Journal of International Development
J. Int. Dev. **33**, 86–108 (2021)
Published online 25 August 2020 in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/jid.3513

FINANCIAL INCLUSION, NUTRITION AND SOCIO-ECONOMIC STATUS AMONG RURAL HOUSEHOLDS IN GURUVE AND MOUNT DARWIN DISTRICTS, ZIMBABWE

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Abstract: This article assessed the association between financial inclusion and nutrition among 987 rural households in two districts of Zimbabwe. Poisson and negative binomial regressions were used for model estimations. Financial inclusion increased dietary diversity and food consumption by 12 and 14 per cent, respectively. Using concentration indices, our results show pro-rich advantages in financial inclusion and household nutrition. Promoting inclusive financial services among rural and poorer households is crucial. This can be achieved through establishing microfinance and agency banking in rural areas. Promoting pro-poor financial inclusion strategies, for example reduction of transaction and banking fees, is important to enhance equity. © 2020 John Wiley & Sons, Ltd.

Keywords: financial inclusion; nutrition; rural households; socio-economic status; Zimbabwe

1 INTRODUCTION

Diets are poor in rural Zimbabwe, as most rural households heavily rely on maize, the staple crop, which is not very nutritious. Assessments in Zimbabwe have shown that only 54 per cent of the population consumes acceptable diets and there is lack of protein—rich foods in the diets (ZimVAC, 2016). Food and nutrition insecurity is worse among poor rural households due to constrained food and income sources. The comparison of dietary

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diversity and food consumption by financial inclusion in Zimbabwe reveals a striking feature (Table 1). The dietary diversity and food consumption in financially included households were higher than in the financially excluded households. The Reserve Bank of Zimbabwe adopted a national financial inclusion strategy for the period 2016 to 2020 to identify barriers to financial inclusion and to enhance access and usage of quality financial products (Reserve Bank of Zimbabwe, 2016). The latest financial inclusion survey in Zimbabwe recorded an increase in financial inclusion, from 60 per cent in 2011 to 77 per cent in 2014. This was mainly attributed to the adoption of mobile money, which has improved the reach of financial services (Chamboko & Makuvaza, 2018).

Financial inclusion refers to easy access to a wide range of formal banking services that meet the economic needs of people at an affordable cost (Allen, Demirguc-Kunt, Klapper, & Martinez Peria, 2016; Zins & Weill, 2016). The financial services include having a bank account, savings, availability of credit, remittance, insurance, payments and mobile money (Allen, Demirguc-Kunt, Klapper, & Martinez Peria, 2016; Suri & Jack, 2016). Recently, scholars, policy makers and development practitioners have embraced the concept of financial inclusion because of its potential implications on household welfare and

Table 1. Household, farm and institutional sample characteristics by financial inclusion status

Variable	Description	Financially included	Financially excluded	Difference
Household dietary diversity	Number of food groups consumed	8.056	6.867	−1.19***
Food consumption score	Frequency of consumption of food groups	42.106	35.296	−6.81***
Farm production diversity	Number of crop and livestock species reared	4.206	3.983	−0.22
Crop diversity	Number of crop species grown	2.050	2.115	0.06
Livestock diversity	Number of livestock species reared	2.156	1.868	−0.29***
Market distance	Distance to the market (km)	26.377	34.654	8.28***
Off-farm income	Members engaged in off-farm income	2.031	1.297	−0.73***
Age	Age of household head (years)	46.531	47.822	1.29
Gender	Gender of household head (1 = male)	0.819	0.791	−0.03
Marital	Marital status of head (1 = married)	0.838	0.803	−0.03
Education	Secondary education and above (1 = yes)	0.650	0.526	−0.12***
Household size	Household size	6.781	5.971	−0.81***
Orphans	Number of orphans	0.656	0.577	−0.08
Chronically ill	Chronically ill member in household (1 = yes)	0.212	0.215	0.00
Per-capita expenditure	Per-capita expenditure	21.742	14.991	−6.75***
Arable land	Total arable land (hectares)	3.662	2.496	−1.17***
High rainfall region	High rainfall region (1 = yes)	0.550	0.363	−0.19***
No. of observations		160	827	

T-test used to compute mean differences between financially included and excluded.
*Statistically significant at 10% level.
**Statistically significant at 5% level.
***Statistically significant at 1% level.

DOI: 10.1002/jid

economic growth (Allen, Demirguc-Kunt, Klapper, & Martinez Peria, 2016; Chiapa, Prina, & Parker, 2016; Nanziri, 2016; Zins & Weill, 2016). Financial inclusion becomes particularly crucial in case of low income and marginalized groups in the society, who are often excluded from formal financial services.

The existing empirical evidence suggests that financial inclusion plays a role in improving income and reducing poverty (Bruhn & Love, 2014; Luan & Bauer, 2016; Suri & Jack, 2016; Abor, Amidu, & Issahaku, 2018) and food insecurity (Fitzpatrick, 2017; Abor, Amidu, & Issahaku, 2018), child schooling levels (Chiapa, Prina, & Parker, 2016) and health shocks (Islam & Maitra, 2012). Abor, Amidu, and Issahaku (2018) found that financial inclusion significantly reduced household poverty and increased per-capita household consumption of food and non-food items in Ghana. In their study, Suri and Jack (2016) also highlight that increased access to mobile money has increased long-term per-capita consumption in Kenya and reduced the number of households in extreme poverty. Fitzpatrick (2017) found that failure to have a bank account was correlated with food insecurity in the United States. Using data from a field experiment in Nepal, Chiapa, Prina, and Parker (2016) found that access to savings accounts among unbanked populations increased the schooling level of girls.

Results on the heterogeneous effects of microcredit on welfare tend to be mixed. Islam and Maitra (2012) found that microcredit mitigates the effects of health shocks on household consumption. However, Luan and Bauer (2016) and Li, Gan, and Hu (2011) found that the credit effects tend to favour households with favourable economic conditions, casting doubt on its role for poor households. On the other hand, Islam (2015) discovered that the welfare effects of microcredit tend to be stronger for poor households and women borrowers. Nanziri (2016) also realized that financially included women had higher welfare compared with excluded women in South Africa.

