

# Does Microfinance Increase Food Security? Evidence from Nepal

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**Abstract** This paper estimates the impact of participation in a microfinance program on household food security using primary data from Nepal. We also disentangle the relationship by gender. Using variants of propensity score matching to adequately address endogeneity of our treatment variable, we find evidence that microfinance has a positive effect on household food security measured by food consumption score. We also present evidence of significant increase in household food security when women are program participants. In comparison, we find no significant gender difference in the effect of microfinance on household food security status.

**Keywords:** *microfinance, food security, food consumption score, treatment effects*

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## 1. Introduction

Microfinance is broadly defined as the provision of financial services to the poor, primarily, to undertake any income generating economic activity. It has been greatly admired as a development tool; so praised that it became the basis for 2006 Nobel Peace Prize. Microfinance institutions (MFIs) provide small scale production credit, ranging from about fifty dollars to several hundred dollars, mostly to the rural poor or people engaged in informal activities to build up a business that enhances their incomes and enables them to lift themselves out of poverty. Besides providing necessary capital, MFIs also provide support to build human capital such as skill-based training. In its prime, anecdotal evidence as well as some economic studies confirmed the positive effects of microfinance [1,2]. However, researchers later pointed out that the impact studies, linking microfinance to various socio-economic factors, failed to establish a causal relationship [3]. The positive effects faded away with the passage of time when studies started to estimate the effects with more rigorous empirical strategies than just comparing the before- and after-situation of the borrowers. More recent studies have shown that expanding access to credit may not affect household welfare or it may decrease sometimes [4,5].

Does microfinance increase or decrease household welfare in the context of Nepal? We answer this question in this study. This paper evaluates the impact of microfinance on household welfare measured by household food consumption score. Nepal started microfinance programs a few decades ago and the evidence into the effects of microfinance on household welfare is scarce. Recognizing the importance of

microfinance, the central bank of Nepal, Nepal Rastra Bank, has made it mandatory for commercial banks and other financial institutions to provide microloans to deprived sectors of society. As of December 2017, about 65 microfinance institutions with around 2100 branches operating in different parts of the country are providing microfinance services to the people (<https://sakchyam.com.np/wp-content/uploads/2018/03/NMBA-Presentation.pdf>). Nationally, the microfinance institutions are serving about ten percent of the total population [2.52 million clients].<sup>1</sup> Around the world, the microfinance sector has grown rapidly since its inception, and with its growth and less stringent loan conditions, it has attracted many poor women also. The 2015 Microcredit Summit Campaign reports that microfinance institutions worldwide attracted 211 million customers, of which about 74 percent are women (<https://stateofthecampaign.org/read-the-full-2015-report/>). Also, microfinance institutions have deliberately focused on and reached out to women living in rural poor and diverse socio-economic environments [6], partly due to the fact that poor women face many difficulties in getting economic opportunities [2]. Research by different scholars has shown that increased participation of women in microfinance has greater effect on household welfare as compared to men. In particular, [2] found that the marginal increase in household consumption expenditure is 18 percent for an additional credit to women as compared to 11 percent in case of men. However, [5] revisited their claim, found a flaw in their empirical strategy, and concluded that the effect is either coming from unobserved factors or there is reverse causality. Therefore, apart from a mixed overall effect, the gender effects of microfinance can also go both ways: either male

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<sup>1</sup> Central Bureau of Statistics, Nepal.

participation has higher effects or female participation does. In addition to the overall effect, this study also assesses the relationship between microfinance participation and household food security by gender.

We address these issues by analyzing the data from a survey conducted in the Bahunepati valley of Nepal in 2017. Five hundred and nine respondents were asked questions about their food consumption behavior and about their participation in a microfinance program. We use the food consumption score (FCS) to measure the food security status of the household. As the data is coming from a natural experiment (non-randomized study), simple econometric approaches to study the relationship might not work in our case. Certain individual-, societal-, and community/village-level characteristics exist that drive individuals to participate in the microfinance program; secondly, microfinance institutions (MFIs) select regions very cautiously based on poverty statistics of the region for their setup. Therefore, various factors affect individual's participation in microfinance program and household food security. In other words our treatment variable is endogenous partly due to self-selection. To control for the endogeneity of our treatment variable, we use variants of propensity score matching such as kernel matching and nearest neighbor matching that allow us to randomize the data as much as possible and to compare the outcome of treatment and control group for establishing a causal relationship. Besides using the full data set for estimating the overall effect of microfinance, we split the sample by gender and apply the matching techniques in order to analyze and estimate the gender effects of microfinance. In particular, we compare female microfinance participants with female and male nonparticipants individually and collectively.

