Household Resilience to Food and Nutrition Insecurity during COVID-19 in Tanzania

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Abstract We examine food and nutrition security and the household’s ability to respond adequately to shock and stressors during the COVID-19 pandemic. Specifically, we assess household resilience to food insecurity and its relation to future food security. We use two survey rounds collected during the pandemic – before and after the second wave of the pandemic – from the vulnerable population living in slums in Tanzania. The findings reveal that many households have low resilience to shock. We find that COVID-19 reduced access to food in 68% of the households and left about 30% without any food to eat. We also find that micronutrient consumption significantly declined among households who reported food insecurity following the second wave of COVID-19. We also find that the probability of experiencing food insecurity reduced with the initial resilience level. High resilient households have a higher likelihood of maintaining or diversifying more their diets even when are exposed to shock. The disruption of income-generating activities was found as a leading pathway through which COVID-19 affected household food security. The findings suggest that with persisting COVID-19 pandemic and the low level of micronutrients consumption, the nutrition of children and adult household members of the vulnerable population is at stake.

Keywords COVID-19 · Food and nutrition insecurity · Household resilience · Tanzania

Introduction

In recent years, building resilience has received growing recognition as an important risk reduction channel for food insecurity and featured prominently in policy debates (HLPE, 2020). Globally, a few studies have been conducted to understand household’s resilience to food insecurity during weather and natural disasters shocks (Clare et al., 2018; Kebede et al., 2016), but less is known in the context when such a shock is a result of a pandemic like COVID-19. Evidence suggests that resilient households can recover their consumption levels after the shock and avoid the damage associated with food insecurity (Kebede et al., 2016). The emerging literature on the impact of COVID-19 broadly agrees that the pandemic has increased food insecurity in different parts of the world (Béné,
2020; Caballero-anthony et al., 2020; Devereux et al., 2020; Leonardelli et al., 2021). The poor and vulnerable groups have suffered the most during COVID-19. Their food security has been severely damaged because of the induced disturbances in the accessibility, utilization and stability of the global food system (Laborde et al., 2020). On a global scale, WFP (2020) predicted that COVID-19 could double the number of food-insecure people to 265 million by the end of 2020 from 135 million in 2019. Similar evidence is generated from simulation studies and macroeconomic indicators (Maliszewska et al., 2020; Sumner et al., 2020). In Sub-Saharan Africa (SSA), Teachout and Zipfel (2020) predicted that following the first wave of the pandemic, in 8 weeks of lockdown 9.1% of the population in the region was pushed into extreme poverty and 31 million adults and 3.6 million children under the age of five became severely food insecure. The country-specific studies in SSA also support the above predictions (Arndt et al., 2020; Kansiime et al., 2021).

Moreover, while most of the available evidence on the negative impact of COVID-19 is established in lockdown contexts (Abay et al., 2020; Arndt et al., 2020; Hirvonen et al., 2021; Julius et al., 2020; Teachout and Zipfel, 2020), there is limited empirical evidence on the impact of other restriction measures that led to the disruption of the food supply chain with implications on food availability and purchasing power of the vulnerable net-buyers in the urban areas (Arndt et al., 2020; Barman et al., 2021). It is also not clear how the poor in developing countries adjust and respond to COVID-19 shock or stresses.

Tanzania is among the few countries in Africa that instead of locking down its economy, it implemented several protective measures such as limiting international mobility, prohibiting gatherings and closure several social and economic income-generating activities. Such measures might have led to a loss of jobs, reduced sales, reduced salaries and wages, more so to households living in urban areas, and consequently reduced their incomes. With dependency on cross-border trade, imposed border restrictions have significant implications on the overall welfare of the majority of urban poor. In the absence of safety net programs, a reduction in household income has devastating effects on poor households’ food security.

Drawing on the experiences in other economic settings, Tanzania should be concerned about food insecurity and its dynamics during COVID-19. The country is hit at a time when malnutrition and hunger are major challenges. Before and shortly after the onset of the COVID-19, around 1,000,000 people in Tanzania were indicated to experience severe food insecurity. Nearly 500,000 people in the selected regions were projected to be in a crisis, and 1,845,800 people were in a stressed situation between May and September 2020 (WFP, 2019). In line with WFP (2020), these figures could rise because of the disruptions the pandemic has caused the economy. The capacity of the Tanzania social protection program is constrained (World Bank, 2018), increasing the need to understand food insecurity dynamics and the household resilience in the face of COVID-19 to generate evidence to inform policies to support the poor. The knowledge of the resilient capabilities of the households and the role it plays in future food security is key for early action.

