



Promoting the itemized educational spending of rural coastal households in Bangladesh through unconditional cash and food assistance

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Abstract

The vulnerable households in the rural coastal regions of Bangladesh have been suffering from chronic poverty because of a lack of resources to invest in the human capital development, such as education and training. The unconditional cash and food (UCF) assistance programs in Bangladesh have been designed to combat chronic poverty. This study examines the impact of the UCF assistance receipt on the itemized educational spending: the total spending on education, school tiffin, educational stationery, uniforms, admission fees, examinations, textbooks, education-related Internet, and education-related transportation by the households. A Fuzzy regression discontinuity design (RDD) is used as an identification strategy, in which the assignment variable is the land ownership by the households. The RDD method is based on the idea that the households just below and above the cutoff of the assignment variable are locally randomized, therefore free from any selection bias. The results consistently show that the UCF assistance increases the spending on all educational items, except for textbooks and education-related transportation. This study suggests that the UCF assistance can be used as a policy tool to accelerate the sustainable development goal of inclusive quality education for rural coastal areas by increasing the itemized spending on education.

Keywords Coastal · Cash food assistance · Unconditional · Education · Spending

Introduction

Persistent extreme poverty and income vulnerability afflict rural coastal households in Bangladesh, primarily because of frequent natural disasters intensified by climate change, deforestation, and environmental pollution, encompassing floods, hurricanes, tropical storms, cyclones, erosion, and rising sea levels (Tasdik Hasan et al., 2020). As a result, low-earning households in the rural coastal regions in Bangladesh often lack the minimum resources to invest in the human capital. In addition, the low investment in children's education is widely considered a key cause of the chronic poverty of the vulnerable rural coastal households in Bangladesh (Kabeer & Mahmud, 2009). Cash transfer programs are supposed to provide opportunities for the vulnerable households to invest more in the human capital, in fields such as education and training (Rosales Mitte, 2017). The unconditional cash and food (UCF) assistance programs in Bangladesh aim to improve the investment capacity of the vulnerable households. This study examines whether the

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UCF programs increase the item-wise educational spending on the rural coastal households.

The quality of education in Bangladesh is staggeringly low. According to the State of Global Learning Poverty 2022 Update, the average learning poverty rate in Bangladesh is 58% (World Bank, 2022). The learning poverty rate is an international measure of the percentage of children in the upper primary grades (ages 10–14) unable to read simple Grade 2 level text because of either dropping out of school or having remained in a school yet not learning much. Approximately 20% of children in Bangladesh drop out of school or never enroll in a school (Sarkar et al., 2019). Achievement of SDG1 “No Poverty” and SDG4, “Quality Education” requires inclusive education policy, targeting quality education for children in the vulnerable households, who with low and unstable income, limited savings, and constrained access to finance, often exhibit reluctance to send their children to school (Asadullah et al., 2020). Inclusive education refers to enhancing the participation for every learner by creating systems that evaluate all individuals equally (Kefallinou et al., 2020). In attempting to meet the SDG education target 4.1 by 2030, the household-level spending on education is as crucial to ensure educational quality as the government spending on education (Ebaidalla, 2018). Accordingly, this paper examines the itemized educational spending instead of examining only the total educational spending because the households’ spending on specific educational items is the better indicator of the educational condition of the vulnerable households than the total educational spending alone.

This study is based on the theoretical framework of the family investment model proposed by Guo and Harris (2000), suggesting that the vulnerable households tend to invest more resources in education, if their budget constraints are lifted. This paper hypothesizes that the additional resources provided to the rural coastal households motivate them to invest more in education. The fluctuating income and earning trends of the rural coastal households often force them to decrease their spending on education. However, even a small amount of cash or food assistance can give the households the resources to invest more in education and stabilize the itemized educational spending. Therefore, the aim of the study is to examine whether the UCF assistance receipt can increase the itemized educational investment of the vulnerable rural coastal households.

The UCF assistance is provided to the comparatively poorer households; therefore, any simple comparison between the households that receive the benefits and those that do not may show a selection bias. The selection bias can be addressed if the benefits are provided randomly to ensure that the characteristics of the two kinds of households are similar on average. This paper applies the Fuzzy regression discontinuity design (Fuzzy RDD), an impact evaluation method for evaluating the impact of any intervention that

has the eligibility criterion and a threshold point to determine who is eligible and who is ineligible to receive the benefits. Fuzzy RDD allows comparison of the units just above and just below the threshold point to explore the impact of the intervention on an outcome. Eligibility for UCF assistance is limited to families owning less than 0.5 acres (50 decimals) (Ministry of Social Welfare Bangladesh, 2013). While eligible, some families with less than 0.5 acres may not receive the UCF. On the other hand, despite being ineligible, some families with land above 0.5 acres also may receive the UCF. The Fuzzy RDD assumes that the families close to the threshold—whether below or above the 0.5 acre cutoff—are likely to have similar characteristics on average. The Fuzzy RDD is considered an identification strategy with high internal validity because it ensures local randomization (Imbens & Lemieux, 2008). Local randomization means “randomization attained locally within a small window.”