## 2. Effects of Microfinance

The basic group-lending model is used by microfinance institutions (MFIs) for providing loans to customer. A few family members or friends or relatives can easily form a group and avail themselves of the opportunity. The loan is extended to an individual, but the whole group is responsible for repayment. They meet weekly or biweekly, depending on the conditions of the MFI, for loan repayments and to discuss the progress or difficulties, if any. Group-based lending is different from conventional lending as it does not require any material collateral; it works on social collateral [2,7] such as peer pressure. As the whole group is responsible for repayment, all the members take care of each other; they monitor each other's activities and train the low productivity members. The peer pressure ensures that repayments are made in due time.

Microfinance has been praised as an effective policy tool and instrument to combat poverty [2,8]. Most of the previous literature has analyzed the impacts of microfinance on a number of socio-economic indicators to measure its effects on poverty, including household food consumption expenditure [9,10,11,12,13,14,15]. In a few studies, calorie consumption is also used as a measure of household food security [16,17]. The effects of microfinance are not consistent across the literature. A number of

studies find that increased access to microfinance increases household food consumption expenditure or calorie consumption [1,2,16,17]. As food consumption increases, we say that households are more food secure. In other cases, microfinance has shown no transformative effects. The consumption expenditure of households is unaffected by program participation [4,18,19]. Besides positive and no effect, [20] and [5] find a negative effect of microfinance on food consumption expenditure. It is evident from the literature that we do not have solid evidence whether microfinance increases or decreases household food security. There are mixed effects of microfinance due to a number of reasons. The perspective of the borrower matters, more or less, in determining the direction of effect of microfinance. Why is the borrower taking a microloan? S/he may turn to microloans for a number of useful activities that are entirely different from starting a new business, such as fulfilling certain immediate family needs, for instance, marrying a daughter or purchasing a refrigerator or television. The loan, therefore, tends to increase the non-food consumption expenditure of the household in the short run. The food consumption probably stays the same or it may increase or decrease depending on whether the microloan is enough to meet the non-food expenditure and where the rest of it is spent. However, in the long run, the same household may have to cut back some of the consumption to pay back the loan. The borrowers can get microloans solely for business purposes. If the potential investment opportunity is lumpy<sup>2</sup> for a borrower, s/he may reduce current consumption to undertake that investment, but then consumption may rebound in the long run. This can create a downward blip in consumption in the short run. It also seems to be the case in the developing world that sometimes borrowers have no knowledge of business; in some instances they end up running the wrong business and may even lose the whole money; they have to sell off their already meager resources to pay back the loan. Also, although microfinance loan conditions are less stringent, the repayment structure is rather strict. It starts immediately, in most cases, after the loan is sanctioned. There is no room for trial-and-error for people to search a better business opportunity. Income might not increase in such cases, but the households have to repay the loan in time, which may require cutting their consumption. Similarly, MFIs mostly provide loans to people living in rural areas. In rural areas, there is a lack of diversification of business activities [21]. Given the lack of diversification, the possibility of earning sufficient profits is limited. If there is no significant increase in income, we may not see any increase in consumption, or we may see a decline due to the fact that out of the profits earned, the borrower has to pay back the interest also. Considering mixed effects, there is more of a possibility that some segments of the population, if not all, who are taking microfinance are actually benefiting from it. Therefore, heterogeneity may exist in the effects of microfinance. It may increase the welfare of some households and decreases the welfare of some others [21]. The average effect of microfinance, either positive or negative, is determined by the overall difference of the positive and

<sup>2</sup> Opportunity that requires large capital investment.

negative effects of microfinance on society. Due to heterogeneity, even if the effect is negative, a segment of the total borrowers is getting benefits from microloans.

The issue of targeting women by MFIs and providing credit to them has remained under debate for quite some time. The premise of focusing women is that they are more responsible towards the household and towards paying back the loan [22]. In some studies, female borrowing as compared to male borrowing has significant effect on household welfare e.g. [1] and [2]. Also, MFIs use the group-lending model, and there is peer pressure involved in it. Women are thought to be more sensitive toward peer pressure [7] and, therefore, appear as more reliable debtors compared to men. However, there is no credible evidence that substantiates the claim that providing loans to women, instead of men, has a higher effect on household welfare.

