Supermarket purchase and child nutritional outcomes in urban Kenya

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Abstract:

Empirical studies that examine the implication of supermarket purchase on child nutritional outcomes are scarce. This article investigates the link between supermarket shopping and height-for-age Z-scores (HAZ) and weight-for-age Z-scores (WAZ) of children and adolescents under the age of 18 years. We use two rounds of survey data (2012 and 2015) from urban Kenya in a series of instrumental variable panel data models. Findings reveal that buying from supermarkets and spending higher shares of income in supermarkets significantly increases child HAZ and decreases the probability of being stunted. Supermarket purchase also positively affects WAZ of children but to a lower extent compared to HAZ outcomes. By examining the dietary differences between supermarket shoppers and non-shoppers, we find that supermarket shoppers have a higher dietary diversity compared to those buying from traditional markets only. Findings have relevance for policies that need to take advantage of the rapid transformation of the retail sector in developing countries for better health outcomes.

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Abstract

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1. Introduction

The food system is one means to tackle the problem of poverty and undernutrition in developing countries (Timmer, 2009). Recently, there have been dramatic changes in the agri-food system of low income countries leading to changes in the food retail sector (Reardon et al., 2004). The rapid expansion of supermarkets is part of the change that is increasing the portfolio of food access for urban and peri-urban residents of low income countries (Reardon et al., 2003; Neven and Reardon, 2004; Trail, 2006; Qaim, 2017). Access to varying market outlets might result in changes in the dietary behavior and transformation to modern diets, mainly due to differences in access to product types, diversity and level of processing (Hawkes, 2008; Popkin, 2014). This has an important implication for nutrition outcomes amidst of the coexistence of over nutrition and undernutrition (Timmer, 2009; Popkin, 2014; Qaim, 2017). Worldwide, malnutrition (both under and over nutrition) affects one in 3 individuals (IFPRI, 2016). At the same time, child undernutrition remains to be a major challenge in low income countries and patterns of improvement for child stunting have not been sufficient to meet the millennium development goals (Haddad, 2013). In this study, we examine the effects of supermarket purchase in three small towns of Kenya on nutritional outcomes of children and adolescents.

Kenya is the second front runner in the supermarket expansion in Africa, after South Africa (Reardon et al., 2004; Planet Retail, 2016). As in other developing countries' trends in the supermarket diffusion, large and affluent urban cities are not the only ones enjoying the benefits of supermarkets but supermarkets are also penetrating poor small towns (Neven and Reardon, 2004; Asfaw, 2008). Major drivers of these changes from the consumer side include increased living standards, urbanization, female labor force participation, ownership of consumer durables facilitating supermarket purchase (fridges and cars) and imitation of western life styles (Trail, 2006). Ultimately, rapid expansion of supermarkets has a trickledown effect not only for consumers but also for small holder producers supplying the market (Timmer, 2009).

Supermarket purchase might have both positive and negative implication for child nutritional outcomes (Asfaw, 2008; Hawkes, 2008). On the positive side, it provides greater variety of foods, regulates food item types sold, gives health warnings on certain food products and creates opportunities for nutrition education at the store (Timmer, 2009). In addition, it can serve as a source of cheap calories for poor consumers and is likely to improve dietary diversity and quality (Rischke et al., 2015). The latter effect has a positive implication for increasing micronutrient availability (Kimenju and Qaim, 2016). On the other hand, the negative side relates to provision of obesogenic food products such as sugar, fat and highly processed products leading to obese and overweight children (Kimenju et al., 2015; Kimenju and Qaim, 2016). This is due to the fact that supermarkets in these small towns in low income countries mainly provide dried, highly processed and packaged food items with longer shelf lives (Asfaw, 2008; Schipmann and Qaim, 2011). We empirically test the net effect of supermarket shopping on child nutrition by using a household survey designed for examining the impact of supermarkets.

We contribute to the thin but growing literature on the nutrition implication of supermarket purchase. Existing studies that examined the effect of supermarkets on diets and nutritional outcomes found that supermarket purchase resulted in an increased consumption of highly and partially processed food (Asfaw, 2008; Demmler et al., 2018);

increased per capita calorie availability (Rischke et al., 2015), higher body mass index, higher probability of being overweight and obese (Kimenju et al., 2015; Demmler et al., 2018), higher levels of fasting blood glucose and higher probability of suffering from pre-diabetes and the metabolic syndrome (Demmler et al., 2017). The studies on the nutrition outcome implication in a developing country context mainly focus on adults' nutritional outcomes. Two exceptions that investigate the effect on child nutrition are studies by Kimenju et al. (2015) and Umberger et al. (2015) finding reduction in level of stunting in Kenya and mixed effects on body mass index of children in Indonesia, respectively. The aforementioned studies however utilize cross sectional data to examine the impact. We therefore fill this research gap by using panel data evidence. Further, we consider under-five children in examining the effect of supermarkets on long-term nutritional outcome-height-for-age Z-score, which previous studies did not. Findings have relevance for the food policy agenda which is in the process of changing due the transformation of agri-food systems.

2. **Data and study site**

Data for this study comes from two rounds of household survey conducted in Central Kenya. The survey was conducted in 2012 and 2015 in the urban and peri-urban areas of three towns: Ol Kalou, Mwea and Njabini. We purposively selected the three towns based on supermarket availability so that it will give a quasi-experimental (appealing) setting for our empirical analysis. Ol Kalou and Mwea each have a supermarket in the towns since 2002 and 2011, respectively. Njabini town did not have supermarket until our last survey round in 2015. Although the towns are distinct in the access to retail outlet-supermarket, they have similar characteristics in terms of size of urban center, infrastructure conditions, and availability of social institutions (Kenya National Bureau of Statistics, 2010; Kimenju et al., 2015; Rischke et al., 2015).

Households were selected using systematic random sampling, roughly 150 from each town. In the initial round, 450 households were interviewed while 453 were interviewed in 2015. Since our sample comes from an urban setting, attrition was a problem due to the relocation of households that were initially sampled. As a result, replacements were made in 2015 using random sampling. In both rounds, the survey involved using structured household questionnaire on issues of socioeconomic characteristics including household composition, income sources, food and non-food consumption expenditures, food purchase from supermarkets during the past one month, the health of household members, and access to various types of services. Further, we took the anthropometric measures of randomly selected child/adolescent and female/male adults, making up to four persons in a household. Enumerators took body measurements according to international standards (Centers for Disease Control and Prevention, 2007) with an accuracy of 0.1 kg for body weight and 0.7 cm for height (de Onis et al., 2004). For the purpose of analysis, we use child level data with panel construction at household level as it was difficult to trace the same child for every household across the survey rounds. Our sample composes of a total of 544 children and adolescents (2-18 years) from both survey rounds with complete data for all relevant variables.

Based on the anthropometric measures, we constructed health outcomes using WHO growth references. We generated Z-score values for height-for-age and weight-for-age of children and adolescents. Z-score values represent the standard deviation from the median height or weight of a well-nourished reference population with the same age and gender. [1] The latest WHO's growth standard takes into account of differences in ethnic and cultural backgrounds when measuring the growth pattern of children (O'Donnel et al., 2008). A child or adolescent is considered to be stunted or underweight if the Z-score value is below the cutoff point of -2 standard deviations. Z-score value below -3 reflects that the child is extremely stunted or underweight (WHO, 2006). Stunting reflects nutrition deficiency over a long-term and is caused by chronic inadequacy of food and repeated exposures to illness (O'Donnell, 2008; WHO, 2010). While HAZ is an indicator of long-term nutritional status of children, WAZ shows a combination of long-term and short-term nutrition measures and reflects magnitude of malnutrition over time (O'Donnell, 2008).

