GHANA
IFPRI
STRATEGY SUPPORT PROGRAM | WORKING PAPER 50 | NOVEMBER 2018

Measures and Determinants of Urban Food Security

Evidence from Accra, Ghana

Cascade Tuholske, Kwaw S. Andam, Jordan Blekking, Tom Evans, and Kelly Caylor

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The urban population in Africa south of the Sahara (SSA) is expected to expand rapidly from 376 million people in 2015 to more than 1.25 billion people by 2050. Measuring and ensuring food security among urban households will become an increasingly pertinent task for development researchers and practitioners. In this paper we characterize food security among a sample of low- and middle-income residents of Accra, Ghana, using 2017 survey data. We find that households tend to purchase food from traditional markets, local stalls and kiosks, and street hawkers, and rarely from modern supermarkets. We characterize food security using three established metrics: the Household Food Insecurity Access Scale (HFIAS); the Household Food Insecurity Access Prevalence (HFIAP); and the Food Consumption Score (FCS). We then estimate the determinants of food security using general linear models.

The food security metrics are not strongly correlated. For example, according to HFIAP, as many as 70 percent of households sampled are food insecure, but only 2 percent fall below acceptable thresholds measured by FCS. Model results show that household education, assets, and dwelling characteristics are significantly associated with food security according to HFIAS and HFIAP, but not with FCS. The poor correlation and weak model agreement between the dietary recall metric, FCS, and the experience-based metrics, HFIAS and HFIAP, call for closer attention to measurement of urban food security. Given Africa's urban future, our findings highlight the need for an urban-oriented comprehensive approach to the food security of urban households.

Keywords: food security, urban, determinants, measurement, Accra

1. INTRODUCTION

The urban population in Africa south of the Sahara (SSA) is projected to nearly quadruple from 376 million in 2015 to over 1.25 billion people by 2050 (UN 2018). How this rapid urban transition is affecting urban food security and how it is reverberating into broader food systems is unclear. Most food security studies across SSA have concentrated on rural areas, and the few case studies that have examined urban food security have depended on metrics designed to study rural food security (Maxwell et al. 2000; Battersby 2013, 2008; Seto and Ramankutty 2016; Haysom and Tawodzera 2018). As such, the degree to which established household-level food security metrics relate to urban households is poorly understood. Little is known about how urban household demographic, socioeconomic, environmental, and spatial characteristics may vary across established household-level food security metrics. The mismatch between rural-centric food security methodology and the reality of the region's rapid urban transition presents clear challenges for African countries to achieve the United Nations' (UN) Sustainable Development Goals (SDGs) 2 and 11 – zero hunger and the development of sustainable cities, respectively.

Food security is a theoretical construct predicated on complex, multiscale spatiotemporal processes that encompass a broad range of human and environmental variables (Jones et al. 2013; Vaitla et al. 2017). It cannot be measured by a single metric. While orthodox methodologies break food security into manageable components, household-level food security measurement remains rooted in rural-centric conceptualizations of food security (Battersby 2008; Haysom and Tawodzera 2018). Many development agencies still advocate for policies centered on rural food security, using the urban transition as a lynchpin to buttress rural producers (FAO 2018, 2017). Such an approach neglects to fully account for how the food security needs among the growing numbers of urban poor—including economic access, diet, and urban food retailing—will affect broader food systems.

Nonetheless, the nascent body of urban food security studies from SSA illuminate how the region's rapid urban transition is presenting new challenges for food systems. For example, evidence shows that the urban poor in SSA rely on purchased food for 90 percent of their calories and spend up to 70 percent of their income on food (Maxwell et al. 2000; Frayne et al. 2010), which suggests that local price stability is paramount to urban food security. Rural households, on the other hand, achieve food security largely through self-production (Sibhatu and Qaim 2017) and are less susceptible to price shocks compared to urban households (Moseley, Carney, and Becker 2010). During the 2007/08 global commodity price shock, urban households across SSA reported being less food secure, whereas food security among rural households improved (Verpoorten et al. 2013). This may be in part because urban households contend with greater food shortages compared to rural households (Walsh and van Rooyen 2015), when higher global food prices are transmitted to local food markets.

Food preferences and retailing options are also different for urban consumers in SSA. Changes in diet and lifestyle brought on by urbanization are burdening health systems by creating a dual burden of disease of both over- and undernourished poor households (Popkin, Adair, and Ng 2013; Tzioumis and Adair 2014). Shifting food preferences among urban consumers are transforming rural production toward large-scale agribusiness in many SSA countries, which can be detrimental to smallholder agriculture (FAO 2017). Finally, the urban transition is also transforming food retail systems, specifically leading to an increase in the number of supermarket retail outlets (Traill 2006; Reardon et al. 2003). It is unclear, however, how this shift in food retailing affects food security and diet among the urban poor (Wenban-Smith, Faße, and Grote 2016).

This paper has two aims. First, we compare the food security status of households from nine low- and middle-income residential areas in Accra using three established food security metrics. Secondly, we examine the household-level demographic, socioeconomic, environmental, and spatial predictors of urban food security and how these predictors vary across the three indicators of household food security. We also identify and discuss the main sources of households' food purchases. With an ever-increasing number of

Africans poised to live in cities, and, given that many of these new residents will be poor, understanding *who* is food (in)secure in cities, *where* food (in)security exists, *why* diets may be changing, and *how* urban food security will affect broader food systems, is relevant for achieving the UN SDGs.

2. MEASURING FOOD SECURITY IN URBAN HOUSEHOLDS

The most direct measurement of household-level food security that captures caloric and nutritional intake are either anthropometry measurements or detailed, multi-visit household expenditure or dietary recall logs (Jones et al. 2013). But acquiring accurate data through such methods is time-intensive, invasive, and expensive. Instead, household food security can be more generally assessed via proxy metrics derived from: (1) single-visit dietary recall; (2) coping strategies; and (3) psychosocial and physical experience of food insecurity (Haysom and Tawodzera 2018). All three metrics of household food security were developed for application in rural settings. Moreover, if used individually, each fails to capture the multidimensionality of household food security (Battersby 2008; Ballard, Kepple, and Cafiero 2013; Jones et al. 2013; Haysom and Tawodzera 2018). Indeed, aggregate pairwise comparison of 8,000 to 30,000 households from a wide range of developing countries showed that established dietary recall metrics have weak correlation both with coping strategies and with experience-based food security metrics (Vaitla et al. 2017). What is more, unless collected repeatedly over time, all these metrics fail to capture any temporal changes in household food security.

The few household-level urban food security assessments that have been done are largely from southern African cities using two interrelated experience-based metrics, the Household Food Insecurity Access Scale (HFIAS) and the Household Food Insecurity Access Prevalence (HFIAP). The data used in these assessments was collected from sub-populations of urban dwellers and is not representative of the city's population. Nonetheless, these case studies show that high levels of food insecurity among low-income households. Surveys conducted in 11 southern African cities by the African Food Security Network (AFSUN) found that the prevalence of food insecurity households measured by HFIAP ranges from 56 percent to 98 percent of sampled households and that poverty significantly correlates with food insecurity (Frayne et al. 2010). A recent survey from Tshwane, South Africa, found lower levels of urban food insecurity, with 61 percent of 507 sampled households being characterized as food secure by HFIAP (Akinboade and Adeyefa 2018). In Nairobi, 85 percent of households in two major slums reported being food insecure based on HFIAP (Kimani-Murage et al. 2014). During the 2007/8 global commodity price spike, food insecurity among over 3,000 randomly selected households in Ouagadougou, Burkina Faso, increased from 66.7 percent before the price spike to 78.0 percent afterwards (Martin-Prevel et al. 2012). The increase in food insecurity due to rising prices further illustrates the importance of household income in assuring food security in urban households. Last, also using HFIAP, a recent survey of households in two medium-sized cities in northern Ghana found over half of households were food insecure (Ayerakwa 2017).

