Association Between Household Food Expenditure and Household-level Dietary Diversity in Informal Urban Settlements of Nairobi, Kenya

By

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**Abstract**

The rapid increase in urbanization seen globally has led to increases in populations residing in informal settlements especially in developing countries. Living conditions in informal settlements are usually low income and often contribute to food or nutrition insecurity. However, the factors leading to food or nutrition insecurity in slums are not clear due to lack of the data for this consumer category. In this study, we used cross-sectional data collected from consumers in four informal settlements of Nairobi - Mukuru, Dandora, Korogocho and Viwandani -to assess the association between household food expenditure and nutrition security in these informal settlements. We also controlled for other factors which may have an impact on the nutrition security in slums like breadwinner gender, household income, and etc. We show that there is a significant positive relationship between household food expenditure and household dietary diversity score. However, the effect is small and demonstrates that large increases in food expenditure may only contribute to small improvements in nutrition security. Households with female primary breadwinners have higher nutrition security scores in these informal settlements than those with male primary breadwinners.

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## Introduction

By 2014, over half of the world's population (54%) was residing in urban areas and this is expected to increase to 66% by 2050 (UNDESAPD, 2014). Urbanization in Africa is taking place at a faster rate than it did in most developed countries. In 1950, the urban percent for Sub-Saharan Africa reached to the same level with some developed areas in 1850 (UNDESA 2018). However, until 2015, the urban percent for Sub-Saharan Africa was only 39% while some more developed regions had reached 34% in 1915. Urbanization has implications on the continent's economic situation as well as the food and nutrition situation. Some studies show that urbanization can reduce poverty through associated economic growth, while other research indicates that urbanization does not contribute to economic growth, while leading to environmental degradation and social problems (Turok et al., 2013).

One key indicator of Sustainable Development Goal (SDG) 11 is "proportion of the urban population living in slums, informal settlements or inadequate housing". According to UN-Habitat, the urban population living in informal settlements in developing countries has decreased from 39% to 30% from 2000 to 2014, while the absolute number continues to grow (UN-Habitat 2016). Residents of the informal settlements have inadequate access to clean water, electricity, sanitation facilities, durable housing, and secure tenure (Joshi et al., 2019). The insufficient living condition also contributes to food and nutrition insecurity for this group. According to 2014 World Bank estimates, 56% of the urban population in Kenya live in informal settlements.

The number of undernourished people in Africa reached 260 million in 2018, and more than 90% of this population live in sub-Saharan Africa (FAO 2019). Many factors contribute to the rising undernourished population in sub-Saharan Africa such as conflicting and extreme weather events, poor health care, and economic crisis. Malnutrition is severe both among children under 5 years and women in Kenya. Out of the 7 million Kenyan children under 5 years, 26% of are stunted (too short for their age) (Kenya DHS 2014). In addition, 4% of the children under 5 years are wasted, 11% are underweight and 4% overweight (Kenya DHS 2014). 26.8% of women in the reproductive age (15-49 years) have anemia and 33% are overweight or obese in 2014 (Kenya DHS 2014; WHO Statistics).

Diverse studies have been conducted on the determinants of food and nutrition insecurity both in urban and rural areas in developing countries. Haddad et al. (1999) used data from the previous 15-20 years to find out the trend of urban poverty and undernutrition in developing countries in Asia and Africa. By reviewing the literature on food security, they found that obvious increase in amount of the poverty and undernourished people are now in urban areas in many countries. Further, they stressed the importance of more research on urban poverty, food insecurity, and undernutrition. Thorne-Lyman et al. (2009) examined the association between household dietary diversity and food expenditure among households in rural Bangladesh. They also made the link between malnutrition and food price to find out the effects of the rising food price on nutrition. They found that there is a positive relationship between household dietary diversity score and mean expenditure on non-grain food groups. In addition, household with low dietary diversity score faces severe micronutrient deficiencies and child malnutrition when the major food price increases.

Most of the existing studies on determinants of nutrition or food insecurity in the urban informal settlements of Africa have focused on household characteristics and they do not assess the association between food expenditure and nutrition security. In this paper, we use both descriptive and econometric analyses to analyze the association between nutrition security and household food expenditure (share) in the informal settlements off Nairobi controlling for other factors like dependency ratio, poverty line, income, safety net, breadwinner gender, and breadwinner age, which may potentially influence nutrition security.

We expected the food expenditure/food expenditure share to be positively correlated with nutrition security. After controlling for other confounding effects, we expected that an increase in food expenditure would be associated with improved household nutrition security. Wanyama et al. (2019) used descriptive analysis and found these effects. Chatterjee et al. (2012) conducted a cross-sectional survey in urban slums to assess their food security status in Mumbai and identified that lower income and less expenditure on food monthly all contributed to severe food insecurity. Given that, we made the hypothesis that household income has a significant impact on nutrition security. Murage et al. (2014) used household income and household size as household characteristics to assess food security situation in the slums of Nairobi and found that all the aforementioned factors have significant impacts on food security in the slums. This also made us to expect variables related to household size to be significant in our analysis. Previous studies have shown that gender of the breadwinner or household head is important in determining what is consumed in the household and also how much money is used in food and other household use (Buvinić et al., 1997; Kabubo-Mariara et al., 2009; Hakeem et al., 2003). Therefore, we conducted additional analysis to find out whether there is significant difference in household income and food expenditure between households with female and male breadwinners. Safety

net programs are presumed as interventions that could help people get more access to food. Neervoort et al. (2013) found out that school feeding program can help children improve their nutrition status and some even can help household be more nutrition/food secure.

## Literature Review

### *Informal settlements in Kenya*

According to the statistics in World Bank[1], there were 53.6% of the population living in slums in Sub-Saharan Africa and 46.5% of the population in Kenya living in informal settlements in 2018. Informal settlements were used to be common in the United States and Europe, while it's now mostly found in developing countries. People in rural areas who want to migrate to urban areas but lack of money usually live in these informal settlements. This is also one of the reasons contributing to the slum formation. Living condition in informal settlements are usually not good enough. Food expenditure couldn't meet the needs for many households in informal settlements. Amendah et al. (2014) reported the coping strategies used in informal settlements in Nairobi. Their results showed that nearly 52% of the income were used on food expenditure. Copying strategies to reduce the food consumption were frequently used for some of the residents in informal settlements. Other than the reduction of food consumption, they also indicated that some households removed their children from school to reduce the expenditure. Near 70% of the interviewed households chose to eat fewer meals because of limited resources. They also pointed

[1] Statistic of population living in informal settlements in Sub-Saharan Africa from World Bank website: https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?locations=ZG
Statistic of population living in informal settlement in Kenya from World Bank Data: https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?locations=KE

that joining a safety net program had a certain probability to prevent using any coping strategies. The poor living condition also contributed to more health expenditure for the residents in informal settlements. Buigut et al. (2015) examined the determinants of catastrophic health expenditure in informal settlements in Kenya. From their results, we know that some of the residents in informal settlements may choose to reduce the health expenditure because they couldn't afford them. Murage et al. (2014) analyzed the food insecurity in informal settlements in Nairobi and pointed out several factors contributing to it. Around 85% of the households were food insecure in their research. Household size, income level, source of livelihood, and health expenditure all mentioned in their research as the factors of food insecurity. Gallaher et al. (2013) pointed out another important factor on food insecurity in residents in informal settlements in Kenya—Urban agriculture. Some residents spent over 80% of their income on food which made them more vulnerable than residents in rural areas. They introduced sack gardening in Kibera and found out that the food security was improved successfully by this new form of urban agriculture.

***Methods used in Food/Nutrition security Research***

Various methods were adopted in different researches and it depended on the topics and data they had. Oluoko-Odingo (2011) discussed several aspects related to food security like vulnerability, resilience, climate change, gender, and coping strategies using literature review. They used two different methods which are principal components analysis (PCA) and multiple regression analysis (MRA) to explore the vulnerable variables for food insecurity and compare the different results. Both primary and secondary data were used in this research to conduct

analysis. The research revealed that poverty was the main reason for food insecurity and climate change can make the situation more complicated but not the main contributor for food insecurity. Mutisya et al. (2016) did their research in a very different aspect on household education attainment by using a longitudinal data collected from 2007 to 2012. The main independent variable they used was average household education attainment which was computed as the ratio of the number of schooling years people to the number of individuals aged 18 years and above in that household. Other variables were also adopted in the model like household wealth, household shocks, food production, dependency burden, household size, duration of stay, household head gender, and study site. Except for the descriptive analysis, a random effect generalized ordered probit model was used to investigate the relationship between the household education attainment and food security. They found out a significant relationship between household education attainment and food security. More education on food security household received, the more food secure they were. Mutisya et al. (2015) did assessment on household food (in)security and nutritional status of urban poor children in two informal settlements in Nairobi. The dependent variable was height for age indicating stunting status of the children. Two primary independent variables were generated, one for household food security status and another for household asset wealth index. They used an adjusted Cox regression to do the statistical analysis. Both food insecurity and wealth status contributed to high probability of stunting among the poor children. Neervoort et al. (2013) assessed the effects of a school feeding program on slum children nutrition status in Kenya. They conducted a survey between two groups with different treatments and checked their medical health status. Children who participated in the school feeding program not only can receive lunch from the organization but also can receive some medical help like anti-worm treatment. To make the study reliable, they

also considered to control some other socio-economic determinants like adoption status, family size, age and education of the mother, and amount of meals consumed at home. By using McNemar and Pearson's chi-square tests, they got the result that the school feeding program really had a positive effect on slum children's nutrition status.