On the basis of the discussion above, we find a consensus on the positive effects of financial inclusion on welfare. One key policy question is whether the increase in financial inclusion will translate into improved welfare, in particular household nutrition and health (Abor, Amidu, & Issahaku, 2018). To the best of our knowledge, we are not aware of studies that have analysed the role of financial inclusion on household dietary diversity (HDDS) and food consumption score (FCS) among rural households in Zimbabwe. The HDDS and FCS have been validated in different countries as good proxy measures of household per-capita energy intake and used extensively for monitoring and surveillance of household economic access to food (Kennedy *et al.,* 2010; Lovon & Mathiassen, 2014).

Furthermore, there is renewed interest in understanding socio-economic inequalities in diet, nutrition and dietary patterns (Wong, Restrepo-Méndez, Barros, & Victora, 2017). Several studies reveal a consistent positive association between multiple indicators of socio-economic status (SES) and diet and nutrition in both developed and developing countries (Turrell, Hewitt, Patterson, & Oldenburg, 2003; Wagstaff, van Doorslaer, & Watanabe, 2003; Mullie, Clarys, Hulens, & Vansant, 2010; Wong, Restrepo-Méndez, Barros, & Victora, 2017). For example, Wong, Restrepo-Méndez, Barros and Victora (2017) found that low child stunting and skilled birth attendance were concentrated among the wealthier households in selected low and middle income countries. Yet we are not aware of studies that have systematically analysed the socio-economic inequalities in financial inclusion and household nutrition in a developing country context and in Zimbabwe.

In this paper, we addressed this gap in literature by examining the role of financial inclusion on nutrition among rural households. Furthermore, we investigate the socio-economic inequalities in financial inclusion and nutrition among rural households

DOI: 10.1002/jid

in Zimbabwe. Answering such questions would guide financial inclusion and nutrition programming strategies in developing countries. As discussed above, Zimbabwe provides a good case study, given that financial inclusion is increasing (Chamboko & Makuvaza, 2018) and food insecurity is still high (ZimVAC, 2016).

2 METHODOLOGY

2.1 Data

The study was conducted in two districts of Mashonaland Central province in Zimbabwe —Guruve and Mount Darwin. The two districts are implementing the Ensuring Nutrition, Transforming and Empowering Rural Farmers and Promoting Resilience in Zimbabwe (ENTERPRIZE) project as part of the DFID-Livelihoods and Food Security Programme. The project is working with diverse stakeholders to improve the food and nutrition security of at least 25 500 smallholder farmers in 16 and 29 wards in Guruve and Mount Darwin, respectively. The project has three main subcomponents (Livelihoods and Food Security Programme, 2018), namely (i) extension and advisory services, which aim to complement and strengthen existing public extension support systems; strengthen farmer to farmer extension; promote the use of mobile based extension methods; promote appropriate post-harvest and storage practices; (ii) markets and rural financing, which links farmers to viable input and output markets and promote inclusive access to formal and informal financial services, for example internal savings and lending groups; and (iii) nutrition component, which strives to increase knowledge and awareness on positive nutrition and health behavioural practices as well as facilitate for increased demand, production and consumption of diverse nutritious foods. The government, non-governmental organizations and the private sector are working together within this project. More recently, the private and non-governmental organization sectors have emerged as important alternative delivery channels for social services alongside state-run services (Sraboni, Malapit, Quisumbing, & Ahmed, 2014).

We used data collected during the ENTERPRIZE project household survey in 2015. Thirty wards were selected for the household survey (10 in Guruve and 20 in Mount Darwin). More wards were selected in Mount Darwin because the district has more project wards compared with Guruve. About 33 farm households were systematically sampled and interviewed per ward. A total of 987 rural households were randomly selected from the two districts. The study objectives, procedure, duration, voluntary participation and confidentiality of records were explained to the households and those that consented were interviewed. Well-trained research assistants administered the household questionnaire. The questionnaire collected information on household demographics; access to finance; agricultural production and extension services; input and output markets; income and expenditure; household food and nutrition security.

2.2 Measurement

2.2.1 Financial inclusion

Financial inclusion is when individuals and businesses have access to useful and affordable financial products and services—transactions, payments, savings, credit and

DOI: 10.1002/jid

insurance that meet their needs (Allen, Demirguc-Kunt, Klapper, & Martinez Peria, 2016; Zins & Weill, 2016; Duvendack & Mader, 2019). Financial inclusion is constructed as a binary variable, which is equal to one if the individual uses at least one product from the formal financial sector (e.g. financial transaction, credit, insurance, savings and investment), and zero otherwise (Nanziri, 2016; Abor, Amidu, & Issahaku, 2018). Nanziri (2016) highlights that this definition relates to financial access, financial capability and engagement with the financial system and appropriate products. The financially excluded comprise of users of products from the informal financial sectors plus individuals who do not use any form of financial product at all. It should be noted that the computation of the financial inclusion variable is fraught with measurement error. As such, our results should be interpreted with caution.

2.2.2 Household dietary diversity

The HDDS was measured using consumption of 12 food groups (cereals, roots and tubers, vegetables, fruits, meat, eggs, fish and seafood, pulses and nuts, milk and milk products, oils and fats, sugar and condiments) over the 7 days preceding the survey (Swindale & Ohri-Vachaspati, 2004; Swindale & Bilinsky, 2006; Krishna Bahadur *et al.,* 2018).

2.2.3 Food consumption score

This is a composite score based on dietary diversity, food frequency and relative nutritional importance of different food groups. The FCS is calculated using the frequency of consumption of different food groups consumed by household during 7 days before the survey. The consumption frequency of 12 food groups mentioned above is multiplied by a group assigned nutrient weights, and the resulting values are summed to obtain the FCS (Kennedy *et al.,* 2010), which is a count variable. The assigned weights for each food group are based on the energy, protein and micronutrient densities of each food group.

2.2.4 Crop and livestock production diversity

We use the number of crop and livestock species produced on a farm as the measure of farm production diversity (Jones, Shrinivas, & Bezner-Kerr, 2014). This is a simple, unweighted count measure. Second, we split and use the simple, unweighted count of species produced on a farm (crop diversity) and livestock species (livestock diversity) separately. Various studies have found that farm production diversity is positively associated with household nutrition in developing countries (Sibhatu, Krishna, & Qaim, 2015; Koppmair, Kassie, & Qaim, 2016).