The AFSUN dataset offers insights into food sources, dietary diversity, socioeconomic, and demographic associations with levels of household food security as measured by HFIAP (Frayne et al. 2010). But the AFSUN data have not been used to examine how dietary diversity correlates with food security measured by HFIAP, nor have they been used to assess how demographic, socioeconomic, dwelling, and spatial determinants of food security status may vary among these proxy measures. To date, only a Ouagadougou case study of 3,000 households has compared proxy measures of household food security in the urban African context (Becquey et al. 2010). The authors found that both HFIAS and the Index-member's Dietary Diversity Score (IDDS) were significantly associated with household-level dietary and nutritional intake, which were calculated from multiple-visit full dietary recall that weighed and measured food portions and ingredients. However, Becquey et al. did not measure food consumed away from home, and they did not assess how household demographic, socioeconomic, environmental, and spatial characteristics relate to measures of household-level food security. In this study, we contribute to the

growing body of knowledge on urban household food security in SSA by comparing measures of household food security and assessing the determinants of food security outcomes.

We employ three measures of household food security: HFIAS; HFIAP; and the Food Consumption Score (FCS). The HFIAS was designed to produce a simple single indicator to monitor and evaluate food security that has been empirically validated for both population and individual level estimates of food security (Jones et al. 2013). Adopted from a set of questions used to estimate prevalence of food insecurity in the United States, HFIAS produces a numeric score derived from nine subjective yes/no questions (Coates, Swindale, and Bilinsky 2007). The questions gauge respondents' behaviors and attitudes related to household food security, including anxiety related to household food insecurity, perceptions of insufficient quality or variety of food, and reduction of food intake and subsequent physical consequences. If the respondent replies in the affirmative to any question, the enumerator asks about the frequency of occurrence. For example, if the respondent replies yes to "In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?", the respondent is then asked the frequency with which this occurred: rarely (1 or 2 times) scored as 1, sometimes (3 to 10 times) scored as 2, or often (more than 10 times) scored as 3. The HFIAS score is the sum of the frequency of occurrence of each of the nine questions and has a range of 0 to 27.

Data used to compute the HFIAS score can be used to calculate the HFIAP, a categorical variable that employs a logic tree from the frequency responses to the HFIAS questions. Using HFIAP, households are categorized as food secure or mildly, moderately, or severely food insecure. It is important to highlight that HFIAS and HFIAP are used to measure access to food as a dimension of food security. But they are not intended to assess the causes of food insecurity or to understand coping strategies, cultural appropriateness of dietary patterns, or nutritional knowledge or uptake.

Our third measure, the FCS, is a composite score that uses data from a seven-day dietary recall questionnaire that measures dietary diversity, food frequency and sourcing, and relative nutritional importance (WFP 2008). Respondents report the number of days out of the last seven their respective household members have consumed locally appropriate food items. The items are grouped into overarching food groups, which are weighted based on the caloric values of those foods. The weighted values are then summed together to produce the FCS. A threshold is applied to determine if a household's food security situation based on consumption is poor (FCS under 21.5), borderline (FCS between 21.5 and 35), or acceptable (FCS greater than 35). FCS has been shown to correlate with per capita calorie consumption across divergent geographical and cultural contexts (Wiesmann et al. 2009).

3. MATERIALS AND METHODS

3.1 Study site

Ghana typifies the urban, economic, and demographic transitions seen in developing and emerging economies in the past few decades across Asia, Latin America, and now increasingly in SSA (Diao et al. 2017; McMillan et al. 2017). When developing economies go through periods of rapid economic growth, the change from a rural agrarian economy to an economy less-dependent on agriculture is often attended by rapid urbanization, as people move out of rural areas into secondary and primary cities. Ghana has been no different. The rural-urban migration that has accompanied Ghana's economic transition has resulted in a population that is now predominantly (54 percent) urban. As a fast-urbanizing country, Ghana's labor is moving out of agriculture to an economy dominated by services (Molini and Paci 2015). The growing labor force in Ghana's service sector is heavily concentrated in and around urban areas (Honorati and de Silva 2016).

This situation is somewhat unique among countries in SSA. According to the UN, the region is only 38.8 percent urban (UN DESA 2018). However, cross-country comparisons of urbanization rates must account for the different definitions of what counts as urban in each country (Richards et al. 2016). For

example, in Ghana, towns with populations greater than 5,000 are considered urban (Ghana Statistical Service 2012). This threshold may account for at least part of the difference between Ghana and other African countries. Nonetheless, urbanization is still a clear manifestation of Ghana's economic and demographic transition, especially when the populations of the largest cities are closely examined. For example, while the national population growth rate between 2000 and 2010 was 2.5 percent, the Accra region, which includes Ghana's capital, recorded a growth rate of 3.1 percent (Ghana Statistical Service 2012).

Accra has been recognized as one of the Africa's rapidly growing mega-cities. The city had an official population of 2.6 million in the 2010 national census. About half of Accra's residents are migrants (Ghana Statistical Service 2014), indicating that much of this growth is not a result of natural increase within the city. Although Ghana's main industrial activities are clustered in Accra, most of Accra's labor force is employed in the services sector. This includes formal sector activities, such as education and health, but also many informal activities, such as trading, catering, manual labor, and transportation. According to UN Habitat, 38.4 percent Accra's residents live in neighborhoods characterized as slums, where urban poverty might be expected to be endemic (Ghana Statistical Service 2014). However, household-level socioeconomic conditions and health status in the city's slums tend to be highly spatially heterogeneous (Weeks et al. 2007, 2012; Jankowska, Weeks, and Engstrom 2011) and the official poverty rate, determined by the consumption threshold of US$1.83 per day, is quite low at 2.2 percent in 2012/13.

Accra's retail food system is diverse. Along with a myriad of roadside shops and individual street hawkers, over 30 open-air markets serve the city (FAO 2016). But like other major cities in SSA (Battersby and Watson 2018), food retailing is evolving in Accra. Whereas there were only three supermarkets before 2005, Accra now has 37 large-format supermarkets, according to an unpublished 2017 survey by IFPRI.

A wide-variety of food products produced from Ghana's rural areas are sold across all retail locations. Traditional staples, such as cassava, plantains and maize, dried and frozen fish, and fruits and vegetables are readily available. Like most West African countries, imports of rice and other commodities play a major role in food consumption. Meat—especially chicken and fish—and processed foods, are increasingly consumed in Accra, and convenience meals away from home are a major food source (Hollinger and Staatz 2015).