Food and nutrition insecurity research in urban slums were not only conducted in Africa. Many researches were conducted in Asia and used different methods to get significant results. Pryer et al. (2002) conducted a survey in urban slums in Dhaka to explore their nutrition and health status and try to identify groups with similar livelihood patterns. In order to avoid the co-linearity problem, they used hierarchical clustering algorithms to perform the analysis and added some normal socio-economic, demographic, and occupational characteristics into the cluster. They also used the normal variables to present the children's nutritional status which were BMI, weight-for-age Z-score; height-for-age Z-score; weight-for-height Z-score. By using the cluster analysis, they got four livelihood groups. Cluster 1 was the richest, loans and income were also the highest among the four groups, and their children had highest nutrition status. Loans, income, BMI, and children nutrition status in Cluster 3 were the lowest. Lohia and Shobha (2014) targeted slum children aged from 6 to 24 months in Mumbai to explore the association between infant and child feeding index (ICFI) and child nutrition status. Standard nutrition variables were used in this study: weight for age (WAZ), length for age (LAZ), weight for length (WLZ), MUAC for age (MUACZ) and body mass index (BMI) for age (BAZ) values and all of their standard deviation and z-scores were calculated. After controlling other variables like child characteristics, maternal characteristics, and household characteristics, they performed the multivariate regression analysis to find out the relationship between ICFI and children nutrition status. They got a significant association between ICFI and Length-for-Age z scores (LAZ) and

BMI-for-Age z scores (BAZ) and confirmed that ICFI could be a useful tool to collect information on key components of young child feeding practices. Agarwal et al. (2009) did their research in slums in North India to find out the prevalence of food insecurity on household level. Except for descriptive statistics, they used cross-tabulation to test the bivariate association of food security with variables like household socio-demographic characteristics, employment, household monthly per capita expenditure on food, and household standard living index. They also examined the net association with those variables using a multivariate logistic regression analysis. They got the results that over half of the households living in the slums in North India were food insecure and this situation was related with low income. Floro and Swain (2013) focused on the occupational choice impact's on food security in urban poor. They collected their data in 14 slums of 4 different countries: Bolivia, Ecuador, Philippines, and Thailand. They examined the correlation between household food security, gender and likelihood of a self-employed person using endogenous switching (ES) probit analysis. They discussed that the simple two-stage least square was not suitable for the analysis due to the endogenous issue. They got the results from the ES model that self-employed women who had a higher risk to be food insecurity had a higher probability to engage in food enterprise activities. They also found out that even the men and women were employed, they still didn't have sufficient earnings to deal with shocks which made them to develop their own strategies.

## Methodology

### *Study setting*

Data used in this study were collected under the Indicator Development for Surveillance of Urban Emergencies (IDSUE) project implemented by Concern Worldwide in partnership with the African Population and Health Research Center (APHRC).

The data collection was designed to assess a group of emergency indicators for the residents in informal settlements. The 4th round of the study was undertaken in four informal settlements of Nairobi, Kenya including Korogocho, Viwandani, Dandora, and Mukuru. Viwandani is located near the industrial area where its residents are youthful and can find jobs in the nearby factories. These young workers have moved from rural areas and haven't set up families in Viwandani. Korogocho is a crowded and more stable informal settlements. Residents in Korogocho have lived in for many years (Buigut et al., 2015 & Beguy, Donatien, et al., 2015). Mukuru is a fast-growing informal settlement which is also located near industrial area and full with casual labor. Dandora is known as the largest dump site and is located near Korogocho (Buigut et al., 2015). In the current study, we utilized 4th round of data collected between April 1stto May 30th, 2012 which had data on household food expenditure and consumption. The location of the four informal settlements are presented in the following five figures (From figure 1 to figure 5). From the map, we can clearly see that Korogocho and Dandora are adjacent and Viwandani located very close to Mukuru.

