internal migration and emigration abroad, result from a combination of push and pull factors. These include not only economic pressures to sustain livelihoods but also environmental vulnerability, in particular in the Ganges Brahmaputra delta region. A relatively recent study by Mallick and Vogt[15] estimates that by 2080, 28 million people will be displaced due to the consequences of sea-level rise.

Food security is an integral part of the human security framework and households' access to food is a substantial human right[16]. In Bangladesh, both the human security of farmers and the human right to food are often compromised due to a mixture of political, economic and environmental factors. The livelihoods of farmer communities are particularly threatened by natural disasters as well as in, andcreasing salinity intrusion and relatively high arsenic contamination. It has been reported that in the Patuakhali district, farmers had to resort to shifting crop production patterns in order to mitigate existing and expected food insecurity risks[17]. At the same time, given the reliance of the urban poor on purchased food, potential hikes in food prices are likely to affect household food security. The exposure to food insecurity risks is not equal across different strata of society. In addition, food security is related to all of the present Sustainable Development Goals (SDG) of the United Nations 2030 agenda[18,19]. In order to meet the SDG, countries must benefit from improved food security governance based on equitable and sustainable food systems. Given the above, our study aims not only to contribute to the existing body of literature but also provide policy recommendations for development of Bangladesh. Therefore, we examined the association between remittances and food security in Bangladesh, controlling for other key factors.

### *Conceptualising the associations between remittances and food security*

We draw from the conceptual framework developed in previous studies[20,21] on remittances and, more broadly, the migration that can affect food security in several ways[20]. We distinguish five channels through which migration can affect food security outcomes. These include the effects on: (1) income; (2) household size and composition; (3) allocation of time to paid work and household chores; (4) knowledge of care practices and (5) insurance effects. The income effect is the most intuitive as remittances, whether monetary or gifts, are likely to ease households' financial pressures. Remittances can, however, act on food security outcomes through different pathways and have differentiated effects.

According to the FAO, food insecurity exists when 'people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life'[22]. In Bangladesh, physical and financial barriers to accessing food can be exacerbated by environmental vulnerability, particularly in the coastal region. In Bangladesh, physical and financial barriers to accessing food can be exacerbated by environmental vulnerability, particularly in the coastal region.

Figure 1 summarises the relationships between remittances, household socio-economic characteristics and the

Public Health Nutrition

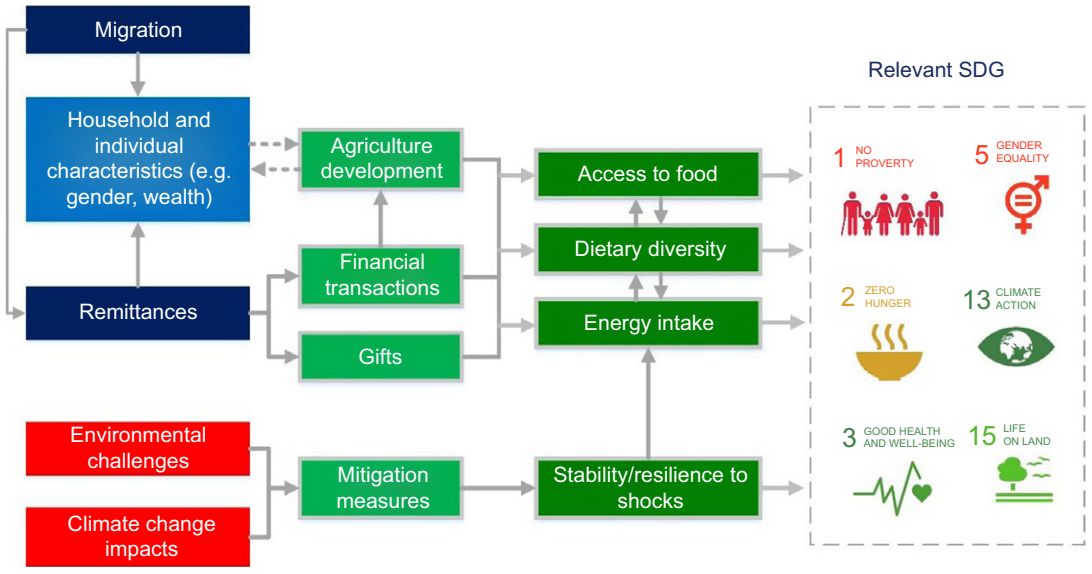


**Fig. 1** Conceptual framework of the study, based on analysis in Szabo *et al.* (2018). Solid arrows indicate direct relationships, whereas dashed arrows indicate indirect relationships

four aspects of food security. Potentially, the most obvious way in which remittances can affect food security is through financial access to food. The positive effect of remittance flows on households' income has been well established in the literature[4,5,19]. Households that receive remittances are not only able to increase their food supplies but also invest more in their health and education[23]. A study from the Asian Development Bank[24] found that Bangladesh households that receive remittances were significantly more likely to have higher food expenditures. Typically, households with higher incomes tend to spend a smaller proportion of their overall expenditure on food, thus leaving more income for non-food consumption. It should also be noted that in addition to the direct effect on food expenditure, remittances can also indirectly influence physical access to food, as households may invest them in transportation, housing, child education and agricultural development.

The effect of remittances on energy intake and dietary diversity is more complex. Because households that receive remittances are expected to spend more on food, it is sensible to assume that the average energy intake of household members is going to increase. Despite the debate in the literature to date, there is evidence that remittances are primarily spent on consumption[25]. By increasing income available for food consumption, remittances are likely to have a positive effect on dietary diversity. However, there is also evidence of the opposite effects. For example, a recent study from Ghana found that migration was associated with lower quality of diet related to a shift towards less nutritious food and eating outside[7].

Although the association between remittance flows and food stability is more difficult to measure, there are empirically proved pathways[20,21]. These interlinkages are particularly important in a country like Bangladesh, where natural hazards are frequent, especially in coastal districts. Cyclones and floods affect the stability of food supplies not only through immediate damage of stocks and agricultural land but also by contributing to shifting population distribution and occupational structures in the study area. In the face of deteriorating environmental conditions, such as increasing soil salinity and arsenic contamination, some farmers chose emigration as a coping strategy in order to sustain their livelihoods[26]. In the context of shocks caused by natural hazards, extreme weather conditions and loss of income due to creeping processes, remittances can act as a natural buffer to ensure the continuity of food supplies. The issue of food stability and resilience to shocks will become even more important, given the predicted impact of climate change in Bangladesh[27,28].