3.2 Data and analysis

The Accra Urban Food Security Survey was implemented over a three-week period in July and August 2017. 677 households were interviewed in nine well-established low- and middle-income residential areas throughout Accra. Structured-area sampling was employed (Montello and Sutton 2013). After identifying the residential areas using UN Habitat slum maps (UN-Habitat 2016) and neighborhood maps that show finer-scale detail and reviewing the socioeconomic characteristics of census enumeration area provided by San Diego State University (Weeks et al. 2007; Jankowska, Weeks, and Engstrom 2011), enumerators surveyed households chosen by the use of approximately even spatial intervals according to the density of housing to achieve complete spatial coverage of the low- and middle-income sections of the selected residential areas. The survey questionnaire included modules related to household demographic, dwelling, labor, income, and socioeconomic characteristics; food expenditures; and market preference as well as questions that would permit the computation of FCS, HFIAS, and HFIAP measures for each household. Enumerators surveyed one adult per household. However, demographic information was collected for all household member, and labor characteristics for up to five household members. Data was collected using Qualtrics mobile data collection platform on Apple iPad tablets.

Using data from the 668 household from which complete information was obtained, four models were generated to assess how household demographic, socioeconomic, environmental, and spatial characteristics relate to the three household food security metrics, as well as how such predictors may vary across the three metrics. While the FCS is a bounded integer variable, the distribution is normal and thus an

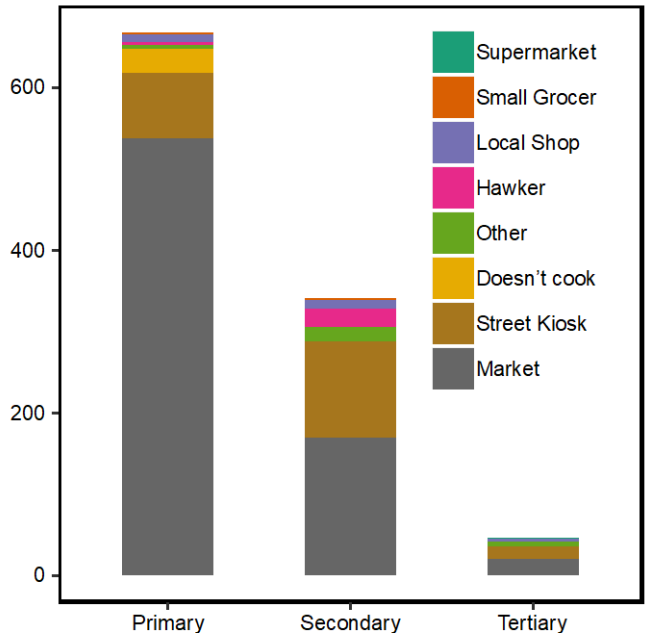
ordinary least squares regression was used. The HFIAS is treated as a count variable because it is the summation of the frequency of occurrences of categorical answers. While the number of zeros is inflated, because the zeros are not assumed to be a result of a different underlying process, a negative binomial model is appropriate (rather than a zero-inflated Poisson regression). A second logistic regression was performed on a binary HFIAS variable that differentiated households based on their HFIAS scores as 0 or >0 (Martin-Prevel et al. 2012). Fourth, for modeling the correlates of HFIAP, marginal effects ordinal logistic regression was used. Results from a marginal effects model indicate the probability of a household switching from a given HFIAP food security category given a change in a predictor variable, holding all else held equal. All analysis was performed in RStudio (Version 1.1.143).

Categorical and continuous independent variables were selected to account for the range of demographic, socioeconomic, environmental, and spatial characteristics pertinent to households in our sample. We controlled for the possibility of free meals consumed by household members at work or school, as well as meals given away to non-household members, household language, and residential area of the household. We employed a slum index to characterize a wide-range of dwelling characteristics to capture the spatial heterogeneity of low- and middle-income residential areas of Accra (Weeks et al. 2007). UN Habitat designates a household as a slum dwelling if it is lacking one or more of five characteristics: durable housing; sufficient living space; access to safe water; access to adequate sanitation; and secure land tenure (UN-Habitat 2016). The slum index is calculated by summing the number of slum indicators a household is lacking and dividing it by five, whereby households with high slum index score exhibit worse socioeconomic conditions based on the household UN slum definition.

Although the household survey attempted to gather monthly household income, we did not include this data in our models because of the high number of missing values and known biases in and the unreliability of self-reported income. As an alternative, we constructed an asset index using procedures similar to those commonly used in creating an asset index with data from Demographic and Health Surveys to approximate household wealth (Rutstein and Johnson 2004). After normalizing the raw data, principal components analysis (PCA) was performed on a list of common household assets (Filmer and Pritchett 2001). To produce a continuous measurement of asset ownership by each individual household, PCA assigns each household asset a factor score. The factor score is produced by multiplying the first principle component for each asset with the normalized count ownership of that asset and summing the result for all assets owned by each household.

Missing values for age of household head, monthly food expenditures, and distance traveled to primary food purchase location were imputed by bootstrapping random values from a Monte Carlo simulation based of the cumulative density function related to the distribution of two variables, respectively. Because over 70 percent of our sample did not receive remittances, we captured this information in our models as a binary variable (Table 1). Finally, because only one household in our sample reported ever shopping at a modern supermarket, we did not include supermarkets among the primary locations of food purchases. All other sampled households sourced food from local markets, neighborhood shops and kiosks, street vendors, or hawkers (Fig 1).

Figure 1 Primary, secondary, and tertiary locations where survey households source their food, count



Note: Only one household reported ever going to a supermarket and it was a tertiary location.

3.3 Descriptive statistics

54 percent of the 668 households in our analytical sample are headed by a male (Table 1). The average household consists of four members. The mean age of the household head is 47 years. On average, 56 percent of household members are employed. Self-employment is the most common form of employment – on average, households have at least one self-employed adult. Both regular and casual wage employment are considerably rarer – one member out of every three surveyed households has regular wage employment and one member out of every six surveyed households has casual employment. Although not reported in Table 1, from the 424 households that provided complete income information, the average monthly income from employment is 890 Ghana cedis.[1]

One-third of all households have at least one adult who has attended or completed primary education. Nearly 40 percent of households have an adult who has attended or completed secondary education, and more than 20 percent of households have an adult who has received some form of post-secondary education. Only 5 percent of households have no adult with any formal education.

Our sample reflects the ethnic diversity of Accra. Asante Twi, originating from central Ghana, is the dominant language for 30 percent of our sample, but languages originating from northern Ghana are predominantly spoken in about 21 percent of the households. Ewe, the main language for people from the Volta region east of Accra, is the main language in 9 percent of the households. The second most common language spoken is Ga (29 percent), the language for the Ga tribe which is indigenous to Accra. Only 2 percent of households speak English as their primary language.

In terms of food consumption, expenditure on prepared food away from home is quite high at nearly 12 Ghana cedis (~ USD $3) per household per day. Household members receive on average 0.17 meals per capita at school or work per day. This may include public food assistance. For example, Ghana has a School Feeding Program that provides meals to children in selected public schools, and currently reaches a third of school children in Ghana (Mwin n.d.).

[1] The exchange rate to the US dollar at the time of the survey was about 4 Ghana cedis.