3. **Empirical strategy**

Our empirical goal is to investigate whether supermarket purchase influences health outcomes of children and adolescents. To this end, we employ panel data approaches and run a series of regressions that take the following form:

$$Z_{it} = \beta_0 + \beta_1 S_{ht} + \beta_2' \boldsymbol{C}_{it} + \beta_3' \boldsymbol{X}_{ht} + \beta_4 T + a_i + \varepsilon_i \qquad [1]$$

$$S_{ht} = \beta_0 + \beta_1 D_{ht} + \beta_2' \boldsymbol{C}_{it} + \beta_3' \boldsymbol{X}_{ht} + \beta_4 T + a_i + \varepsilon_i \qquad [2]$$

where Z_{it} in equation [1] is nutritional outcome measures, height-for-age and weight-for-age Z-scores of child i at time t, S_{ht} refers to supermarket food purchase status of the household for the past month in each survey round. $\boldsymbol{C}_{it}$ is a vector of child level

[1] The formula for calculating the Z-scores is: $Z_i = \frac{x_i - \bar{x}}{\sigma_x}$ where x_i is the observed measure of height or weight of a child at a certain age and gender. $\bar{x}$ and σ_x are the median and standard deviation of the measures for the reference population.

characteristics and $\boldsymbol{X}_{ht}$ is a vector of household and maternal characteristics. T controls for survey rounds, a_i is a time invariant unobserved effect and ε_i is an idiosyncratic error term. The supermarket purchase variable has both binary and continuous treatment variants. In Model 1, S_{ht} is a dummy variable taking a value of 1 if a household shopped from a supermarket in the past month and zero otherwise. In Model 2, it represents the share of supermarket food purchase out of total food expenditure of the household in one month period.

It is expected that supermarket purchase is endogenous and factors influencing supermarket purchase decision might systematically affect nutritional outcomes of children and adolescents. In order to take this into account, we use an instrumental variable approach in all our estimations. Equation [2] represents the first stage regression of an instrumental variable regression where the supermarket purchase dummy variable (Model 1) and share of supermarket purchase (Model 2) is estimated as a function of independent variables and an instrument. Our instrument is households' distance from the nearest supermarket, measured in kilometers, represented as D_{ht} (Equation [2]). We follow previous studies that examined the nutritional implication of food purchase from supermarkets employing the same instruments (Rischke et al., 2015; Kimenju et al., 2015; Demmler et al., 2017).

One might argue that distance from supermarket reflects the socioeconomic status of the households and hence influence nutrition status of households. Given our study settings where small towns are considered, the positioning of supermarkets does not depend on the socioeconomic status of the neighborhoods as opposed to other urban settings. Rather, supermarkets in small towns are located in town centers where other retailers are found as well. A test for instrument validity shows that the instrument is strong (F-statistic=123.7, P-value=0.00)[2] and statistically insignificant in the nutrition outcome regressions. Therefore, we argue that distance from supermarket serves the purpose as a valid instrument.

To choose an appropriate model for our panel data estimations, we tested whether random effects or fixed effects are suitable. According to the Hausman test, we fail to reject the null hypothesis that the coefficients are systematically different, hence favoring random effects. Our main estimation results are therefore random effects instrumental variable regressions. As an additional variant of our estimations, we run pseudo fixed effects estimation, i.e., Mundlak approach due to Mundlak (1978). This involves inclusion of time averages over the two survey years for time varying explanatory variables (household and maternal characteristics) (Mundlak, 1978; Wooldridge, 2002). It has an advantage since it allows keeping time-invariant variables while estimating fixed effects estimator (Wooldridge, 2002). The models for the Mundlak approach are represented as:

$$Z_{it} = \beta_0 + \beta_1 S_{ht} + \beta_2' \boldsymbol{C}_{it} + \beta_3' \boldsymbol{X}_{ht} + \beta_4' \widetilde{\boldsymbol{X}}_h + \beta_5 T + a_i + \varepsilon_i \qquad [3]$$

$$S_{ht} = \beta_0 + \beta_1 D_{ht} + \beta_2' \boldsymbol{C}_{it} + \beta_3' \boldsymbol{X}_{ht} + \beta_4' \widetilde{\boldsymbol{X}}_h + \beta_5 T + a_i + \varepsilon_i \qquad [4]$$

where equations 3 and 4 additionally include $\widetilde{\boldsymbol{X}}_h$ referring to the mean values of the household and mother specific characteristics over the two survey years. In all the estimations (Equations 1-4), we cluster the standard errors by town. This allows for correlation of errors in each town due to town specific characteristics.

[2] This is based on instrumental variable regression by pooling the sample (ivregress command) since the post-estimation for testing instrument validity is not available for panel instrumental variable regression (xtivreg).

As a last step, we check if dietary differences exist between supermarket shoppers and non-shoppers using 30 day recall data of food consumption at household level. For this purpose, we examine the mean differences in the dietary diversity and food variety scores. Food variety score was constructed using simple count of food items consumed. We generated dietary diversity score using sum of 12 food groups-taking a value of 1 if a household consumed any food item in the food group. [3] Instrumental variable random effects regressions were also used to investigate whether supermarket purchase affects diet diversity after controlling for relevant confounding factors.

Robustness check

In an instrumental variable approach, it is assumed that the endogenous variable is a continuous variable. Hence, one might argue that the binary nature of the supermarket dummy variable and the censoring from below of the share of supermarket purchase variable influence the results of our estimations. As a robustness check, we use a control function approach where the first stage is estimated using double-hurdle (craggit) model. Craggit model has an added benefit because it estimates the continuous and binary treatment variables in one model (Bruke, 2009). In the second stage, we include the residuals from the first stage in a series of random effects and Mundlak estimations.

4. **Results**

Descriptive results

Table 1 summarizes the descriptive statistics of major variables used for the analysis in this study. In Table 2, we present the nutritional status of children in our sample by

[3] The food groups are cereals; tubers and roots; legumes and nuts; vegetables and fruits; meat (including poultry); fish; eggs; milk and milk products; oil and fats; sweets; and spices

supermarket purchase status of the households. The average height-for-age Z-score (HAZ) of all children is -0.80. Roughly 15% of the children in the sample are stunted. Comparing nutritional outcomes by supermarket purchase status, children in supermarket purchasing households have higher average HAZ (-0.56) compared to children living with households purchasing from traditional markets only (-1.08). The share of stunted children is 10 percent lower in households that purchased food from supermarkets. This pattern is similar for groups of children who are above and below five years. The difference is however higher for above five children (12%) than below five children (2.4%) (see Table 2).

The problem of having less than optimal body weight is less of a problem in our sample with roughly 7 percent of all children being underweight. As can be seen in Table 2, the percentage of underweight children is lower within households that purchase from supermarkets compared to those who purchase from traditional markets. Graphical illustrations in Figures 1 and 2 also show that higher HAZ and WAZ of children are observed for supermarket purchasing households across the overall distribution. The distributions are shifted to the right for those buying in the supermarket roughly at all points.

Regression results

To begin, patterns observed in the descriptive results are indicative of a positive link between supermarket food purchase and health outcomes but still remain unconditional to confounding factors affecting child nutritional outcomes. Regression results testing the effect of supermarket purchase on nutritional outcomes of children and adolescents are provided in Tables 3-6.

Effect of supermarket purchase on height-for-age Z-score

In Tables 3 and 4, we present the findings for height-for-age Z-scores. While Table 3 summarizes the binary treatment of the supermarket purchase, Table 4 contains results with the continuous treatment, the share of supermarket purchase. In both tables, Models A-C present random effects regression and Model D contains regression with Mundlak approach. [4] As the main results of the random effects and Mundlak approach are similar, we mainly focus on Model C when interpreting our results.

Findings reveal that purchasing food from supermarkets significantly affects long-term nutritional outcomes of children after controlling for relevant confounding factors. Children living in supermarket buying households have 0.35 higher standard deviation in HAZ compared to those buying from traditional markets only, on average. This effect remains consistent even after controlling for living standard, i.e., total household expenditure (Model 1B). An implication is that supermarkets contribute to the nutrition outcome of all income groups. Results also remain consistent once past infection of the child, treatment of water in the household and distance of the household to health center (Model 1C).