Finally, other factors and pathways affect food security, such as previously mentioned environmental dynamics and individual socio-economic characteristics. The natural environment and climate change can affect both the availability and accessibility of food and the stability of food supplies. In Bangladesh, these environmental challenges define the interconnection between wealth and location of the households. It has been previously shown that poor rural households are particularly likely to be food insecure[28], although comprehensive quantitative evidence on this specific association is scanty.

## Data and methods

### *Data*

In order to conduct statistical analyses, we make use of the 2016 Household Income and Expenditure Survey (HIES).

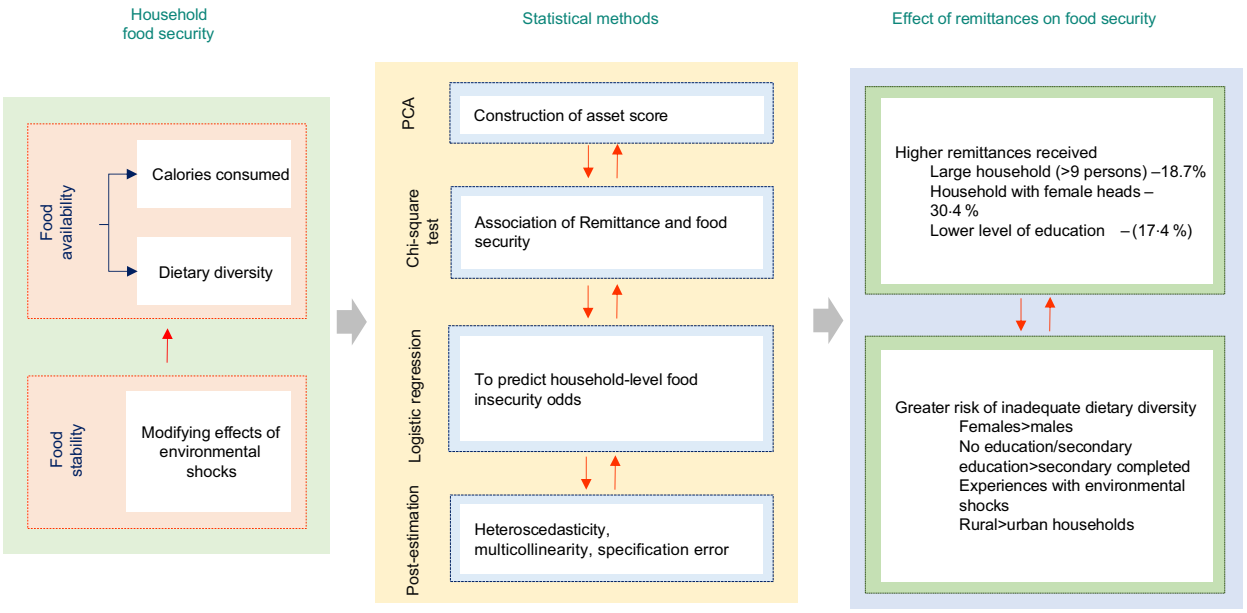


**Fig. 2** Analytical approach for assessing the association between remittances and food security

HIES is a nationally representative survey, which has been periodically carried out by the Bangladesh Bureau of Statistics[29]. The sample design involves two-stage random samplings and is based on the Integrated Multipurpose Sample design framework established for the 2001 Population and Housing Census. The Integrated Multipurpose Sample encompasses 1000 Primary Sampling Units, including 360 urban and 640 rural Primary Sampling Units.

We followed the quantitative approach developed by the International Food Policy Institute for estimating food security[30]. Regarding food availability, we used the indicator of energies consumed per capita, which is obtained by dividing the household's energy availability by household size. We used the national cut-off point for nutritional requirements (2122 kcal/d) to classify an individual as food insecure[29,31]. Financial access to food is approximated by the proportion of household-level expenditure on food. Following International Food Policy Institute's approach, the household is classified as food insecure if it spends more than 65 % of its overall expenditure on food consumption[30]. In order to quantify diet diversity, we used a score based on the count of food groups consumed over the last 2 weeks. The specific food groups are based on the original categorisation by the Bangladesh Bureau of Statistics and include food grains, pulses, eggs, fish, meat, vegetables, milk and dairy, sweetmeat, oil and fats, fruits, drinks, sugar and molasses. Following previous literature[32], households were considered food insecure if they consumed three or fewer food groups within 24 h prior to the survey.

Food stability, the fourth aspect of the food security concept, is the most difficult to measure and thus rarely investigated. We, therefore, incorporated this aspect in our analysis by examining the modifying effect of environmental shocks on household food security. In addition to remittances, key explanatory variables include the receipt of remittance and socio-economic characteristics of the household. We use a binary indicator of remittances, classifying households by those who have been receiving remittances over the last 12 months and those who have not. Remittances include both monetary transfers and gifts. Another key explanatory variable is respondents' gender; this variable will allow us to test the presupposed difference in food security between males and females. We presented analytical approach adopted in the current study in Fig. 2.

Other control variables include respondents' educational attainment of the household head that is measured by three categories: (i) no institutional education (baseline); (ii) secondary incomplete and (iii) secondary or above[33]. Then, we included other characteristics of the household, that is, a dummy denoting whether household experienced environmental shocks, age of household head (categorised into four categories, <30, 30–49, 50–69 and 70 and more), household size (categorical, 1–4 persons being baseline, 5 to 8 and 9 or more). The next control variable, household wealth status, has been constructed based on total consumption expenditure, where wealth quintile is a multilevel variable (see next section), and we considered the poorest category as a baseline level. Locational variables include rural *v.* urban residence and geographical region (Bangladeshi divisions, where Barisal division is a baseline). Descriptive statistics of the control variables are presented in Table 1.