Table 1: Household characteristics from 2017 Accra Urban Food Security Survey

	Mean or count	Standard deviation or percent	Minimum	Maximum
Age of household head, years	46.87	14.27	17	95
Household size	4.01	2.03	1	13
Male head of household, 0/1	361	54.0%		
Asset Index	0.00	1.61	-2.34	9.47
Received remittances, 0/1	193	28.5%		
Slum Index	0.09	0.117	0	0.6
No school, 0/1[†]	36	5.4%		
Primary school, 0/1[†]	223	33.4%		
Secondary school, 0/1[†]	253	37.9%		
Tertiary school, 0/1[†]	156	23.3%		
Household members employed, percent	56	0.27	0.11	1
Self-employed, number	1.02	0.81	0	5
Casually employed, number	0.16	0.43	0	4
Regularly employed, number	0.33	0.60	0	3
Travel time to market, minutes	15.0	15.9	0	180
Free meals at school or work, 0/1	0.17	0.36	0	3
Meals given to non-household members	1.61	5.35	0	70
Street food expenses, cedis	11.67	14.22	0	150
Total food expenses, cedis	555.01	376.69	2	3,000

Observations: 668 households.
[†]The highest education attained by any working household member.
Note: Asset index normalizes the count data for each asset. Thus, the counts are centered at a mean of zero.

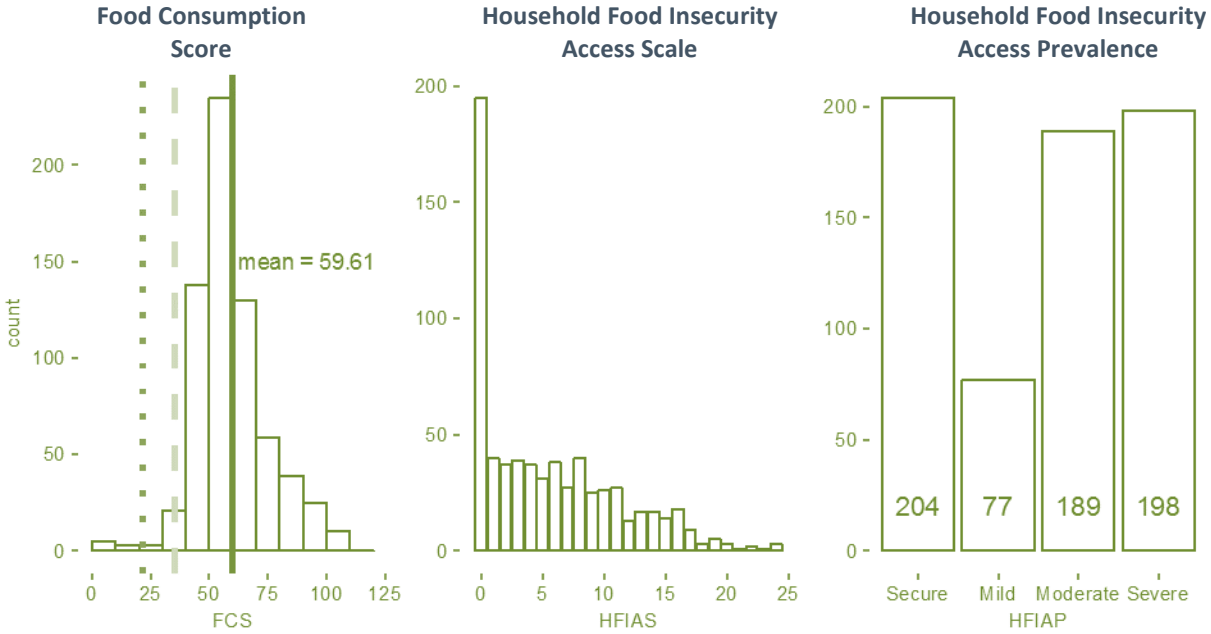
4. RESULTS

4.1 Comparing measures of food security

Based on HFIAP, nearly 70 percent of households sampled are categorized as mildly to severely food insecure (Figure 2). Over the previous month, these households experienced anxiety related to food insecurity or were unable to access sufficient or preferred foods. But few households characterized as food insecure by HFIAP have high HFIAS scores. Those who answered “yes” to any of the nine HFIAS questions did not experience the problem frequently. Thus, our results indicate prevalent but low frequency of anxiety and experiences related to food insecurity among low- and middle-income households in Accra. In contrast, only 14 of the 668 households in the survey sample can be characterized as borderline or food insecure according to the FCS. This signals that households within our sample consumed sufficient calories over the previous seven days.

There is no correlation between FCS and HFIAS (Figure 3) or between FCS and HFIAP (Figure 4). In contrast, HFIAS and HFIAP are more closely correlated, with each being computed from the same information (Figure 5). The increase in variance in HFIAS scores as HFIAP categories moves from secure to severe suggests that some sample households may not have answered “yes” to less serious HFIAS questions. For example, such households may have responded ‘no’ to the question “Did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food”, but responded ‘yes’ to the question about a more serious situation, “Did you or any household member go to sleep at night hungry because there was not enough food?” Affirmative responses to questions such as these would place the respondent in the severe HFIAP category.

Figure 2 Distribution of the Food Consumption Score (FCS), Household Food Insecurity Access Scale (HFIAS), and the Household Food Insecurity Access Prevalence (HFIAP) for survey households



Note: Households below the dotted line dotted line in panel FCS are food insecure, while those below the dashed-line are borderline food insecure.

Figure 3: Household Food Insecurity Access Scale (HFIAS) plotted against Food Consumption Score (FCS)

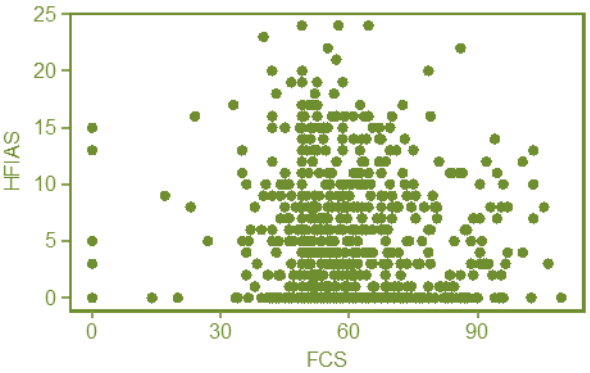


Figure 4 Boxplot of Food Consumption Score (FCS) against Household Food Insecurity Access Prevalence (HFIAP)

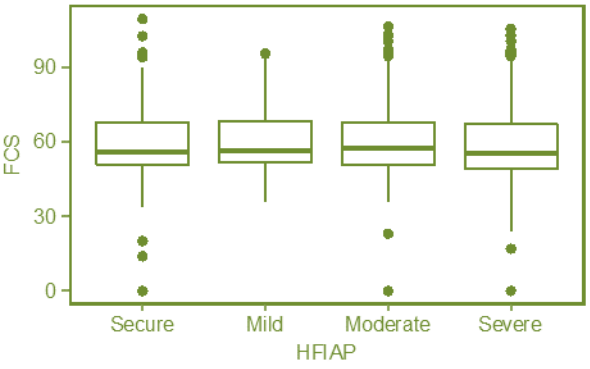


Figure 5: Boxplot of Household Food Insecurity Access Scale (HFIAS) against Household Food Insecurity Access Prevalence (HFIAP)