In our study we are focusing Nepal. Two thirds of Nepal is hilly while the remaining one third is plains. Our data was collected in one of the hilly areas. The difficult terrain of the country poses challenges for economic development. Poor communication and infrastructure facilities increase administration and operating costs of MFIs. Therefore, MFIs are mostly based in the center of government and business activities, Kathmandu, or located in the plain lands. We collected data from Sindhupalchok district which is about 85 kilometers north-east of Kathmandu. This mountainous region links Nepal with China. The total population of the area is 0.2 million and roughly 92 percent depends directly or indirectly on agriculture for earning their livelihood; about 45 percent of the population lives below the poverty line and is mostly employed in the informal sector: porters, masons, etc.<sup>3</sup> Apart from farming, people invest money in activities such as goat rearing.<sup>4</sup> MFIs in our area of interest use the group-lending model for loan disbursement. About 11 microfinance institutions are providing services to the people.

We explore the following research questions in the study:

Research question 1: Whether microfinance has no effect, positive effect, or negative effect on household food security.

Research question 2: Whether female participation in microfinance program has no, positive, or negative effect on household food security.

Research question 3: Whether microfinance provided to women has a greater effect on household food security than microfinance provided to men.

### 3. Materials and Methods

#### 3.1. Study Area and Sample Selection

The data for this paper comes from a survey conducted in a small village in the Bahunapati valley of Nepal. The village is located in the Sindhupalchok district and is comprised of nine wards.<sup>5</sup> Random selections of houses

were made from each ward, keeping in view the population of the ward and the desired sample size. Random Route Sampling method using the conventional “right-hand rule” was applied for selection of houses.<sup>6</sup> In-person interviews were conducted for data collection.

A total of 509 individual interviews were conducted. Data were collected on different modules that include social capital, food security, demographics, etc. Under the food security module, different questions were asked but we are using only one question for the purposes of our analysis. The question is, “Could you please tell me how many days in the past 7 days your household has eaten the following foods?” A total of 17 different food items was listed in response. The seven-day recall period was used, which is justified as [23] and [24] used the same recall period for measuring food security of different countries. We used the same question for constructing our food security indicator variable which is the food consumption score.

### 3.2. Measures

#### 3.2.1. Food Consumption Score

The Food Consumption Score (FCS) is a frequency weighted diet diversity score calculated using the frequency of consumption of different food groups consumed by a household during the seven days immediately preceding the survey [23,24,25]. FCS is used by the World Food Program for identification of the most food insecure households. It provides information on people’s current diet patterns and helps determine the target group for food security intervention as well as the type and scale of food security intervention [24]. In the survey we asked people about the frequency of their food consumption over the past seven days. The food items include: Maize; Rice/Paddy; Millets; Roots and Tubers; Wheat/Barley; Fish; White-Meat (poultry); Pork; Red-Meat (goat, sheep); Red-Meat (buffalo); Eggs; Pulses/Lentils; Vegetables; Oil/Ghee/Butter; Fresh Fruits; Sugar/Salt; and Milk/Curd. Afterwards, we continue the food items into nine categories: staples, pulses, vegetables, fruits, meat and fish, milk, sugar, oil, and condiments, as listed in [23], and sum all the consumption frequencies of food items belonging to the same group. We truncate any value of the food group above seven. We then calculate the weighted score by multiplying the value of each group by its weight. Table 1 provides a list of food items and their respective weights.

Table 1. Food Items and Food Categories

	Food Items	Food Group	Weight
1.	Maize, Rice/Paddy, Millet, Roots and tubers, Wheat/barley	Staples	2
2.	Pulses/Lentils	Pulses	3
3.	Vegetables	Vegetables	1
4.	Fresh fruits	Fruits	1
5.	Fish, White meat, Red meat, Eggs	Meat and Fish	4
6.	Milk/Curd	Milk	4
7.	Sugar	Sugar	0.5
8.	Oil/Ghee/Butter	Oil	0.5

<sup>3</sup> <http://www.csdnepal.org.np/rpcontents/downloadfile/impact-of-the-earthquake-on-microfinance-a-stu>

<sup>4</sup> <http://swbbl.com.np/wp-content/uploads/2018/07/devaki.pdf>

<sup>5</sup> Ward is the smallest administrative unit in Nepal, and the primary sampling unit for the survey.