2.2.5 Market access

Access to markets for buying food, agriculture productivity enhancing inputs and selling farm produce are shown to improve household nutrition (Sibhatu, Krishna, & Qaim, 2015; Koppmair, Kassie, & Qaim, 2016). The intensity of market participation has been argued as a better measure than distance as it measures the degree of commercialization (Chamberlin & Jayne, 2013). However, in the absence of adequate data to compute the intensity of market participation, distance to urban market or travel time indicators are also frequently argued as being a meaningful proxy of access to buyers and services (Chamberlin & Jayne, 2013). We used the geographic distance from the farm household to the closest market where food can be sold or bought as an indicator of market access. Sibhatu, Krishna and Qaim (2015) used a similar approach to measure market access in Indonesia, Kenya, Malawi and Ethiopia.

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2.2.6 Socio-economic status

The SES is usually measured by either education, income, wealth, deprivation or occupational status. SES is used to determine an individual or a household's social standing and is typically broken into different levels (e.g. poor, average and rich) to describe the level an individual or group may fall into (Turrell, Hewitt, Patterson, & Oldenburg, 2003; Wagstaff, van Doorslaer, & Watanabe, 2003; Wagstaff & Watanabe, 2003; Yang & Leveille, 2013; Wong, Restrepo-Méndez, Barros, & Victora, 2017). Turrell, Hewitt, Patterson and Oldenburg (2003) used separate indicators for education, occupation and household income on dietary patterns in Australia and concluded that each indicator reflects a different underlying social process and hence they are not interchangeable. Wong, Restrepo-Méndez, Barros, and Victora (2017) used the wealth quintiles derived from the asset index as a measure of SES. In this study, we created five wealth quintiles computed from per-capita expenditure.

2.3 Estimation Strategy

2.3.1 Financial inclusion and household nutrition

To investigate the relationship between financial inclusion, farm production diversification and market access on dietary diversity, we estimate the following regression models:

$$HN = b_0 + b_1\text{Financial inclusion} + b_2\text{Farm production diversity} + b_3\text{Market access} + b_4 I + b_5 H + \varepsilon \quad (1)$$

where HN is the nutrition outcome (i.e. dietary diversity and food consumption); I and H are the vectors of individual and household characteristics, respectively; b_i is the parameter to be estimated and ε is an error term. The parameters b_1, b_2 and b_3 capture how financial inclusion, production diversity and market access are correlated with household nutrition, controlling for a set of observable individual and household characteristics. In the extended model specifications, we split farm production diversity into crop and livestock diversity and assess their separate roles on dietary diversity as follows:

$$HN = b_0 + b_1\text{Financial inclusion} + b_2\text{ Crop diversity} + b_3\text{ Livestock diversity} + b_4\text{ Market access} + b_5 I + b_6 H + \varepsilon \quad (2)$$

In Equation 2, our key parameters of interest are b_1, b_2, b_3 and b_4 which capture how financial inclusion, crop and livestock diversification and market access are correlated with nutrition. A positive and significant estimate for b_1,b_2,b_3 and b_4 implies that financial inclusion, crop and livestock diversification and market access are associated with higher nutrition outcomes. The dietary diversity is a count variable that can take values between 1 and 12 (or between 1 and 9 when only including the healthier food groups) and is not normally distributed. We used Poisson and negative binomial regressions for estimating the household dietary diversity and food consumption models, respectively. The Poisson model for household dietary diversity fits the data reasonably well because the

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goodness-of-fit χ^2-squared test is insignificant (543, $p > 0.05$). For the food consumption, the goodness-of-fit χ^2-squared test (5410, $p < 0.001$), is statistically significant indicating that the data do not fit the Poisson model well. Hence, the negative binomial regression that is suitable for over-dispersed data is used for food consumption and Poisson for the dietary diversity model (Cameron & Trivedi, 2010). Robust variance estimator is used to obtain correct standard errors for model coefficient estimates in both models (Wilber & Fu, 2010). For both Poisson and negative binomial regression models, we compute the incident rate ratios (IRRs) and their 95 per cent confidence intervals. An IRR of one or greater shows a positive effect while less than one denotes a negative relationship. The IRR is interpreted as per cent change in expected count, thus by what percentage the dietary diversity score change when the explanatory variable changes by one unit (Long & Freese, 2014).

2.3.2 *Socio-economic inequalities in financial inclusion and nutrition*

We employ the concentration indices that are extensively used in the measurement of socio-economic-related health inequality (Wagstaff, van Doorslaer, & Watanabe, 2003; Wagstaff & Watanabe, 2003; O'Donnell, O'Neill, van Ourti, & Walsh, 2016). Concentration indices measure inequality in one variable over the distribution of another. In this study, we investigate the socio-economic inequalities in financial inclusion, HDDS and FCS. The standard concentration index can be specified as follows (Wagstaff, van Doorslaer, & Watanabe, 2003):

$$\text{Concentration index} = \frac{2}{N\mu}\sum_{i=1}^{n} Y_i R_i \; - \; 1 \; - \; \frac{1}{N} \tag{3}$$

where Y_i represents financial inclusion, HDDS or FCS for the ith household, μ represents the mean for the dependent variables, $R_i = {}^{1}/_{N}$ is the rank of the household in the SES distribution, with $i = 1$ representing the lowest ranked household (i.e. the poorest) and $i = N$ for the highly-ranked household (i.e. wealthiest). The concentration index is often written in a more convenient way as follows:

$$\text{Concentration index } (Y) = \frac{2}{\mu} Cov(Y, R) \tag{4}$$

In Equation 4, concentration index (Y) depends only on the covariance between the outcome variable (financial inclusion, HDDS and FCS) and the household rank in the SES distribution and not on the measure of SES itself. The sign of concentration index (Y) represents the direction of concentration index with the index itself ranging from−1 to+1. In the absence of inequality (perfect equality), the index is zero, thus financial inclusion, HDDS or FCS is equally distributed in the population (i.e. no SES-related disparities). A value of −1 implies that disparities are concentrated in the poor households (i.e. pro-poor) while a value of +1 show that inequalities are concentrated in the richest households. The standard concentration index is used for analysing inequalities in HDDS and FCS.