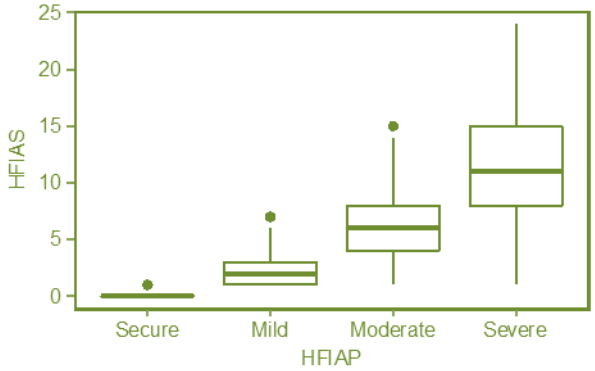
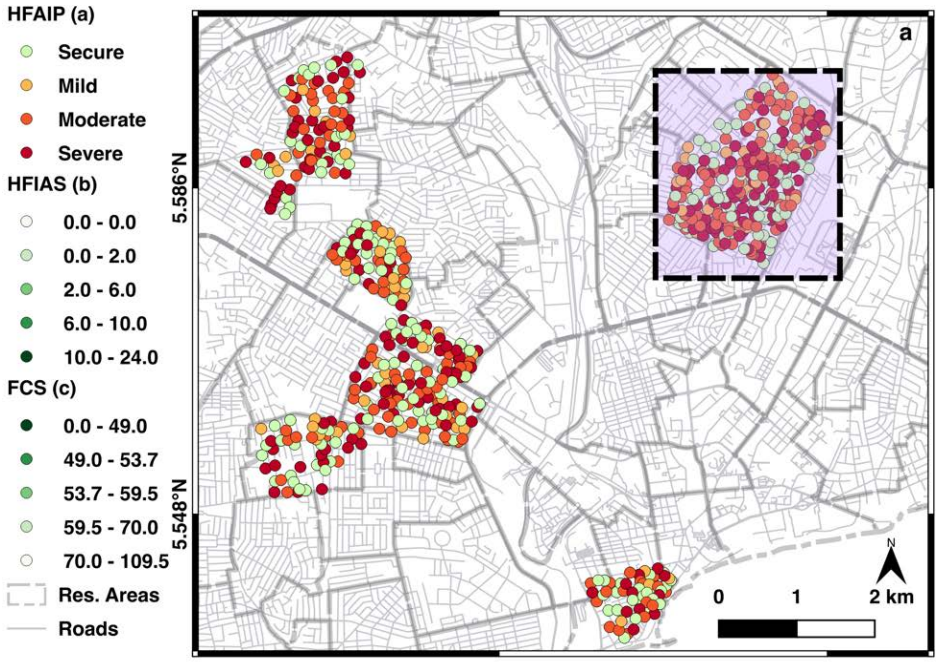
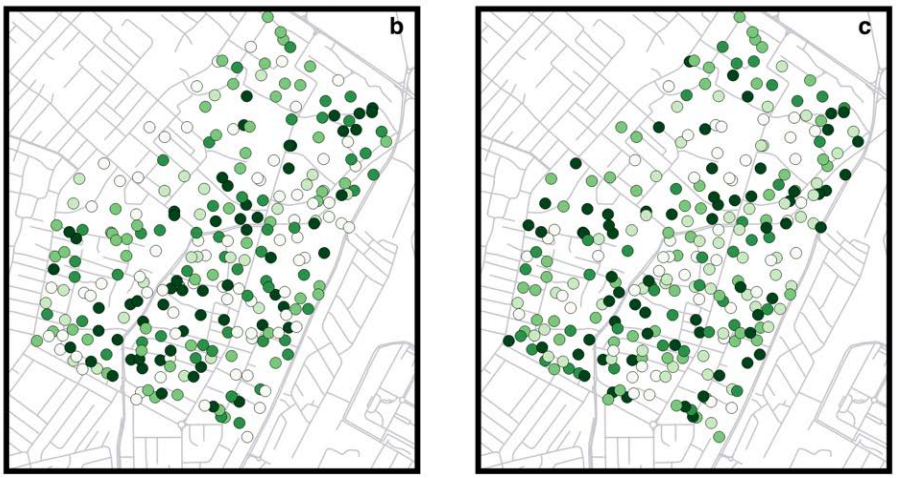


Figure 6: Spatial distribution of food security in Accra measured by the Household Food Insecurity Access Prevalence (HFIAP) for all sampled households (main map a) and for areas around Nima residential area by the Household Food Insecurity Access Score (HFIAS, map b) and Food Consumption Score (FCS, map c)





Note: This figure depicts the spatial heterogeneity in outcomes. For the HFIAS and FCS, intervals are derived from sample quintiles. Five households are not shown because of inaccurate GPS coordinates.

Across all three food security metrics, we find high spatial heterogeneity (Figure 6). While cluster analysis was not performed due to the spatially discontinuous sampling between residential areas, no clear spatial pattern is visually evident in the point maps of all three measures of household-level food security. Overall, residential areas can be characterized as having a wide range of household-level food security outcomes across all three household-level food security metrics.

4.2 Drivers of food insecurity in Accra

We now turn to our analysis of the determinants of these different measures of household food security. The model results are consistent for HFIAS and HFIAP, but differ for FCS. Household demographic composition plays an important role in determining food security outcomes measured by HFIAS and HFIAP (Table 2, Table 3). Across HFIAP categories, smaller households have a greater likelihood of being food secure. But the size of the household has no significant effect on FCS. The HFIAS logit model suggests that larger households tend to have a greater likelihood of food insecurity. Though the affect size is near zero, households with an older head have a greater likelihood of being food secure according to HFAIP. The slum index has no significant effect across all four models, nor does the sex of the household head. The lack of a significant relationship between household demographics, household composition, and slum conditions suggests that household diet and food consumption is sufficient across all households no matter the composition or quality of housing.

Table 2 Predictors of household Food Consumption Score (FCS) and Household Food Insecurity Access Scale (HFIAS)

	Food Consumption Score (FCS) ordinary least squares model		Household Food Insecurity Access Scale (HFIAS) negative binomial model		Household Food Insecurity Access Scale (HFIAS) logit model	
	Estimate	**SE**	**Estimate**	**SE**	**Estimate**	**SE**
Age of household head, years	-0.078	0.043	0.637	0.004	-0.014	0.007
Household size	-0.087	0.543	0.007	0.046	0.308**	0.100
Male head of household, 0/1	1.876	1.260	0.100	0.106	-0.260	0.220
Asset Index	0.637	0.408	0.000	0.037	-0.406***	0.075
Receives remittances, 0/1	4.289**	1.307	0.735	0.110	0.063	0.228
Slum Index	2.704	5.200	0.228	0.438	1.054	0.935
No school, 0/1†	-0.835	2.962	0.006	0.244	1.153	0.594
Primary school, 0/1†	-1.305	1.759	0.594	0.149	0.583	0.298
Secondary school, 0/1†	-0.681	1.609	0.298	0.137	0.224	0.264
Household members employed, percent	0.816	0.747	0.220	0.063	-0.197	0.133
Self-employed, number	0.960	1.018	0.264	0.086	-0.096	0.178
Casually employed, number	0.752	1.512	0.178	0.125	0.310	0.299
Regularly employed, number	0.676	1.227	0.299	0.104	-0.161	0.209
Travel time to market, minutes	0.092*	0.036	0.935	0.003	-0.006	0.006
Free meals at school or work, 0/1	-1.056	1.620	0.209	0.135	-0.259	0.267
Meals given to non-household members	0.356***	0.106	0.267	0.009	0.000	0.020
Street food expenses, cedis	0.088*	0.041	0.020	0.003	0.031***	0.009
Total food expenses, cedis	0.005**	0.002	0.430	0.000	0.000	0.000
Control for language	Yes	Yes	Yes	Yes	Yes	Yes
Control for residential area	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	57.409***	3.643	0	0.306	0.954	0.637
Adjusted R-squared	0.181					