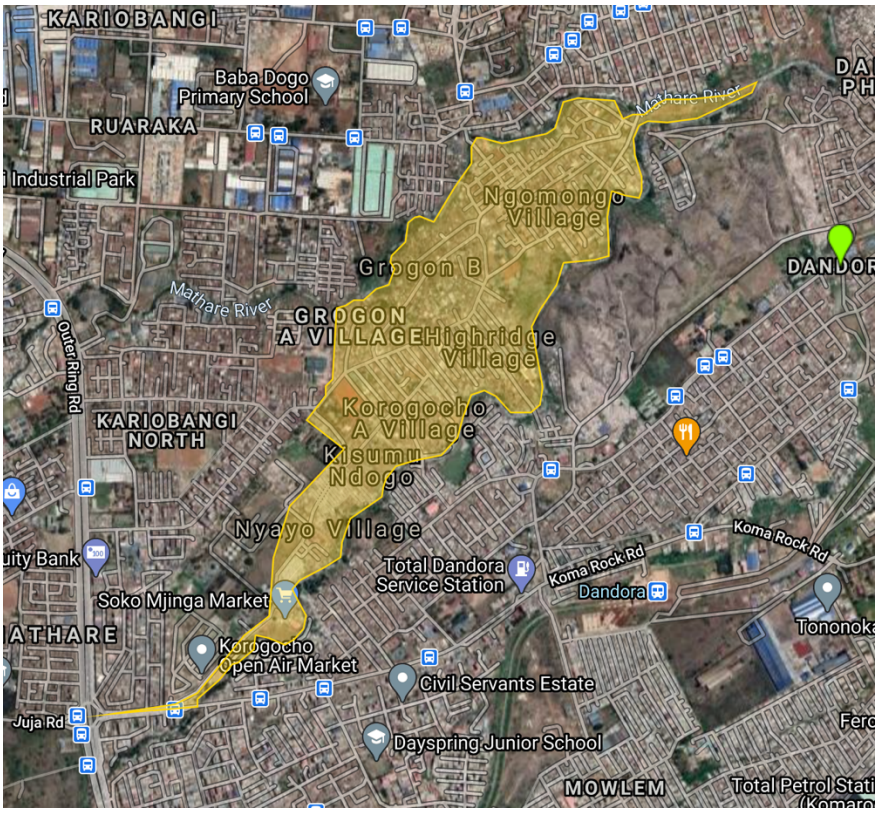


**Figure 1** Map of Korogocho Slum in Nairobi (Made by Google Maps)

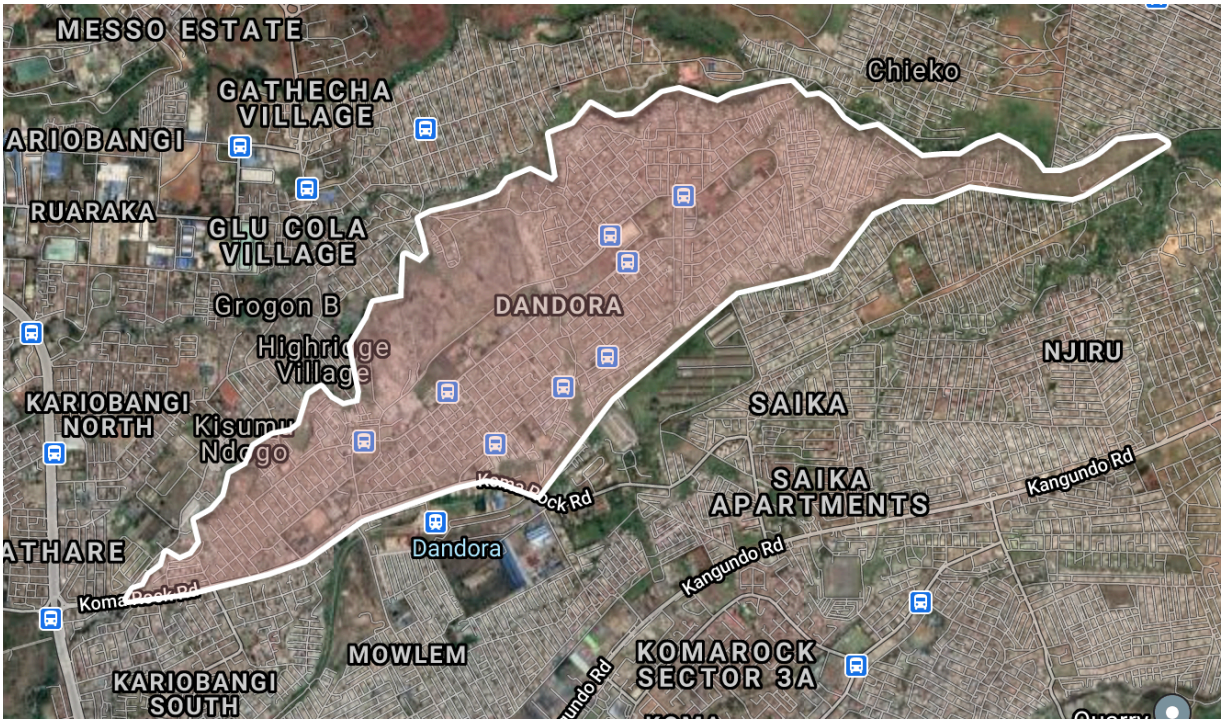


**Figure 2** Map of Dandora Slum in Nairobi (Made by Google Maps)


**Figure 3** Map of Viwandani Slum in Nairobi (Made by Google Maps)

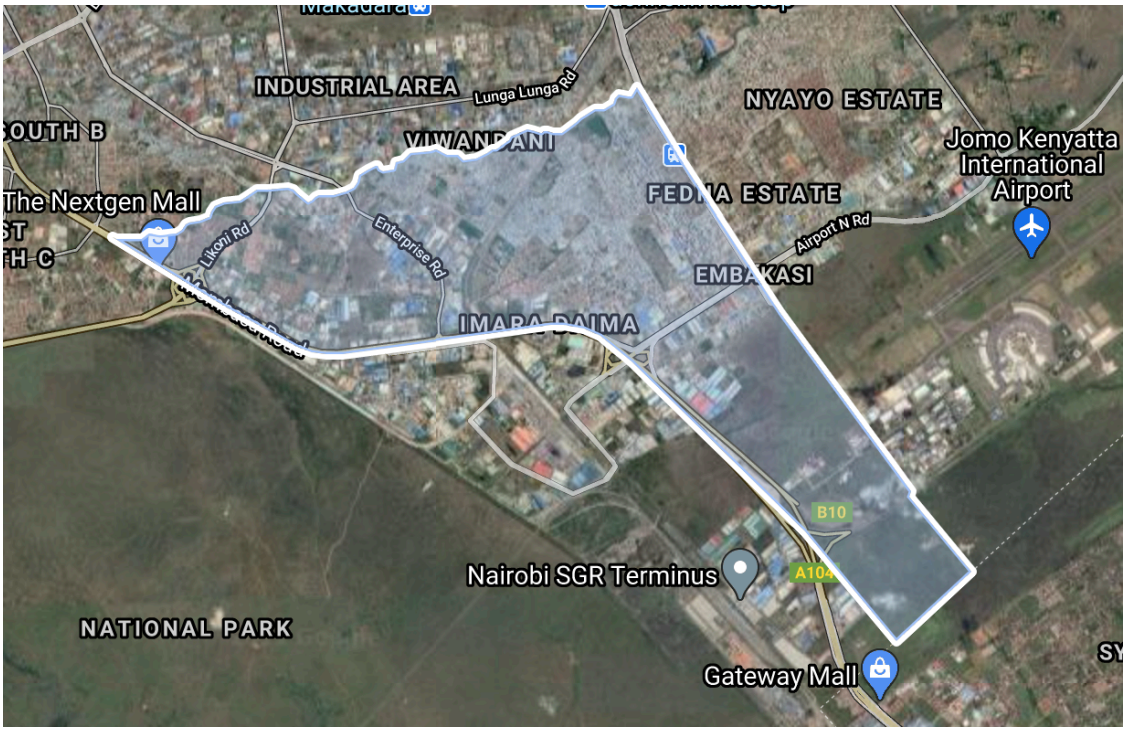


**Figure 4** Map of Mukuru Slum in Nairobi (Made by Google Maps)

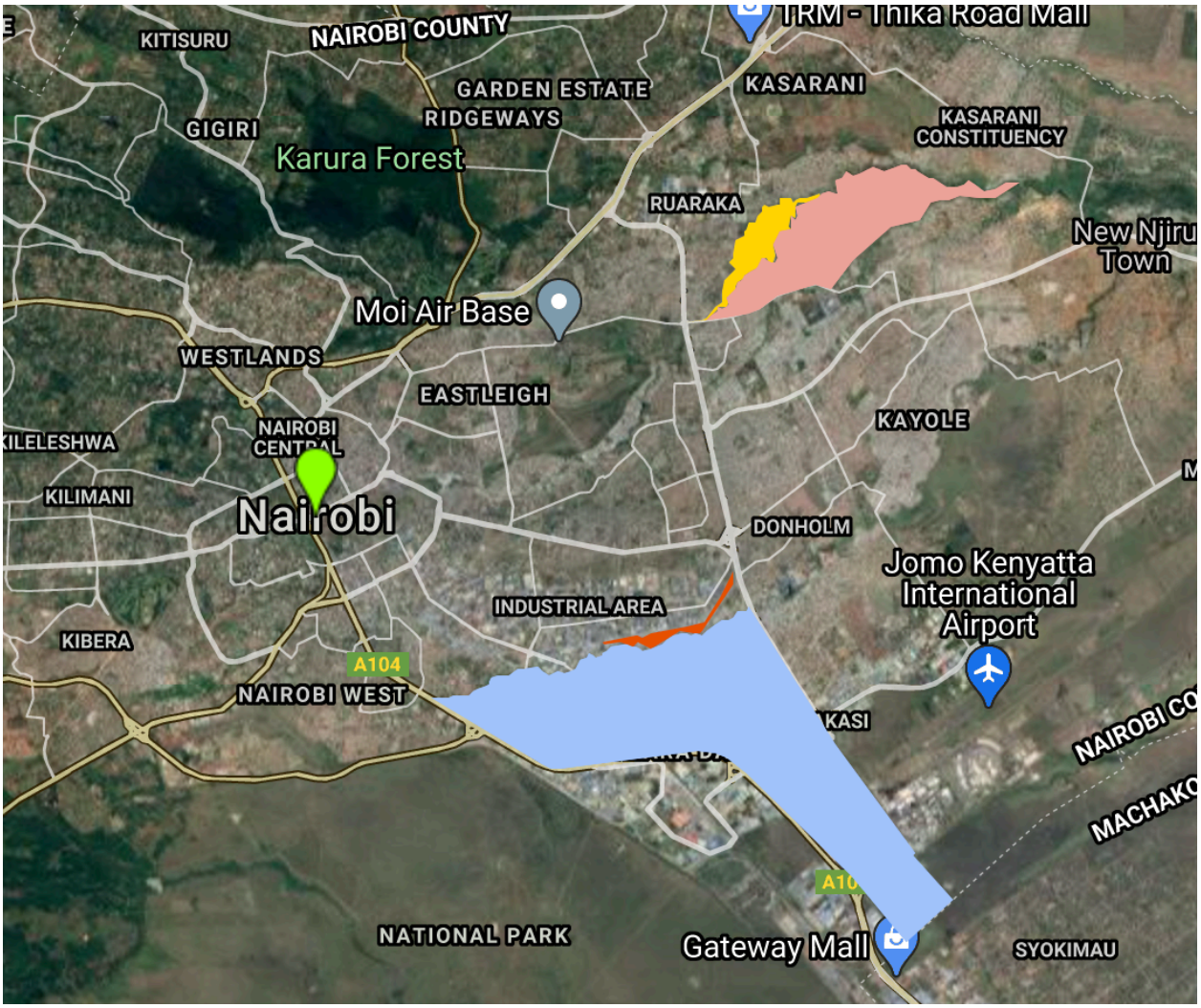


**Figure 5** Location of the four informal settlements (Yellow: Korogocho; Pink: Dandora; Red: Viwandani; Blue: Mukuru; Made by Google Maps)

The sampling methods used for the IDSUE project have been reported previously (Buigut et al., 2015). Briefly, the data were collected using a modified cluster sampling method on account of the absence of household or enumeration area listings. Each informal settlement was divided into villages with approximate boundaries and each village divided into segments of similar population size. Each segment was then given a unique identifier. Sub-segments were further

defined, with 150-200 households in each sub-segment. A random sample of sub-segments was taken and interviewed from each segment. Overall, we analyze data from 1549 households.

The questionnaire used in this project covers domains as following: household living arrangements, source of drinking water, hygiene & sanitation, food security, food consumption and expenditure, health and health seeking behavior, interpersonal relationships, personal and property security, non-food consumption & expenditure, and household livelihoods.