Turning to factors influencing the nutritional outcomes of children and adolescents in our sample, parameter estimates for child characteristics show significant results. Girls have 0.19-0.25 higher standard deviation in HAZ than boys and older children have significantly higher HAZ. Results show that there is a strong curvature in the children's age

[4] First stage results for the instrumental variable regression are documented in Table A1 in the Appendix. Table A2 summarizes the full results of the Mundlak regression with estimates for the time averages.

and HAZ relationship, reflected in the squared term for the age of the child. As children become older than a certain age, roughly14 years in our sample, HAZ starts to decline for older children. With respect to the mother's characteristics, findings reveal that children with taller, educated and older mothers have significantly higher HAZ. Interestingly, maternal education does not significantly influence nutritional outcome once household expenditure is controlled for (Models 1B and 1C). This reflects that mother's education in our study area determines the socio-economic status of the household. In relation to the gender of the household head, results show that children living in female-headed households have lower average HAZ than children in male-headed households.

Treatment of water by the household contributes to better nutritional outcomes of children. In line with this, we find that children residing in households that treat water have significantly higher HAZ relative to children from households that do not always treat drinking water. The negative coefficient on the distance to health centers indicate that better access to health facilities improve long-term nutritional outcome, although the estimate is not consistently significant in all models.

One can expect that the effect of supermarket purchase depends on how much the household purchases from supermarket outlets. Table 4 summarizes regression results with the share of supermarket food purchase out of total household food expenditure as an independent variable. Results indicate that HAZ of children and adolescents is significantly higher in households that have higher share of supermarket purchase. One percent increase in share of supermarket purchase is associated with 0.02 higher standard deviations in HAZ. This implies that higher intensity of food purchase from supermarkets results in better nutritional outcomes. Parameter estimates for other independent variables follow similar pattern as Table 3.

The effect of supermarket shopping on diets of households might differ depending on the age cohort one considers. To test this, we use an interaction term between the supermarket purchase variables and a dummy variable for the age group of the children above- and below-five. The point estimate for the interaction term reveals that the effect of supermarket purchase is not statistically different between below five children and above five children although the sign tends to show that the effect is lower for below five children. In order to further examine the effect between the two age groups, we estimated the same models in Table 3 and 4 for above five children only (see Table A3 in the appendix). [5] We find similar result as in the full sample, though lower magnitude, showing that supermarket purchase affects HAZ positively for both age groups.

Effect of supermarket purchase on weight-for-age Z-score

Table 6 summarizes regression results with weight-for-age Z-score as dependent variable. Results reveal that WAZ of children in supermarket buying households is 0.11 standard deviation higher compared to households buying from traditional markets only. In comparison to the result for HAZ, it is noticeable that the magnitude of influence is three times lower for supermarket dummy and twice lower for supermarket purchase share variables. An implication is that the effect of supermarket on child nutrition is more pronounced for the long-term measure of child growth, HAZ. Findings are in line with the

[5] Estimation for under-five children separately is not carried out due to the small sample size (112 children).

study by Kimenju and Qaim (2016) who showed that nutrition transition reduces child stunting.

One might question whether the result on child WAZ is mainly driven by possibility of being overweight due to the nutrition transition associated with supermarket purchase. However, only five children in our sample are above the threshold of WAZ for overweight children (>2 standard deviation). We therefore do not expect that results are driven by that. [6] Although studies have shown that supermarkets result in overweight and obesity in adults (Asfaw, 2008; Kimenju et al., 2015; Demmler et al., 2018), this may not be the case when considering child growth (Kimenju et al., 2015).

As a robustness of the regression results, we report control function approach that uses craggit model at the first stage and random effects and Mundlak approach regressions in the second stage for HAZ and WAZ (see the Appendix, Table A4 and A5 for the second stages and Table A6 for the first stage craggit model). Results show that the effects are similar in terms of sign, significance and magnitude, hence showing the robustness of our findings.

Dietary differences between supermarket shoppers and non-shoppers

The effect of supermarket purchase on nutritional outcomes mainly stems from the differences in diets between those who shop from supermarkets and those who do not. We test this descriptively by calculating the dietary diversity score and food variety scores of households' food consumption. Table 7 contains tests for the mean differences in the scores

[6] Robustness check by excluding the five children gives consistent result.

and food categories with differences. We find that dietary diversity score and food variety scores are significantly higher in households buying from supermarkets. A plausible argument is that this might result from the purchase of various non-healthy food items from supermarkets. However, the difference remains even when excluding non-healthy food items such as fats, oils, sugars from the dietary diversity and food variety scores. Regression results food variety score also confirm that supermarket shoppers have significantly higher diversity in the food they consume compared to the non-shoppers (results are summarized in Table 8). Coming to the specific food categories, a significant and relatively larger magnitude of difference is observed for the food groups that are rich in protein (meats, fishes and eggs) which might have a direct implication for the growth of children and adolescents (see Table 7).

In general, we find that supermarket purchase has a significant effect on the long-term nutritional outcomes of children. Our results are consistent with findings by Kimenju et al. (2015) for children and adolescents in urban Kenya. Using panel data and including children less than five years, results confirm and strengthen previous findings.

5. Conclusion

This paper contributes to the understanding of the link between supermarket purchase and child nutritional outcomes in developing countries. Using two rounds of survey data from three towns in Kenya, we find that supermarket purchase significantly increases the long-term nutritional outcomes of children and adolescents under the age of 18. Buying foods from supermarkets and buying higher shares of foods from supermarkets increases height-for-age Z-scores. This positive link exists for both under-five and above five children as examined by the interactions and split sample analysis. In relation to weight outcomes, we find that buying food from supermarket is associated with higher WAZ but the magnitude is lower compared to HAZ outcomes. This implies that supermarkets have higher contribution to the long-term growth outcome.

Descriptive results show that there is dietary difference between those shopping from supermarket and those that do not. Descriptive results show that dietary diversity is significantly higher in households buying from supermarkets, measured in dietary diversity score and food variety score. The difference remains even when excluding non-healthy food items such as fats, oils, sugars from the scores. Specific food groups that are consumed by significantly higher share of supermarket buyers are food groups that are rich in protein and vegetables. This has a direct implication for the growth of children and adolescents.

An important policy implication arising from our study is that supermarkets are one of the means through which better nutritional outcomes for children and adolescents can be promoted in developing countries as poor households are increasingly sourcing their food from supermarkets. The effect can be magnified if food supplies at supermarkets compose greater variety-including fruits and vegetables-that potentially contribute to child growth. This way, one can take advantage of the rapid nutrition transition occurring in low income countries for better health outcomes of children.

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Table 1. Descriptive statistics of major variables

Variables	All	Supermarket purchase=1	Supermarket purchase=0
Child/adolescent characteristics			
Age of child in months	104.2 (49.3)	97.1 (46.7)	112.6 (51.0)
Female child (1,0)	0.52 (0 .50)	0.52 (0.50)	0.52 (0.50)
Malaria or respiratory infection in past month	0.09 (0.29)	0.11 (0.31)	0.07 (0.26)
Maternal characteristics			
Height of mother/caregiver in cm	159.1 (5.79)	159.1 (5.35)	159.1 (6.27)
Weight of mother/caregiver in kg	66.4 (13.9)	68.5 (14.3)	64.0 (13.0)
Education of mother/caregiver in years	10.0 (4.58)	11.6 (4.50)	8.26 (4.00)
Age of mother/caregiver in years	35.2 (9.70)	33.8 (7.82)	36.9 (11.3)
Household characteristics			
Female headed household (1,0)	0.25 (0.44)	0.24 (0 .43)	0.27 (0.45)
Household always treats drinking water (1,0)	0.57 (0.50)	0.59 (0.49)	0.54 (0.50)
Distance to health center in km	2.29 (2.28)	2.70 (2.53)	1.82 (1.86)
Household expenditure (1000 KES /adult equivalence)	9.90 (6.08)	11.8 (6.78)	7.72 (4.22)
Share of supermarket purchase (percent)	7.69 (10.6)	14.3 (10.6)	0.00
Supermarket purchase dummy (1,0)	0.54 (0.50)		
Number of observations	544	293	251

Note: Standard deviation in parentheses

Table 2. Summary statistics of nutritional outcomes by supermarket food purchase status