In this paper, we examine household food and nutrition insecurity dynamics during COVID-19. We also examine household resilience to food insecurity and how it is linked to future food security. We use data from two rounds of surveys collected in December 2020 and April 2021 from households living in slums in urban Tanzania. Owing to the lack of data before the outbreak of COVID-19, we are not intending to make any causal inference instead we are interested in the dynamics during the pandemic and how households cope with the shock. This paper adds to the growing literature on the impact of COVID-19 on food security in a non-lockdown context. It also extends the current literature on household resilience to food insecurity. Our analysis is mainly descriptive and supported with few regressions. The descriptive results show that COVID-19 reduced food availability in 68% of the households and left about 30% without any food to eat. Furthermore, the results show that many households have low resilience to shock, making them vulnerable to pandemic shock. The regression results indicate that the probability of experiencing food insecurity reduced with the initial resilience level. We also find that high resilient households have a higher likelihood of maintaining or diversifying their diets even when exposed to shock.
Data and Key Variables

Data

The data used in this study came from the two rounds of surveys collected in urban areas of the Dar es Salaam region in Tanzania between December 2020 and April 2021. Two districts, Ilala and Kinondoni, and two wards—Mwananyamala and Buguruni from these districts were respectively randomly selected using a multi-stage sampling design for the survey. The areas surveyed constitute the vulnerable urban households living in slums. The first round of the survey took place in December 2020 and covered 408 households. Of these, 300 households were tracked in the second round of the survey, which took place in April 2021. The first round of the survey involved field visits with face to face interviews while the questionnaires during the follow-up round were administered through mobile phone interviews. The data collected in the second round allow us to assess the implications of the second wave of COVID-19 that occurred in early January 2021, conduct dynamic analysis and assess the role of resilience during the pandemic.

A short questionnaire format—the Resilience Index Measurement and Analysis (RIMA) developed by FAO (2018a) with a slight modification was used to gather information on household food consumption and variables for constructing the resilience index. Similarly, we collected information on food consumption based on the seven-day recall. In line with WFP (2015), we also collected information on the frequency of consumption for each food in the food groups.

In the questionnaire, we also included questions in the Likert scale to assess a household’s resilience to food insecurity based on subjective measures. We collected information on households’ perception of their capacity to: adapt to shock, recover from shock within six months, and be prepared in case of re-emergence of the second wave of COVID-19 infections. We also collected detailed information on households’ perceptions of the severity of the pandemic and their coping strategies.

Measures for food security and resilience

We constructed a measure of food security – Household Diet Diversity Score (HDDS) – by summing food groups of each food consumed by the household in the last seven days. To measure resilience, we used the quantitative objective resilience measurement approach – RIMA, developed by FAO (2016) to construct the household Resilience Capacity Index (RCI). RCI is helpful to perform a dynamic analysis of resilience. A detailed discussion of the construction of the RCI is found in (FAO, 2016, 2018b). RIMA has an advantage in that it allows comparison across households. However, RIMA relies on the predefined resilience dimensions and standardized indicators, making it challenging to capture the context-specific nature of resilience (Jones et al., 2018). To account for such limitations, we complement RIMA with the subjective measures for resilience. The subjective measure is regarded as an alternative or complementary approach to objective measures (Béné et al., 2016; Seara et al., 2016). Instead of choosing resilient capabilities for the household, the respondents were asked to self-evaluate and identify appropriate capabilities.

Model specification and estimation strategy

Estimating the role of RCI on Food Security

We begin specifying the model by assuming that food security is a function of RCI and other explanatory variables that affect food security but do not affect RCI. To this end, our model is as follows:

\[ Y = f[RCI(X_1, X_2, \ldots, X_m), X_{m+1}, X_{m+2}, \ldots X_n] \]  

where, \( Y \) is an outcome variable for food security—a dummy indicating whether the household experienced a loss or gain in diet diversity following the shock. Variables \( 1, \ldots, m \) are correlates of resilience that are specific to the household or individual and \( m + 1, \ldots, n \) are variables affecting \( Y \) but not RCI.