<sup>6</sup> See EU-MIDIS (2009) for step-wise explanation of the process.

### 3.2.2. Participation in Microfinance Program

Participation in microfinance program is our primary variable of interest. The survey asked the respondents whether they are participants of any microfinance group. It is a dichotomous variable with 1 indicating the individual's participation in the program, and 0 otherwise.

### 3.2.3. Control Variables

In addition to the above variables, data were also collected on several other variables that may be correlated with food security indicators and can be used as potential control variables. In propensity score matching, we use these variables to generate the probability of treatment. Demographic and socio-economic characteristics, such as income, caste, type of family, possession of agricultural land, household size, and remittances are employed as control variables in the models. The survey asked about the household's average monthly income in the last year, and the answer was recorded on nine different income categories. We re-categorized the income into three categories to save degrees of freedom: less than NPR 10,000 a month; NPR 10,001 to NPR 30,000; and NPR >30,000.

Nepalese society is composed of multi-ethnic groups. The caste system of Nepal consists of 7 major castes: (1) Brahman/Chhetri; (2) Tarai/Madhese Other Castes; (3) Dalits; (4) Newar; (5) Janajati; (6) Muslim; and (7) Others [26]. According to the Central Bureau of Statistics, Nepal, the people belong to 125 different castes.<sup>7</sup> Of the total population, about 29 percent is Brahmin or Chhetri and about 24.5 percent is Newar or Janajati. The questionnaire allowed for eight different castes and we re-categorized them into three. Our categories are: Brahman/Chhetri; Newar/Janajati; and Other Caste. We combine the sub-categories of Brahman and Chhetri and make them one caste as these two are considered the top castes and they are more or less similar; Newar and Janajati are combined into one caste as these are considered to be same socially; Dalits, Muslim, and Others are the third category called Other Caste.

The traditional family structure in Nepal is of two types: Nuclear family<sup>8</sup> and Joint family<sup>9</sup> system. The questionnaire recorded the family structure information of the respondent; whether s/he is living in a nuclear family or joint family, and we used that information in the models. As compared to the nuclear family system, the joint family system has more earning members, which contributes significantly to the total earnings of the household. Therefore, joint families have more income. The joint family system also encourages dependency on other family members. Therefore, the household is more food secure even if some of the family members are not working. [27] found that joint family system is significant in explaining food security of the household.

Possession of agricultural land might affect food security indicators directly or indirectly. Households may consume the produce of their land or sell the product of their farms at a certain price; the income from this activity allows the household to purchase other food items,

which has a bearing on food consumption score. The questionnaire asked respondents if they possess any agricultural land, and the answer was recorded on a binary scale with 1 indicating possession of land and 0 otherwise. Also, if a person possesses agricultural land, s/he may want to get a loan for agricultural purposes. Initially when microfinance programs were started, the households who possessed at least some land (less than half an acre according to [1]) were eligible to participate in a microfinance program.

We also include remittances as an explanatory dichotomous variable in the models. Remittances are an extra source of income and households receiving remittances might not participate in a microfinance program.

In addition to the aforementioned variables, we also use a dichotomous and an ordered variable indicating whether the individual has volunteered in the community for any work and how actively s/he volunteered. The individuals responded to an ordered variable on a five-point Likert scale ranging from very-inactive to very-active. If a person is active in the community in volunteering, s/he may encounter different people and may have more knowledge about microfinance programs that different MFIs offer. We also use community level (ward in Nepal) fixed effects in the calculation of propensity score. There could be a difference in wards due to infrastructure development.

## 3.3. Empirical Methodology

Our analysis of the welfare effects of microfinance focuses on the food consumption score. The indicator is affected by a number of factors including socio-economic and demographic factors. Our main independent variable is participation in a microfinance program. The linear relationship between the food consumption score and participation in microfinance program is shown by the following equation:

$$FCS_j = \alpha + \beta_1 MF + \beta_2 Female + \beta_3 Female * MF + \beta_H H_j + u_j \quad (1)$$

Where  $FCS_j$  is indicating food consumption score of household  $j$ ;  $MF$  is an individual's participation in microfinance program, which is also a treatment indicator;  $H_j$  represents household characteristics and socio-economic factors that affect FCS; and  $u_j$  is the household specific error term. The household factors that we consider in our estimation are: whether the individual is living in a nuclear family or a joint family; size of the household; whether the household owns any agricultural land; whether the household received any remittances in the past year; and the average monthly income of the household.