The household head was first approached to consent to participate in the interview. All the people participating the interview was asked to sign the consent form. Ethical approval was obtained from Kenya Medical Research Institution (KEMRI) of KEMRI Ethics Review Committee.

***Measurement approach***

- **Dietary Diversity**

Dietary diversity is often defined as the variety of food groups or food items consumed by an individual or household (Ruel 2002). Consuming a diverse diet has been associated with a higher likelihood of meeting micronutrient intake requirements, and lower risk of nutrient deficiency diseases such as anemia (Zerfu et al., 2016). More diverse diets have also been associated with improved nutritional status and growth of infants especially among the poor in developing countries (Arimond et al.,2010)

Dietary diversity can be calculated at the individual or household level. One example of a household-level measure is the Household Dietary Diversity Score (HDDS) which assesses the economic ability of a household to access a variety of foods (FAO 2011). Household-level indicators of dietary diversity have been shown to be associated with increased household per capita consumption, and caloric availability from staples as well as non-staples (Hoddinott and Yohannes, 2002). Importantly though, household-level dietary diversity metrics should not be interpreted as proxy measures of an individual's diet quality (ref Kennedy et al., 2011). Individual-level dietary diversity indicators that have been validated as indicators of micronutrient adequacy (e.g., the Minimum Dietary Diversity for Women, and the Infant and Young Child Dietary Diversity indicator (FANTA 2006; WHO 2008; FAO 2016)) may be used to this end. Nonetheless, household-level diet diversity metrics are still useful indicators of household economic access to food (Leroy et al., 2015).

We assessed dietary diversity in this study using household-level consumption data collected using a recall of all food and beverages consumed by any household member in the past 7 days (FAO 2011). The HDDS can be generated using 12 or 16 food groups (FAO 2011); however, other studies have also calculated the HDDS using 9 food groups, excluding three groups (i.e., oils and fats; sweets; spices, condiments and beverages) that do contribute strongly to the micronutrient density diets (Sibhatu et al., 2015). We calculated HDDS using 12 food groups and included an additional measure using 9 food groups for a robustness check. The nine food groups included: 1) cereals; 2) white roots and tubers; 3) vegetables; 4) fruits; 5) meat; 6) eggs; 7) fish and other seafood; 8) legumes, nuts and seeds; and, 9) milk and other milk products. The 12 food groups also incorporate oils and fats, spices, condiments and beverages. All food groups

consumed by any household member during the recall period were summed to produce these scores.

We used two ways to check the robustness of our analysis. The first one was that we added food expenditure share in our model and to check the results. Model 2 and 3 are the ones we added food expenditure share. Moreover, we used HDDS 9 to make another robustness check. Each model we conducted analyses for both HDDS 12 and HDDS 9. We ran four regressions to assess the robustness of our results. In all the analyses, we used household dietary diversity with 12 and 9 scores as the dependent variables. In all the three models we also controlled for location differences using the four informal settlement dummies.

- **Measurement of Independent Variables**

*Household food expenditure and food expenditure share* To generate the food expenditure variable, weekly food expenditure was calculated at the household level and multiplied by 4 to derived the monthly value. Household non-food expenditure was calculated by summing all non-food item costs during the recall period. Data on non-food expenditures were collected through 7-day, 30-day and 3-month recall periods, depending on the good/service and the typical frequency of purchase. Monthly non-food expenditure was summed up by four times of weekly non-food expenditure, one third of 3-month non-food expenditure, and one-month non-food expenditure. Household total monthly expenditure was calculated as the sum of monthly food and non-food expenditures. We converted the monthly income, expenditure from Kenya shilling to US dollar using the Central Bank of Kenya[2] exchange rate 1 US dollar: 83.785 Kenya Shilling

[2] Data from the website of the Central Bank of Kenya: https://www.centralbank.go.ke/statistics/exchange-rates/

as was the exchange rate during the time of survey (arithmetic mean was calculated using the monthly exchange rate of April and May in 2012).

Additionally, we used share of food expenditure share for robustness check, calculated as monthly food expenditure divided by total monthly expenditure.

- **Regression framework**

To estimate the relationship between food expenditure/food expenditure share and household diets, we used the following regression models:

$$HDDS_j = \alpha + \beta F_j + \gamma X_j + \delta F_j * G_j + \varepsilon_j \quad (1)$$

Where HDDSj is the household dietary diversity score of household $j$ (using both 12 and 9 food groups); Fj is household monthly food expenditure; Xj is a vector of socioeconomic characteristics that we control for in our analysis, such as household monthly food expenditure, breadwinner age, breadwinner gender, dependency ratio, safety net, poverty line, household monthly income (US Dollar). Fj *$G_j$ is the interaction term of household monthly food expenditure and breadwinner gender. We include an interaction term in order to check the significance of the difference between female and male breadwinners. $\alpha$, $\beta$, $\gamma$ and $\delta$ are the parameters to be estimated.

*Household monthly income* This factor was already calculated in the dataset. We directly used this variable in our models to conduct regressions.

*Breadwinner age and gender* In most cases household breadwinners are synonymous to household heads. Titus et al., (2007) found the association between food security and household

head characteristics including age, gender, and occupation. In this analysis we used breadwinner characteristics as a proxy for the household head characteristics as we did not have additional information on household heads. Both breadwinner age and gender were treated as dummy variables.

*Dependency ratio* Murage et al. (2014) used dependency ratio as one of their variables and calculated as the ratio of the number of non-working people to the number of working people. Here, we calculated our dependency ratio as the number of people under 15 divided by household size.

*Safety net* In our analysis, we used safety net program as one of our control variables to reveal its effect on nutrition security of the informal settlement households.

*Poverty line* According to World Bank, the international poverty line in US dollar for 2012 is $1.9 per person per day. We used this poverty line as a benchmark and calculated the percentage of person living under poverty line in each informal settlement.

***Mediation analysis***

Mediation analysis is a statistical way to find out the causal relationship between two variables and a third variable (Lockwood et al., 20010). It is a method used to examine third-variable effect and find out the indirect impact of the third variable on the two main variables (Fairchild and McDaniel, 2017). Fairchild and McDaniel (2017) introduced meditation analysis as a 'best (but) oft-forgotten' practice in their paper. Meditation analysis is quite widely used among nutrition research. Meditation analysis was used to better understand the effect of the

independent variable on the outcome. VanderWeele (2016) provided two different traditional method for meditation analysis: the difference method and the product method. The difference method presented the indirect effect of two coefficients as the difference of these two coefficients. While the product method interpreted the effect by doing the product of the exposure coefficient in the mediator model and the mediator coefficient in the outcome model. They also pointed out that if the mediator is fit by OLS regression and the outcome is continuous, then these two approaches will be no difference. In this analysis, we adopted the commonly used method which provided by MacKinnon and Dwyer (1993) to conduct the mediation analysis. We hope to check whether monthly food expenditure share has indirect effect on household dietary diversity score. Figure 6 represented the pathway of the potential indirect effect of the monthly food expenditure share. Accordingly, we developed equation 2, equation 3, and equation 4 to be the models used in mediation analysis. The coefficient of breadwinner fender in equation 2 is *c* which should be the total effect of the breadwinner gender on HDDS. *c'* is the coefficient of breadwinner gender in equation 3. *a* is the coefficient of breadwinner gender in equation 4 which presented the potential effect of breadwinner gender on monthly food expenditure share. *b* is the coefficient of monthly food expenditure share in equation 3. The total effect *c* should be the sum of *c'* and the product of *a* and *b*.

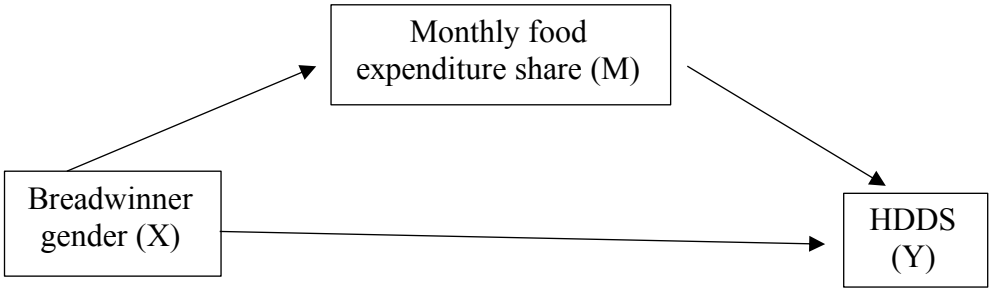


**Figure 6** Mediation analysis path diagram

$$HDDS = \iota_1 + cBreadwinner\ gender + \epsilon_1 \quad (2)$$

$$HDDS = \iota_2 + c'Breadwinner\ gender + b\ monthly\ food\ expenditure\ share + \epsilon_2 \quad (3)$$

$$Monthly\ food\ expenditure\ share = \iota_3 + aBreadwinner\ gender + \epsilon_3 \quad (4)$$

## Results

### *Descriptive analysis*

In this section, we present results of the descriptive analysis conducted for the variables mentioned in the above sections. Table 1 shows results of the socioeconomic analysis of the sampled households, for the pooled sample and for the four different informal settlements separately.