To estimate the impact of household resilience on food insecurity on future food security, we estimate the following logit model.

\[
\Pr(Y_h = 1) = \beta_1 RC_{h,t-1} + \beta_2 X_{h,t-1} + \beta_3 Z_h + \epsilon
\]
where, \( Y_h = 1 \) if a household experience a food loss (gain), \( RCI_{h,t} \) is a resilience index for the household \( h \) at time \( t \), \( X_{h,t} \) is a vector of time-variant covariates, and \( Z_h \) is a vector of time-invariant covariates. To estimate Eq. (2), we use a balanced sample of households interviewed before and after the second wave of COVID-19.

**Results**

Descriptive results

*Impact of COVID-19 on food security*

To understand the impact and severity of COVID-19 on the vulnerable urban poor, we asked respondents how they were affected. We also asked their perceptions of the severity of the effect at the household and community levels. Evidence suggests that topics such as severity, while can be quantified, the subjective rating can offer an in-depth understanding of the problem (Rammstedt, 2009). Figure 1 shows that about 75% of the household were affected by COVID-19. COVID-19 had a severe socio and economic impact in 66% of the households. Nearly 25% of these households acknowledge that the pandemic had the most severe impact. 9.1% of the households reported that they were not much affected by COVID-19.

Regard the impact of the pandemic in the community, 80% believed that their community was severely damaged.

Figure 2 presents the impact of COVID-19 on food security and other socioeconomic dimensions. As can be seen, food security is proportionately more affected by the COVID-19 than other household’s socioeconomic dimensions. The pandemic reduced food availability in 68% of the households and left about 30% without any food to eat. To cope with the impact of COVID-19 to survive or restore their regular eating pattern, dietary change emerges as a major coping mechanism by many families (more than 60%), with borrowing showing the least used option. Only 35% of the households borrowed or received help from relatives and friends to support their families. The less reliant on borrowing describes the credit constraint nature of vulnerable households in Tanzania, in particular, and developing countries in general (Martin & Walsh, 2020; Winter-Nelson and Temu, 2005).

The households were also asked to rate their current level of food (in)security with reference to April, 2020 and June, 2020 during the onset of COVID-19 and when economic disruptions were at the peak. Figure 3 shows that close to half (51%) of the households reported worsening food security situation. Moreover, 33% of these households reported experiencing food insecurity in the last seven days. 42% of the households have the feeling that their food security status

**Fig. 1** Households’ perception of the severity of COVID-19 shock

The most serious problem

one of the serious problem

A minor problem

not at all a problem

- 24.7
- 41.6
- 9.1
- 24.7

0 20 40 60 80 100

percent

- 32.2
- 59.4
- 7.7
- 0.7

0 20 40 60 80 100

percent

- The most serious problem
- one of the serious problem
- A minor problem
- not at all a problem
during COVID-19 has not changed; of these households, 22% continuing battling with food insecurity in the current period. Only 7% reported an improved food security situation throughout the pandemic, with a small proportion (2.7%) indicated at least a day of worries that their households would not have enough food.

A combined effect of pandemic shock and food insecurity could be linked to the increased depression reported by 44% of the households in Fig. 2.

The potential channels of the impact of COVID-19 on food security are through the disruption of livelihood activities. Figure 2 shows that 42% of the households engaged in business experienced reduced sales, while 36% closed their business. This has a profound implication on the poor urban household’s earning, given the high proportion of them engaging in small informal businesses. With reduced income, households compromise the quality and quantity of food consumed, as evidenced by their adopted coping strategies.
mechanisms. 19% of the working class lost their jobs because of COVID, and 23% had their salary cut.

**Household current food security**

To assess how households have been fairing during COVID-19, we collected information on the type of food a household ate in the last seven days and constructed HDDS. We assess the potential heterogeneity in HDDS level across households’ socioeconomic characteristics; male and female headed households, levels of education and households reported affected by COVID-19 and not (Fig. 4). Overall, households have a high level of diet diversity, as indicated by an average score of 8 food groups and above. Male headed households appear to have higher average scores than female headed. Similarly, households headed with more educated individuals have higher diet diversity than households whose heads are less educated or not educated. Households not affected by COVID-19 have an average higher score (about 9 food groups) than 8.7 food groups consumed by affected households.