Wagstaff (2005) notes that in the case of a binary outcome variable—financial inclusion, the computed concentration index might not only exceed the −1 and+1 boundaries but also violates key properties like the 'mirror property'. In this study, the mirror property states that inequality indices of financial inclusion and exclusion are mirror images of each other (Kjellsson & Gerdtham, 2013). In other words, we should expect to get the same

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magnitudes when measuring financial inclusion or exclusion with only the difference being the sign. Thus, we adopt the corrected concentration index for analysing inequalities in financial inclusion as suggested by Erreygers (2009) which addresses some of the shortcomings of the standard concentration index. The corrected concentration index by Erreygers (2009) can thus be expressed algebraically as follows:

$$E(Y_i) = 8 \times Cov(Y, R) \tag{5}$$

where Y_i is financial inclusion, $E(Y_i)$ is the corrected concentration index and concentration index (Y_i) is as defined in Equation 4.

3 RESULTS

3.1 Descriptive Results

Mobile money is increasing rapidly in developing countries and has the potential to contribute to financial inclusion. Overall, 69.40 per cent of the households in our sample have used mobile money. Of these 685 households, those using Ecocash provided by Econet consisted of 80.15 per cent; 14.74 per cent used Telecash provided by Telecel and 5.11 per cent used Netcash provided by Netone. Among those using mobile money, the main services included receiving remittances (42.77 per cent); payment of services (24.53 per cent); receiving payments (17.96 per cent); banking money (10.22 per cent) and others (4.53 per cent). Table 1 shows the descriptive statistics according to financial inclusion status. About 16 per cent of the survey sample were financially included. The low financial inclusion in the two districts can be because of the past inflationary environment that occurred in the past decade in the country. Formal financial institutions in Zimbabwe and other developing countries tend to avoid rural locations and to discriminate against low income earners. In addition, the conversion of the Agricultural Finance Corporation into the Agricultural Bank of Zimbabwe also increased financial exclusion of farmers. The rural finance component of the ENTERPRIZE project is working on financial literacy education programmes, village savings and loans and other financial interventions to expand financial inclusion in smallholder farming areas. The dietary diversity and FCS for financially included households is significantly higher than that of the excluded. Hence, households that are financially included consume more food than their counterparts. Financially included households rear more livestock species compared with those excluded. To measure household health status, we used the number of orphans and presence of chronically ill members in the household (Robertson *et al*., 2012). Financially excluded households are located further away from the market compared with those that are included. This means that farmers in financially excluded households incur higher travel costs to the market and this can potentially lower the budget available for purchase of diverse and nutritious foods from the market. Households facing such constraints may be considered autarkic and may only consume what they produce due to high transaction costs (Pellegrini & Tasciotti, 2014). Many smallholder farmers in developing countries complement their farm income with off-farm income where opportunities do exist (Sibhatu, Krishna, & Qaim, 2015). Off-farm income is measured as the number of household members engaged in off-farm income activities. Cash income from off-farm activities increase the households' ability to buy diverse foods from the

DOI: 10.1002/jid

market and consequently increases dietary diversity. Households that are financially included have more members engaged in off-farm income activities than those excluded.

3.2 Socio-Economic Inequalities in Nutrition and Financial Inclusion

3.2.1 Household nutrition, financial inclusion and socio-economic status

It might be that household nutrition is positively linked to the household SES. To investigate this, we looked at the proportion of households in each wealth quintile by dietary diversity and food consumption category.

Dietary diversity tertiles. Because there are no universal cut-offs points for categorizing households according to their HDDS, the sample distribution was divided into HDDS tertiles that were characterized as low (0–5), moderate (6–7) and high (8–12) dietary diversity score (Pauzé *et al.,* 2016). Figure 1 shows that 37 and 26 per cent of the households in the poorest and poor wealth quintiles were categorized as having low dietary diversity. Over 50% of households in the rich and richest wealth quintiles have higher dietary diversity. Dietary diversity is low in poor rural households and increases with an increase in SES.

Food consumption status. The household food consumption status was based on the three thresholds of the FCS set according to assumptions of a dietary pattern (Lovon & Mathiassen, 2014). A score below 21 reflects a household that is not expected even to eat staples and vegetables daily and therefore is considered to have poor food consumption. Households, with scores between 21 and 35, are assessed as having borderline food consumption, and a score above 35 reflects a household with daily staple and vegetable consumption as well as oil and pulses four times a week, which is considered an acceptable minimum for an adequate diet (Lovon & Mathiassen, 2014; Leroy *et al*., 2015).

Figure 2 shows the food consumption status of households by socio-economic position. About 24 per cent of households in the poorest wealth quintile have poor food

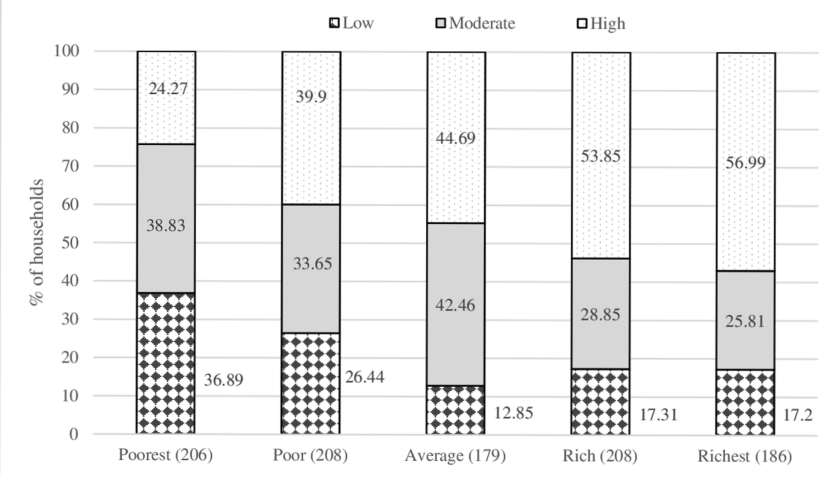

FIGURE 1. Proportion of households with low, moderate and high dietary diversity by wealth quintile