The paper contains the following sections: “[Background and Literature Review](#)” section that discusses the UCF program background and provides a brief literature review; “[Data and Methods](#)” section that discusses the methodology and data; and “[Analysis and Discussion](#)” section that describes the results and the analysis, followed by the discussion and conclusion in “[Discussion and conclusion](#)” section.

Background and literature review

UCF program background

The conditional cash and food assistance (CCF) and the unconditional cash and food assistance (UCF) are two major types of social safety net (SSN) programs in Bangladesh, which are implemented by the government along with non-government organizations and foreign aid organizations. The CCF assistance programs are targeted to increase the school enrollment by providing conditions to be fulfilled to receive any assistance. However, the UCF assistance programs have no conditions to be fulfilled by the recipients. The UCF assistance programs have been in operation in Bangladesh since 1971 to combat poverty and inequality. The initial SSN programs were limited to the food assistance programs for disaster-affected areas. The SSN programs have targeted various household levels since 1997 to address extreme poverty and inequality. The Bangladesh government allocated approximately 245.21 billion Bangladeshi Taka (BDT) in the fiscal year (FY) 2016 to the SSN programs (Bari et al., 2022). The allocated funds constituted 2.08% of the GDP of the FY2016 (The Ministry of Finance Bangladesh, 2017). The major UCF assistance programs are discussed below:

The UCF programs can be of two types: the unconditional food assistance and unconditional cash transfer

programs. The major unconditional food assistance programs in Bangladesh are the Vulnerable Group Feeding (VGF) program, Vulnerable Group Development (VGD) program, and Gratuitous Relief (GR), which are designed to ensure the food security of the extremely poor households. The major unconditional cash transfer programs are the Old Age Allowance Program; Widow, Destitute, and Deserted Women Allowance; Allowances for Financially Insolvent Disabled; and Maternity Allowance for Poor Mothers.

One of the major unconditional cash assistance programs is the Old Age Allowance Program, which was launched in 1998 to support the poor and vulnerable elderly persons. Each participant receives BDT 4800 per year. For the program, the allocated amount in the FY2016 budget was BDT 14.40 billion, and 3 million people were its beneficiaries. The Ministry of Social Welfare has been implementing the Old Age Allowance Program.

The second major unconditional cash assistance program is the Widow, Destitute, and Deserted Women Allowance, which was launched in 1999 as financial support for the vulnerable women. Each participant receives BDT 4,800 a year. For the program, the allocated amount in the FY2016 budget was BDT 5.34 billion, and approximately 1.10 million people were its beneficiaries. The Ministry of Social Welfare has been implementing the program too.

The Ministry of Social Welfare has been implementing a program called the Allowances for Financially Insolvent Disabled to ensure the basic needs of physically disabled insolvent citizens of Bangladesh. In FY 2016, the allocated amount for the program was BDT 3.60 billion. Each recipient received a monthly allowance of BDT 3,600 for a year, and 0.60 million people received the benefit (Ministry of Finance Bangladesh, 2017).

The maternity allowance for the poor mother programs started in 2007 to support poor pregnant women. A total of BDT 1.58 billion was allocated for the program in FY2016. Each participant received a monthly allowance of BDT 6,000 for a year, and 0.03 million women received the benefit.

The VGF program was launched in 1974 as staple food assistance for the vulnerable households. This program has been implemented by the Bangladesh government and World Food Programs. Under the VGF program, the allocated amount in the FY2016 budget was BDT 14.61 billion, and 3 million people were the beneficiaries.

The VGD program began in 1975 as a staple food assistance program for the vulnerable female-headed households. Under the VGD program, the allocated amount in the FY2016 budget was BDT 9.90 billion, and 0.10 million metric tons of rice were distributed. The program was implemented by the Bangladesh government and the Bangladesh Rural Advancement Committee jointly, and World Food Programs.

The GR program provides food assistance for disaster-affected households. A total of 27,000 metric tons of rice was allocated, and the estimated number of the beneficiaries of the program was 1.13 million (Ministry of Finance Bangladesh, 2017).

The key eligibility criteria for the households to be enrolled in the UCF assistance programs are the ownership of 0.5 acres or less of land, being a female-headed household, having any physically or mentally disabled household member, and having any household member aged over 60 years. This study explores whether the UCF assistance programs in Bangladesh can increase the investment in education and ensure the quality education for the vulnerable rural coastal households. Table 1 reports the list of the UCF programs with their objectives, target groups, and funding:

Literature review

The impact of the cash and food assistance programs on different educational outcomes has been estimated in some studies (for example, Awaworyi Churchill et al., 2021; de Janvry et al., 2006; Gaentsch, 2020; Giang & Nguyen, 2017; Kilburn et al., 2017). However, to the best of our knowledge, the impact of cash transfers on the itemized educational investments has not been examined in any previous studies. Findings of previous studies are still inconclusive about whether conditional or unconditional cash transfers bring more welfare to targeted households. Gaentsch (2020) argues that conditionality has a heterogeneous impact based on family types, risk groups, and ethnic backgrounds. In other words, while small households can easily comply with the conditions, large households face difficulties in complying with the conditions; thus, the conditional cash transfer is less effective for larger households.