Public Health Nutrition

**Table 1** Background characteristics of the households

| Characteristics | Total sample (*n* 45 977) | |
|---|---|---|
| | *n* | % |
| Age group of household head | | |
| Less than 30 | 7568 | 16·46 |
| 30–49 years | 22 322 | 48·55 |
| 50–69 years | 13 273 | 28·87 |
| More than 70 years | 2814 | 6·12 |
| Sex of household head | | |
| Male | 40 107 | 87·25 |
| Female | 5861 | 12·75 |
| Education of household head | | |
| No institutional education | 19 354 | 42·09 |
| Secondary incomplete | 19 841 | 43·15 |
| Secondary or above complete | 6782 | 14·75 |
| Region | | |
| Barisal | 4297 | 9·35 |
| Chittagong | 7906 | 17·20 |
| Dhaka | 9347 | 20·33 |
| Khulna | 7195 | 15·65 |
| Rajshahi | 2876 | 6·26 |
| Rangpur | 11 478 | 24·96 |
| Sylhet | 2878 | 6·26 |
| Location | | |
| Urban | 13 953 | 30·35 |
| Rural | 32 024 | 69·65 |
| Wealth quintiles | | |
| Poorest | 9047 | 19·98 |
| Poor | 9056 | 20·00 |
| Medium | 9064 | 20·01 |
| Rich | 9063 | 20·01 |
| Richest | 9060 | 20·00 |
| Receiving remittances | | |
| No | 41 874 | 91·15 |
| Yes | 4064 | 8·85 |

HIES 2016.

### *Statistical analysis*

The socio-economic status of each household was assessed by asset scores based on the households' dwelling characteristics (e.g. wall, roof and floor materials), water and sanitation facilities, utilities (e.g. gas, electricity and internet), holdings of durable goods (e.g. radio, television and almirah) and other assets (e.g. ownership of land and livestock). The asset scores were generated by employing a principal component analysis approach[34]. The principal component analysis is a widely used technique for dimensionality reduction and, for example, assessing socio-economic status in low-income settings[35]. The first principal component analysis was used to construct asset scores since it accounted for the highest proportion of the total variation. A higher asset score indicates that a household is more wealthy[36]. By using the asset scores, households were ranked from the poorest to the richest and divided into five equal wealth quintiles.

We used $\chi^2$ test to measure the association between receiving remittances and food-security status estimated using two different approaches (i.e. expenditure and energy-based method). We utilised a series of logistic regressions to test the hypothesis on the potential association of remittances with food security. Logistic regression is a commonly used statistical model for binary endogenous variables, i.e. when the outcome takes two values, such as 0 = 'having insufficient energy intake' (often denotes as a *failure*) and 1 = 'having sufficient energy intake' (*success*)[37,38]. The model assumes that the logit of the probability of success is a function of a linear predictor and has a standard logistic distribution. The coefficients are estimated by using the maximum likelihood method.

In the analysis, we defined two endogenous variables that measure food security; the first using expenditure on food and the other based on energy intake defined as consuming more than 2122 calories/d. Thus, in model 1, we considered 'food security' (inadequate dietary diversity) and, in model 2, we selected binary outcome of 'food security (2122 calories or more)' as the outcome variables, respectively. We used 'receiving remittances' (binary) as the key explanatory variable in both models. We applied sampling weights in the regression analysis. We performed post estimation test for the presence of heteroscedasticity, multicollinearity and the specification error for both regression models.

## Results

### *Background characteristics of the households*

In the analysed data set, 48·55 % of the household heads were in the age group of 30 to 49 years, and the male household head share was higher than the female (87·25 %). The education level of the household heads showed that 'no institutional education' (42·09 %) and 'incomplete secondary' (43·15 %) education status of the household heads were more common. Only 14·75 % of household heads had secondary or above complete education. Approximately 20 % of the household heads were from the Dhaka division, whereas 9 % and 6 % were from Barisal and Sylhet, respectively. It is visible that 91·15 % of household heads did not recieved any remittances (Table 1).

### *Remittances and food security*

Descriptive statistics by food security and remittance status are summarised in Table 2. Receiving remittances was high in households with the oldest household heads (26·2%). In Bangladesh, households' mean remittances were 12 605·9 BDT, whereas higher remittances were received in the Sylhet and Dhaka region, followed by Chittagong (Fig. 2 and figures in the supplementary material). Comparatively, only 14·7% of households with household heads aged 30 to 49 years reported received remittance, and the mean value of remittances in these households was 5899·8 BDT. Households with female heads of households were considerably more likely to receive remittances than households with a male head of household (30·4% *v.*

**Table 2** Results of bivariate analysis using $\chi^2$ test of the relationship between socio-demographic characteristics of the households, remittances and food insecurity