DOI: 10.1002/jid

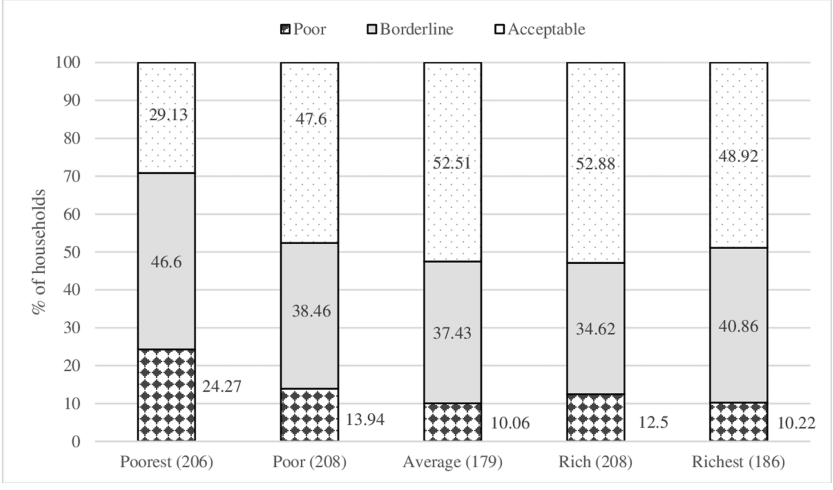

FIGURE 2. Proportion of households with poor, borderline and acceptable food consumption by wealth quintile.

consumption compared with 10 per cent in the richest wealth category. The poor and borderline can be grouped together as they are both referring to food insecure households. Cumulatively, 70% of the households in the poorest category are food insecure compared with 51 per cent in the richest category. The proportion of households having acceptable minimum diet increases as we move from the poorest to the richest wealth quintile. These results suggest that food consumption status is closely linked to socio-economic position.

We first provide the mean and range of per-capita expenditure by wealth quintile (Table 2). The mean per-capita expenditure for the richest household was US$55.77 and was higher than all the socio-economic classes. A higher proportion of financially included households is found in the richest quintile relative to the poorest. These results are in agreement with literature that reports that richer households are more financially included than poor households (Allen, Demirguc-Kunt, Klapper, & Martinez Peria, 2016). The Kruskal–Wallis H procedure is used to test the equality of the median of HDDS and FCS distributions across the five wealth groups simultaneously. The χ^2-square test results

Table 2. Financial inclusion and nutrition by wealth quintile

Wealth quintile	Mean per-capita expenditure in US$ (minimum to maximum)	Observation	Financial inclusion (%)	HDDS mean (median)	FCS mean (median)
Poorest	1.87 (0.6–2.5)	206	11.2	6.2 (6)	30.5 (28)
Poor	3.96 (2.6–5.0)	208	8.7	6.8 (7)	35.9 (34)
Average	7.28 (5.3–9.6)	179	15.1	7.4 (7)	38.1 (37)
Rich	14.38 (10–20)	208	18.3	7.5 (8)	38.4 (37)
Richest	55.77 (21–240)	186	29.0	7.6 (8)	39.6 (35)
	Kruskal–Wallis H test			χ^2-square 70.4 (p = 0.0001)	χ^2-square 46.5 (p = 0.0001)

FCS, food consumption score; HDDS, household dietary diversity.

DOI: 10.1002/jid

are significant; therefore, there is a statistically significant difference in the median HDDS and FCS between the five different wealth groups.

3.3 Econometric Results

3.3.1 Financial inclusion, production diversity and nutrition

The regression estimates for the role of financial inclusion on dietary diversity and food consumption are presented in Table 3. Financial inclusion increased dietary diversity and food consumption by 12 and 14 per cent, respectively. Farm production diversity significantly increased dietary diversity and food consumption by 5 and 8 per cent, respectively. The estimated IRRs for market access are negative and significant in the two models. A kilometre further away from the market is associated with a decrease in the number of food groups consumed and FCS. Off-farm income and education are positively associated with HDDS. Engaging in an additional off-farm income activity is associated with a 2 per cent increase in household dietary diversity. The IRR for education is positive and significant in both outcome variables suggesting that individuals that spend more years in school have a higher probability of diversifying and consuming more food. The variable for chronically ill is negative and significant in the dietary diversity model indicating that households with chronically ill members are more likely to consume few food groups. Being resident in Guruve district is associated with a 9.5 per cent increase in dietary diversity. In general, Guruve is characterized by higher crop-livestock integration and has better road infrastructure, which could possibly lower travel costs and subsequently improve nutrition.

In Table 4, we split farm production diversity into crop and livestock diversity. With this decomposition in the model, we found that the effect of financial inclusion on nutrition remained significant, hence providing evidence of the overall robustness of the model. Crop diversity positively and significantly increased dietary diversity and food consumption by 6 and 8 per cent, respectively. However, the magnitudes of the effects are smaller than those of financial inclusion. Livestock diversification positively improves the dietary diversity and food consumption by 5 and 8 per cent, respectively.

3.3.2 Financial inclusion and household nutrition by socio-economic status

The discussion on descriptive results in Section 3.2 above suggests there exist socio-economic inequalities in financial inclusion and nutrition among rural household. To statistically confirm existence of these socio-economic inequalities, we rely on concentration indices. We estimated the inequalities in the distribution of financial inclusion and household nutrition in relation to wealth (measured by per-capita expenditure) using concentration indices (O'Donnell, O'Neill, van Ourti, & Walsh, 2016). The concentration indices were calculated using a user written command, conindex (O'Donnell, O'Neill, van Ourti, & Walsh, 2016). Figure 3a–c reveals that there is no ambiguity in the distribution of financial inclusion, dietary diversity and food consumption. The concentration curves always lie below the diagonal, which indicate greater financial inclusion, dietary diversity and food consumption among those ranked higher according to per-capita expenditure.