To further check the diet diversity, we adapt Swindale and Bilinsky (2006) recommendations to identify households with inadequate diet diversity if they have less than the average upper tercile diversity. The results presented in Fig. 5 indicate that 42% of the households have an insufficient level of diet diversity. For comparison purposes, we follow Cheteni et al. (2020) and classify households into three levels of food insecurity based on the HDDS: high food insecure (≤ 3 food groups), moderate food insecure (≥ 4 and ≤ 5 food groups), and food secure (≥ 6 food groups). Figure 5 shows that 18% of the households are severely food insecure, 28% are moderately food insecure, and 52% are food secure.

Nevertheless, HDDS only measures whether a specific food group was consumed and do not consider the frequency consumption of a food group (Leroy et al., 2015). To get more insight, we compliment the HDDS with food frequency analysis and report the results in Table 1. Most households in the sample consumed micronutrient-rich food less frequently; a significant number consumed none (Table 1 and Appendix Fig. 9). Energy-rich foods such as cereals are consumed more frequently than food rich in micronutrients such as fruits. On average, cereals are consumed about six times a week in male and female headed households. Vegetable is the second with an average consumption of about five times a week. The higher frequency consumption of vegetables reflects the poverty nature of the households under investigation. Vegetables are relatively cheaper at the local markets and used as a substitute for high priced Animal Source Foods (ASF). ASF is the least frequently consumed food group among the interviewed households. Despite its low consumption, ASF is relatively

![Fig. 4 Mean household diet diversity score by socioeconomic status](image-url)
more frequently consumed among male headed households than in female headed households, with a significant difference observed in meat.

Moreover, the HDDS do not account for the portion size of the food consumed and could lead to overestimating the intake of a particular food or food

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**Table 1** Average number of days of consumption of a specific food group by household headship

|                      | Cereals | Meat | Fish | Dairy | Vegetable | Fruits | Beans | Nuts | Eggs | N  |
|----------------------|---------|------|------|-------|-----------|--------|-------|------|------|----|
| Male headed household| 5.95    | 1.19 | 2.13 | 0.82  | 5.37      | 1.79   | 4.05  | 2.07 | 0.35 | 256 |
| Female headed household| 6.3    | 0.9  | 2.1  | 0.64  | 4.97      | 1.89   | 4.37  | 2.44 | 0.21 | 149 |
| Difference (male–female) | − 0.35* | 0.29* | 0.02 | 0.18  | 0.40      | − 0.10 | − 0.318 | − 0.36 | 0.133 |    |

**Fig. 5** Proportion of households with adequate and inadequate diet diversity

**Fig. 6** The household food security status in the last seven days

|                           | percent |
|---------------------------|---------|
| Rely of less preferred food| 71.1    |
| Limit variet of food eaten| 73.8    |
| Limit portion size at meals time| 70.4    |
| Reduce number of meals    | 81.2    |
| Restrict consumption by adults| 52.3    |
| Borrow food, or rely on help| 34.6    |
| No food of any kind in the hh| 29.4    |
| Go whole day without eating| 15.1    |
groups (Ruel, 2003). We complement HDDS with the subjective self-evaluation of the household food security in the last seven days to capture the psychosocial part of food insecurity. The subjective indicators in Fig. 6 show that 81% of the household reduced the number of meals per day and 70% limited portion size at times of meals, implying fewer calories intake.

Next, we explore the dynamics of food security during COVID-19. Table 2 provides the results for food security dynamics during the pandemic by comparing the average frequency consumption of different food groups between the first and the second rounds of the survey. There is a significant decline in meat, fish, dairy, fruits and pulses consumption. On the contrary, consumption of cereal and vegetables increased in round two of the survey.