The mean household dietary diversity score across all informal settlements was 8.33 when employing the HDDS 12. When using HDDS, the mean score was decreased to be 5.73.

Overall, households spent 42% of their monthly expenditure on food. Residents in Mukuru spent the least proportion (33%) while the households in Korogocho spent 51%. Overall the studied households generated an average monthly income of USD 119.36. Residents in Mukuru had the highest average incomes (USD 140.56) and Dandora had the largest variability in incomes across households.

The average household size across the four slums ranged between 3-4 members. The majority (76%) of the breadwinners were male across the four informal settlements, with the age more

than 30 years. In the study sites, 27% of the study households were documented as benefitting from one or more safety net programs.

**Table 1** Socioeconomic characteristics of study households

| | Pooled sample (N=1549) | | Dandora (N=368) | | Korogocho (N=447) | | Mukuru (N=379) | | Viwandani (N=355) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variables | Mean | SE | Mean | SE | Mean | SE | Mean | SE | Mean | SE |
| HDDS 12 | 8.33 | 0.05 | 8.26 | 0.10 | 8.70 | 0.08 | 7.77 | 0.11 | 8.56 | 0.11 |
| HDDS 9 | 5.73 | 0.04 | 5.73 | 0.09 | 5.85 | 0.07 | 5.37 | 0.09 | 5.94 | 0.09 |
| Household size | 3.63 | 0.04 | 3.99 | 0.09 | 4.07 | 0.08 | 3.12 | 0.08 | 3.26 | 0.06 |
| Number of children under 5 | 1.45 | 0.03 | 0.83 | 0.04 | 2.33 | 0.05 | 0.60 | 0.04 | 1.90 | 0.04 |
| Dependency ratio | 0.46 | 0.01 | 0.36 | 0.01 | 0.58 | 0.01 | 0.28 | 0.01 | 0.58 | 0.01 |
| Breadwinner age | 34.03 | 0.25 | 34.83 | 0.48 | 36.72 | 0.55 | 31.59 | 0.40 | 32.43 | 0.51 |
| Breadwinner gender (Dummy; male=0) | 0.24 | 0.01 | 0.26 | 0.02 | 0.26 | 0.02 | 0.18 | 0.02 | 0.24 | 0.02 |
| Safety net (Dummy; No=0) | 0.27 | 0.01 | 0.31 | 0.02 | 0.24 | 0.02 | 0.32 | 0.02 | 0.21 | 0.02 |
| Monthly food expenditure (US dollar) | 70.29 | 0.92 | 82.84 | 2.20 | 63.01 | 1.46 | 63.73 | 1.68 | 73.43 | 1.90 |
| Monthly food expenditure share | 0.42 | 0.004 | 0.38 | 0.01 | 0.51 | 0.01 | 0.33 | 0.01 | 0.45 | 0.01 |
| Household monthly income (US dollar) | 119.36 | 2.50 | 138.28 | 6.33 | 99.69 | 3.50 | 140.56 | 5.19 | 101.87 | 4.61 |
| Poverty line (Dummy; Under poverty line=0) | 0.76 | 0.01 | 0.79 | 0.02 | 0.72 | 0.02 | 0.86 | 0.02 | 0.70 | 0.02 |
| Interaction (Breadwinner gender # monthly income US Dollar, Male=0) | 23.28 | 1.54 | 32.06 | 4.53 | 19.26 | 1.97 | 20.62 | 2.74 | 22.09 | 2.87 |
| Interaction (Breadwinner gender # monthly food expenditure-US Dollar, Male=0) | 15.95 | 0.87 | 19.93 | 2.19 | 15.23 | 1.42 | 11.05 | 1.37 | 17.95 | 1.95 |

Table 2, Table 3, and Table 4 present the results of the t-tests of monthly income, monthly food expenditure, and monthly food expenditure share in terms of different breadwinner gender. Table 2 shows the t-test analysis of monthly average household income (US Dollar) for households with male and female breadwinner. The average monthly household income of households with male breadwinner were much higher (USD 125.9) than those with female breadwinners (USD 98.29) (p-value=0.00).

**Table 2** T-test analysis of Monthly Average HH income (US Dollar) for households with male and female breadwinners

| Monthly Average HH Income (US dollar) | Obs | Mean | dif | St_Err | t_value | p_value |
|---|---|---|---|---|---|---|
| Male Breadwinner | 1182 | 125.90 | 27.64 | 5.835 | 4.75 | 0 |
| Female Breadwinner | 367 | 98.29 | | | | |

*H0: the difference of monthly average household income (US dollar) between male breadwinner and female breadwinner is equal to 0；
Ha: the difference of monthly average household income (US dollar) between male breadwinner and female breadwinner is not equal to 0

The t-test analysis of monthly food expenditure (USD) for households with male and female breadwinners are presented in Table 3. The results show significant difference of monthly food expenditure between households with male and female breadwinners. On average, households with male breadwinners spent more money on food consumption annually (USD 71.21) compared to those with female breadwinner (USD 67.32) (p-value=0.072).

**Table 3** T-test analysis of annual food expenditure (US dollar) for households with male and female breadwinner

| Monthly food expenditure (US dollar) | Obs | Mean | dif | St_Err | t_value | p_value |
|---|---|---|---|---|---|---|
| Male Breadwinner | 1182 | 71.208 | 3.889 | 2.164 | 1.8 | 0.072 |
| Female Breadwinner | 367 | 67.32 | | | | |

*H0: the difference of monthly household food expenditure (US dollar) between male breadwinner and female breadwinner is equal to 0；
Ha: the difference of monthly household food expenditure (US dollar) between male breadwinner and female breadwinner is not equal to 0

The t-test analysis of monthly food expenditure share for households with male and female breadwinners are presented in Table 4. The results didn't show significant difference of monthly food expenditure share between households with male and female breadwinners. On average, households with male breadwinners spent less percentage of expenditure on food consumption (41.9%) compared to those with female breadwinner (42.7%) (p-value=0.356).

**Table 4** T-test analysis of monthly food expenditure share for households with male and female breadwinner

| Monthly food expenditure share | Obs | Mean | dif | St_Err | t_value | p_value |
|---|---|---|---|---|---|---|
| Male Breadwinner | 1182 | 0.419 | -0.009 | 0.009 | -0.9 | 0.356 |
| Female Breadwinner | 367 | 0.427 | | | | |

*H0: the difference of monthly food expenditure share between male breadwinner and female breadwinner is equal to 0；
Ha: the difference of monthly food expenditure share between male breadwinner and female breadwinner is not equal to 0

We conducted a further analysis to examine the food expenditure share by different household income quantiles and the results are presented in Table 5. Our analysis revealed that the study households' food expenditure share covered around 42% of the total expenditure. Looking at the analysis separately for each informal settlement, residents in Korogocho had highest food expenditure share, the residents in Mukuru had the least and the difference between these two were around 18%. Moreover, Mukuru showed a trend of more food expenditure share with more annual income, while residents in Viwandani spent less on food even with higher incomes.

**Table 5** Food expenditure share by household income quartiles

| | Overall (N=1549) | Dandora (*N*=368) | Korogocho (*N*=447) | Mukuru (*N*=379) | Viwandani (*N*=355) |
|---|---|---|---|---|---|
| Lowest quartile (Q1) | 0.44 | 0.38 | 0.50 | 0.31 | 0.47 |
| Q2 | 0.42 | 0.37 | 0.50 | 0.33 | 0.45 |
| Q3 | 0.43 | 0.39 | 0.52 | 0.34 | 0.44 |
| Highest quartile (Q4) | 0.39 | 0.38 | 0.50 | 0.34 | 0.42 |
| Overall | 0.42 | 0.38 | 0.51 | 0.33 | 0.45 |

### *Meditation Analysis Results*

The results for meditation analysis are presented in table 6 and 7. Table 6 is the result of meditation analysis of HDDS12. Table 7 presents the result of meditation analysis of HDDS 9. According to the framework, we know that if the meditation regression is significant, the total effect should be the sum of the coefficient of breadwinner gender in equation 3 and the product of the coefficient of breadwinner gender in equation 4 and the coefficient of monthly food expenditure share in equation 3. However, from the results presented in both table 6 and 7, we can find that the results of equation 4 were both insignificant, which indicated an insignificant indirect effect of breadwinner gender and monthly food expenditure share.