The model specification presented in Equation 1 can be estimated using a simple linear regression model and the coefficient  $\beta_1$  would then give us the true causal effect overall and for male microfinance participants while  $\beta_3$  gives the differential effect for females. However, this simple specification assumes that there is zero covariance between the error term and the independent variables, which means that all the unobserved factors are uncorrelated with the observed factors. This implies that the treatment assignment is completely random, which is

<sup>7</sup> <https://cbs.gov.np/statistical-year-book-2017/>

<sup>8</sup> It consists of a couple and their immediate children.

<sup>9</sup> A type of family in which three or more generations and their spouses and children live together as a single household.

the most important condition for estimation of true causal effect. It allows us to assume that the treatment and control groups are theoretically interchangeable, and the difference between the average value of food consumption score of the two groups is the effect of treatment. However, in our case, we may have some factors, such as wealth, that affect both the participation in microfinance program and FCS. In addition, individual, household, and community- or village-level characteristics could influence individuals to opt for the program. Individuals in our data selected themselves into microfinance program which makes treatment assignment non-random. In case of non-random treatment assignment, as opposed to randomized control trials, systematic differences exist between the baseline characteristics of treated and control subjects. As the two groups, treatment and control, are not the same, they are not interchangeable and, therefore, we cannot observe the counterfactuals, and cannot use simple regression analysis [28,29,30,31]. To estimate the true causal effect, we need to model the selection, using different matching techniques, to the treatment or control group to ensure that the treatment assignment is random<sup>10</sup> which, in turn, ensures that the two groups are not different from each other on baseline characteristics or the treatment status is not confounded with any observed or unobserved measures [29]. That way, the treatment effect can be obtained by comparing the outcomes of the two groups [32].

Our goal in this paper is to estimate the average treatment effect on the treated (ATT), by comparing the average outcome of those who received the treatment with an estimate of what would have happened if those same individuals had not received the treatment under certain conditions. We are interested in ATT because, although, there are few barriers to entry, people self-select into the program and, therefore, it is plausible to know the difference in the food consumption score of the same people between the two states.

The ATT is formally identified as:

$$|E[FCS_{j,1} | X, MF = 1] - E[FCS_{j,0} | X, MF = 1]|$$

where  $FCS_{j,1}$  and  $FCS_{j,0}$  are food consumption scores of household “j” under treatment and control assignment, respectively, MF is an indicator variable denoting whether the individual received the treatment (MF=1) or not (MF=0) [29,33,34]. We only observe one outcome for each subject in the sample—the outcome of the actual treatment and, therefore, we cannot estimate the true causal effect unless we have a reliable estimate for the unobserved outcome. As stated earlier, in observational studies, due to non-randomization, the two groups, control and treatment, are not the same. Therefore, we use different methods to randomize the observed data as much as possible and provide good estimates for the counterfactual outcome. Different methods, such as matching, inverse probability of treatment weighting, propensity score weighting, and covariate adjustment are used in the extant literature to capture the true causality in case of observational studies [29,30].

We use matching based on propensity scores to estimate the counterfactual outcomes. Using the matched sample and propensity score as weights, we estimate the effects of microfinance. In addition to propensity score weighting, we use inverse probability of treatment weighting (IPTW) based on propensity scores to check the robustness of our results.

### 3.4. Propensity Score Matching: Balance Diagnostics

In our analysis, because we are performing propensity score matching using different samples and we calculate propensity scores each time we change the sample, we perform balance diagnostics every time. We estimated the propensity score model each time, split the entire sample into five blocks, and examined the distribution of propensity scores in each block. In each case, the mean of the propensity score of a treatment group in each block is not different from the mean of the propensity score of a control group. Figure 1, 2, and 3 display the graphs of common support for different samples that we are using for the analysis. We also tested for covariate balance each time we estimated the propensity score and made sure that the covariates are balanced in every strata. Similarly, after conditioning on propensity score, we examined the standardized difference in individual covariates and found that it does not exceed 25 percent. For the purposes of brevity, we are not presenting tables showing the individual standardized difference in covariates of different samples. Nonetheless, we display overall mean and median standardized difference in covariates in the relevant results table.