| | Remittances received (yes) | | Remittances received (in BDT) | | Inadequate household dietary diversity | | Insufficient energy intake | |
|---|---|---|---|---|---|---|---|---|
| Characteristics of household | *n* | % | Mean | SD | *n* | % | *n* | % |
| Age group of the household head | | | | | | | | |
| Less than 30 | 7568 | 15·6 | 6850·7 | 37 247·2 | 7568 | 16·1 | 7568 | 20·9 |
| 30–49 | 22 322 | 14·7 | 5899·8 | 37 013·8 | 22 322 | 14·5 | 22 322 | 19·6 |
| 50–69 | 13 273 | 18·1 | 8772·4 | 44 206·3 | 13 273 | 16·6 | 13 273 | 14·7 |
| 70 or more | 2814 | 26·2 | 12 605·9 | 56 069·9 | 2814 | 22·4 | 2814 | 16·4 |
| *P* value | <0·001 | | <0·001 | | <0·001 | | <0·001 | |
| Sex of the household head | | | | | | | | |
| Male | 40 107 | 14·5 | 4983·3 | 33 134·8 | 40 107 | 15·2 | 40 107 | 18·1 |
| Female | 5861 | 30·4 | 23 128·3 | 71 899·8 | 5861 | 20·4 | 5861 | 18·8 |
| *P* value | <0·001 | | <0·001 | | <0·001 | | 0·224 | |
| Household size | | | | | | | | |
| 1–4 | 30 702 | 17·3 | 7592·7 | 40 610·6 | 30 702 | 18·3 | 30 702 | 15·0 |
| 5–8 | 14 740 | 14·8 | 6327·3 | 38 509·2 | 14 740 | 11·1 | 14 740 | 24·3 |
| 9 or more | 533 | 18·8 | 17 027·4 | 80 579·4 | 533 | 4·3 | 533 | 32·3 |
| *P* value | <0·001 | | <0·001 | | <0·001 | | <0·001 | |
| Education level | | | | | | | | |
| No institutional education | 19 354 | 15·6 | 6121·6 | 39 206·3 | 19 354 | 22·7 | 19 354 | 20·1 |
| Secondary incomplete | 19 841 | 17·4 | 7533·9 | 38 798·3 | 19 841 | 12·4 | 19 841 | 17·7 |
| Secondary or above | 6782 | 16·4 | 9951·8 | 49 061·7 | 6782 | 6·3 | 6782 | 14·3 |
| *P* value | <0·001 | | <0·001 | | <0·001 | | <0·001 | |
| Region | | | | | | | | |
| Barisal | 4297 | 18·1 | 6052·1 | 33 294·4 | 4297 | 9·6 | 4297 | 22·1 |
| Chittagong | 7906 | 19·0 | 8217·9 | 40 554·4 | 7906 | 11·0 | 7906 | 14·5 |
| Dhaka | 9347 | 16·5 | 12 613·1 | 55 814·4 | 9347 | 7·3 | 9347 | 18·3 |
| Khulna | 7195 | 16·0 | 5257 | 30 697 | 7195 | 15·9 | 7195 | 14·0 |
| Rajshahi | 2876 | 18·8 | 5343·2 | 43 137 | 2876 | 6·4 | 2876 | 23·2 |
| Rangpur | 11 478 | 14·4 | 2744·3 | 22 128·9 | 11 478 | 33·8 | 11 478 | 20·9 |
| Sylhet | 2878 | 15·0 | 14 555·2 | 60 917 | 2878 | 4·1 | 2878 | 17·1 |
| *P* value | <0·001 | | <0·001 | | <0·001 | | <0·001 | |
| Location | | | | | | | | |
| Rural | 13 953 | 14·5 | 7375·5 | 42 531·1 | 13 953 | 9·1 | 13 953 | 14·5 |
| Urban | 32 024 | 17·4 | 7261·4 | 39 818·8 | 32 024 | 18·8 | 32 024 | 19·8 |
| *P* value | <0·001 | | 0·782 | | <0·001 | | <0·001 | |
| Wealth quintiles | | | | | | | | |
| Poorest | 9047 | 14·0 | 2604·2 | 16 117·4 | 9047 | 31·5 | 9047 | 26·6 |
| Poor | 9056 | 15·5 | 4132·3 | 30 380·7 | 9056 | 20·3 | 9056 | 21·2 |
| Medium | 9064 | 16·5 | 5562·9 | 31 562·4 | 9064 | 14·4 | 9064 | 17·3 |
| Rich | 9063 | 18·6 | 8835·6 | 40 192·9 | 9063 | 8·9 | 9063 | 14·6 |
| Richest | 9060 | 18·5 | 15 494·8 | 66 102·5 | 9060 | 3·4 | 9060 | 10·8 |
| *P* value | <0·001 | | <0·001 | | <0·001 | | <0·001 | |
| Livestock ownership | | | | | | | | |
| No | 36 032 | 15·9 | 7206 | 40 155·2 | 36 032 | 16·2 | 36 032 | 18·2 |
| Yes | 9945 | 18·6 | 7622·3 | 42 441·7 | 9945 | 14·8 | 9945 | 18·0 |
| *P* value | <0·001 | | 0·366 | | 0·001 | | 0·635 | |
| Experienced any environmental shocks | | | | | | | | |
| No | 41 874 | 16·7 | 7499·3 | 41 179·2 | 41 874 | 16·0 | 41 874 | 18·0 |
| Yes | 4064 | 15·2 | 5272·1 | 35 030·2 | 4064 | 14·7 | 4064 | 20·2 |
| *P* value | 0·020 | | 0·001 | | 0·032 | | 0·001 | |
| Receiving remittances category (BDT) | | | | | | | | |
| No remittance | | | | | 38 384 | 16·5 | 38 384 | 18·4 |
| 4000 or less | | | | | 2294 | 20·3 | 2294 | 19·6 |
| 4001–10 000 | | | | | 1652 | 11·9 | 1652 | 16·8 |
| 10 000 or more | | | | | 3647 | 8·6 | 3647 | 15·4 |
| *P* value | | | | | <0·001 | | <0·001 | |
| Receiving remittances | | | | | | | | |
| No | | | | | 38 384 | 16·5 | 38 384 | 18·4 |
| Yes | | | | | 7593 | 12·8 | 7593 | 17·0 |
| *P* value | | | | | <0·001 | | 0·002 | |

14·5%). Large households (households with nine members or more) were also more likely to receive remittance (18·7 %). In addition, receiving remittances was more common in households with higher levels of education. About 17·4 % of households with household heads who had incomplete secondary education stated that they received remittances.

In terms of geographical differences, proportion of households receiving remittances was the highest in the Chittagong division (19·0 %), where the mean value of remittances was 8217·9 BDT. Comparatively, in Rajshahi and Rangpur, respectively 18·8% and 14·4% of all households reported receiving remittances. The proportion of households receiving remittances was slightly higher in urban areas (17·4 %) than in rural areas (14·5%). Based on the asset quintiles, it was observed that 14% of the poorest households received remittances, while 18·5% of the richest households received remittances. Considering the food diversity category, the proportion of households with inadequate diet diversity was higher among those households who did not receive remittances (16·5% *v.* 12·8%). Similarly, 17% of food-insecure households (measured by energy intake) reported receiving remittances, compared with 18·4% of food-insecure households who did not receive any remittances. Based on the results of the $\chi^2$ tests, the association between characteristics of household and receiving remittance was statistically significant for all variables presented in Table 2.