	All	Supermarket purchase=1	Supermarket purchase=0	Difference	No. Obs.
All children/adolescents					
HAZ	-0.80 (1.24)	-0.56 (1.18)	-1.08 (1.26)	0.52***	544
WAZ	-0.59 (1.06)	-0.48 (1.08)	-0.75 (1.01)	0.27**	350
% Stunted	15.1	10.2	20.7	10.5***	544
% Underweight	7.1	6.2	8.5	2.3	350
Children above five years					
HAZ	-0.85 (1.20)	-0.60 (1.07)	-1.11 (1.28)	0.50***	432
WAZ	-0.63 (1.07)	-0.54 (1.08)	-0.75 (1.03)	0.22	238
% Stunted	15.7	9.8	22.1	12.2***	432
% Underweight	7.6	6.4	9.2	2.8	238
Children below five years					
HAZ	-0.60 (1.37)	-0.40 (1.47)	-0.93 (1.15)	0.53**	112
WAZ	-0.50 (1.05)	-0.36 (1.08)	-0.73 (0.96)	0.37*	112
% Stunted	12.5	11.6	14.0	2.4	112
% Underweight	6.3	5.8	7.0	1.1	112

Note: Standard deviations in parentheses. HAZ: Height-for-age Z-score; WAZ: Weight-for-age Z-score. Stunted /underweight if Z-score<-2

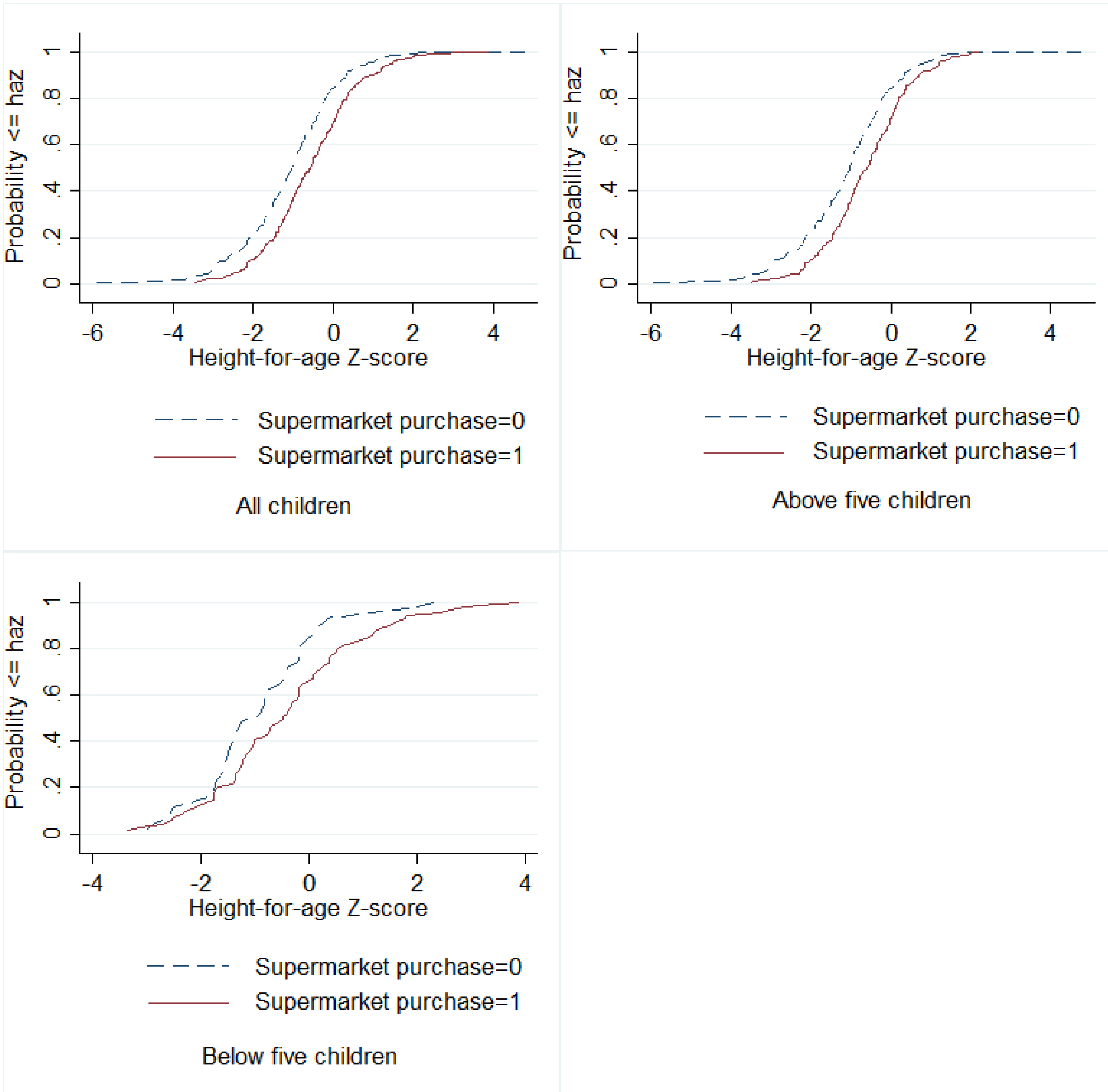

Figure 1. Distribution function plot-Height-for-age Z-score by supermarket purchase dummy variable

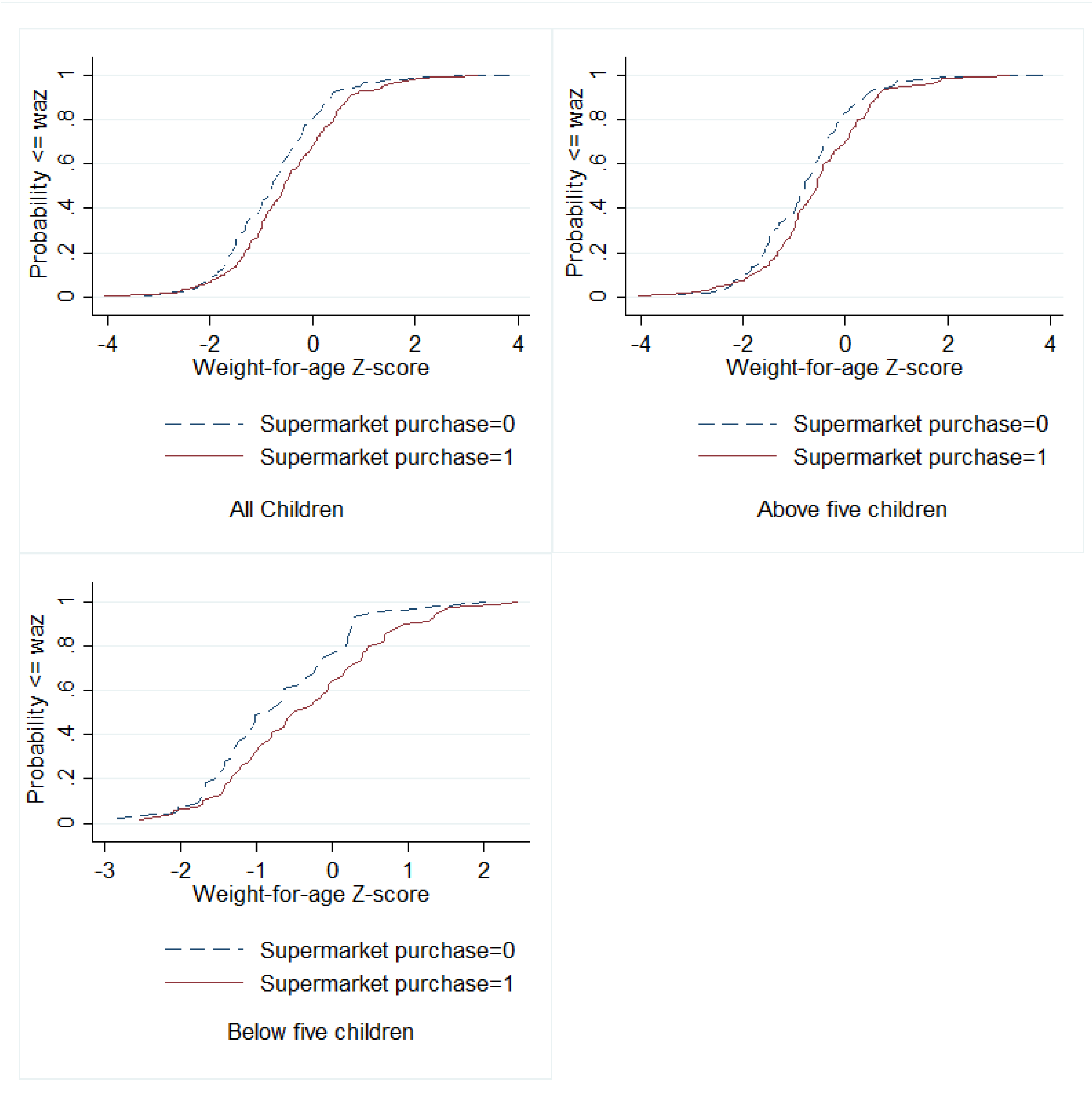

Figure 2 Distribution function plot-Weight-for-age Z-score by supermarket purchase dummy variable