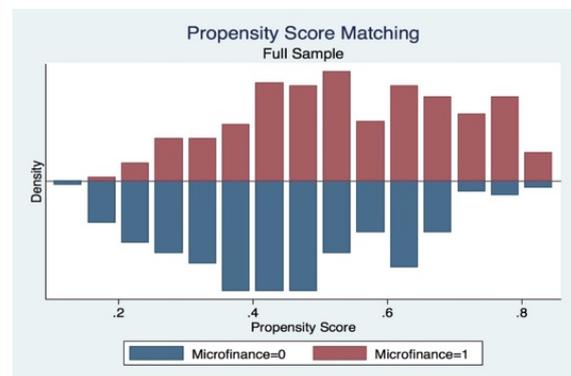


Figure 1. Common Support graph for full sample

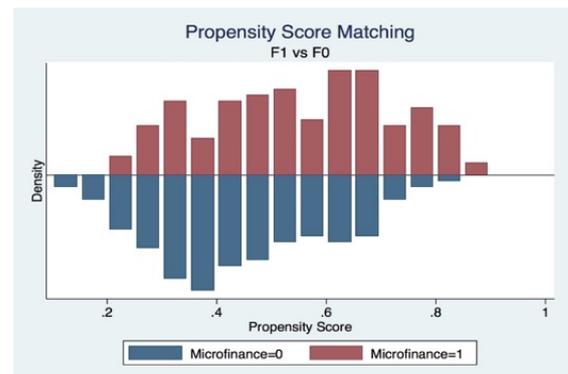
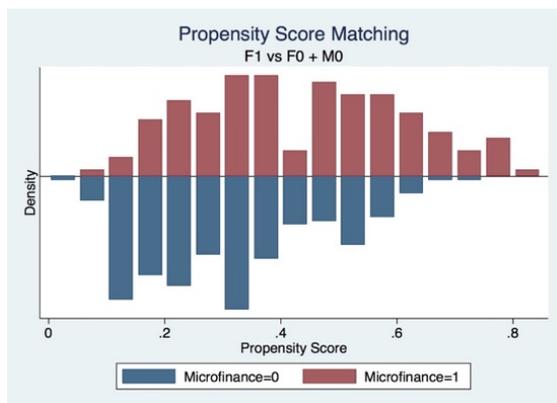


Figure 2. Common Support graph for female only sample (Notes: F1 and F0 represents participant females and non-participant females, respectively.)

<sup>10</sup> When the randomization is lacking, the true treatment effect is confounded; we cannot distinguish whether the effect is through treatment or if it is due to the fundamental difference in the characteristics of the two groups [30].



**Figure 3.** Common Support graph for non-participant males and female only sample (Data source: Nepal Study Center, UNM. Notes: F1, F0, and M0 represents participant females, non-participant females, and non-participant males, respectively.)

### 3.5. Choice of Matching Strategies

**Table 2. Difference in Matching Strategies**

Sample Type	N	N treated	N Control	Mean SDIC (%)	Median SDIC (%)
Original Sample	509	251	258	12.4	11.9
1:1 w/o replacement w/CS	496	248	248	10.4	9.9
1:1 w replacement w/CS	372	248	124	6.7	5.3
Caliper 1:3 with replacement w/CS	460	248	212	5.6	4.6
Caliper 1:4 with replacement w/CS	479	248	231	4.5	3.6
Caliper 1:9 with replacement w/CS	499	248	251	2.5	2.0
Caliper 1:10 with replacement w/CS	503	248	255	2.7	2.0
Kernel Matching w/CS BW=0.06	504	248	256	3.0	2.2

Notes: n1: n2: n1 treatment and n2 control observations; CS: Common support; Caliper: 0.2 of the standard deviation of the logit of the propensity score; BW: bandwidth. N: Sample size; N-treated: Treatment observations; N-control: Control observations; SDIC: Standardized difference in covariates.

Choosing matching strategies involves a trade-off between bias and efficiency. The first match, for instance, in one-to-one matching, provides the best control for a treatment, and it leads to least biased estimates. One-to-one matching decreases the sample size and provides least biased estimates. However, it comes at a cost of efficiency. On the other hand, increasing the number of matches, for instance, one-to-many matching, increases the sample size and efficiency but it also increases the bias. We performed numerous matching strategies to come up with one or two strategies that give us the least-biased and efficient estimates. Each time, after doing the matching, we recorded the overall mean and median standardized difference in covariates. Each strategy decreased the difference in covariates, but we have chosen the one that provides the least difference in them among all the strategies. For instance, Table 2 shows the mean and median standardized difference in covariates along with the number of observations in the relevant

group [35]. The original sample has a mean and median standardized difference of 12.4 and 11.9 percent. The different matching strategies showed a decline in these numbers and with nearest neighbor matching of 1:9, which means one treated observation is matched against 9 control observations, the difference is the least. If we increase or decrease the number of matched control observations, the difference in the mean or median increases.