Kilburn et al. (2017) used DID and argued that unconditional cash transfer has a long-term impact on schooling outcomes because it unconditionally helps vulnerable households alleviate their economic constraints. In contrast, Porreca and Rosati (2019) argue that conditional cash transfers reduce women's time allocation for child care to comply with the conditions. Churchill et al. (2021) argued that unconditional cash transfer programs have a negative impact on child labor participation only eventually. Dinku (2019) argues that conditional cash transfers can reduce child labor in the short run. Previous studies suggest that conditional cash transfers are more effective in the short run, whereas unconditional cash transfers are more effective in the long run.

Furthermore, a few studies (Anindita & Sahadewo, 2020; Canavire-Bacarreza et al., 2020; Porreca & Rosati, 2019; Sabates et al., 2019) have explored the causal impact of the cash and food assistance on the educational spending. Canavire-Bacarreza et al. (2020) argue that the old age allowance

Table 1 Brief description on UCF programs

	Program name	Objectives, target group, and funding
1	Old age allowance	Objectives: To ensure the betterment of the Aged Poor Target Group: Elderly and poor persons Funding Amount: Each participant receives BDT 4,800 per annum
2	Widow/deserted/destitute women's allowance	Objectives: Financial support for the vulnerable women Target Group: Widow/deserted/destitute women Funding Amount: Each participant receives BDT 4,800 per year annum
3	Maternity Allowance Program	Objectives: To support poor pregnant women Target Group: Poor mothers Funding Amount: Each participant receives BDT 6,000 per year
4	Allowances for the financially insolvent and disabled	Objectives: To ensure the basic needs of the physically disabled insolvent citizens of Bangladesh Target group: Physically disabled insolvent citizens Funding Amount: Each participant receives BDT 3,600 per year
5	Vulnerable group development	Objectives: To ensure food security Target Group: The vulnerable households Funding Amount: Staple food assistance
6	Vulnerable group feeding	Objectives: To ensure food security Target Group: The vulnerable households Funding Amount: Staple food assistance
7	General relief activities	Objectives: To ensure food security Target Group: The vulnerable households Funding Amount: Staple food assistance
8	Gratuitous relief-food	Objectives: To ensure food security Target Group: The vulnerable households Funding Amount: Staple food assistance

has had a positive impact on the educational spending for children, as a positive externality. However, the findings of Anindita and Sahadewo (2020) suggest that conditionalities encourage beneficiary households to invest more in education. Thus, a question remains whether the conditional or unconditional cash transfers are more effective in improving the amount of the educational investments.

While acknowledging the significant contributions of the previous studies, the identification strategies applied by most of the studies have some limitations in exploring the causality. Sabates et al. (2019) applied the DID and propensity score matching and argued that the unconditional cash transfers have a positive impact on the spending on school uniforms in Rwanda. However, the propensity score matching showed bias in the estimation (King & Nielsen, 2019). Giang and Nguyen (2017) argue that the safety net receipt increases the school enrollment using the DID fixed effect estimation but the internal validity of the DID estimation is low because it requires a strong assumption of the common trends. Similarly, Porreca and Rosati (2019) analyzed the effect of unconditional cash transfers by applying an intention-to-treat analysis that estimated only the effect of the treatment assignment rather than treatment receipt.

This paper aims to address the research gaps of the previous studies. First, no previous research has focused on estimating the impact of the cash transfer programs on the

educational outcomes in the context of the rural coastal regions. Second, although most previous studies focused on the impact of cash transfers on the total educational spending, no empirical studies examined the impact of the unconditional cash transfers on the itemized educational spending. To examine only the impact of the cash transfers on the total educational spending may give an illusionary indication of the quality of education achieved through it, whereas the itemized educational spending reveals the quality of education more accurately. Item-wise, the educational spending on school tiffin, educational stationery, uniforms, admission, examinations, textbooks, education-related Internet, and education-related transportation are crucial indicators of the quality of education. In addition, this paper applied the Fuzzy RDD, which provides a causal estimation with high internal validity as it uses assumptions, which are not strong. RDD relies on two assumptions: the continuity of the running variable density and the pretreatment variables around the cutoff, which can be evaluated through manipulation tests and checks for continuity in the pretreatment variables (Imbens & Lemieux, 2008). The findings of this research will provide policy implications to formulate cash transfer programs as a tool to boost the itemized educational spending in the vulnerable rural coastal areas worldwide.