**Table 6** Meditation analysis of HDDS 12

| Equation | (2) | (3) | (4) |
|---|---|---|---|
| VARIABLES | HDDS12 | HDDS12 | Monthly Food Expenditure Share |
| Breadwinner Gender | -0.174 | -0.213** | 0.00857 |
| | (0.115) | (0.108) | (0.00927) |
| Monthly Food Expenditure Share | | 4.524*** | |
| | | (0.295) | |
| Constant | 8.376*** | 6.481*** | 0.419*** |
| | (0.0562) | (0.134) | (0.00451) |
| Observations | 1,549 | 1,549 | 1,549 |
| R-squared | 0.001 | 0.133 | 0.001 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

**Table 7** Meditation analysis of HDDS 9

| Equation | (2) | (3) | (4) |
|---|---|---|---|
| VARIABLES | HDDS9 | HDDS9 | Monthly Food Expenditure Share |
| Breadwinner Gender | -0.303*** | -0.333*** | 0.00857 |
| | (0.0999) | (0.0945) | (0.00927) |
| Monthly Food Expenditure Share | | 3.504*** | |
| | | (0.259) | |
| Constant | 5.799*** | 4.331*** | 0.419*** |
| | (0.0486) | (0.118) | (0.00451) |
| Observations | 1,549 | 1,549 | 1,549 |
| R-squared | 0.006 | 0.111 | 0.001 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

### *OLS Regression Analysis*

As mentioned above, we ran three regressions to assess the robustness of our results. Table 8 shows the results of these three regressions. Model 1 excluded the variable of monthly food expenditure share and did the regression for the rest variables. Model 2 did the regression of the variables excluding the monthly food expenditure. All the variables were included in the model 3.

From the results of table 8, monthly food expenditure was positive significant in model 1 and 3, indicating that more food expenditure is positively associated with higher nutrition security for households in slums. Meanwhile, monthly food expenditure share was positive and significant in model 2 and 3, which indicated a positive association between nutrition security and food expenditure share. Poverty line was positively significant in all the regressions and indicated a strong association between household nutrition security and poverty line. If the household had

income more than 1.9 US dollar a day, they were more nutrition secure. Breadwinner gender was significant only in HDDS 12 in model 1 and 3, which might show that if the breadwinner was male, nutrition security was worse than those households with a female breadwinner. Breadwinner age had a negative correlation to nutrition and was significant in most of the models except the HDDS 12 in model 2. From this result, nutrition insecurity was shown to be more severe when the breadwinner was older in all three models. Safety net was positive and significant in three models, indicating that if the household participated in the safety net programs, the household may have better nutrition security. The coefficient of dependency ratio was negative significant in HDDS 9 in model 1 and 3. If more people over 15 in this household, the HDDS 9 was even worse. The interaction term in model 1 is breadwinner gender and household monthly food expenditure. It was negative significant in both HDDS 12 and HDDS 9 which indicated that monthly food expenditure for the household with female breadwinner was associated with a lower household dietary diversity score. The same results could be found in model 3 which had two interactions—one was breadwinner gender and monthly food expenditure, another was breadwinner gender and monthly food expenditure share. This could be explained by the fact that our descriptive analysis showed that women have significantly lower monthly food expenditure than men, which could be due to the significantly lower income levels compared to men. When controlling for food expenditure share on model 2, the results were still negative but weren't significant and was consistent with the results of the same interaction in model 3. For different informal settlements locations, the result showed significant differences between four informal settlements in many regressions.

**Table 8** Results of the OLS regression to assess contribution of food expenditure (share) on nutrition security indicators

| | Model 1 | | Model 2 | | Model 3 | |
|---|---|---|---|---|---|---|
| VARIABLES | HDDS 12 | HDDS 9 | HDDS 12 | HDDS 9 | HDDS 12 | HDDS 9 |
| Monthly food expenditure (US dollar) | 0.0268*** | 0.0238*** | | | 0.0220*** | 0.0200*** |
| | (0.00149) | (0.00129) | | | (0.00161) | (0.00140) |
| Poverty line (dummy; under poverty line=0) | 0.366*** | 0.246** | 0.475*** | 0.341*** | 0.389*** | 0.266*** |
| | (0.118) | (0.103) | (0.123) | (0.108) | (0.116) | (0.101) |
| Breadwinner gender (dummy; male=0) | 0.373* | 0.226 | 0.129 | -0.144 | 0.577* | 0.288 |
| | (0.211) | (0.183) | (0.299) | (0.261) | (0.298) | (0.259) |
| Breadwinner age | -0.0191*** | -0.0212*** | -0.00427 | -0.00838** | -0.0148*** | -0.0178*** |
| | (0.00445) | (0.00387) | (0.00464) | (0.00406) | (0.00442) | (0.00385) |
| Safety net (dummy; no=0) | 0.173* | 0.191** | 0.588*** | 0.552*** | 0.317*** | 0.308*** |
| | (0.0985) | (0.0855) | (0.104) | (0.0907) | (0.0991) | (0.0863) |
| Dependency ratio | -0.375 | -0.560** | 0.382 | 0.119 | -0.270 | -0.469** |
| | (0.254) | (0.221) | (0.263) | (0.230) | (0.251) | (0.219) |
| Monthly income (US dollar) | -0.000820 | -0.000397 | 0.00158*** | 0.00171*** | -0.000381 | -4.58e-05 |
| | (0.000528) | (0.000459) | (0.000539) | (0.000471) | (0.000523) | (0.000456) |
| Slum (base=Viwandani) | | | | | | |
| Korogocho | 0.466*** | 0.218** | -0.140 | -0.304*** | 0.249** | 0.0432 |
| | (0.121) | (0.105) | (0.128) | (0.112) | (0.123) | (0.107) |
| Dandora | -0.606*** | -0.532*** | -0.0472 | -0.0437 | -0.419*** | -0.379*** |
| | (0.139) | (0.121) | (0.146) | (0.128) | (0.140) | (0.122) |
| Mukuru | -0.729*** | -0.595*** | -0.346** | -0.273** | -0.489*** | -0.403*** |
| | (0.146) | (0.127) | (0.157) | (0.137) | (0.148) | (0.128) |
| Interaction: Breadwinner gender (Male=0) & monthly food expenditure (US dollar) | -0.00604** | -0.00575** | | | -0.00539* | -0.00567** |
| | (0.00266) | (0.00231) | | | (0.00278) | (0.00242) |
| Monthly food expenditure share | | | 4.840*** | 4.029*** | 2.627*** | 2.027*** |
| | | | (0.366) | (0.320) | (0.377) | (0.329) |
| Interaction: Breadwinner gender (Male=0) & monthly food expenditure share | | | -0.641 | -0.268 | -0.652 | -0.212 |
| | | | (0.654) | (0.572) | (0.652) | (0.568) |
| Constant | 7.237*** | 5.089*** | 5.729*** | 3.874*** | 6.136*** | 4.231*** |
| | (0.239) | (0.208) | (0.296) | (0.259) | (0.281) | (0.245) |
| Observations | 1,549 | 1,549 | 1,549 | 1,549 | 1,549 | 1,549 |
| R-squared | 0.259 | 0.256 | 0.186 | 0.171 | 0.284 | 0.277 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Robustness check results are shown in Table 8. By checking the different results between models, we can draw more conclusions. Comparing model 1 and 3, annual food expenditure was always significant, providing strong evidence for the positive association between annual food expenditure and household nutrition security. Even with the variable of food expenditure share in model 3, other variables all showed consistent significance. However, there are slight changes for some variables comparing model 2 and 3. From the results shown of HDDS 12 in model 2 and 3, breadwinner gender was not significant any more in model 3. Dependency ratio was only significant in model 3 but not in model 2. From the comparison between models, breadwinner gender, dependency ratio, and monthly income may not strongly support the household's nutrition security. While the consistence of safety net in three models showed a significant way to improve household's nutrition security.

HDDS 9 is conducted in each model and all the results are presented in table 6. Even in the same model, the results were still different for HDDS 12 and HDDS 9. In model 1, breadwinner gender was only significant in HDDS 12 and dependency ratio was only significant in HDDS 9. Same results could be found in model 3 for these two variables. While in model 2, breadwinner age only showed significance in HDDS 9.

**Discussion**

Before the analysis, we hypothesized to have the result that households with female breadwinner may have better nutrition security. We did get the positive significant results in two models. However, the results also showed negative interaction terms and told us the opposite way owing to the significant difference of monthly income between male and female breadwinner. Female breadwinner may be more important for deciding the food

expenditure, but if they don't have enough income, they have limited choice on the food and can be vulnerable from the nutrition insecurity. It's not surprising that households with male breadwinners have significantly higher income than those with female breadwinner. In the urban slums, men are likely to engage in jobs that may pay more compared to women. In addition, women may be having other reproductive roles such as child care which may make them work less in income generating activities. Our finding that household with male breadwinners are spending more on food consumption may be driven by the fact that households with men breadwinners already have more income than women, therefore in absolute value they may spend more on food than those with women breadwinner.