## 4. Results

### 4.1. Descriptive Analysis of the Measures

Table 3 summarizes the key variables of our data set disaggregated by participation status. Notably, the food consumption score of participants is higher than non-participants.<sup>11</sup> The average FCS of households participating in a program is 72.65 while for non-participant households it is 64.39, and the two scores differ at a significance level of 1 percent. The table also shows that almost half of the sample (49%) is participating in a microfinance program, and back-of-the-envelope calculation shows that out of participants, female participants (56%) are higher than male participants (44%). Table 4 shows the distribution of scores by gender. The statistics show that households with a female or male participant have a higher score than the households with no participant. For both genders, almost 50 percent are participants. Although the number of male participants (111) is lower than female participants (140), the male participant households have a higher food consumption score than female participant households. Similarly, the mean score of male non-participant households is higher than female non-participant households. This shows that on average male households are better off than female households. If we compare participants, male or female, separately with both male and female non-participants, the numbers show that participants are better off. The households of male and female participants have a mean food consumption score of 74.99 and 70.80 respectively which is greater than the combined mean score (64.39) of male and female non-participant households. The difference in average scores of participant and non-participant households could point to the fact that microfinance is helping households, overall, one-way or the other. However, this effect might be confounded; therefore, further analysis is required into the matter.

**Table 3. Comparison of FCS by Participation**

Variable	Participant	Non-Participant	All	Difference
<i>Main Outcome and independent variable</i>				
FCS	72.7	64.4	68.5	8.3***
Microfinance			49.3	
N	258	251	509	

Data source: Nepal Study Center, UNM.

Notes: \*, \*\*, \*\*\* denotes statistical significance at 0.10, 0.05, and 0.01 level respectively. N represents sample size.

<sup>11</sup> The test results show that the mean score of participants is significantly different from the mean score of non-participants.

**Table 4. Comparison of FCS by Gender**

Variable	Participant	Non-participant	Difference
<i>Female</i>			
FCS	70.8	62.4	8.4***
N	140	142	
<i>Male</i>			
FCS	75.0	67.0	8.0***
N	111	116	

Data source: Nepal Study Center, UNM.

Notes: \*, \*\*, \*\*\* denotes statistical significance at 0.10, 0.05, and 0.01 level respectively. N represents sample size.

## 4.2. Main Results

Table 5 displays the naïve results of estimating the effects of microfinance participation on food consumption score. We did the analysis on different parts of the sample, split by gender, and estimated the effects of microfinance using simple least squares regression. The first column shows the overall effect of microfinance; Columns 2 and 3 show the comparison of female participants with female non-participants, and female and male non-participants. The coefficient of microfinance is highly significant across all columns. The first column shows that, on average, microfinance increases the food consumption score of households. The food consumption score of female participant households is higher than female non-participant households, and male and female non-participant households combined. The coefficient on the interaction term is null and insignificant, which shows that there is no gender effect in the effects of microfinance. The participation in a microfinance program has the same effect on the food consumption score of a household irrespective of gender.

**Table 5. OLS Results of FCS**

	Full Sample	F1 vs F0	F1 vs F0 + M0	M1 vs M0 + F0
Microfinance	8.33***	8.38***	8.36***	7.56***
	(2.13)	(1.96)	(2.19)	(2.70)
Female	-4.83*		-4.94*	-4.72*
	(2.50)		(2.55)	(2.42)
Female*MF	0.00			
	(0.00)			
Controls	✓	✓	✓	✓
N	509	282	398	369

Data source: Nepal Study Center, UNM.

Notes: The above results are obtained from ordinary least squares regression. Female\*MF is an interaction term showing the effect when females are in the microfinance program. Control variables include type of family: joint family or nuclear family; household size; possession of agriculture land-dichotomous variable; remittances-dichotomous variable: whether the household received remittances from abroad; income: 3 categories of income are included (< NRS 10,000, NRS 10,001 to NRS 30,000, and > NRS 30,000). \*, \*\*, \*\*\* denotes statistical significance at 0.10, 0.05, and 0.01 level respectively. Clustered standard errors by wards in parenthesis for column 1 & 3, while bootstrap standard errors for the rest of the columns. F1: female participants; F0: female non-participants; M1: male participants; M0: male non-participants.