Table 3 Supermarket Purchase and Height-for-age Z-score (HAZ)-Instrumental variable regression

	RE			Mundlak
	Model 1A	Model 1B	Model 1C	Model 1D
Supermarket purchase dummy (0,1)	0.34***	0.29***	0.35***	0.34***
	(0.07)	(0.08)	(0.04)	(0.04)
Age of child in 10 months	0.09***	0.10***	0.11***	0.11***
	(0.02)	(0.02)	(0.00)	(0.01)
Age of child in 10 months squared	-0.01***	-0.01***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Female child (1,0)	0.20***	0.19**	0.25**	0.25**
	(0.07)	(0.08)	(0.10)	(0.12)
Height of mother/caregiver in cm	0.04**	0.04**	0.04**	0.16**
	(0.02)	(0.02)	(0.02)	(0.07)
Education of mother/caregiver in years	0.03***	0.01	0.01	0.05
	(0.01)	(0.01)	(0.01)	(0.07)
Age of female mother/caregiver in years	0.02***	0.02***	0.01***	0.02
	(0.00)	(0.00)	(0.00)	(0.02)
Female headed household (1,0)	-0.13*	-0.17***	-0.15**	-0.59
	(0.08)	(0.06)	(0.08)	(1.10)
Year dummy, 1=2015	0.30***	0.30***	0.25***	0.19***
	(0.07)	(0.07)	(0.05)	(0.04)
Household expenditure (1000 KES /adult equivalence)		0.03***	0.03***	0.01
		(0.00)	(0.00)	(0.01)
Malaria or respiratory infection (1,0)			-0.32	-0.33
			(0.23)	(0.25)
Hh always treats drinking water (1,0)			0.16***	0.08**
			(0.05)	(0.04)
Distance to health center in km (log)			-0.03*	-0.22
			(0.02)	(0.16)
Time averages (mother and household characteristics)	No	No	No	Yes
Constant	-9.33***	-8.91***	-9.07***	-8.85***
	(2.85)	(2.74)	(2.71)	(2.50)
Number of obs.	544	544	544	544
Number of groups	393	393	393	393
R-squared-overall	0.17	0.19	0.20	0.21
Chi2	114.02	616.15	6.40	7.76
P-value(chi2)	0.00	0.00	0.04	0.02
Hausman test Chi2= 6.86, P-value=0.87				

* p<0.1; ** p<0.05; *** p<0.01

Table 4 Share of supermarket purchase and Height-for-age Z-score-Instrumental variable regression

	RE			Mundlak
	Model 2A	Model 2B	Model 2C	Model 2D
Share of supermarket purchase	0.02***	0.02***	0.02***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)
Age of child in months	0.09***	0.10***	0.11***	0.11***
	(0.02)	(0.02)	(0.01)	(0.01)
Age of child in months squared	-0.01***	-0.01***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Female child	0.21***	0.19**	0.25***	0.25**
	(0.07)	(0.08)	(0.09)	(0.11)
Height of mother/caregiver	0.04**	0.04**	0.04***	0.15**
	(0.02)	(0.02)	(0.02)	(0.08)
Education of mother/caregiver	0.02***	0.01	0.01	0.04
	(0.00)	(0.01)	(0.01)	(0.07)
Age of female mother/caregiver	0.02***	0.02***	0.01***	0.02
	(0.01)	(0.01)	(0.01)	(0.02)
Female headed household	-0.18**	-0.20***	-0.19**	-0.63
	(0.08)	(0.05)	(0.08)	(1.12)
Year dummy, 1=2015	0.34***	0.34***	0.29***	0.23***
	(0.08)	(0.08)	(0.06)	(0.06)
Household expenditure (1000 KES /adult equivalence)		0.03***	0.03***	0.01
		(0.01)	(0.01)	(0.01)
Malaria or respiratory infection (dummy)			-0.27	-0.28
			(0.21)	(0.23)
Hh always treats drinking water			0.19***	0.09
			(0.03)	(0.06)
Distance to health center in km (log)			0.01	-0.28*
			(0.01)	(0.16)
Time averages (mother and household characteristics)	No	No	No	Yes
Constant	-9.37***	-8.97***	-9.17***	-8.93***
	(2.79)	(2.66)	(2.47)	(2.21)
Number of obs.	544	544	544	544
Number of groups	393	393	393	393
R-squared-overall	0.17	0.19	0.20	0.21
Chi2	49.45	50.83	8.83	10.69
P-value(chi2)	0.00	0.00	0.01	0.00
Hausman test Chi2= 9.42, P-value=0.67				

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table 5. Supermarket purchase and HAZ-with interactions-IV Random effects

	Model 1E	Model 2E
Supermarket purchase dummy (0,1)	0.38**	
	(0.19)	
Share of supermarket purchase		0.02**
		(0.01)
Age of child in 10 months	0.07	0.07*
	(0.05)	(0.04)
Age of child in 10 months squared	-0.004**	-0.01***
	(0.00)	(0.00)
Female child	0.16*	0.18*
	(0.10)	(0.10)
Height of mother/caregiver	0.04***	0.04***
	(0.01)	(0.01)
Education of mother/caregiver	0.01	0.00
	(0.01)	(0.02)
Age of female mother/caregiver	0.02**	0.02**
	(0.01)	(0.01)
Household expenditure (1000 KES /adult equivalence)	0.03***	0.03***
	(0.01)	(0.01)
Female headed household	-0.18	-0.21
	(0.13)	(0.14)
Malaria or respiratory infection (dummy)	-0.20	-0.17
	(0.16)	(0.16)
Hh always treats drinking water	0.18*	0.20**
	(0.10)	(0.10)
Distance to health center in km (log)	-0.05	0.00
	(0.05)	(0.04)
Year dummy, 1=2015	0.30***	0.33***
	(0.08)	(0.10)
Supermarket dummy*Less than five years[1]	-0.16	-0.01
	(0.27)	(0.02)
Constant	-8.94***	-9.06***
	(1.80)	(1.77)
Number of obs.	544	544
Number of groups	393	393
R-squared-overall	0.19	0.19
Chi2	105.61	171.53

* $p<0.1$; ** $p<0.05$; *** $p<0.01$ [1] Supermarket dummy variable is a predicted value from first stage regression of supermarket dummy variable on the explanatory variables and the instrument.