Data and methods

Study area and description of the data

This study uses the rural coastal households as the units of the analysis. The rural coastal households are characterized by high-income instability, resource unavailability, and climate vulnerability because of the excessive dependence on the natural resources, frequent natural disasters, and the devastating effects of climate change (Lázár et al., 2020). Continuous sea-level rises, high tidal surges, high salinity, frequent floods, cyclones, and devastating erosion make the income pattern highly fluctuating and unstable in those regions (Nishat & Mukherjee, 2013). All the features of those households make them distinct from any other region of the country. The analysis is limited to the coastal regions for three reasons. First, households located in coastal regions are more climate-vulnerable region and the recurrent natural disasters affect them more than those in any other region of Bangladesh. Documented by Verschuur et al. (2023), approximately 250,000 individuals were left homeless, and the livelihoods of 2.5 million farming households in the coastal regions of Bangladesh were adversely affected because of the cyclone Amphan in 2020. The living conditions of the households in coastal regions are even worse than those in the northern regions in Bangladesh. Even though the households in northern regions of Bangladesh face drought in a particular season, the households of coastal regions have to encounter not only natural disasters, such as floods, cyclones, and river erosion throughout the year, but also climate change impacts, such as the sea-level rising and high salinity. Annually, the coastal districts of Bangladesh incur losses amounting to approximately USD 1 billion in assets because of natural disasters (Verschuur et al., 2023). Second, the UCF programs target especially the households that are climate change vulnerable and frequently affected by natural disasters, so focusing on the coastal regions can enable us to explore the impact of those UCF programs more thoroughly. Third, the coastal regions of Bangladesh represent the climate change vulnerable regions of the world (Bari et al., 2022). Thus, this study will have universal policy implications regarding how to bring about welfare for climate-vulnerable households of the world.

The units of the analysis were 8,193 households selected from the Household Income and Spending Survey (HIES) 2016–2017, a national survey conducted at five-year intervals in Bangladesh (Bangladesh Bureau of Statistics, 2017). The HIES 2016–2017 dataset contains 46,076 observations. The households included in this study were from 19 coastal districts: Bagerhat, Barguna, Barisal, Bhola, Chandpur, Chittagong, Cox's Bazar, Feni,

Gopalganj, Jashore, Jhalokathi, Khulna, Lakshmipur, Narail, Noakhali, Patuakhali, Pirojpur, Satkhira, and Shariatpur. The sample is limited to the rural households in the coastal districts, which reduces the sample size from 46,076 to 9,520 households. To include only the vulnerable households, only households with the financial assets of less than or equal to BDT 50,000.00 were included, and the sample size was reduced to 8,700 observations. The dataset does not have any specific income indicative variable; therefore, the amount of financial assets has been regarded as a measurement of vulnerability, and the income of BDT 50,000.00 has been taken as the threshold because it is the highest income to be eligible for social benefits in Bangladesh. Moreover, the households that received UCF assistance before 2015 were excluded, reducing the sample size to 8,559 observation units. Furthermore, to keep the study variable of land ownership the way it was in the previous year, households that sold or purchased the land in the previous year were excluded. Moreover, the observations with missing data related to the running variables, treatment variables, and outcome variables were excluded, setting the final number of the observations to 8,193 households.

The treatment variable was generated from the section on the SSN programs. A household is considered treated if any member of the household received the last payment from the UCF assistance programs in 2015 or 2016, and a household is not considered treated if no member received any of the UCF assistance in those years. The study variable land ownership was generated from the section on the land ownership. Only the ownership of totally cultivable land is defined as land ownership for the purpose of this study. The outcome variables were generated from the educational spending information section.

Table 2 presents the summary statistics of the running variable, the treatment variable, outcome variables, and relevant covariates. The households were divided into eligible and ineligible households. A household is considered “eligible” if it owns less than or equal to 0.5 acres of land and “ineligible” if it owns more than 0.5 acres of land. The eligibility refers only to the eligibility on the basis of the land ownership criterion. However, even the ineligible households can be provided with UCF assistance if they qualify on the basis of other criteria, such as being a female-headed household, a household with at least one member with a physical or mental disability, or a household with at least one member over 60 years of age. The table shows that 21% of the eligible households were assisted with benefits, whereas 79% were not. In addition, 85% of the ineligible households were not given benefits, whereas 15% were. It can be seen that the ineligible households that own land, more than 0.5 acres, spend more on education as a whole, which is not a

Table 2 Summary statistics

Variables	Ineligible households based on land ownership	Eligible households based on land ownership
Running variable		
Land ownership (acre)	2.27 (13.84)	0.52 (0.12)
Treatment variable		
UCF assistance	0.15 (0.36)	0.21 (0.41)
Outcome variable (BDT)		
Total educational spending	12,408.92 (1,213.72)	8,218.08 (15,377.88)
Tiffin spending	909.52 (2,055.65)	827.89 (1,809.68)
Stationery purchase spending	1,087.99 (2,132.04)	808.25 (1,466.40)
School uniform purchase spending	814.30 (1,425.05)	733.06 (1,213.72)
Book purchase spending	734.06 (1,524.71)	753.35 (1,234.02)
Educational transportation spending	647.94 (347.13)	347.13 (1,607.98)
Educational internet spending	70.07 (418.97)	18.24 (176.45)
Admission fee spending	438.22 (1,791.29)	318.02 (1,117.34)
Examination fee spending	332.34 (888.74)	432.61 (1,100.54)
Covariates		
Age of the head of household	50.16 (14.64)	44.50 (14.00)
Average age	33.73 (13.41)	28.89 (12.60)
Gender (= 1 if male headed)	0.85 (0.36)	0.91 (0.28)
No. of household members (≤ 15 years)	1.23 (1.09)	1.49 (1.14)
No. of household members (16–40 years)	1.60 (1.04)	1.64 (0.92)
No. of household members (40–60 years)	0.78 (0.75)	1.01 (0.77)
No. of household members (> 60 years)	0.54 (0.71)	0.34 (0.58)
Observation number	1,276	6,917