The concentration indices (Table 5) confirm that financial inclusion, HDDS and FCS are heavily concentrated among better-off sample households identified by a higher position in the per-capita expenditure distribution. For robustness checks, we use land

DOI: 10.1002/jid

Table 3. Financial inclusion and farm production diversity on household dietary diversity and food consumption

	HDDS			FCS		
Variable	IRR	Standard error	[Confidence interval]	IRR	Standard error	[Confidence interval]
Financial inclusion	1.123***	0.037	[1.052–1.197]	1.135***	0.041	[1.058–1.218]
Farm production diversity	1.054***	0.008	[1.038–1.070]	1.079***	0.009	[1.061–1.096]
Market distance	0.999**	0.000	[0.998–1.000]	0.999*	0.000	[0.999–1.000]
Off-farm income	1.016**	0.007	[1.003–1.029]	1.011	0.007	[0.997–1.026
Age	0.998	0.001	[0.997–1.000]	1.000	0.001	[0.998–1.002]
Gender	1.058	0.046	[0.971–1.152]	1.039	0.047	[0.951–1.135]
Marital	0.944	0.043	[0.863–1.033]	1.024	0.049	[0.932–1.125]
Education	1.058**	0.029	1.002–1.117]	1.051*	0.031	[0.993–1.113]
Group membership	0.984	0.027	[0.933–1.037]	0.994	0.028	[0.941–1.051]
Household size	0.999	0.004	[0.991–1.008]	0.994	0.005	[0.985–1.003]
Orphans	0.983	0.012	[0.959–1.007]	0.987	0.013	[0.962–1.012]
Chronically ill	0.945*	0.030	[0.889–1.005]	0.998	0.032	[0.937–1.063]
Per-capita expenditure	1.000	0.000	[0.999–1.001]	1.001	0.001	[1.000–1.002]
Land size	1.004	0.005	[0.993–1.014]	1.008	0.006	[0.996–1.020]
Natural region	1.040	0.029	[0.984–1.099]	1.026	0.031	[0.967–1.090]
District	1.095***	0.030	[1.038–1.155]	1.028	0.030	[0.971–1.089]
Constant	5.704***	0.391	[4.987–6.524]	24.372***	1.735	[21.198–28.021]
lnalpha				−2.049	0.055	[−2.157 to −1.940]
Observations	975			975		

FCS, food consumption score; HDDS, household dietary diversity.
The dependent variables are household dietary diversity and food consumption score. Models were estimated with a Poisson estimator for dietary diversity and negative binomial estimator for food consumption. Incidence rate ratios (IRRs) are shown with standard errors and 95% confidence interval.
*Statistically significant at 10% level.
**Statistically significant at 5% level.
***Statistically significant at 1% level.

Table 4. Financial inclusion, crop and livestock production diversity on household dietary diversity and food consumption

	HDDS			FCS		
Variable	IRR	Standard error	[Confidence interval]	IRR	Standard error	[Confidence interval]
Financial inclusion	1.124***	0.037	[1.053–1.199]	1.136***	0.041	[1.058–1.219]
Crop diversity	1.056***	0.012	[1.033–1.081]	1.079***	0.013	[1.053–1.106]
Livestock diversity	1.051***	0.012	[1.027–1.076]	1.078***	0.014	[1.052–1.106]
Market distance	0.999**	0.000	[0.998–1.000]	0.999*	0.000	[0.998–1.000]
Off-farm income	1.016**	0.007	[1.003–1.029]	1.011	0.007	[0.997–1.026]
Age	0.999	0.001	[0.997–1.000]	1.000	0.001	[0.998–1.002]
Gender	1.057	0.046	[0.971–1.152]	1.039	0.047	[0.951–1.135]
Marital	0.945**	0.043	[0.863–1.034]	1.024	0.049	[0.932–1.125]
Education	1.058	0.030	[1.002–1.118]	1.051*	0.031	[0.992–1.114]
Group membership	0.984	0.027	[0.933–1.037]	0.994	0.028	[0.941–1.051]
Household size	0.999	0.004	[0.991–1.008]	0.994	0.005	[0.985–1.003]
Orphans	0.983	0.012	[0.960–1.007]	0.987	0.013	[0.962–1.012]
Chronically ill	0.945*	0.030	[0.889–1.005]	0.998	0.032	[0.937–1.063]
Per-capita expenditure	1.000	0.000	[0.999–1.001]	1.001	0.001	[1.000–1.002]
Land size	1.004	0.005	[0.993–1.014]	1.008	0.006	[0.996–1.020]
Natural region	1.040	0.029	[0.983–1.099]	1.026	0.031	[0.967–1.090]
District	1.096***	0.030	[1.039–1.157]	1.029	0.030	[0.971–1.090]
Constant	5.690***	0.394	[4.968–6.516]	24.362***	1.749	[21.164–28.044]
lnalpha				−2.049	0.055	[−2.157 to −1.940]
Observations	975			975		

FCS, food consumption score; HDDS, household dietary diversity.
The dependent variables are household dietary diversity and food consumption score. Models were estimated with a Poisson estimator for dietary diversity and negative binomial estimator for food consumption. Incidence rate ratios (IRRs) are shown with standard errors and 95% confidence interval.
*Statistically significant at 10% level.
**Statistically significant at 5% level.
***Statistically significant at 1% level.