### *Regression analysis*

Table 3 presents the regression results with food security as the outcome variable based on dietary diversity score and energy intake. The result shows that there is a statistically significant positive relationship between receiving remittances and the likelihood of food insecurity. If a household received remittances within the last 12 months, it is significantly less likely to suffer from inadequate dietary diversity (Adj. OR = 0·769, $P < 0·01$) compared with households that have not received remittances. Controlling for other factors in the model, the association between receiving remittances and the probability of sufficient energy intake was not statistically significant. This might indicate that households are more likely to fulfil their basic energy intake requirements but struggle to have a sufficiently diverse diet.

It is observed that households in the highest wealth quintile have much lower odds of experiencing inadequate dietary diversity (Adj. OR = 0·125, $P < 0·001$) and insufficient energy intake (Adj. OR = 0·338, $P < 0·001$) compared with the baseline category of the lowest quintile (poorest households). The results also reveal an interesting dependency between gender and food security. Females are more likely to suffer from inadequate dietary diversity (Adj. OR = 1·531, $P < 0·001$) and insufficient energy intake (Adj. OR = 1·361, $P < 0·001$) in comparison with males. Further, the level of education has also been found to be a significant predictor of food security. More specifically, households with higher levels of education (those who completed secondary education or higher) are less likely to experience inadequate dietary diversity (Adj. OR = 0·492, $P < 0·001$) compared with the households with no institutional education or incomplete secondary education.

Food security varies geographically (Fig. 3 and see online supplemental Fig. 2). Compared with households located in Barisal (baseline category), households in Sylhet (Adj. OR = 0·342), Rangpur (Adj. OR = 0·451), Khulna (Adj. OR = 2·048) and Rajshahi (Adj. OR = 4·250) are less likely to suffer from inadequate dietary diversity (IDD). Households in Sylhet and Chittagong divisions are less likely to experience insufficient energy intake compared with households in the Barisal division (Adj. OR = 0·54 and Adj. OR = 0·50, respectively). The geographical variation in inadequate dietary diversity (Adj. OR) and insufficient energy intake (Adj. OR) are showing in Fig. 4. Compared with households that did not experience environmental shocks, households who have experienced such shocks are significantly more likely to be affected by food insecurity in the form of poor dietary diversity (Adj. OR = 0·767, $P < 0·01$). Moreover, rural households are more likely to suffer from inadequate dietary diversity (Adj. OR = 1·216, $P < 0·01$) and insufficient energy intake (Adj. OR = 1·106, $P < 0·05$) compared with urban households.

## Discussion

The current study considered the impact of remittances on food security in Bangladesh. The results of our analysis on the nationally representative HIES data showed that remittances have a significant positive effect on household food security in Bangladesh. The analysis further revealed that gender, education, location and wealth are all significantly associated with food security. In Bangladesh, women and girls can be exposed to higher food insecurity risks through challenges they face in terms of their access to education and employment opportunities, which restricts their economic autonomy and weakens their bargaining position within the family. Their weak bargaining position impacts households towards food insecurity[39]. Existing research showed that this position also influences the relative empowerment of women within households[40].

A study by Mallick *et al.* (2010) showed that poverty incidence and food consumption or expenditure among female household heads were higher than the male household head[15]. Food security is related to poverty, and the relationship between receiving remittance is more general. Therefore, programmes related to the effective utilisation of remittance income at the household level can improve a household's overall poverty situation and result in a positive change in food security. In the long term, remittance

**Table 3** Associations between remittances, food security status and socio-economic factors in Bangladesh*

| | Inadequate dietary diversity | | Insufficient calorie intake | |
|---|---|---|---|---|
| Characteristics of household | Adj-OR | 95 % CI | Adj-OR | 95 % CI |
| Remittances | | | | |
| Baseline: Not receiving any remittances | 1 | 1, 1 | 1 | 1, 1 |
| Received remittances | 0·769*** | 0·709, 0·835 | 0·973 | 0·908, 1·042 |
| Household head age (in years) | | | | |
| Baseline: Less than 30 | 1 | 1, 1 | 1 | 1, 1 |
| 30–49 | 0·943 | 0·869, 1·023 | 0·783*** | 0·731, 0·838 |
| 50–69 | 1·013 | 0·927, 1·106 | 0·524*** | 0·484, 0·567 |
| 70 or more | 1·320*** | 1·164, 1·497 | 0·560*** | 0·496, 0·632 |
| Gender | | | | |
| Baseline: Male | 1 | 1, 1 | 1 | 1, 1 |
| HH head is female | 1·531*** | 1·408, 1·664 | 1·361*** | 1·261, 1·468 |
| Size of the household | | | | |
| Baseline: 1–4 persons | 1 | 1, 1 | 1 | 1, 1 |
| 5–8 persons | 0·692*** | 0·647, 0·740 | 2·161*** | 2·047, 2·281 |
| 9 or more persons | 0·342*** | 0·219, 0·535 | 4·644*** | 3·824, 5·639 |
| Education level of the household head | | | | |
| Baseline: No institutional education | 1 | 1, 1 | 1 | 1, 1 |
| Secondary incomplete | 0·625*** | 0·587, 0·665 | 0·976 | 0·923, 1·032 |
| Secondary complete or above | 0·492*** | 0·437, 0·553 | 1·032 | 0·945, 1·128 |
| Region | | | | |
| Baseline: Barisal | 1 | 1, 1 | 1 | 1, 1 |
| Chittagong | 1·065 | 0·934, 1·213 | 0·500*** | 0·452, 0·553 |
| Dhaka | 0·836** | 0·731, 0·956 | 0·858** | 0·781, 0·943 |
| Khulna | 2·048*** | 1·805, 2·323 | 0·670*** | 0·605, 0·742 |
| Rajshahi | 4·250*** | 3·792, 4·763 | 0·888** | 0·812, 0·971 |
| Rangpur | 0·451*** | 0·374, 0·543 | 0·986 | 0·877, 1·108 |
| Sylhet | 0·342*** | 0·275, 0·425 | 0·540*** | 0·476, 0·614 |
| Location | | | | |
| Baseline: Urban | 1 | 1, 1 | 1 | 1, 1 |
| Rural | 1·311*** | 1·216, 1·413 | 1·106** | 1·039, 1·179 |
| Wealth quintile | | | | |
| Baseline: Poorest | 1 | 1, 1 | 1 | 1, 1 |
| Poor | 0·605*** | 0·562, 0·651 | 0·728*** | 0·678, 0·781 |
| Medium | 0·433*** | 0·399, 0·469 | 0·567*** | 0·526, 0·611 |
| Rich | 0·284*** | 0·259, 0·312 | 0·468*** | 0·432, 0·508 |
| Richest | 0·125*** | 0·109, 0·144 | 0·338*** | 0·306, 0·373 |
| Livestock | | | | |
| Baseline: No | 1 | 1, 1 | 1 | 1, 1 |
| Yes | 0·627*** | 0·585, 0·672 | 0·820*** | 0·771, 0·871 |
| Experienced environmental shocks | | | | |
| Baseline: No | 1 | 1, 1 | 1 | 1, 1 |
| Yes | 0·767*** | 0·693, 0·849 | 1·053 | 0·968, 1·147 |
| Constant | 0·304*** | 0·261, 0·354 | 0·459*** | 0·406, 0·520 |
| LR | −15 981·6 | | −20 271·9 | |
| $\chi^{22}$ | 7416·3 | | 2287·2 | |
| DF | 22 | | 22 | |
| *P* value | 0 | | 0 | |
| Pseudo $R^2$ | 0·188 | | 0·0534 | |
| Number of observations | 45 289 | | 45 289 | |