Table 6 shows the propensity score weighting results. For the full sample (Column 1) and female only sample

(Column 2), we get the matched sample after doing the nearest neighbor matching with nine and five nearest neighbors, respectively, as it gives us the least standardized difference in covariates. However, for Column 3, we use kernel matching. The coefficient of microfinance is significant and positive in all three columns, which is consistent with some of the literature. The food consumption score of participant households increased by about 6 points (see Column 1) while in case of females only, the food consumption score of participant households increased by about 7 points on average (see Columns 2 and 3). Like the naïve results, there is no gender effect of microfinance participation on household food consumption score, as shown by the interaction term in Column 1. Table 7 shows the inverse probability of treatment weighting results of food consumption score. The results are similar to Table 6.

**Table 6. OLS Results of FCS on Matched Sample with Propensity Score Weights**

	Full Sample	F1 vs F0	F1 vs F0 + M0
Microfinance	5.95**	6.94***	6.85***
	(2.95)	(2.36)	(2.30)
Female	-4.31		-3.68
	(2.93)		(2.89)
Female*MF	0.26		
	(3.82)		
Controls	✓	✓	✓
N	494	255	385

Data source: Nepal Study Center, UNM.

Notes: \*, \*\*, \*\*\* denotes statistical significance at 0.10, 0.05, and 0.01 level respectively. N represents number of observations. Robust standard errors in parenthesis. Control variables include type of family: joint family or nuclear family; household size; possession of agriculture land-dichotomous variable; remittances-dichotomous variable: whether the household received remittances from abroad; income: 3 categories of income are included (< NRS 10,000, NRS 10,001 to NRS 30,000, and > NRS 30,000).

**Table 7. OLS results of FCS on Matched Sample with Inverse Probability of Treatment Weights**

	Full Sample	F1 vs F0	F1 vs F0 + M0
Microfinance	6.55**	6.27***	6.49***
	(2.90)	(2.29)	(2.34)
Female	-3.92		-3.29
	(2.76)		(3.05)
Female*MF	-0.16		
	(3.69)		
Controls	✓	✓	✓
N	498	262	385

Data source: Nepal Study Center, UNM.

Notes: \*, \*\*, \*\*\* denotes statistical significance at 0.10, 0.05, and 0.01 level respectively. N represents number of observations. Robust standard errors in parenthesis. Control variables include type of family: joint family or nuclear family; household size; possession of agriculture land-dichotomous variable; remittances-dichotomous variable: whether the household received remittances from abroad; income: 3 categories of income are included (< NRS 10,000, NRS 10,001 to NRS 30,000, and > NRS 30,000).

## 5. Conclusion

Microfinance was initially adopted to provide financial services to marginalized people in society, who have the potential to flourish but lack access to financial support. It came as a panacea for poor people who could now play their active roles in the main stream of the economy. It influences different socio-economic spheres of life as researchers have found a positive association between microfinance and poverty reduction, women empowerment, health, food security, and other indicators.

Using different matching techniques and data from Nepal, we tested the following research questions: (1) Whether participation in microfinance has a positive effect on the food consumption score; (2) Whether microfinance has a positive effect on household welfare if provided to females; and (3) whether the effect of microfinance on food consumption score is higher if provided to females than males. Our econometric analysis suggests that microfinance has an overall positive effect on the food consumption score. This is consistent with some of the literature that found positive effects of microfinance [2,16,17,36]. If we look at the effects of microfinance on the household food consumption score where a woman is a participant, we see a significant increase in the food consumption score. This shows that female participation in microfinance programs is helping poor households. For our third research question, we try to disentangle the relationship using an interaction term in the model. The results show that there is no gender difference in the effects of microfinance on the food consumption score of households. Our results are different from some previous studies that find that providing microfinance to women rather than men helps households more [1,2]. Overall, this study expands the existing literature on the impacts of microfinance on food security. Most of our findings strengthen the already existing evidence: the significant positive effect of microfinance on household welfare.

Developing countries are striving to achieve higher levels of economic growth with improvement in the well-being of inhabitants. No solid evidence is available that proves microfinance helps in all situations. However, there is evidence of heterogeneity in the effects of microfinance. We have found evidence supporting the positive effects of microfinance. We have also found evidence that microfinance helps if provided to females, and there is no gender difference in the effects of microfinance.

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