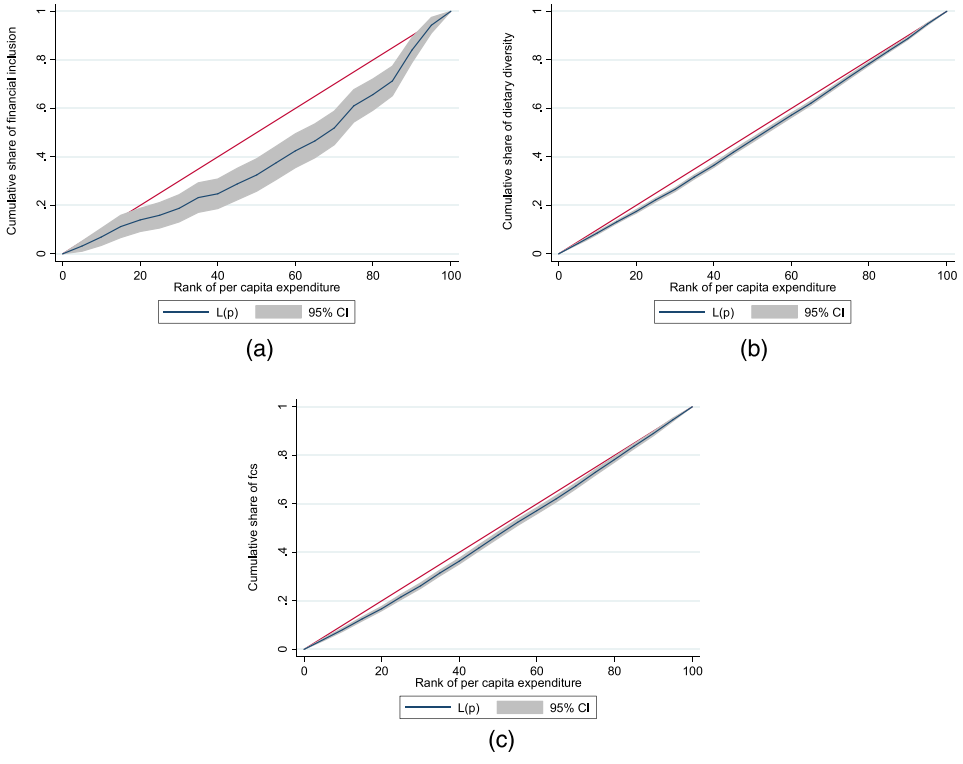

FIGURE 3. Concentration curve for (a) financial inclusion against wealth rank, (b) dietary diversity against wealth rank and (c) food consumption score against wealth rank. [Colour figure can be viewed at wileyonlinelibrary.com]

size to compute wealth inequalities (results not shown). In both specifications, our results are robust and point to the existence of wealth-related inequalities in financial inclusion, HDDS and FCS.

Table 5. Wealth-related inequalities in financial inclusion, HDDS and FCS

	Financial inclusion		HDDS		FCS	
Variable	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Concentration index	0.14**	0.03	0.04***	0.01	0.05***	0.01
Number of observations	987		987		987	

FCS, food consumption score; HDDS, household dietary diversity.
Robust standard errors adjusted for 23 wards. The Erreygers (2009) corrected concentration index used for binary financial inclusion, and the standard concentration index (O'Donnell, O'Neill, van Ourti, & Walsh, 2016) for HDDS and FCS.
*Statistically significant at 10% level.
**Statistically significant at 5% level.
***Statistically significant at 1% level.

DOI: 10.1002/jid

4 DISCUSSION

Our descriptive results show the existence of wealth-related inequalities in financial inclusion among rural households in Zimbabwe. These findings are mostly in line with previous other studies that have analysed inequalities in health care. For instance, Makate and Makate (2017) found that wealth inequalities in maternal health care use are mostly pro-rich in Zimbabwe. Econometric results suggest that financial inclusion among rural households in Zimbabwe may have a positive effect on household dietary diversity and food consumption. Crop and livestock diversification, controlling for other confounding variables, was associated with higher household dietary diversity and food consumption. Furthermore, off-farm income diversification significantly increased household nutrition. Other variables found to be strong predictors of household dietary diversity were distance to a major market and education. These summarized results are discussed in detail below.

4.1 Determinants of Dietary Diversity and Food Consumption

The estimates for financial inclusion were significant and positively associated with household dietary diversity and food consumption. Our results clearly suggest that strengthening financial inclusion should be a key element in strategies to improve diets and nutrition among rural households in the country. These resonates with earlier studies that found positive nutrition effects of financial inclusion (Abor, Amidu, & Issahaku, 2018), microcredit (Hamad & Fernald, 2012) and savings (Steinert *et al.,* 2018).

Smallholder farmers in Africa commonly produce many different crop and livestock species, for food security and risk management strategy. Indeed, recent empirical evidence from various developing countries showed that crop and livestock diversification are important strategies for improving household, women and children nutrition (Torheim *et al.,* 2004; Jones, Shrinivas, & Bezner-Kerr, 2014; Shively & Sununtnasuk, 2015; Koppmair, Kassie, & Qaim, 2016; Hirvonen & Hoddinott, 2017; Saaka, Osman, & Hoeschle-Zeledon, 2017). Jones, Shrinivas, and Bezner-Kerr (2014) and Koppmair, Kassie, and Qaim (2016) found that farm production diversity improved household nutrition in Malawi. In Mali, Torheim *et al*. (2004) found that the number of crops cultivated was positively associated with adult nutrition.

The estimated coefficients for market access were negative in the two models, suggesting that households in remoter areas have lower dietary diversity. Hence, better market access through reduced distances could potentially contribute to higher dietary diversity and food consumption (Frelat *et al.,* 2016). Off-farm income is important for regular food purchases. Promoting off-farm income diversification through the introduction of additional off-farm enterprises may increase opportunities to generate cash income and can thus even have positive nutritional effects. Similar results are reported by Sibhatu and Qaim (2017) in Ethiopia. Our econometric findings show that education of the household head contributed to household dietary diversity and food consumption. Education is likely to have a positive effect on household nutritional knowledge and skills to use nutrition messages, which consequently contribute to better nutrition (Thorne-Lyman *et al.,* 2010; Hirvonen, Hoddinott, Minten, & Stifel, 2017; Sinyolo & Mudhara, 2018).

DOI: 10.1002/jid

4.2 Socio-Economic Inequalities, Financial Inclusion, and Nutrition

The concentration indices show that financial inclusion, HDDS and FCS are heavily concentrated among richer households identified by a higher position in the per-capita expenditure distribution. Similar results were noted in other studies. Mullie, Clarys, Hulens, and Vansant (2010) found that most healthy dietary patterns were associated with a higher socio-economic position. In other related fields, Makate and Makate (2017), found pro-rich inequality in maternal health care in Zimbabwe while Wong, Restrepo-Méndez, Barros, and Victora (2017) showed pro-rich patterns in low child stunting and skilled birth attendance in selected low- and middle-income countries. Hence, there is need to promote both pro-rich and pro-poor financial inclusion and nutrition strategies to enhance inclusivity and equity.