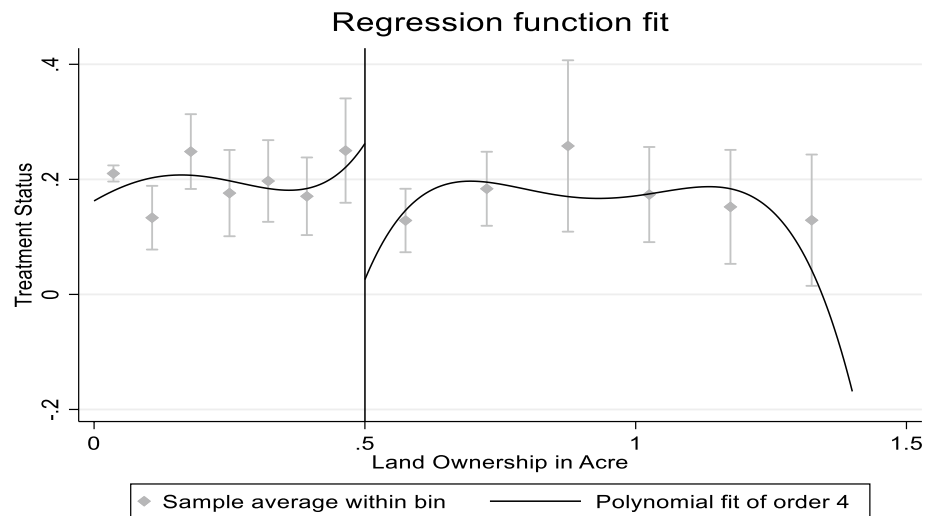
Standard errors are in parentheses

surprise because they have more funds in comparison to the eligible households. Furthermore, based on the data, the ineligible households spend more on all the education items except book purchase and examination fees. Moreover, the age of the household head and the average age of the household members of the ineligible households are higher than those of the eligible households. Therefore, a rigorous identification strategy is needed to address selection bias.

Identification strategy

The Fuzzy RDD was applied as an identification strategy to estimate the impact of the UCF assistance on the households' educational spending. RDD can be defined as an identification strategy in which each unit has an assignment variable such as an eligibility index (Wherry & Meyer, 2016). The assignment variable (a.k.a. running variable) should have a well-defined threshold point defining the eligibility to be

Fig. 1 Discontinuity in the Treatment Status. The horizontal axis represents land ownership in acres, and the vertical axis represents the treatment status



enrolled in a program, and the assignment of variable should run continuously around the threshold point. Moreover, the units around the threshold point are assumed to be similar in terms of both the observable and unobservable traits. The RDD estimates the average local treatment effect (LATE) in place of the average treatment effect (ATE) because it measures the treatment effect locally, within a small window, consisting of households just below and above the threshold of the assignment variable (Hahn et al., 2001). The RDD removes the selection bias just above and below the cut-off of the assignment variable. There are two types of the RDD: Sharp RDD and Fuzzy RDD. In the case of the Sharp RDD, the eligibility is based on the threshold point, and it is deterministic in the sense that all the households, which are eligible based on threshold point, receive the benefits, and all the households, which are ineligible based on the threshold point, do not receive the benefits.

In contrast, when using the Fuzzy RDD, the eligibility based on the threshold is probabilistic, in the sense that it increases only the probability of receiving the benefits, but it does not determine the actual receipt of the benefits. As a result, the probability of the eligible households receiving the benefits in the Sharp RDD is one, whereas the probability of the eligible households receiving benefits in the Fuzzy RDD is less than one, as depicted in Fig. 1. In other words, the compliance is 100% in the Sharp RDD, while the compliance in the Fuzzy RDD is less than 100%. The Fuzzy RDD involves measuring LATE of the compliers via the treatment variable.¹

In this study, the UCF assistance was not provided randomly by the government. As a result, the comparison of the

average outcome of the groups that received the treatment and the group that did not receive the treatment may cause a selection bias. This study uses local randomization based on the assignment variable, i.e., land ownership, to address the selection bias. Land ownership of 0.5 acres is considered the threshold for this study. The eligibility based on the land ownership in acres is the instrumental variable. The value of eligibility dummy is 1 for the households, which own land of the area of 0.5 acres or less, and 0 for the households, which own land of more than 0.5 acres. The eligibility is not deterministic but rather probabilistic because it does not determine whether a household actually receives the UCF assistance, but rather just increases the probability of receiving it.