**Households resilience to food insecurity**

Table 3 presents the resilience levels of the household by their source of livelihood across quintiles. Due to the small sample in some of the livelihood categories, we grouped households engaging in agriculture, casual labour and those surviving on transfers for comparative purpose. We also obtained a small business category by combining formal and informal small business owners and combined government and private jobs to obtain salaried employment. The main limitation of the resilience index is the lack of a clear cutoff value to identify which households are resilient and not (Atara et al., 2020). Tefera et al. (2017) used the average resilience level to group individuals into resilient and not resilient categories; those that lie above and below the average value are resilient and not resilient, respectively. Ferede and Muluneh (2015) and Atara et al. (2020) categorized household into vulnerable if $\text{RCI} < 10\%$, moderately resilient if $10\% < \text{RCI} < 25\%$, resilient if $25\% < = \text{RCI} < = 50\%$) and highly resilient if the RCI is above 50%. Chamdimba et al. (2020) assessed the resilience of the household across quintiles. We adapt Chamdimba et al. (2020) to assess the proportion of resilient and non-resilient households.

Table 3 shows that many households in the business sector (39%) have low and medium resilience levels than other activities. The disaggregated results by business type (not reported) show that most of these households are from informal business. This is not surprising given its small size and low productivity, and informal business vulnerability to shocks. Salaried households also display a higher resilience level for most of the households. A combined group of agriculture, casual labour and transfer recipients is found to do better than the rest of the household.

### Table 2: Differences in consumption between the first and second round of survey

|                | Round 1 | Round 2 | Diff (Round 1-Round 2) | SE |
|----------------|---------|---------|------------------------|----|
| Cereal         | 6.863   | 6.980   | −0.117***              | (0.038) |
| Meat           | 1.180   | 0.427   | 0.753***               | (0.089) |
| Fish           | 3.497   | 3.137   | 0.360**                | (0.176) |
| Eggs           | 0.263   | 0.420   | −0.157**               | (0.064) |
| Dairy          | 0.863   | 0.087   | 0.777***               | (0.106) |
| Vegetables     | 6.657   | 6.980   | −0.323***              | (0.078) |
| Fruits         | 2.887   | 2.453   | 0.433**                | (0.182) |
| Pulses         | 4.400   | 3.700   | 0.700***               | (0.186) |
| Nut and Seeds  | 2.297   | 2.507   | −0.210                 | (0.191) |
| Sugar          | 6.237   | 4.827   | 1.410***               | (0.175) |

### Table 3: Household resilience level by their livelihood characteristics

|                | Low | Medium | High | Total |
|----------------|-----|--------|------|-------|
| Small business | 97  | 76     | 76   | 249   |
| Salaried employment | 28 | 32     | 33   | 93    |
| Agriculture and transfer recipients | 12 | 17     | 22   | 51    |
| Total          | 137 | 125    | 131  | 393   |

34.9% 31.8% 33.3% 100
in the other two livelihood activities. 43% of these households are in the higher resilience category than 35% and 30% in the salaried and business category, respectively.

While the composite resilience measure is insightful, the subjective indicators enable to capture household self-evaluation of resilience to shock based on the reason not captured by quantitative measure. Evidence suggests that psycho-social characteristics such as perceived adaptive capacity, capacity to recover and prepare for shock could be better measured by subjective ratings (Burnham and Ma, 2017; Clare et al., 2018). Figure 7 displays the respondents’ perception of the extent to which their households and community managed to recover from COVID-19 shock. 46% of the households have not yet recovered from shock but are optimistic that they will recover soon. In comparison, 24% think that they are only partially recovered and perceive that it might take longer to recover fully. 4% of the households have no hopes at all that they will recover. However, 20% reported that they have already recovered from the shock, and it did not take long. We observe similar patterns in the community perception of recovery.

In Fig. 8, we compare the building pillars of household resilience capability—capacity to recover and the capacity to adapt and prepare. The top-left displays household’s perceptions of their ability to recover from COVID-19 shock over six months. We particularly asked households to assess their ability to recover within six months in case of the re-emergence of a new wave of infections. As seen in the figure, more than three-quarters of the households indicated they are unlikely to recover. Specifically, 44% of the households perceive that they are not at all likely to recover, while 37% are not very likely to recover. When comparing these results with figures in the bottom-left, it is noticeable that about the same proportion (20%) of the households who felt that they could fully recover within six months also believes they can adapt to shock. Worthy pointing out is the relatively slightly higher proportion of the households with the feeling that they are extremely likely to change their livelihood activities in response to the shock. We observe a consistent pattern of households’ perception of their resilience in the top-right Fig. 81% described their households as unlikely that they would be well prepared in advance in case the second wave of COVID-19 takes the ground. The dynamics analysis using the second round of the survey indicates that even the households that perceived themselves as able to recover and adapt experienced a decline in consumption in some food groups (Appendix 2 Tables 5 and 6).