Table 6. Supermarket purchase and Weight-for-age Z-score-Instrumental variable regression

	RE		Mundlak	
	(1)	(2)	(3)	(4)
Supermarket purchase dummy (0,1)	0.11***		0.10***	
	(0.04)		(0.04)	
Share of supermarket purchase		0.01**		0.01**
		(0.00)		(0.00)
Age of child in 10 months	-0.03	-0.03	-0.04*	-0.03
	(0.02)	(0.02)	(0.02)	(0.02)
Female child	0.09	0.13	0.12	0.15
	(0.10)	(0.11)	(0.13)	(0.13)
Height of mother/caregiver	0.03*	0.03*	0.16***	0.15***
	(0.02)	(0.02)	(0.04)	(0.04)
Weight of mother/caregiver	0.02***	0.02***	0.01	0.01
	(0.00)	(0.00)	(0.02)	(0.02)
Education of mother/caregiver	-0.00	-0.00	0.02	0.02
	(0.03)	(0.03)	(0.05)	(0.05)
Age of female mother/caregiver	0.02***	0.01***	0.03***	0.03***
	(0.00)	(0.00)	(0.00)	(0.00)
Household expenditure (1000 KES /adult equivalence)	0.02*	0.02**	-0.01	-0.00
	(0.01)	(0.01)	(0.03)	(0.02)
Female headed household	-0.01	-0.00	-1.26	-1.39
	(0.12)	(0.12)	(1.25)	(1.33)
Malaria or respiratory infection (dummy)	-0.38***	-0.39***	-0.40***	-0.42**
	(0.12)	(0.13)	(0.15)	(0.16)
Hh always treats drinking water	0.12	0.14	-0.11	-0.10
	(0.11)	(0.11)	(0.15)	(0.15)
Distance to health center in km (log)	-0.03*	-0.01	-0.04	-0.10
	(0.02)	(0.01)	(0.16)	(0.18)
Year dummy, 1=2015	-0.21**	-0.22**	-0.32*	-0.33*
	(0.10)	(0.11)	(0.17)	(0.18)
Time averages (mother and household characteristics)	No	No	Yes	Yes
Constant	-7.28**	-7.36**	-7.06**	-7.19**
	(3.01)	(2.90)	(2.97)	(2.87)
Number of obs.	350	350	350	350
Number of groups	279	279	279	279
R-squared-overall	0.19	0.20	0.21	0.21
Chi2	10.27	10.18	7.64	7.32
P-value(chi2)	0.01	0.01	0.02	0.03

* p<0.1; ** p<0.05; *** p<0.01

Table 7. Dietary diversity by supermarket purchase status

	All	Supermarket purchase=1	Supermarket purchase=0	Difference
Diet diversity score 1 (including all food groups)[a, b]	11.1 (0.04)	11.3 (0.04)	10.8 (0.06)	0.48***
Diet diversity score 2 (excluding oils and fats, sweets and spices)	8.1 (0.04)	8.3 (0.04)	7.8 (0.06)	0.48***
Food variety score 1 (including all food groups)[b]	42.9 (0.59)	46.9 (0.78)	38.2 (0.79)	8.67***
Food variety score 2 (excluding oils and fats, sweets and spices)	37.4 (0.52)	40.9 (0.68)	33.1 (0.70)	7.83***
Food groups with differences				
Tubers and roots	0.99 (0.01)	0.98 (0.01)	0.996 (0.004)	-0.02*
Legumes, nuts, seed	0.99 (0.005)	0.99 (0.01)	0.991 (0.01)	-0.002
Fruits	0.99 (0.005)	1.00 (0.00)	0.98 (0.01)	0.02**
Meats	0.95 (0.01)	0.98 (0.01)	0.91 (0.02)	0.07***
Fishes	0.39 (0.02)	0.48 (0.03)	0.28 (0.03)	0.20***
Eggs	0.78 (0.02)	0.87 (0.02)	0.67 (0.03)	0.20***
Milk and milk products	0.99 (0.004)	0.99 (0.005)	0.99 (0.006)	0.001
Sweets	0.998 (0.002)	0.996 (0.004)	1.00 (0.00)	-0.004
Spices	0.996 (0.003)	0.996 (0.004)	0.996 (0.004)	0.00
Number of observations[c]	491	266	225	

[a] Food groups are cereals; tubers and roots; legumes and nuts; vegetables and fruits; meat (including poultry); fish; eggs; milk and milk products; oil and fats; sweets; and spices

[b] Data on food consumption has been collected at household level for a 30 day recall period.

[c] Number of observations refer to unique households in the sample

Note: Standard deviation in parentheses

Table 8-Effect of supermarket purchase on food variety score

	Food variety score 1[a]		Food variety score 2[b]	
	(1)	(2)	(3)	(4)
Supermarket purchase dummy (0,1)	3.08**		2.42**	
	(1.51)		(1.17)	
Share of supermarket purchase		0.18**		0.14*
		(0.09)		(0.08)
Education of mother/caregiver	0.16***	0.14***	0.17***	0.15***
	(0.03)	(0.03)	(0.03)	(0.04)
Age of female mother/caregiver	-0.18***	-0.18***	-0.12***	-0.11***
	(0.02)	(0.03)	(0.02)	(0.02)
Female headed household	-0.88	-1.10**	-0.74*	-1.00***
	(0.61)	(0.44)	(0.41)	(0.23)
Year dummy, 1=2015	2.82**	3.15***	4.07**	4.30***
	(1.43)	(1.16)	(1.68)	(1.43)
Household expenditure (1000 KES /adult equivalence)	0.98***	0.97***	0.85***	0.82***
	(0.20)	(0.21)	(0.14)	(0.16)
Distance to health center in km (log)	0.52	0.93	0.51	0.81
	(0.37)	(0.60)	(0.32)	(0.53)
Constant	34.68***	35.01***	27.87***	28.01***
	(2.44)	(2.48)	(2.45)	(2.57)
Number of obs.	491	491	491	491
Number of groups	393	393	393	393
R-squared-overall	0.36	0.36	0.37	0.36
Chi2	19.23	15.15	55.23	48.44
P-value(chi2)	0.00	0.00	0.00	0.00

[a] This score represents dietary diversity score including all food groups.
[b] This score represents dietary diversity score excluding oils and fats, sweets and spices.
[c] Number of observations refer to unique households in the sample

Appendix

Table A1-First stage regressions of instrumental variable regressions

	Supermarket dummy		Supermarket purchase share	
	RE	Mundlak	RE	Mundlak
Distance between hh and supermarket in km (log) [a]	-0.15***	-0.15***	-0.15***	-0.15***
	(0.01)	(0.01)	(0.01)	(0.01)
Age of child in 10 months	0.00	-0.00*	0.00	-0.00*
	(0.00)	(0.00)	(0.00)	(0.00)
Age of child in 10 months squared	-0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Female child	-0.02	-0.01	-0.02	-0.01
	(0.03)	(0.03)	(0.03)	(0.03)
Height of mother/caregiver	-0.00	-0.01	-0.00	-0.01
	(0.00)	(0.03)	(0.00)	(0.03)
Education of mother/caregiver	0.01***	0.00	0.01***	0.00
	(0.00)	(0.01)	(0.00)	(0.01)
Age of female mother/caregiver	-0.00	0.01	-0.00	0.01
	(0.00)	(0.01)	(0.00)	(0.01)
Female headed household	-0.03	0.01	-0.03	0.01
	(0.02)	(0.12)	(0.02)	(0.12)
Year dummy, 1=2015	0.01	-0.01	0.01	-0.01
	(0.01)	(0.05)	(0.01)	(0.05)
Household expenditure (1000 KES /adult equivalence)	0.01***	-0.00	0.01***	-0.00
	(0.00)	(0.01)	(0.00)	(0.01)
Malaria or respiratory infection (dummy)	-0.02	-0.02	-0.02	-0.02
	(0.03)	(0.03)	(0.03)	(0.03)
Household always treats drinking water	0.03	-0.01	0.03	-0.01
	(0.05)	(0.08)	(0.05)	(0.08)
Distance to health center in km (log)	0.01	-0.00	0.01	-0.00
	(0.02)	(0.01)	(0.02)	(0.01)
Mean-height of mother/caregiver		0.01		0.01
		(0.03)		(0.03)
Mean-education of mother/caregiver		0.01		0.01
		(0.01)		(0.01)
Mean-Age of female mother/caregiver		-0.01**		-0.01**
		(0.00)		(0.00)
Mean-Female headed household		-0.05		-0.05
		(0.15)		(0.15)
Mean-household expenditure/adult equivalent		0.01		0.01
		(0.01)		(0.01)
Mean- household always treats drinking water		0.06		0.06
		(0.06)		(0.06)
Mean- distance to health center in km (log)		0.01		0.01
		(0.02)		(0.02)
Constant	0.77	0.81	0.77	0.81
	(0.61)	(0.51)	(0.61)	(0.51)
Number of obs. (groups)	544 (393)	544 (393)	544 (393)	544 (393)
R-squared-overall	0.52	0.52	0.52	0.52