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ †Tertiary education is the reference category

Table 3 Ordered logit marginal probabilities of a household being in a specific Household Food Insecurity Access Prevalence (HFIAP) food security category

	Secure		Mild		Moderate		Severe	
	Effect	**SE**	**Effect**	**SE**	**Effect**	**SE**	**Effect**	**SE**
Age of household head, yrs	0.003*	0.001	0.001*	0.000	-0.001*	0.000	-0.003*	0.001
Household size	-0.040**	0.015	-0.008*	0.003	0.010*	0.004	0.039**	0.014
Male head of household, 0/1	0.060	0.033	0.013	0.007	-0.014	0.008	-0.059	0.033
Asset Index	0.061***	0.012	0.013***	0.003	-0.015**	0.005	-0.059***	0.012
Receives remittances, 0/1	-0.033	0.034	-0.007	0.008	0.007	0.007	0.033	0.035
Slum Index	-0.213	0.137	-0.045	0.030	0.051	0.035	0.206	0.133
No school, 0/1[†]	-0.171***	0.045	-0.058*	0.023	-0.025	0.037	0.254*	0.102
Primary school, 0/1[†]	-0.099*	0.043	-0.023*	0.012	0.018*	0.008	0.104*	0.049
Secondary school, 0/1[†]	-0.062	0.042	-0.014	0.010	0.013	0.009	0.063	0.043
Household members employed, percent	0.030	0.020	0.006	0.004	-0.007	0.005	-0.029	0.019
Self-employed, number	0.013	0.027	0.003	0.006	-0.003	0.006	-0.012	0.026
Casually employed, number	-0.077	0.042	-0.016	0.009	0.018	0.011	0.075	0.041
Regularly employed, number	0.032	0.032	0.007	0.007	-0.008	0.008	-0.031	0.031
Travel time to market, mins	0.003**	0.001	0.001*	0.000	-0.001*	0.000	-0.003**	0.001
Free meals at school or work, 0/1	0.039	0.043	0.008	0.009	-0.009	0.010	-0.038	0.041
Meals given to non-household members	-0.001	0.003	0.000	0.001	0.000	0.001	0.001	0.003
Street food expenses, cedis	-0.004***	0.001	-0.001**	0.000	0.001**	0.000	0.004***	0.001
Total food expenses, cedis	0.000*	0.000	0.000*	0.000	0.000*	0.000	0.000*	0.000
Control for language	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control for residential area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: * p < 0.05, ** p < 0.01, *** p < 0.001 [†]Tertiary education is the reference category

While the highest educational attainment of any member within a household is not a significant predictor of FCS, higher education significantly increases household food security measured by HFIAS and HFIAP (Table 2, Table 3). Households that have members who attended or completed tertiary education (23.3 percent of our sample) have a greater likelihood of being in the food secure HFIAP category. This is especially evident between households with no adult members who received schooling and those households with members who have some tertiary education, with the greatest effect size among severely food insecure households with no education in the HFIAP ordered logit marginal probabilities model. In contrast, educational attainment was not significantly correlated in any way to a households' FCS.

Household wealth as measured by the asset index increases the likelihood of a household being food secure based on HFIAS and HFIAP (Table 2, Table 3), suggesting that household wealth is associated with household food security, at least as measured by these metrics. However, the asset index is not significantly associated with FCS. Furthermore, household labor does not appear to play a role in determining the level of household food security. Both the labor type and the share of the household engaged in employment does not significantly affect food security across all four models.

Annual remittances are significantly associated with a higher FCS. Receiving remittances, all else equal, increases the FCS for a household by four score points. This highlights the potential for remittances and gifts as a mechanism to increase the quantity and diversity of a household's diet by raising disposable income to purchase higher-calorie foods or more diverse food types. Higher total monthly food expenditures also are associated with a higher FCS and with improved food security outcomes based on HFIAP. But the effect size is nearly zero. Total monthly food expenditures are not significantly associated with HFIAS.

Giving free meals to non-household members are significantly associated with a higher FCS. However, these variables are not significant determinants of HFIAS or HFIAP (Table 2, Table 3). The ability to give away meals may imply that those households have excess food. Longer travel times to markets are significant predictors of a higher FCS, as well as better HFIAP outcomes. But the effect size of market distance measured in minutes is quite small. Finally, increased daily expenditures on prepared food purchased away from home from street food vendors, fast food outlets, or restaurants is significantly correlated with higher FCS, but also a greater likelihood of food insecurity based on HFIAS and HFIAP models. However, the effect size is nearly zero across all models.

5. CONCLUSIONS

This paper examined the food security status of a sample of low- and middle-income households in Accra, Ghana, using three established food security metrics to determine what household characteristics are predictors of the food security status of these urban households. According to the Food Consumption Score (FCS), a dietary recall measure, we find that households in our sample generally do not suffer from insufficient calories. However, a clear majority of households in the sample experience a regular inability to access "sufficient, safe, and nutritious food to maintain a healthy and active life to access food to achieve", per FAO's definition of food security (FAO 2008). With 70 percent of our sample characterized using the Household Food Insecurity Access Prevalence (HFIAP) measure as mildly to severely food insecure, it is clear that these urban households regularly worry about having enough food and, at times, cannot access sufficient food to meet their needs. By this measure, our results agree with the handful of similar case studies from cities in SSA that have also shown high levels of food insecurity among low-income urban residents (Frayne et al. 2010; Martin-Prevel et al. 2012; Kimani-Murage et al. 2014; Ayerakwa 2017).

Our sample should not be considered representative of all low- and middle-income households in Accra, however. For example, by design the sample does not include households in informal settlements. Moreover, our sample contains mostly households who have lived in Accra for several years – less than 5 percent of the heads of the households surveyed have lived in Accra for less than five years. Even though often-vulnerable groups, such as recent migrants and residents of informal settlements are under-represented in the sample, the data suggests that those households have relatively high levels of food insecurity compared with well-established households. As such, food insecurity, as measured by HFIAP, could be prevalent among a substantial number of Accra's newest and poorest residents, although we cannot confirm this with our sample. Furthermore, the extreme spatial heterogeneity of household food security measured by all three indicators—FCS, HFIAS, and HFIAP—reveal that low- or middle-income residential areas have a broad spatial distribution of household-level food security outcomes with little clustering within these residential areas (Figure 6). Because cities like Accra are changing so rapidly, some households may be achieving economic and educational advancements ahead of their nearby neighbors. As noted in studies of socioeconomic and health status in Accra (Weeks et al. 2007; Jankowska, Weeks, and Engstrom 2011) , blanket terms that characterize neighborhoods as slums can be misleading. Interventions should account for the wide distribution of different food security situations within low- or middle-income residential areas.

The HFIAS and HFIAP models of food security predictors show that educational attainment, household assets, and the demographics of a household all associate with how households perceive their ability to access food. As households primarily rely on purchased food to meet their needs—fewer than 3 percent of households obtain food from farming, gardening, or fishing—the ability to afford food ultimately underpins household-level food security in our sample. While our models do not show the exact mechanisms through which these variables directly lead to higher or lower levels of experiences related to food security, higher educational levels have been shown in case studies from other countries to strongly correlate with decreased levels of poverty (Bigsten et al. 2003; Litschig and Morrison 2013). Thus, vis-à-vis educational attainment, greater wealth increases a household's economic access to food, decreases anxiety

related to procuring food, and may increase household resiliency to food insecurity should food prices increase.