*$P < 0·05$.
**$P < 0·01$.
***$P < 0·001$.

income can be used for investments in education and women empowerment. Continued investments in schooling, particularly of women and girls, will be important to increase food security.

The current study showed that the growing remittances have important policy implications for improving and strengthening household-level food security status in Bangladesh. Increased food production does not mean food security if households do not have enough money to buy food. Therefore, the availability of remittances improves the household poverty situation. Recent evidence suggests that remittances, the portion of a migrant's income sent back to the family members left behind, are helping to improve the livelihoods of households in many low-income countries including Bangladesh[41,42]. The study showed that food security is also associated with geographical location and socio-economic factors. Socioeconomic factors, such as households' wealth, can have a direct and indirect effect on household food security. In the current study, we found that receiving remittances can improve food expenditure, diversity of food and increase the consumption of food energies significantly.

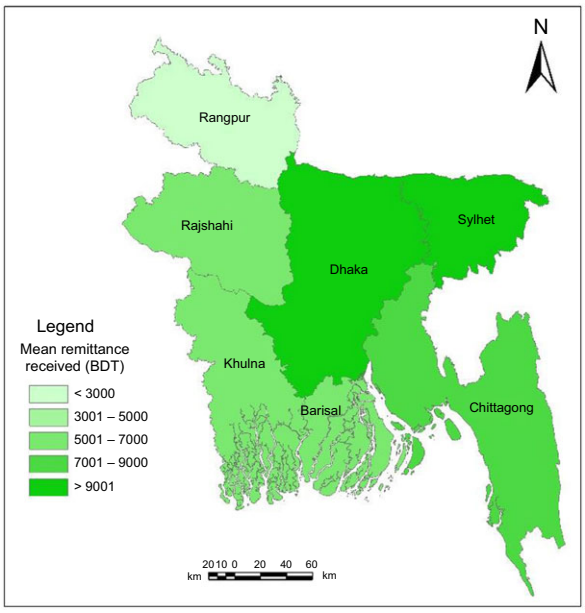


**Fig. 3** Distribution of the mean remittances received (BDT) across different geographical regions in Bangladesh

Most of the people living in extreme poverty and hunger in Bangladesh have experienced positive effects of the flows of remittances, given the fragmented coverage of social protection, informality in economic activities and employment and wide gaps in public health infrastructure[43]. In spite of these constraints, Bangladesh made significant progress towards SDG 2 ('end hunger, achieve food security, improved nutrition and promote sustainable agriculture') by achieving remarkable success in food production and self-sufficient in major food production though it had a food deficit in the past. In addition, the Bangladesh government has emphasised crop diversification to ensure the higher accessibility of food to all people, particularly for the poor and vulnerable populations[44].

According to an estimation of the World Bank (2020), the international remittance inflow has already declined by US $14 billion in 2020, which constitutes around 1·75 % of Bangladesh's Gross Domestic Product[2]. Therefore, inequalities have been accentuated in the context of current economic development, and the crisis is likely to reverse years, if not decades, of gains in poverty reduction, undermining the progress made by Bangladesh towards achieving the SDG. Besides this, resilience is a major factor in ensuring sustainable agriculture and other primary activities (such as fisheries and forestry) (SDG 15, target – 15·2) for the region with significant environmental challenges with considering pandemic crisis (SDG 13, target – 13·1), which jointly ensure the progress towards food security (SDG 2), and healthy lives and well-being (SDG 3). Therefore, to undertake the progress towards SDGs 2 within the view of remittance-related policy response is necessary.

The positive impact of remittance inflows on food security makes it crucial to include remittances as essential components of food security programmes in Bangladesh. The current study provides an overview of the links between gender empowerment and food security and the importance of the SDG and their follow-up. Therefore, it contributes to the provision of evidence towards the progress towards SDG 5, which aims to ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic

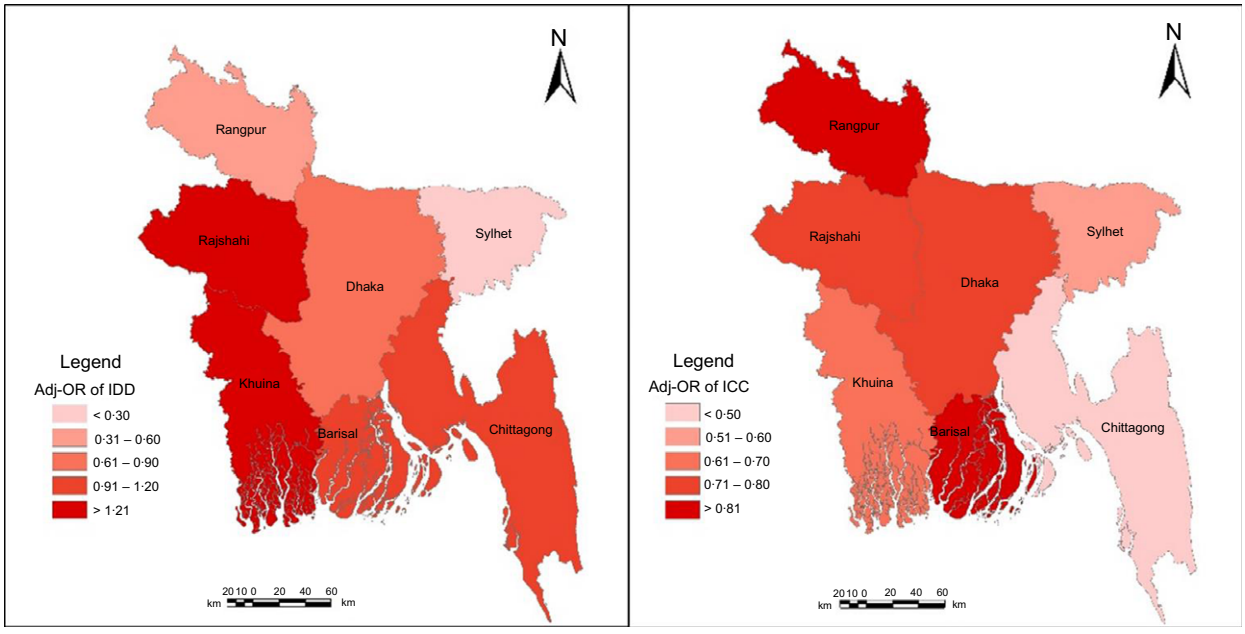


**Fig. 4** Geographical variation in inadequate dietary diversity (IDD) and insufficient energy intake (ICI) based on regression model results (Adj. OR)

and public life (target – 5·5). Moreover, it also contributes evidence towards the design of social protection policies, with a specific focus on promoting shared responsibility (target – 5·4) and reducing all forms of discrimination against all women within the household (target – 5·1).

Remittance has differential effects on human capital improvement besides the effect on food consumption behaviour or food security. A number of papers have analysed the differential effects of remittances focusing on education, health, child labour and women empowerment[39–44]. Using a nationally representative household survey from Ghana, Adams *et al.* (2013) found that households receiving internal or international remittances spend more at the margin on one important investment good (e.g. education) compared with what they would have spent without remittances, which brings support to the idea that remittances can help increase the level of investment in human capital[39]. Bui and Kugler (2012, 4th M&D conference) looked at differential impacts when a larger fraction of remittances are received by women and improving children's health, school attendance and a negative effect on child labour. This suggests that the identity of the receiver matters in terms of increasing human capital investments for children[40].

This paper focused on quantifying the household-level associations between remittances, socio-economic factors, the occurrence of environmental shocks and food security. To the best of our knowledge, it is the only study quantifying such association at the national level in Bangladesh using the 2016 HIES data.

Although this manuscript provides significant policy recommendations for the socio-economic development of Bangladesh, it is not without limitations. First, the endogeneity problem arising from the selection into remittance receipt has not been addressed in the current study. Second, the study does not address the differential impacts of remittance receipt relative to that of emigration of household members or relatives. Third, the analysis was performed at the household level using cross-sectional data. Using panel data for the analysis may provide more insightful results and implications. Fourth, more advanced statistical modelling, including matching techniques, might be useful when aiming to examine the causal effects of remittances rather than associations using logistic regressions. Finally, the fact that the majority of household heads were females might be a result of male migration. These limitations will be key considerations in our future research agenda. Overall, further research should consider evaluative modelling techniques and temporal changes and focus more specifically on the influence of hazards and stresses on food security status considering all livelihood categories in the coastal regions in Bangladesh.

## Acknowledgements

*Acknowledgements:* The authors would like to thank the Bangladesh Bureau of Statistics (BBS) for providing access to the Household Income Expenditure Survey 2016 data. *Financial support:* This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors. *Conflict of interest:* There are no conflicts of interest. *Authorship:* S.S., S.A. and A.W. have participated in the conceptualisation, data analysis, data acquisition and drafting of the manuscript. M.P., R.I. and F.Z. contributed in data analysis and writing. J.K.M.K. edited the manuscript and reviewed critically the initial draft. All authors have seen and approved the final version. *Ethics of human subject participation:* This article has been prepared using secondary data (Household Income and Expenditure Survey 2016 of Bangladesh) from Bangladesh Bureau of Statistics. Thus, no ethical approval is required separately for the current study.

## References

1. Ratha D, De S, Kim EJ *et al.* (2021) Resilience COVID-19 crisis through a migration lens. *Glob Knowl Partnersh Migr Dev* **34**, 56.
2. The World Bank (2020) *World Bank Predicts Sharpest Decline of Remittances in Recent History*. Washington, DC: The World Bank.
3. Giuliano P & Ruiz-Arranz M (2009) Remittances, financial development, and growth. *J Dev Econ* **90**, 144–152.
4. Szabo S, Adger WN & Matthews Z (2018) Home is where the money goes: migration-related urban-rural integration in delta regions. *Migr Dev* **7**, 163–179.
5. Azzarri C & Zezza A (2011) International migration and nutritional outcomes in Tajikistan. *Food Policy* **36**, 54–70.
6. Karamba WR & Quiñones EJ (2011) Migration and food consumption patterns in Ghana. *Food Policy* **36**, 41–53.
7. Demi SM & Kuwornu JKM (2013) Assessing the degree of food insecurity among farming households: evidence from the central region of Ghana. *Res Humanit Soc Sci* **3**, 51–62.
8. Kuwornu JKM, Osei E, Osei-Asare YB *et al.* (2018) Off-farm work and food security status of farming households in Ghana. *Dev Pract* **28**, 724–740.
9. Bangladesh Bank (2017) *Utilisation of Workers' Remittances in Bangladesh*. Dhaka: Bangladesh Bank.
10. World Bank (2018) *Migration and Remittances: Recent Developments and Outlook – Transit Migration*. Washington, DC: World Bank.
11. Mallick B & Vogt J (2012) Cyclone, coastal society and migration: empirical evidence from Bangladesh. *Int Dev Plan Rev* **34**, 217–240.
12. Sepuldeva M, Van Banning T & van Genugten WJM (2004) *Human Rights Reference Handbook*. Tilburg: Tilburg University.
13. Islam MB, Ali MY, Amin M *et al.* (2011) *Climatic Variations: Farming Systems and Livelihoods in the High Barind Tract and Coastal Areas of Bangladesh*. Berlin: Springer-Verlag Berlin.
14. Grosso G, Mateo A, Rangelov N *et al.* (2020) Nutrition in the context of the sustainable development goals. *Eur J Public Health* **30**, I19–I23.
15. Pérez-Escamilla R (2017) Food security and the 2015–2030 sustainable development goals: from human to planetary health. *Curr Dev Nutr* **1**, e000513.
16. Zezza A, Carletto C, Davis B *et al.* (2011) Assessing the impact of migration on food and nutrition security. *Food Policy* **36**, 1–6.