* $p<0.1$; ** $p<0.05$; *** $p<0.01$ [a] Instrument in first stage regression

Table A2-Full result of Mundlak models (with time average coefficients)

	HAZ		WAZ	
	(1)	(2)	(3)	(4)
Supermarket purchase dummy (0,1)	0.34***		0.10***	
	(0.04)		(0.04)	
Share of supermarket purchase		0.02***		0.01**
		(0.00)		(0.00)
Age of child in 10 months	0.11***	0.11***	-0.04*	-0.03
	(0.01)	(0.01)	(0.02)	(0.02)
Age of child in 10 months squared	-0.01***	-0.01***		
	(0.00)	(0.00)		
Female child	0.25**	0.25**	0.12	0.15
	(0.12)	(0.11)	(0.13)	(0.13)
Height of mother/caregiver	0.16**	0.15**	0.16***	0.15***
	(0.07)	(0.08)	(0.04)	(0.04)
Weight of mother/caregiver			0.01	0.01
			(0.02)	(0.02)
Education of mother/caregiver	0.05	0.04	0.02	0.02
	(0.07)	(0.07)	(0.05)	(0.05)
Age of female mother/caregiver	0.02	0.02	0.03***	0.03***
	(0.02)	(0.02)	(0.00)	(0.00)
Female headed household	-0.59	-0.63	-1.26	-1.39
	(1.10)	(1.12)	(1.25)	(1.33)
Year dummy, 1=2015	0.19***	0.23***	-0.32*	-0.33*
	(0.04)	(0.06)	(0.17)	(0.18)
Household expenditure (1000 KES /adult equivalence)	0.01	0.01	-0.01	-0.00
	(0.01)	(0.01)	(0.03)	(0.02)
Malaria or respiratory infection (dummy)	-0.33	-0.28	-0.40***	-0.42**
	(0.25)	(0.23)	(0.15)	(0.16)
Hh always treats drinking water	0.08**	0.09	-0.11	-0.10
	(0.04)	(0.06)	(0.15)	(0.15)
Distance to health center in km (log)	-0.22	-0.28*	-0.04	-0.10
	(0.16)	(0.16)	(0.16)	(0.18)
Mean-height of mother/caregiver	-0.12**	-0.11	-0.13***	-0.12***
	(0.06)	(0.07)	(0.04)	(0.04)
Mean-weight of mother/caregiver			0.01	0.01
			(0.02)	(0.02)
Mean-education of mother/caregiver	-0.04	-0.04	-0.03	-0.03
	(0.08)	(0.08)	(0.04)	(0.04)
Mean-Age of female mother/caregiver	-0.01	-0.01	-0.01**	-0.02*
	(0.02)	(0.02)	(0.01)	(0.01)
Mean-Female headed household	0.44	0.45	1.28	1.42
	(1.20)	(1.23)	(1.38)	(1.47)
Mean-household expenditure/adult equivalent	0.03*	0.02	0.03	0.02
	(0.01)	(0.01)	(0.02)	(0.02)
Mean- household always treats drinking water	0.09	0.12**	0.32***	0.30***
	(0.06)	(0.05)	(0.12)	(0.11)

Table A2-continued				
Mean- distance to health center in km (log)	0.19	0.30*	0.02	0.10
	(0.15)	(0.16)	(0.17)	(0.19)
Constant	-8.85***	-8.93***	-7.06**	-7.19**
	(2.50)	(2.21)	(2.97)	(2.87)
Number of obs.	544	544	350	350
Number of groups	393	393	279	279
R-squared-overall	0.21	0.21	0.21	0.21
Chi2	7.76	10.69	7.64	7.32
P-value(chi2)	0.02	0.00	0.02	0.03

* *p*<0.1; ** *p*<0.05; *** *p*<0.01

Table A3. Supermarket purchase and HAZ- Above five children-Instrumental variable regression

	RE		Mundlak	
	(1)	(2)	(3)	(4)
Supermarket purchase dummy (0,1)	0.25***		0.24***	
	(0.09)		(0.09)	
Share of supermarket purchase		0.01**		0.01***
		(0.01)		(0.00)
Age of child in 10 months	-0.06*	-0.06**	-0.07**	-0.07**
	(0.03)	(0.03)	(0.03)	(0.03)
Female child	0.16	0.17	0.17	0.18
	(0.11)	(0.11)	(0.13)	(0.13)
Height of mother/caregiver	0.05**	0.05**	0.17***	0.17***
	(0.02)	(0.02)	(0.05)	(0.06)
Education of mother/caregiver	0.02***	0.01***	0.06	0.06
	(0.00)	(0.00)	(0.08)	(0.08)
Age of female mother/caregiver	0.01*	0.01**	0.02	0.02
	(0.01)	(0.01)	(0.02)	(0.02)
Household expenditure (1000 KES	0.03***	0.03***	0.00	-0.00
/adult equivalence)	(0.00)	(0.00)	(0.02)	(0.02)
Female headed household	-0.11	-0.14**	-0.06	-0.09
	(0.07)	(0.07)	(0.56)	(0.56)
Malaria or respiratory infection	-0.28	-0.25	-0.31	-0.29
(dummy)	(0.26)	(0.24)	(0.29)	(0.28)
Hh always treats drinking water	0.19***	0.20***	0.08	0.08
	(0.07)	(0.07)	(0.06)	(0.08)
Distance to health center in km (log)	-0.03	0.01	0.00	-0.03
	(0.03)	(0.02)	(0.06)	(0.03)
Year dummy, 1=2015	0.40***	0.40***	0.29***	0.29***
	(0.05)	(0.06)	(0.01)	(0.01)
Time averages (mother and household characteristics)	No	No	Yes	Yes
Constant	-9.16***	-9.22***	-8.37***	-8.47***
	(3.38)	(3.13)	(2.96)	(2.72)
Number of obs.	432	432	432	432
Number of groups	343	343	343	343
R-squared-overall	0.22	0.23	0.23	0.24
Chi2	8.28	2.44	1.73	1.58

* *p*<0.1; ** *p*<0.05; *** *p*<0.01

Table A4-Control function approach-Second stage-HAZ

	RE		Mundlak	
	(1)	(2)	(3)	(4)
Supermarket purchase dummy (0,1)	0.37**		0.36**	
	(0.16)		(0.14)	
Share of supermarket purchase		0.02***		0.02***
		(0.00)		(0.00)
Age of child in 10 months	0.09***	0.09***	0.08***	0.08***
	(0.02)	(0.01)	(0.02)	(0.01)
Age of child in 10 months squared	-0.01***	-0.01***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Female child	0.17**	0.20***	0.17*	0.20***
	(0.07)	(0.07)	(0.09)	(0.07)
Height of mother/caregiver	0.04**	0.04**	0.15*	0.14
	(0.02)	(0.02)	(0.08)	(0.09)
Education of mother/caregiver	0.01	0.00	0.04	0.04
	(0.01)	(0.01)	(0.07)	(0.07)
Age of female mother/caregiver	0.02***	0.02***	0.02	0.02
	(0.00)	(0.01)	(0.02)	(0.01)
Female headed household	-0.18***	-0.22***	-0.59	-0.60
	(0.03)	(0.03)	(1.09)	(1.11)
Household expenditure (1000 KES /adult equivalence)	0.03***	0.03***	0.01	0.01
	(0.01)	(0.00)	(0.01)	(0.01)
Malaria or respiratory infection (dummy)	-0.20	-0.15	-0.21	-0.17
	(0.23)	(0.23)	(0.25)	(0.25)
Hh always treats drinking water	0.18***	0.21***	0.07	0.08
	(0.00)	(0.01)	(0.05)	(0.06)
Distance to health center in km (log)	-0.04*	0.02	-0.21	-0.30*
	(0.02)	(0.03)	(0.14)	(0.15)
Year dummy, 1=2015	0.29***	0.34***	0.23***	0.27***
	(0.06)	(0.07)	(0.06)	(0.09)
Time averages (mother and household characteristics)	No	No	Yes	Yes
Residual from first stage binary treatment (CF)	-0.10		-0.09	
	(0.11)		(0.09)	
Residual from first stage continuous treatment (CF)		-0.01**		-0.01
		(0.00)		(0.01)
Constant	-9.06***	-9.23***	-8.68***	-8.86***
	(2.96)	(2.76)	(2.49)	(2.08)
Number of obs.	544	544	544	544
Number of groups	393	393	393	393
R-squared-overall	0.20	0.20	0.20	0.21