From the descriptive results, our mean household dietary diversity score of HDDS 12 for all informal settlements was 8.33. Wanyama et al., (2019) found the mean value of HDDS12 ranging around 9-10 for urban poor in Kenya and Uganda, while our result is a little lower than their finding. The difference between HDDS 12 and HDDS 9 is about 3 which is in line with Sibhatu et al., (2015). Although our results were significant, the estimates were very small. All of the estimates of monthly food expenditure were smaller than 0.03 which means that households in slums need to spend much more to get a small improvement in their nutrition security. Besides this main independent variable, we also concluded that certain household characteristics can also affect the nutrition security status. If households participated in safety net projects, they had a greater chance to get better nutrition security. Households with younger breadwinner also had better nutrition security. Higher percent of dependency ratio contributed to a higher HDDS which could be interpreted in two way: one situation was that the household size is small, and another was more people over 15 years in that household. Living over the poverty line can lead to better nutrition security.

In our research, spending more on food consumption or higher food expenditure share were related to higher household nutrition security. Our results confirmed previous studies by Wanyama et al. (2019). Wanyama et al. (2019) used a descriptive method to analyze the diets and food purchase patterns among the slum dwellers in Kenya and Uganda. Their results showed the potential association between food expenditure and household dietary diversity in informal settlements. However, their analysis was only descriptive without any kind of econometric modeling. Wanyama et al. (2019) was the only exception that analyzed association between food expenditure and diet diversity, although they only presented descriptive analysis and they did not conduct rigorous econometric modelling to control for other factors that may affect dietary diversity in a household.

A set of studies have shown strong gender effects on household nutrition (Kenndy et al., 1992; Ajani 2008; Ene-Obong et al., 2017) or food security and our analysis also got strong conclusion for it. While due to the lack of data on gender of the person responsible for food purchases, it was difficult to analyze the importance of gender effects on household nutrition which is a critical point for the policy recommendation. Significant result for the association between food expenditure and nutrition security reminded us to conduct more analyses and dig more deeper from this aspect. More specific study of food consumption and nutrition in terms of woman and children could be conducted if the survey have more food consumption information. What's more, our data can't be the representative for all slums in Kenya. Larger samples with data on gender of the person responsible for food purchases should be conducted as follow-up analysis.

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## Appendix A: Household Dietary Diversity Score Table[3]

| Question number | Food group | Examples | YES=1 NO=0 |
|---|---|---|---|
| 1 | CEREALS | corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) + *insert local foods e.g. ugali, nshima, porridge or paste* | |
| 2 | WHITE ROOTS AND TUBERS | white potatoes, white yam, white cassava, or other foods made from roots | |
| 3 | VITAMIN A RICH VEGETABLES AND TUBERS | pumpkin, carrot, squash, or sweet potato that are orange inside + *other locally available vitamin A rich vegetables (e.g. red sweet pepper)* | |
| 4 | DARK GREEN LEAFY VEGETABLES | dark green leafy vegetables, including wild forms + *locally available vitamin A rich leaves such as amaranth, cassava leaves, kale, spinach* | |
| 5 | OTHER VEGETABLES | other vegetables (e.g. tomato, onion, eggplant) + *other locally available vegetables* | |
| 6 | VITAMIN A RICH FRUITS | ripe mango, cantaloupe, apricot (fresh or dried), ripe papaya, dried peach, and 100% fruit juice made from these + *other locally available vitamin A rich fruits* | |
| 7 | OTHER FRUITS | other fruits, including wild fruits and 100% fruit juice made from these | |
| 8 | ORGAN MEAT | liver, kidney, heart or other organ meats or blood-based foods | |
| 9 | FLESH MEATS | beef, pork, lamb, goat, rabbit, game, chicken, duck, other birds, insects | |
| 10 | EGGS | eggs from chicken, duck, guinea fowl or any other egg | |
| 11 | FISH AND SEAFOOD | fresh or dried fish or shellfish | |
| 12 | LEGUMES, NUTS AND SEEDS | dried beans, dried peas, lentils, nuts, seeds or foods made from these (eg. hummus, peanut butter) | |
| 13 | MILK AND MILK PRODUCTS | milk, cheese, yogurt or other milk products | |
| 14 | OILS AND FATS | oil, fats or butter added to food or used for cooking | |
| 15 | SWEETS | sugar, honey, sweetened soda or sweetened juice drinks, sugary foods such as chocolates, candies, cookies and cakes | |
| 16 | SPICES, CONDIMENTS, BEVERAGES | spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages | |
| Household level only | Did you or anyone in your household eat anything (meal or snack) OUTSIDE the home yesterday? | | |
| Individual level | Did you eat anything (meal or snack) OUTSIDE the home yesterday? | | |

[3] FAO (2011) Guidelines for Measuring Household and Individual Dietary Diversity (Food and Agriculture Organization, Rome).

**Table 3 Aggregation of food groups from the questionnaire to create HDDS**

| Question number(s) | Food group |
|---|---|
| 1 | Cereals |
| 2 | White tubers and roots |
| 3,4,5 | Vegetables[1] |
| 6,7 | Fruits[2] |
| 8,9 | Meat[3] |
| 10 | Eggs |
| 11 | Fish and other seafood |
| 12 | Legumes, nuts and seeds |
| 13 | Milk and milk products |
| 14 | Oils and fats |
| 15 | Sweets |
| 16 | Spices, condiments and beverages |

[1] The vegetable food group is a combination of vitamin A rich vegetables and tubers, dark green leafy vegetables and other vegetables.
[2] The fruit group is a combination of vitamin A rich fruits and other fruits.
[3] The meat group is a combination of organ meat and flesh meat.

## Appendix B: Questions used in the IDSUE Project Survey[4]



# KENYA - Indicator Development Surveillance for Urban Emergencies

Report generated on: November 19, 2014

Visit our data catalog at: http://aphrc.org/catalog/microdata/index.php



[4] The detail of the project and the file can be found at the website: http://microdataportal.aphrc.org/index.php/catalog/68

## Variables

| ID | Name | Label | Type | Format | Question |
|---|---|---|---|---|---|
| V29 | q1_1 | 1.1.start time (24 hrs) | discrete | character | START TIME (24 HRS) |
| V30 | q1_2 | 1.2.field worker's code | discrete | character | FIELD WORKER'S CODE |
| V31 | q1_3 | 1.3.date of interview (ddmmyyyy) | discrete | character | DATE OF INTERVIEW (DDMMYYYY) |
| V33 | hhid | Household id (anonymyzed) | contin | numeric | |
| V34 | q1_7a | 1.7 gps coordinates | discrete | character | |
| V35 | q1_7b | 1.7 gps coordinates | discrete | character | |
| V36 | q1_8 | 1.8 Informed consent signed | discrete | numeric | |
| V37 | q1_12 | 1.12. is respondent reference person named in q1.4? | discrete | numeric | FW: IS RESPONDENT REFERENCE PERSON NAMED IN Q1.4? |
| V39 | q1_14 | 1.14. does respondent live in this household? 1=yes; 2=no | discrete | numeric | FW: DOES RESPONDENT LIVE IN THIS HOUSEHOLD? |
| V40 | q1_16 | 1.16. how are you related to (name of individual in q1.4)? | discrete | numeric | How are you related to (NAME OF INDIVIDUAL IN Q1.4)? (CODESHEET A1) |
| V41 | q1_17a | 1.17' How many children (<15) live in this household? | discrete | numeric | How many adults and children live in this household? |
| V42 | q1_17b | 1.17' How many adults (>15) live in this household? | contin | numeric | How many adults and children live in this household? |
| V43 | q1_17c | 1.17' Total number of children under 5 years | discrete | numeric | How many adults and children live in this household? |
| V44 | q1_18a | 1.18 How long has your household lived in this village(months)? | contin | numeric | How long has your household lived in this village? |
| V45 | q1_18b | 1.18 How long has your household lived in this village(Years)? | contin | numeric | How long has your household lived in this village? |
| V46 | q1_19 | 1.19Where did this household come from before | discrete | numeric | Where did this household come from before settling in this slum? |