Regression Results

Table 4 presents the results from the logit regression of the association between the initial level of resilience and future food security. The first column shows that the coefficient of RCI on dummy variable indicating a decline in food security is negative and significant.

![Fig. 7 Households’ perception of their capacity to recover from COVID-19 shock](image-url)
The results imply that the probability of experiencing food insecurity reduced with the initial resilience level. Similar findings can be observed in the second column, where the effect of RCI on dummy variable indicating an increase in food security at a time \((t + 1)\) is positive and significant. The implication for the positive coefficient is that high resilient households have a higher likelihood of maintaining or diversifying more their diets even when exposed to shock. The results corroborate with D’Errico et al. (2018) findings in Tanzania and Uganda.

Discussion and Conclusion

Existing research shows that the vulnerable poor are disproportionately affected by COVID-19. This evidence is commonly found in the lockdown context and lacks in the non-lockdown context. This study adds to the growing literature on the impact of COVID-19 on food security in a non-lockdown context and extends the current literature by assessing household resilience to food insecurity.

We find that COVID-19 affected the food security of about three-quarter of the vulnerable households in urban Tanzania. We observed that despite a relatively higher proportion of the household having higher diet diversity scores, nearly 50% have inadequate diet diversity levels. The frequency in micronutrients rich food consumption and portion sizes are low even among households with higher diet diversity scores. On average households consume Animal Source Food (ASF) once a week despite its relevance on child and women in productive age nutrition established in the literature (Herber et al., 2020; Hoddinott et al., 2015; Iannotti et al., 2017). ASF contain high-quality

![Fig. 8 Perception of the capacity to respond to COVID-19 shock](image)
protein than plants, and it is widely linked to child growth and cognitive ability (Black, 2003; Headey et al., 2018). The consumption of the micronutrient was also found to decline between waves, given the already low consumption levels. We observe a significant reduction in meat, fish and dairy consumption in the second visit while cereal and starchy foods consumption increased.

These findings suggest that with persisting COVID-19 pandemic and the low level of micronutrients consumption, the nutrition of children and adults of the vulnerable population is at stake. If the status quo remains unchanged over the mid-term and long run, unborn infants and children under age five from poor households are unlikely to realize their full growth potential. Poor nutrition during childhood has been associated with poor adult health and poverty in adulthood (Alemán-díaz et al., 2016; Richter et al., 2015). Underweight mothers have also reported giving birth to children with growth anomalies (Currie and Moretti, 2007).

We also find that cereal and starch foods are consumed more frequently for an average of six days in female and male headed households. Although we did not collect information on the level of calories consumption, we gathered subjective responses on the impact of food security at the household level. The results show that, despite cereal being frequently consumed, a high proportion of households reported have reduced portion sizes and eating less than three meals a day, implying fewer calories. 81% of the households reduced the number of meals per day, and 70% limit portion size at times of meals. Lack of enough food in the household is even more concerning given its strong link with severe under-nutrition in children under age five and child mortality (Moradi et al., 2019; Mulu and Mengistie, 2017).

Furthermore, we observed that the interaction between COVID-19 and food security work through the disruption of income-generating activities. Households reported a reduction in sales, closure of businesses, lay off from work and reduced salary. Moreover, while the effects on food security could be expected during the early onset of a pandemic, the effect appeared to persist over a longer period. 51% of the households reported continuing worsening food security eight months after the outbreak of the pandemic. We observed that 33% of those who reported worsening conditions also experienced food insecurity in the last seven days.

Estimates from the subjective resilience responses also indicate only a fewer households that perceived themselves as able to recover and adapt to the pandemic. Many households are revealed to be less resilient to food insecurity; COVID-19 may exacerbate the undernutrition levels in Tanzania, particularly among the vulnerable households. The decline in the consumption of micronutrients observed after the second wave of COVID-19 indicates the low resilience level of households in slums to adapt to shock. Similarly, the worsening food insecurity found demonstrates the inability to recover from the shock.