Due to the poor correlation and model agreement between the HFIAS and HFIAP models and the FCS model, we echo recent calls to develop multifaceted metrics specifically designed to measure food security in the urban context in SSA (Battersby and Watson 2018; Haysom and Tawodzera 2018). While our sample is much smaller, we confirm the weak correlation in the *urban context* between dietary recall-based measures, such as FCS, and experience-based metrics, like HFIAS and HFIAP, found by Vaitla et al. (2017) in their much larger aggregate study. Given that we find a strong correlation between socioeconomic household characteristics— age of household head, assets, and education—and HFIAP outcomes, experience-based metrics like the HFIAS or HFAIP may be appropriate in the urban context. The accuracy of the FCS is less clear: Either households consume sufficient calories, yet still experience anxiety related to food insecurity, or the FCS is not an appropriate metric to capture food insecurity expressed by the HFAIP among low- and middle income-households in a city such as Accra. While the HFIAS and HFIAP model results reveal that households worry about food security and some experience food insecure situations, they do not provide information on the mechanisms that underpin such anxieties nor offer insights into how sourcing of food nor seasonality may play a role in decision making related to food security in cities. The HFIAS and HFIAP models also do not explain the range of urban households' dietary preferences. One potential approach to address the discrepancy between metrics, like the World Food Programme's Consolidated Approach to Reporting Indicators of Food Security (CARI), is to capture for each household multiple metrics that cover different aspects of household food security, e.g., dietary diversity, coping, and poverty, and combine them into a single food security index (WFP 2015).

Our results further buttress the need for a greater understanding of how the food security challenges of the urban poor will cascade into broader food systems (Battersby 2008; Richards et al. 2016; Seto and Ramankutty 2016; Haysom and Tawodzera 2018). Despite the growing importance of ensuring urban food security, food security research and development practice still tends to be overwhelmingly geared toward improving rural agricultural output (FAO 2018) and enhancing rural livelihoods through off-farm employment, often as a means to stem the influx of migrants to cities (FAO 2017). Although some policy-makers and development practitioners may consider urban food security as part of the rationale for improving agricultural production in rural areas, it is more common for development projects to view improved food security and incomes in rural areas as their sole objective. This rural focus fails to adequately account for the needs of the urban poor who will soon make up the greatest share of the population in SSA (Battersby 2013). Indeed, recent research shows that on a global scale 50 percent of urban households can be characterized as food insecure compared with 46 percent of rural households (Battersby and Watson 2018). Ensuring urban food security in SSA will require policies that encourage commercial agriculture in rural areas, but also policies that strengthen infrastructure and market linkages between rural food production and urban consumption, which would have the added benefit (beyond greater urban food security) of ensuring that rural producers have access to new urban markets (Richards et al. 2016).

Throughout SSA, many local governments lack the institutional capacity to rapidly implement effective policies to meet the needs of the growing numbers of urban poor. Yet local governments do have options to shore up household food security. For example, our results suggest that ensuring access to high-quality education opportunities for all urban dwellers may strengthen food security in the long-term. But overarching urban policies in the medium term – such as transportation and water and sanitation infrastructure improvements – can reduce poverty-levels and disease-risk and may reduce vulnerability to food insecurity among low- and middle-income households. Through infrastructure and improved urban services, local governments can strengthen household food security directly by reducing the economic burden of procuring food.

Finally, our findings are a reminder of the important role of governance in food systems within urban areas. Both informal and formal governance arrangements for food retailing influence household food purchases and food security (Blekking, Tuholske, and Evans 2017). Dealing with the diverse governance systems common in most cities in SSA will require a nuanced approach that balances the modernization of food retailing, especially the entrance of supermarkets, with the needs of low-income consumers and local vendors. To take one example, modernized food retailing may have negative consequences for the urban poor who may not be able to afford the larger unit sizes of staples sold in supermarkets or transport costs required to shop at supermarkets which may be located at some distance away (Battersby and Watson 2018). Only one household within our sample reported ever purchasing food from supermarkets, despite the substantial influx of modern grocery stores into Accra. This finding is similar to Tawodzera's (2011) findings for Harare, Zimbabwe, and Battersby and Watson's (2018) findings for Kisumu, Kenya. On the other hand, although the households in these studies report infrequent shopping at modern supermarkets compared with traditional sources, supermarkets may be serving as wholesale centers for smaller traditional shops. The emerging evidence lends support to the view that governance of the food system will require policies that support modernization, but at the same time recognition of the importance of maintaining access to traditional markets, street vendors and hawkers, and prepared street food for poor consumers (Battersby and Watson 2018).

Ghana's urban transition has outpaced its neighbors in SSA, and, despite economic growth, our results show that many low- and middle-income urban households report being food insecure. Policymakers across SSA should take heed. International policy resonates with national leaders. Thus, initiatives such as the Sustainable Development Goals often feed into national policy objectives and donor funding. The SDGs, notably, do not interlink SDG 1 and 2 – zero poverty and zero hunger – with SDG 11, the development of sustainable cities (Battersby 2017). This is even though the planet is now more urban than rural, and that urban poverty and economic inequality are at record highs. Sustainable cities will depend on ensuring that the growing numbers of urban poor are food secure. If the future of African countries lies primarily within cities, then to feed the future, policy and research agendas that focus on ensuring urban food security must be pursued.

REFERENCES

Akinboade, O. A. and S. A. Adeyefa. 2018. "An Analysis of Variance of Food Security by Its Main Determinants Among the Urban Poor in the City of Tshwane, South Africa." *Social Indicators Research* 137 (1): 61–82. https://doi.org/10.1007/s11205-017-1589-1.

Ayerakwa, H. M. 2017. "Urban Households' Engagement in Agriculture: Implications for Household Food Security in Ghana's Medium Sized Cities." *Geographical Research* 55 (2): 217–230. https://doi.org/10.1111/1745-5871.12205.

Ballard, T. J., A.W. Kepple, and C. Cafiero. 2013. *The Food Insecurity Experience Scale: Development of a Global Standard for Monitoring Hunger Worldwide.* Technical Paper. Rome: Food and Agriculture Organization of the United Nations. http://www.fao.org/economic/ess/ess-fs/voices/en/.

Battersby, J. 2008. "Beyond the Food Desert: Finding Ways to Speak about Urban." *Geografiska Annaler* B: 157–161. https://doi.org/10.1007/s10460-008-9120-6.

———. 2013. "Hungry Cities: A Critical Review of Urban Food Security Research in Sub-Saharan African Cities." *Geography Compass* 7 (7): 452–463. https://doi.org/10.1111/gec3.12053.

———. 2017. "MDGs to SDGs–new Goals, Same Gaps: The Continued Absence of Urban Food Security in the Post-2015 Global Development Agenda." *African Geographical Review* 36 (1): 115–129. https://doi.org/10.1080/19376812.2016.1208769.

Battersby, J., and V. Watson. 2018. "Addressing Food Security in African Cities." *Nature Sustainability* 1 (4): 153-155. https://doi.org/10.1038/s41893-018-0051-y.