This study estimates only the treatment effect of the compliers who act according to the treatment assignment (Bari et al., 2022). Like any other instrumental variable setting, this study has compliers, always takers, and never takers. The households are considered “compliers” if the treatment receipt is based on the land ownership criterion (Bertanha & Imbens, 2020). “Always Takers” are the households that receive UCF assistance, not depending on the land ownership criterion. In contrast, the “never takers” are the households that fail to obtain the UCF assistance, not depending on the land ownership criterion (Yau & Little, 2001). In the Fuzzy RDD setting, all the three conditions of the instrumental variable can be checked more easily than in a simple instrumental variable setup (Imbens, 2008). The first condition of the IV is the relevance condition that the IV should be correlated with the endogenous variable. In the RDD setup, the first-stage estimation confirms that the eligibility dummy, which is our IV, has a strong correlation to the treatment variable. The second condition is the exclusion restriction condition, in which the IV should be uncorrelated to the outcome variable. In the RDD setup, the continuity check of the running variable and the continuity check of

¹ Here, compliance refers to the degree to which units assigned to receive treatment group actually receive the treatment, whereas units assigned to the control group actually do not receive the treatment.

the pretreatment covariates around the cutoff confirm that the exclusion condition is fulfilled. Finally, the third condition of the IV is an exogeneity condition in which the IV is assigned randomly. In the RDD setup, the continuity check of the pretreatment covariates around the cutoff also shows that the benefits are assigned randomly.

In this study, the discontinuity of treatment status around the cutoff was estimated using the first-stage estimation equation:

$$X_i = g(\text{Land Ownership}_i) + \rho \text{Eligibility}_i + \varepsilon_i$$

where X_i denotes an treatment variable dummy, which is 1, if household received any UCF assistance. Eligibility_i is the eligibility dummy acting as the instrumental variable, with a value of 1 when Land Ownership_i is below or equal to the eligibility cutoff: $\text{Eligibility}_i = 1$ (when $\text{Land Ownership}_i \leq 0.5$ Acre). Land Ownership_i is the assignment variable, measured in acres. The coefficient ρ measures discontinuity in the probability of treatment status around the cutoff value.

The estimated \hat{X}_i is obtained through the first-stage estimation. Then, the estimated \hat{X}_i is used in the second-stage estimation equation:

$$Y_i = f(\text{Land Ownership}_i) + \pi \hat{X}_i + u_i$$

where Y_i denotes the outcome variables, namely, the total spending on education, spending on the school tiffin, educational stationery, uniforms, admission, examination, textbook, education-related Internet, and education-related transportation. The LATE is denoted by π . The flexible functions $g(\text{Land Ownership}_i)$ and $f(\text{Land Ownership}_i)$ are used to ensure the inclusion of the observations far from the cutoff and polynomial terms to adjust for linear and nonlinear relations. The ratio of the change in the outcome variable and the change in the treatment probability is the LATE denoted by π in this study:

$$\pi = \frac{\text{Discontinuity in Outcome at the Cutoff}}{\text{Discontinuity in the Treatment Status at the Cutoff}}$$

This study employs a local randomization-based regression discontinuity (RD) framework. The local randomization-based RD estimates use a window in a finite sample with the assumption that the observations in the short window are randomly selected for treatment (Cattaneo et al., 2016). Furthermore, we employ a number of robustness checks to confirm that the findings are consistent.

Two tests were conducted to check the robustness. First, to validate the RDD setting, there should not be any significant discontinuity in the distribution of the assignment variable of land ownership at the cutoff. The manipulation test proposed by Cattaneo et al. (2018) is used to check for any significant discontinuity in the conditional density of

the assignment variable of land ownership. Second, any significant discontinuity in the pretreatment covariates can make the RD design questionable. Therefore, whether there is any discontinuity in the pretreatment covariates needs to be checked.

Analysis and discussion

Main results

The first stage of the two-stage least squares regression is reported in Table 3. The first-stage estimation showed that the eligibility had a positive impact on the UCF assistance receipt at the 1% significance level. The first-stage estimation proves the relevance condition of the eligibility as an instrumental variable. Figure 1 shows the discontinuity in the treatment status around the cutoff. A significant discontinuity around the cutoff of the assignment variable is evident in Fig. 1, suggesting the relevance of the eligibility criteria around the cutoff of the UCF assistance receipt.