Public Health Nutrition

17. Azzarri C (2011) International migration and nutritional outcomes in Tajikistan. *Food Policy* **36**, 54–70.
18. FAO (2013) *The State of Food Insecurity in the World 2013: The Multiple Dimensions of Food Security*. Rome: FAO.
19. Zapata GP (2012) Kelegama S (ed.). 2011. Migration, remittances and development in South Asia. (New Delhi: Sage, pp. 346). *J Int Dev* **24**, 950–951.
20. Raihan S, Khondker BH, Sugiyarto G *et al.* (2009) *Remittances and Household Welfare: A Case Study of Bangladesh*. Dhaka: Asian Development Bank.
21. Gibson J, McKenzie D & Stillman S (2011) What happens to diet and child health when migration splits households? Evidence from a migration lottery program. *Food Policy* **36**, 7–15.
22. Matthew W & Walsham M (2010) *Assessing the Evidence: Environment, Climate Change and Migration in Bangladesh*. Dhaka: International Organization for Migration (IOM), Regional Office for South Asia.
23. Rawlani AK & Sovacool BK (2011) Building responsiveness to climate change through community based adaptation in Bangladesh. *Mitig Adapt Strateg Glob Chang* **16**, 845–863.
24. Szabo S, Hossain MS, Adger WN *et al.* (2015) Soil salinity, household wealth and food insecurity in tropical deltas: evidence from south-west coast of Bangladesh. *Sustain Sci* **11**, 411–421.
25. BBS (2011) *Household Income and Expenditure Survey 2010*. Dhaka: BBS.
26. Smith LC & Subandoro A (2007) *Measuring Food Security Using Household Expenditure Surveys*. Washington, DC: International Food Policy Research Institute.
27. Rahman PMM, Matsui N & Ikemoto Y (2008) *The Chronically Poor in Rural Bangladesh: Livelihood Constraints and Capabilities*. Oxfordshire: Taylor & Francis.
28. Mekuria G, Wubneh Y & Tewabe T (2017) Household dietary diversity and associated factors among residents of finote selam town, north west Ethiopia: a cross sectional study. *BMC Nutr* **3**, 3–8.
29. BBS (2016) *Household Income and Expenditure Survey 2016*. Dhaka: BBS.
30. Filmer D & Pritchett LH (2001) Estimating wealth effects without expenditure data—or tears: an application to educational enrollments in states of India. *Demography* **38**, 115–132.
31. Vyas S & Kumaranayake L (2006) Constructing socio-economic status indices: how to use principal components analysis. *Health Policy Plan* **21**, 459–68.
32. Houweling TA, Kunst AE & Mackenbach JP (2003) Measuring health inequality among children in developing countries: does the choice of the indicator of economic status matter? *Int J Equity Health* **2**, 8.
33. Agresti A (2018) *An Introduction to Categorical Data Analysis*. New Jersey: Wiley.
34. Scott AJ, Hosmer DW & Lemeshow S (1991) Applied logistic regression. *Biometrics* **47**, 1632.
35. Quisumbing AR (2003) *Household Decisions, Gender, and Development: A Synthesis of Recent Research*. Washington, DC: International Food Policy Research Institute (IFPRI).
36. Sraboni E, Malapit HJ, Quisumbing AR *et al.* (2014) Women's empowerment in agriculture: what role for food security in Bangladesh? *World Dev* **61**, 11–52.
37. IPC-IG & UNICEF ROSA (2020) *Socio-Economic Impacts of COVID-19, Policy Responses and the Missing Middle in South Asia*. Brasília: International Policy Centre for Inclusive Growth.
38. UNDP (2018) *Sustainable Development Goals: Bangladesh Progress Report 2018*. Dhaka: UNDP.
39. Adams RH & Cuecuecha A (2013) The impact of remittances on investment and poverty in Ghana. *World Dev* **50**, 24–40.
40. Bui S & Kugler A (2011) *Are Remittances in the Hands of Women more Effective – Evidence from Vietnam*. Bonn: IZA Institute of Labor Economics.
41. Sikder MJU, Higgins V & Ballis PH (2017) Remittances and livelihood strategies: improving household life chances. In *Remittance Income and Social Resilience among Migrant Households in Rural Bangladesh* (pp. 119–162). New York: Palgrave Macmillan US. doi: 10.1057/978-1-137-57771-9_4.
42. Maphosa F (2007) Remittances and development: the impact of migration to South Africa on rural livelihoods in southern Zimbabwe. *Dev South Afr* **24**(1), 123–136. doi: 10.1080/03768350601165942.
43. Gubert F (2017) Migration, remittances and development: insights from the migration and development conference. *Rev Econ Dev* **25**, 29.
44. Edwards AC & Ureta M (2003) International migration, remittances, and schooling: evidence from El Salvador. *J Dev Econ* **72**, 429–461.


Public Health Nutrition