| | | | | | |
|---|---|---|---|---|---|
| V63 | q4_1 | 4.1. what was the main source of food? | discrete | numeric | In last 4 weeks, what was the main source of food for your household? |
| V64 | q4_2 | 4.2. How many meals did you consume yesterday? | discrete | numeric | How many meals did you consume in your house yesterday (day and night)? |
| V65 | q4_3 | 4.3. Did you consume a meal or tea prepared outside? | discrete | numeric | Did you consume a meal or tea prepared outside the home yesterday (day & night? |
| V66 | q4_5 | 4.5 Did you eat cooked food purchased from the streets? | discrete | numeric | Did you eat cooked food purchased from the streets Yesterday? |
| V67 | q4_6 | 4.6. How many meals did children eat in the houseYesterday? | discrete | numeric | How many meals did children in your household eat in the houseYesterday? |
| V68 | q4_7 | 4.7. Did children in your household eat a meal or tea served outside? | discrete | numeric | Did children in your household eat a meal or tea served outside the home yesterday? |
| V69 | q4_9 | Did children eat cooked food purchased from street? | discrete | numeric | Did children eat cooked food purchased from the streets Yesterday? |
| V70 | q4_10a | You or anyone ate Grains/cereals | discrete | numeric | Grains/cereals (Bread, Nyoyo or any other food made from millet, sorghum, maize, rice, ugali, porridge, mandazi, chapati) |
| V71 | q4_10b | You or anyone ate Roots and tubers | discrete | numeric | Roots and tubers (potatoes, sweet potato, cassava, nduma or any foods made from roots) |
| V72 | q4_10c | You or anyone ate Legumes and nuts | discrete | numeric | Legumes and nuts (Beans, peas, nyoyo, ndengu, nuts seeds or other foods made from these) |
| V73 | q4_10d | You or anyone ate Dairy products | discrete | numeric | Dairy products (milk, yogurt, cheese, mala or food made from dairy) |
| V74 | q4_10e | You or anyone ate Flesh foods | discrete | numeric | Flesh foods (meat, fish, poultry, pork and liver/organ meats) |
| V75 | q4_10l | You or anyone ate Fish | discrete | numeric | Fish (all types of fish e.g. omena, tilapia,..et.c.) |
| V76 | q4_10f | You or anyone ate Eggs | discrete | numeric | Eggs |

| ID | Name | Label | Type | Format | Question |
|---|---|---|---|---|---|
| V77 | q4_10g | You or anyone ate Vegetables | discrete | numeric | Vegetables (Carrot, dark green leafy vegetables (cassava, sweet potato leaves, osuga, kunde, etc), pumpkin, sukuma wiki, managu, terere, sucha, saga, mitoo, mrenda, pumpkin leaves, cabbage and locally available leaves) etc |
| V78 | q4_10h | You or anyone ate Fruits | discrete | numeric | Fruits (Orange, lemon (or other citrus fruits), pineapple, banana, mango, paw paw, , etc |
| V79 | q4_10i | You or anyone ate Oils and fat | discrete | numeric | Oils and fat (Oils, fats or butter added to food/used for cooking) |
| V80 | q4_10j | You or anyone ate Sugar or honey | discrete | numeric | Sugar or honey (Sugar/honey added to food such as tea, porridge, bread) |
| V81 | q4_10k | You or anyone ate Others | discrete | numeric | Others (condiments, tea, coffee) |
| V82 | q4_12 | 4.12.Did you worry that your household would NOT have enough food? | discrete | numeric | In the past 4 weeks, did you worry that your household would NOT have enough food? How often? |
| V83 | q4_13 | 4.13. NOT able to eat the kinds of food due to lack of resources? | discrete | numeric | In the past 4 weeks, were you or any household member NOT able to eat the kinds of food you preferred because of a lack of resources? How often? |
| V84 | q4_14a | 4.14. Had to eat a limited variety of foods due to lack of resources? | discrete | numeric | In the past 4 weeks, did you or any household member have to eat a limited variety of foods due to lack of resources? |
| V85 | q4_14 | 4.15 Had to eat a smaller meal than you felt because there was NOT enough food? | discrete | numeric | In the past 4 weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was NOT enough food? |
| V86 | q4_15 | 4.16.Had to eat fewer numbers of meals in a day because there was NOT enough foo | discrete | numeric | In the past 4 weeks, did you or any household member have to eat fewer numbers of meals in a day because there was NOT enough food? |
| V87 | q4_16 | 4.17. NO food to eat because of lack of resources to get food? | discrete | numeric | In the past 4 weeks, was there ever NO food of any kind to eat in your household because of lack of resources to get food? How Often? |
| V88 | q4_17 | 4.18. Sleep at night hungry because there was NOT enough food? | discrete | numeric | In the past 4 weeks, did you or any household member go to sleep at night hungry because there was NOT enough food? How often? |
| V89 | q4_18 | 4.19. Go without eating anything because there was NOT enough food? | discrete | numeric | In the past 4 weeks, did you or any household member go a whole day and night without eating anything because there was NOT enough food? |
| V90 | q4_19 | 4.20. Got relief food from any source? | discrete | numeric | In the past 4 weeks, did your household get relief food from any source? |
| V91 | q4_20 | 4.21.Enrolled in any social safety net? | discrete | numeric | In the past 4 weeks, has your ousehold been enrolled in any social safety net? (e.g. merry go round) |
| V92 | q4_21 | 4.22. Any child benefited from a feeding program? | discrete | numeric | In the past 4 weeks, did any child in the household benefit from a feeding program? |

## Food Consumption and Expenditure(Round 1-4)

| | |
|---|---|
| Content | |
| Cases | 25502 |
| Variable(s) | 11 |
| Structure | Type:<br>Keys: () |
| Version | |
| Producer | |
| Missing Data | |

## Variables

| ID | Name | Label | Type | Format | Question |
|---|---|---|---|---|---|
| V212 | hhid | Household id (anonymyzed) | contin | numeric | |
| V213 | q0 | food item | discrete | character | |
| V214 | code | Food item code | contin | numeric | |
| V215 | q1 | Food item consumed | discrete | numeric | Have you or members of your household consumed (eaten)... [FOOD ITEM] ... during the past week? |
| V216 | q2 | Quantity of food item consumed | contin | numeric | How much of this food did your household CONSUME during the last week (7 days) - including food that was purchased, and food produced or grown by your household or received as a payment or a gift? |
| V217 | q3 | Unit of food item consumed | discrete | numeric | |
| V218 | q4 | Amount spent on the food item | contin | numeric | What was the total value of that food consumed? |
| V219 | q5 | Main source of the food item | discrete | numeric | What was the main source of this food? Did you obtain some from any other source? |
| V220 | slum | Slum location | discrete | numeric | |
| V221 | round | Survey round of data collection | discrete | numeric | |
| V222 | item | Food item name | discrete | character | |

## Non-Food Expenditure Section(Round 1-4)

| | |
|---|---|
| Content | |
| Cases | 24906 |
| Variable(s) | 7 |
| Structure | Type:<br>Keys: () |
| Version | |
| Producer | |
| Missing Data | |

## Variables

| ID | Name | Label | Type | Format | Question |
|---|---|---|---|---|---|
| V203 | hhid | Household id (anonymyzed) | contin | numeric | |
| V209 | q90 | Expenditure item name | discrete | character | |
| V204 | code | Non-food item code | contin | numeric | |
| V205 | q91 | Amount spent on the item? | contin | numeric | What is the total value of all [ITEM] PURCHASED, PRODUCED AT HOME and RECEIVED AS GIFT during the LAST 1 WEEK, 1 MONTH or 3 MONTHS? |
| V206 | Recall | Expenditure recal period | discrete | numeric | |
| V207 | slum | Slum location | discrete | numeric | |
| V208 | round | Survey round of data collection | discrete | numeric | |

## Earning Household Members Section(Round 1-4)

| | |
|---|---|
| Content | |
| Cases | 6224 |
| Variable(s) | 13 |
| Structure | Type:<br>Keys: () |
| Version | |
| Producer | |
| Missing Data | |

## Variables

| ID | Name | Label | Type | Format | Question |
|---|---|---|---|---|---|
| V14 | hhid | Household id (anonymyzed) | contin | numeric | |
| V16 | q9_3 | 9.3 Age of the person | contin | numeric | What are the ages of the people who earn? |
| V17 | q9_4 | 9.4 Sex of the person | discrete | numeric | What are the sexes of the people who earn? (1=Male, 2=Female) |
| V18 | q9_5 | 9.5 Source of income | discrete | numeric | What is their source of income |
| V19 | q9_5other | Other source of income of the person | discrete | character | What is their source of income |
| V20 | q9_6 | 9.6 Is the person a breadwinner? | discrete | numeric | Among the persons who earn income in 9.2, who is the breadwinner? |
| V21 | q9_7 | 9.7 What is his/her mode of payment? | discrete | numeric | What is the mode of payment for persons in 9.2? |
| V22 | q9_7other | Other mode of payment | discrete | character | What is the mode of payment for persons in 9.2? |
| V23 | q9_8 | Computed monthly income | contin | numeric | How much did persons in 9.2 earn in last payment period? |
| V24 | q9_9 | 9.9 Average hours per day did the main breadwinner work? | contin | numeric | How many hours per day on average did the persons in 9.2 work in the last week? |
| V25 | q9_10 | 9.10 Days in the last week worked? | contin | numeric | How many days in the last week did the persons in 9.2 work? |
| V26 | slum | Study site (Korogocho/Viwandani) | discrete | numeric | |
| V27 | round | Survey round | discrete | numeric | |