Among other possible explanation for the low resilience is the lack of access to credit, transfers, social network and low social protection coverage, which are important during the pandemic to enable the poor to recover. The contribution and effectiveness of social protections such as cash transfer and food aid on household resilience have been extensively documented (Ahmad, 2013; Hidrobo et al., 2014, 2018; Ximena and Galarza, 2020). Evidence in the COVID-19 pandemic context demonstrates positive recovery of the poor households in Kenya due to the income support measures provided by the government (Nechifor et al., 2021). The importance of increasing household resilience is confirmed in our logit regression results. A higher initial resilience level reduced the probability of the household becoming food insecure while positively associated with higher diversity after the second wave of COVID-19.

These findings make a case for the provision of social protection to the households living in disadvantageous

| Table 4 | Logit results of the likelihood of experiencing a loss or gain in HDDS at time \( t + 1 \) |
|---------|-------------------------------------------------|
|         | Loss in Household Diet Diversity Score | Gain in Household Diet Diversity Score |
| Resilience Capacity Index | \(-0.208^{***}\) | \(0.514^{***}\) |
| Male headed household | \(-0.012\) | \(-0.113\) |
| Household size | \(0.057\) | \(-0.087\) |
| Household head’s years of schooling | \(-0.002\) | \(-0.154^{***}\) |
| Constant | \(14.563^{***}\) | \(-37.155^{***}\) |
| Observations | 291 | 291 |

Standard errors in parentheses
* \( p < 0.10 \), ** \( p < 0.05 \), *** \( p < 0.01 \)
areas, particularly in the urban areas where the impact of COVID-19 is likely to be higher. Tanzania already has social protection program in place; however, its coverage is very low. Extending these benefits to reach a large population, including urban poor households can potentially minimize COVID-19 impact.

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**Declarations**

**Ethical standards: approval and informed consent** The manuscript cites only published sources. No approval by an Institutional Review Board was necessary, and informed consents were not required.

**Conflict of interests** Not applicable.

**Appendix 1**

Figure 9.

**Appendix 2**

Tables 5 and 6.

**Table 5** Average difference in consumption among household that indicated higher ability to recover from shock across two rounds

|        | Round_2 | Round_1 | Diff    | S.E    | Obs |
|--------|---------|---------|---------|--------|-----|
| Cereal | 6.980   | 6.920   | 0.060   | 0.082  | 100 |
| Meat   | 0.540   | 1.180   | −0.640***| 0.176  | 100 |
| Fish   | 3.500   | 3.220   | 0.280   | 0.338  | 100 |
| Eggs   | 0.320   | 0.460   | −0.140  | 0.191  | 100 |
| Dairy  | 0.040   | 0.940   | −0.900***| 0.220  | 100 |
| Vegetables | 7.000 | 6.640    | 0.360*  | 0.209  | 100 |
| Fruits | 2.540   | 3.220   | −0.680  | 0.430  | 100 |
| Pulses | 4.140   | 3.180   | 0.960** | 0.391  | 100 |
| Nut and seeds | 2.600 | 1.920 | 0.680   | 0.442  | 100 |
| Sugar  | 4.660   | 6.620   | −1.960***| 0.392  | 100 |

![Food group frequency consumption in the last seven days (Round 1)](image_url)
Table 6  Average difference in consumption among household that indicated higher ability to adapt from shock across two rounds

|               | Round_2 | Round_1 | Diff.    | S.E      | Obs |
|---------------|---------|---------|---------|----------|-----|
| Cereal        | 6.981   | 6.925   | 0.057   | (0.056)  | 106 |
| Meat          | 0.547   | 1.094   | −0.547**| (0.257)  | 106 |
| Fish          | 3.321   | 3.151   | 0.170   | (0.375)  | 106 |
| Eggs          | 0.358   | 0.340   | 0.019   | (0.162)  | 106 |
| Dairy         | 0.094   | 0.604   | −0.509**| (0.215)  | 106 |
| Vegetables    | 6.962   | 6.396   | 0.566** | (0.256)  | 106 |
| Fruits        | 2.868   | 3.321   | −0.453  | (0.440)  | 106 |
| Pulses        | 4.189   | 3.698   | 0.491   | (0.418)  | 106 |
| Nut and seeds | 2.830   | 2.358   | 0.472   | (0.485)  | 106 |
| Sugar         | 4.509   | 6.057   | −1.547***| (0.421)  | 106 |

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