* *p*<0.1; ** *p*<0.05; *** *p*<0.01

Table A5. Control function approach-Second stage-WAZ

	RE		Mundlak	
	(1)	(2)	(3)	(4)
Supermarket purchase dummy (0,1)	0.15		0.14	
	(0.12)		(0.11)	
Share of supermarket purchase		0.01***		0.01***
		(0.00)		(0.00)
Age of child in months	-0.03	-0.03	-0.04*	-0.04*
	(0.02)	(0.02)	(0.02)	(0.02)
Female child	0.08	0.08	0.09	0.08
	(0.10)	(0.10)	(0.11)	(0.11)
Height of mother/caregiver	0.03	0.03*	0.16***	0.17***
	(0.02)	(0.02)	(0.05)	(0.05)
Weight of mother/caregiver	0.02***	0.02***	0.01	0.01
	(0.00)	(0.00)	(0.02)	(0.02)
Education of mother/caregiver	-0.00	-0.00	0.02	0.02
	(0.02)	(0.03)	(0.04)	(0.04)
Age of female mother/caregiver	0.02***	0.02***	0.02***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)
Female headed household	-0.01	-0.02	-1.13	-1.11
	(0.11)	(0.13)	(1.11)	(1.09)
Household expenditure (1000 KES /adult equivalence)	0.02	0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.03)	(0.03)
Malaria or respiratory infection (dummy)	-0.36***	-0.35***	-0.37***	-0.37***
	(0.12)	(0.11)	(0.14)	(0.14)
Hh always treats drinking water	0.12	0.12	-0.13	-0.12
	(0.12)	(0.12)	(0.16)	(0.14)
Distance to health center in km (log)	-0.03**	-0.01	0.02	0.01
	(0.01)	(0.01)	(0.14)	(0.14)
Year dummy, 1=2015	-0.21**	-0.20*	-0.31*	-0.32*
	(0.10)	(0.10)	(0.17)	(0.17)
Time averages (mother and household characteristics)	No	No	Yes	Yes
Residual from first stage binary treatment (CF)	-0.02		-0.03	
	(0.14)		(0.15)	
Residual from first stage continuous treatment (CF)		0.00		0.01
		(0.00)		(0.00)
Constant	-7.30**	-7.27***	-6.97**	-6.79**
	(3.18)	(2.82)	(3.12)	(2.69)
Number of obs.	350	350	350	350
Number of groups	279	279	279	279
R-squared-overall	0.19	0.20	0.20	0.21

* p<0.1; ** p<0.05; *** p<0.01

Table A6-First stage craggit model for control function

	Supermarket dummy	Share of purchase
Distance between hh and supermarket in km (log)	-0.54***	-3.07**
	(0.05)	(1.27)
Age of child in 10 months	-0.01	0.42
	(0.05)	(0.82)
Age of child in 10 months squared	-0.00	-0.02
	(0.00)	(0.04)
Female child	-0.11	-3.88*
	(0.15)	(2.00)
Height of mother/caregiver	-0.05	1.70
	(0.11)	(1.23)
Education of mother/caregiver	0.03	0.18
	(0.05)	(1.01)
Age of female mother/caregiver	0.05	-0.59
	(0.03)	(0.44)
Female headed household	0.25	-1.92
	(1.01)	(8.61)
Year dummy, 1=2015	-0.04	-5.14**
	(0.19)	(2.44)
Household expenditure (1000 KES /adult equivalence)	-0.00	-0.20
	(0.04)	(0.59)
Malaria or respiratory infection (dummy)	0.10	-5.02
	(0.26)	(3.89)
Hh always treats drinking water	0.03	-0.39
	(0.24)	(4.95)
Distance to health center in km (log)	-0.19	8.77**
	(0.44)	(3.65)
Mean-height of mother/caregiver	0.03	-1.91
	(0.11)	(1.25)
Mean-education of mother/caregiver	-0.00	0.37
	(0.05)	(1.06)
Mean-Age of female mother/caregiver	-0.06*	0.34
	(0.03)	(0.48)
Mean-Female headed household	-0.46	5.46
	(1.03)	(8.89)
Mean-household expenditure/adult equivalent	0.10**	0.53
	(0.04)	(0.60)
Mean- household always treats drinking water	0.15	-3.10
	(0.30)	(5.44)
Mean- distance to health center in km (log)	0.12	-13.73***
	(0.45)	(3.89)
Constant	2.73	47.02
	(2.42)	(35.78)
sigma	12.13***	12.13***
	(1.12)	(1.12)
Number of obs.	544	544
Chi2 (P-value(chi2))	140.74 (0.00)	140.74 (0.00)

* *p*<0.1; ** *p*<0.05; *** *p*<0.01 Note: The model is estimated is craggit that includes time average to account for the panel structure.

Table A7-Effect of supermarket purchase on dietary diversity score

	Diet diversity score 1[a]		Diet diversity score 2[b]	
	(1)	(2)	(3)	(4)
Supermarket purchase dummy (0,1)	0.07		0.07	
	(0.10)		(0.09)	
Share of supermarket purchase		0.004		0.004
		(0.01)		(0.01)
Education of mother/caregiver	0.02***	0.02***	0.02***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)
Age of female mother/caregiver	-0.01*	-0.01*	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Female headed household	-0.07	-0.08	-0.06	-0.06
	(0.08)	(0.09)	(0.07)	(0.07)
Year dummy, 1=2015	0.30***	0.31***	0.29***	0.30***
	(0.11)	(0.09)	(0.10)	(0.09)
Household expenditure (1000 KES /adult	0.04***	0.04***	0.04***	0.04***
equivalence)	(0.01)	(0.01)	(0.01)	(0.01)
Distance to health center in km (log)	0.05***	0.06***	0.04***	0.05***
	(0.02)	(0.02)	(0.01)	(0.02)
Constant	10.57***	10.58***	7.55***	7.56***
	(0.13)	(0.13)	(0.14)	(0.14)
Number of obs.[c]	491	491	491	491
Number of groups	393	393	393	393
R-squared-overall	0.22	0.22	0.23	0.23
Chi2	70.97	120.21	107.56	208.93
P-value(chi2)	0.00	0.00	0.00	0.00

[a] This score represents dietary diversity score including all food groups.
[b] This score represents dietary diversity score excluding oils and fats, sweets and spices.
[c] Number of observations refer to unique households in the sample

Table A9 Bias minimizing treatment effects estimation-Supermarket purchase dummy and HAZ

Estimators	ATT	Confidence Interval	Diagnostic tests
Minimum biased estimator (MB) [a]	0.461	[0.154, 0.681]	
Control function (Heckman two-stage) [b]	0.350	[-0.214, 1.150]	F = 6.374 p = 0.000
Klein and Vella approach [c]	0.369	[0.105, 0.596]	F = 490.281 LR = 27.145 p = 0.018

Note: results estimated using bmte command (McCarthy, Millimet and Tchernis, 2014) that proposes using methods that do not rely on exclusion restriction. Findings are similar in magnitude and significance. :estimations were carried out with first stage propensity score matching and alternative methods in second stage. Time averages are included in the estimations since our data is panel. However, estimates are not clustered at household level.

[a] Minimum biased estimator proposed by Millimet and Tchernis, 2013-minimizes bias by estimation using individuals with propensity scores in a neighborhood with minimum bias propensity scores.

[b] Control function approach by Heckman et al. (1999) and Navarro, 2008-identification achieved by using observations in the extreme end of the propensity score.

[c] Klein and Vella (2009)-relies on the hetroscedasticity of the errors in the selection and outcome equation for identification.