Table 4 reports the impact of the UCF assistance on the item-wise educational expenses. The local randomization-based RD estimate shows that the UCF assistance has

Table 3 Result of first-stage estimation

Outcomes	RD estimates	
	Conventional	Robust
Treatment status	0.20*** (0.06)	0.22*** (0.06)

Standard errors are in parentheses. Significance levels were determined using the robust method, where * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$. "Robust" estimates use bias-corrected coefficient estimators and robust variance estimators

Table 4 Local randomization-based regression discontinuity estimation

Outcomes	Local randomization-based RD estimates (In BDT)
Total educational expenses	11,510.77***
Tiffin expenses	1751.45***
Stationery purchase expenses	1583.72***
School uniform purchase expense	1088.99***
Book purchase expense	630.90*
Educational transportation expenses	431.52*
Educational internet expenses	763.78***
Admission fee expenses	640.69***
Examination fee expenses	864.55***

Significance levels are determined using the robust method where * $p < 0.10$ ** $p < 0.05$, and *** $p < 0.01$

a positive and statistically significant impact on the total household spending on education, on school tiffin, educational stationery, uniforms, admission, examination, education-related Internet, and total educational spending at the 1% significance level. However, the impact of the UCF receipt was not statistically significant with regard to book purchases and educational transportation.

Robustness checks

(A) Test for manipulation of land ownership

The Cattaneo test confirmed that there was no significant discontinuity in the distribution of the assignment variable of the land ownership, suggesting that no manipulation occurred. Figure 2 shows the graph of the Cattaneo et al. (2018) test.

(B) Checking discontinuity in covariates

Table 5 shows that the RD estimates of the covariates are not statistically significant. Therefore, there was no significant discontinuity in the pretreatment covariates at the cutoff. The discontinuity in the pretreatment covariates indicates that the eligibility dummy as the IV fulfills the condition of exogeneity. In other words, the table shows that the pretreatment covariates are balanced. Balance in the gender dummy, disabled member dummy, and the number of the household members show that there is no difference in the UCF program benefits according to the key eligibility criteria of the households to be enrolled in the UCF assistance programs affecting the spending on education by the households, such as the status of a female-headed household, one with at least one physically or mentally disabled member, and with at least one household member over 60 years of age.

Fig. 2 The manipulation test proposed by Cattaneo et al. (2018). In all the figures above, the horizontal axis represents land ownership in acres, and the vertical axis shows the probability density function

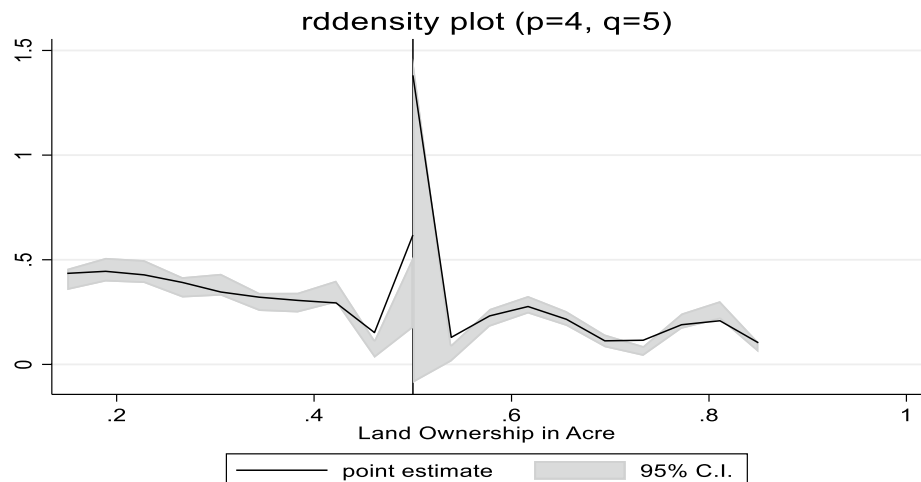


Table 5 Checking for discontinuity in covariates

Covariates	RD estimate
Gender (= 1 if male headed)	−0.02 (0.05)
Age of the HH head	−0.01 (2.50)
Disabled members (= 1 if any HH Member is Disabled)	0.01 (0.01)
HH members (≤ 15 years)	0.05 (0.17)
HH members (16–40 years)	0.20 (0.15)
HH members (40–60 years)	0.06 (0.15)
HH members (> 60 years)	−0.01 (0.12)
Average age	−0.64 (2.65)

The Robust standard errors are in parentheses. The significance levels were determined using the robust method, where *for $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$

Discussion and conclusion

One of the main limitations of the vulnerable households, affected by climate change, is the lack of resources to invest in the human capital, and more precisely in their children's education. Both the public and household spending on education need to be increased to ensure inclusive quality education for the members of the vulnerable households (Hadna & Kartika, 2017). Abu-Hamad et al. (2014) argue that cash and food assistance reduces the financial burdens of the vulnerable households and increases the households' willingness to invest in education. The household-level spending on education is one of the key factors contributing to the student success to completing the primary education cycle (Mostert & Vall Castello, 2020). In addition, the cash transfers are

supposed to secure children's education by covering the education expenses. An increase in the households' spending on education is an essential indicator of accelerating the SDG of inclusive quality education (Ebaidalla, 2018).

In this study, the total spending on education, the spending on school tiffin, educational stationery, uniforms, admission, examination, textbooks, education-related Internet, and education-related transportation are considered as indications of the households' willingness to invest in education and to ensure the quality of education for the household members. Unlike other studies that focus on the educational attainment of school children, this study focuses on whether the UCF assistance boosts the vulnerable households' capability and willingness to invest in education and upgrade the quality of education. The spending on school tiffin is the measurement of the nutritional investment for school-going children. The spending on educational stationery, uniforms, admission, examination, textbooks, education-related Internet, and education-related transportation indicate investments that would ensure quality education for the children.