5 CONCLUSION AND IMPLICATIONS

This study investigated the effect of financial inclusion on nutrition among rural households. A total of 987 rural households were randomly drawn from two districts of Mashonaland Central in Zimbabwe, and the data were analysed using Poisson and negative binomial regression models and concentration indices. The descriptive results indicated that financially included households had higher dietary diversity and food consumption. Wealthier households were more financially included and had relatively higher dietary diversity and FCSs than poor households.

The econometric results showed that financial inclusion was positively associated with household nutrition. Hence, enhancing and expanding financial inclusion among rural households is key to achieving the food and nutrition security goal in Zimbabwe. The public and private sectors and development agencies need to promote inclusive financial services (e.g. credit, savings, insurance and money transfers) among rural households in Zimbabwe. One possible avenue is through establishing microfinance and agency banking centres in rural areas as well as improving mobile network connectivity to facilitate efficient mobile money transfers. There is need to strengthen village savings and lending schemes in rural areas and linking them to formal financial services. Financial literacy is regarded as the first step of financial inclusion (Atkinson & Messy, 2013); hence, there is scope for increased trainings on financial literacy through the village savings and lending schemes. Financial institutions should also address the issues of consumer protection and confidence to stimulate demand for financial services.

Crop and livestock diversification had consistent and positive associations with household nutrition. Interventions and extension programmes that promote crop and livestock diversification as well as integrating crop and livestock production need to be promoted in rural areas. The estimated results also suggest that improving market access through better road infrastructure and enhancing off-farm diversification would result in improved household nutrition.

Our findings suggest the need for decision makers to consider implementing pro-poor financial inclusion and nutrition policies and strategies. Expanding agency banking, promoting off-farm income opportunities and financial literacy education programmes among poorer rural households in Zimbabwe can be very beneficial. Strategies that deliberately focus on the poor and mostly vulnerable segments of the society are important to reduce inequalities between the rich and the poor. For example, lowering transaction and

DOI: 10.1002/jid

banking fees for poorer rural households could be used to nudge poorer households to use financial services.

5.1 Limitations

This article is based on cross-sectional data that were collected at a single point in time. This has limitations in that we cannot account for seasonality in diets. The survey has data on whether the household consumed different foods, but we do not have information on the quantities consumed to enable calculation of nutrient intakes. The data are based on recall method and might not accurately reflect participants' past feeding dietary habits owing to recall bias. Establishing causality with cross-section data is a challenge. Future research might need to consider use of panel data to address these shortcomings with regards to causality. The survey included a question on whether the household used any financial services in the past 12 months. This was coded as a dummy variable to measure financial inclusion. The weakness of this measure is that it fails to capture the types of financial services that households have access to. This is an area that warrants future research. Finally, the study findings are based on a livelihoods and food security programme targeting the poor and vulnerable rural households and as such our results are not nationally representative.

5.2 Robustness Checks

The fact that financially excluded households tend to be located further away from the market may be an indication that there is a systematic impact of distance on access to financial services. Distance may thus be having more impact on household nutrition than financial inclusion. In Tables 6 and 7, we include an interaction term (for financial inclusion and distance) to control for the joint impact of some variables. When the interaction term is included, our results are robust and show that financial inclusion is positively associated with household nutrition.

ACKNOWLEDGEMENTS

We would like to thank the Department for International Development (DFID), UK for supporting and funding the Livelihoods and Food Security Programme managed by Food and Agriculture Organization of the United Nations in Zimbabwe. We would like to acknowledge World Vision, Zimbabwe for giving us access to the data. We also thank the research assistants for administering the survey and smallholder rural households for providing the survey responses.

5.3 Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

DOI: 10.1002/jid

Table 6. Financial inclusion and farm production diversity and interaction term on household dietary diversity and food consumption

	HDDS			FCS		
Variable	IRR	Standard error	[Confidence interval]	IRR	Standard error	[Confidence interval]
Financial inclusion	1.104**	0.050	[1.010–1.206]	1.122**	0.053	[1.022–1.231]
Farm production diversity	1.054***	0.008	[1.038–1.070]	1.079***	0.009	[1.062–1.096]
Market distance	0.999***	0.000	[0.998–1.000]	0.999*	0.000	[0.998–1.000]
Financial inclusion*market distance	1.001	0.001	[0.998–1.003]	1.000	0.001	[0.998–1.003]
Off-farm income	1.016**	0.007	[1.003–1.029]	1.011	0.007	[0.997–1.026]
Other covariates	Yes			Yes		
Observations	975			975		

FCS, food consumption score; HDDS, household dietary diversity.
The dependent variables are household dietary diversity and food consumption score. Models were estimated with a Poisson estimator for dietary diversity and negative binomial estimator for food consumption. Incidence rate ratios (IRRs) are shown with standard errors and 95% confidence interval, same covariates as in Table 3.
*Statistically significant at 10% level.
**Statistically significant at 5% level.
***Statistically significant at 1% level.

Table 7. Financial inclusion, crop and livestock production diversity and interaction term on household dietary diversity and food consumption

	HDDS			FCS		
Variable	IRR	Standard error	[Confidence interval]	IRR	Standard error	[Confidence interval]
Financial inclusion	1.105**	0.050	[1.011–1.208]	1.122**	0.054	[1.021–1.232]
Crop diversity	1.056***	0.012	[1.033–1.080]	1.079***	0.013	[1.053–1.105]
Livestock diversity	1.052***	0.012	[1.028–1.077]	1.079***	0.014	[1.052–1.106]
Market distance	0.999***	0.000	[0.998–1.000]	0.999*	0.000	[0.998–1.000]
Financial inclusion*market distance	1.001	0.001	[0.998–1.003]	1.000	0.001	[0.998–1.003]
Off-farm income	1.016**	0.007	[1.003–1.029]	1.011	0.007	[0.997–1.026]
Other covariates	Yes			Yes		
Observations	975			975		

FCS, food consumption score; HDDS, household dietary diversity; IRR, incidence rate ratio.
*Statistically significant at 10% level.
**Statistically significant at 5% level.
***Statistically significant at 1% level.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.