Effective UCF assistance can accelerate the attainment of the SDG of quality education (Canavire-Bacarreza et al., 2020; Giang & Nguyen, 2017; Porreca & Rosati, 2019). This study suggests that an inclusive education policy can be implemented for the vulnerable rural coastal households by providing social protection through the UCF assistance. Increasing the investment in the household-level education should be regarded as a key indicator of improving the quality of education (Porreca & Rosati, 2019). Chronic poverty can be reduced by ensuring that the disadvantaged households have enough resources to invest in quality education (Nygård et al., 2019). Moreover, the households' spending on education is crucial for educational planning (Tilak, 2002). Based on the Fuzzy RDD, the results of the present study found that the UCF assistance has a positive impact on the total educational spending, encompassing school meals, educational materials, uniforms, admission and examination fees, as well as Internet connectivity for educational purposes, and contributes to enhancing inclusive and quality education within the rural coastal regions. The findings of the study are consistent with Anindita and Sahadewo's (2020) claim that cash transfers relax the budget constraints of the households, thus increasing the education investments.

Conditional cash transfers are argued to be more effective than unconditional cash transfers, but the conditionality has a heterogeneous impact based on the household conditions in Bangladesh (Huda et al., 2020). Sometimes, the conditions are too strict for a vulnerable household affected by a natural disaster to comply with the minimum conditions, such as the required school attendance for their children. Failing to comply with the conditions makes the cash grant discontinue in a conditional cash transfer case. However, the unconditional cash transfer programs give the flexibility

to use the funds based on the necessities of the household. Awaworyi Churchill et al. (2021) and Kilburn et al. (2017) argue that the unconditional cash transfers are more effective than the conditional cash transfers in the long run as the vulnerable households receive the benefits uninterrupted. As vulnerable households in Bangladesh often lack the income-generating resources, they often choose to utilize child labor instead of accepting conditional cash grants, which require regular school attendance. On the other hand, the cash grants obtained from the unconditional cash transfers may be used for income-generating purposes because there are no conditions to abide by, and the increased income may increase the spending on education in the long run (Begum et al., 2021). This study shows that the unconditional cash assistance has a significant impact on increasing the itemized spending on education. The increase in the educational spending may be the result of a cash grant or its investment in income generation.

One of the interesting findings of the study is that the tiffin spending, which is a type of food spending, increased evenly, even though the households received food assistance. The main reason for this increase needs some explanation. Food assistance includes staple foods, such as rice and wheat, but tiffin food generally includes foods with higher nutritional value, such as fruits, eggs, and dairy. Therefore, the findings suggest that the vulnerable households save their money on staple foods because they receive staple foods as assistance and spend more on foods with a higher nutritional value. Shrinivas et al. (2018) argue that if poor households obtain staple food assistance, they consume more staple food but spend less on it; as a result, they spend more of their budget on foods with a higher nutritional value. The increase in tiffin, uniform, and stationary spending suggests that UCF assistance increases the quality of the educational setting of children in a household. In addition, the spending on admissions and examinations indicates that a household chooses a better school because better schools require higher admission and examination fees. Further, education-related Internet spending suggests that a household is spending to make advanced online educational materials available for their school-going children.

Book spending covers textbooks and notebooks. The fact that textbooks are mainly distributed freely up to the secondary education level may be one reason why the UCF has no impact on the book spending. Moreover, households are generally within a walking distance of educational institutions, and households differ little in terms of educational transportation expenses, even if they receive the UCF assistance.

These findings are consistent with the family investment model promoted by Guo and Harris (2000). The family investment model suggests that vulnerable households tend to invest more resources in education, if their budget constraints are lifted to some extent. We conclude that the UCF

assistance can increase the educational investments of the rural coastal households. However, there are different UCF assistance programs, and this study does not identify which program has a greater impact on the educational spending. All the different programs have a common objective; to ensure an improved life standard for the target groups, and education is one of the key components of it. Therefore, our findings suggest that the UCF assistance programs, as a whole, increase the educational spending.

This study has some limitations that need to be considered before interpreting the findings. First, the data of the study are cross-sectional, so the temporal gap between the receiving of the treatment receipt and outcome remains unmeasured. Second, the findings have limited external validity, as the Fuzzy RDD measures only the LATE. Third, the study does not explore the impact of the food and cash assistance separately because of the nature of the dataset. Fourth, the study considers the UCF assistance as a bundle of programs, so the impact of separate UCF programs is not explored. This study broadens the scope for further studies to explore the causal impact of separate UCF programs on educational spending by the household in the rural coastal areas of Bangladesh.

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Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

Ethical approval This research exclusively utilized observational data and did not involve any studies with animal or human participants, nor was it conducted in private or protected areas. As a result, ethical approval was not required.

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