Becquey, E., Y. Martin-Prevel, P. Traissac, B. Dembele, A. Bambara, and F. Delpeuch. 2010. "The Household Food Insecurity Access Scale and an Index-Member Dietary Diversity Score Contribute Valid and Complementary Information on Household Food Insecurity in an Urban West-African Setting." *Journal of Nutrition* 140 (12): 2233–2240. https://doi.org/10.3945/jn.110.125716.

Bigsten, A., B. Kebede, A. Shimeles, and M. Taddesse. 2003. "Growth and Poverty Reduction in Ethiopa: Evidence from Household Panel Surveys." *World Development* 31 (1): 87–106. https://doi.org/10.1016/S0305-750X(02)00175-4.

Blekking, J., C. Tuholske, and T. Evans. 2017. "Adaptive Governance and Market Heterogeneity: An Institutional Analysis of an Urban Food System in Sub-Saharan Africa." *Sustainability* 9 (12): 2191. https://doi.org/10.3390/su9122191.

Coates, J., A. Swindale, and P. Bilinsky. 2007. *Household Food Insecurity Access Scale (HFIAS) for Measurement of Household Food Access: Indicator Guide (v. 3).* Washington, D.C.: Food and Nutrition Technical Assistance Project, Academy for Educational Development.

Diao, X., P. Fang, E. Magalhaes, S. Pahl, and J. Silver. 2017. *Cities and Rural Transformation: A Spatial Analysis of Rural Youth Livelihoods in Ghana.* IFPRI Discussion Paper 1599. Washington, D.C.: International Food Policy Research Institute.

FAO (Food and Agriculture Organization of the United Nations). 2008. *The State of Food and Agriculture 2008.* Rome.

———. 2016. *Street Food Vending in Accra, Ghana.* https://doi.org/10.1016/S0263-2373(14)00003-6.

———. 2017. *The State of Food and Agriculture 2017: Leveraging Food Systems for Inclusive Rural Transformation*. Rome.

———. 2018. *The State of Food and Agriculture 2018. Migration, Agriculture and Rural Development.* Rome.

Filmer, D., and L. H. Pritchett. 2001. "Estimating Wealth Effects without Expenditure Data-or Tears: An Application to Educational Enrollments in States of India." *Demography* 38 (1): 115-132. https://doi.org/10.2307/3088292.

Frayne, B., W. Pendleton, J. Crush, B. Acquah, J. Battersby-Lennard, E. Bras, A. Chiweza, et al. 2010. *The State of Urban Food Insecurity in Southern Africa.* Urban Food Security Series 2. Kingston: Queen's University; Cape Town: African Food Security Network.

Ghana Statistical Service. 2012. *2010 Population and Housing Census Final Results, National Analytical Report*. Accra, Ghana. www.statsghana.gov.gh/pop_html.

———. 2014. *Ghana Living Standards Survey Round 6.* Accra, Ghana.

Haysom, G., and G. Tawodzera. 2018. "'Measurement Drives Diagnosis and Response': Gaps in Transferring Food Security Assessment to the Urban Scale." *Food Policy* 74: 117–125. https://doi.org/10.1016/j.foodpol.2017.12.001.

Hollinger, F., and J. M. Staatz. 2015. *Agricultural Growth in West Africa: Market and Policy Drivers.* Rome: Food and Agriculture Organization of the United Nations; Abidjan: African Development Bank. https://doi.org/10.1073/pnas.1108924108.

Honorati, M., and S. J. de Silva. 2016. *Expanding Job Opportunities in Ghana.* Directions in Development. Washington, DC: World Bank. https://doi.org/10.1596/978-1-4648-0941-5.

Jankowska, M. M., J. R. Weeks, and R. Engstrom. 2011. "Do the Most Vulnerable People Live in the Worst Slums? A Spatial Analysis of Accra, Ghana." *Annals of GIS* 17 (4): 221–235. https://doi.org/10.1080/19475683.2011.625976.

Jones, A. D., F. M. Ngure, G. Pelto, and S. L. Young. 2013. "What Are We Assessing When We Measure Food Security? A Compendium and Review of Current Metrics." *Advances in Nutrition: An International Review Journal* 4 (5): 481–505. https://doi.org/10.3945/an.113.004119.

Kimani-Murage, E. W., L. Schofield, F. Wekesah, S. Mohamed, B. Mberu, R. Ettarh, T. Egondi, C. Kyobutungi, and A. Ezeh. 2014. "Vulnerability to Food Insecurity in Urban Slums: Experiences from Nairobi, Kenya." *Journal of Urban Health* 91 (6): 1098–1113. https://doi.org/10.1007/s11524-014-9894-3.

Litschig, S., and K. M. Morrison. 2013. "The Impact of Intergovernmental Transfers on Education Outcomes and Poverty Reduction." *American Economic Journal: Applied Economics* 5 (4): 206–240. https://doi.org/10.1257/app.5.4.206.

Martin-Prevel, Y., E. Becquey, S. Tapsoba, F. Castan, D. Coulibaly, S. Fortin, M. Zoungrana, M. Lange, F. Delpeuch, and M. Savy. 2012. "The 2008 Food Price Crisis Negatively Affected Household Food Security and Dietary Diversity in Urban Burkina Faso." *Journal of Nutrition* 142 (9): 1748–1755. https://doi.org/10.3945/jn.112.159996.

Maxwell, D., C. Levin, M. Armar-Klemesu, M. Ruel, S. Morris, and C. Ahiadeke. 2000. *Urban Livelihoods and Food and Nutrition Security in Greater Accra, Ghana.* IFPRI Research Report 112. Washington, D.C.: International Food Policy Research Institute; Acccra: Noguchi Memorial Institute for Medical Research; Geneva: World Health Organization.

McMillan, M., D. Rodrik, C. Sepulveda, and J. F Kennedy. 2017. *Structural Change, Fundamentals and Growth: A Framework and Case Studies*. NBER Working Paper 23378. Cambridge, MA: National Bureau of Economic Research. https://doi.org/10.3386/w23378.

Molini, V., and P. Paci. 2015. *Poverty Reduction in Ghana Progress and Challenges.* Washington, D.C.: World Bank. https://doi.org/10.1596/K8485.

Montello, D. R., and P. C. Sutton. 2013. *An Introduction to Scientific Research Methods in Geography and Environmental Studies*. 2nd ed. Thousand Oaks, California, USA: SAGE Publications Ltd.

Moseley, W. G., J. Carney, and L. Becker. 2010. "Neoliberal Policy, Rural Livelihoods, and Urban Food Security in West Africa: A Comparative Study of The Gambia, Cote d'Ivoire, and Mali." *Proceedings of the National Academy of Sciences* 107 (13): 5774–5779. https://doi.org/10.1073/pnas.0905717107.

Mwin, D.O. 2017. *Sustaining the Ghana School Feeding Programme - Providing Equal Opportunities and Increasing Enrolment*. Accessed August 16, 2018. https://www.graphic.com.gh/features/opinion/sustaining-the-ghana-school-feeding-programme-providing-equal-opportunities-and-increasing-enrolment.html.

Popkin, B. M, L. S. Adair, and S. W. Ng. 2013. "The Pandemic of Obesity in Developing Countries." *Nutrition Review* 70 (1): 3–21. https://doi.org/10.1111/j.1753-4887.2011.00456.x.NOW.

Reardon, T., C. P. Timmer, C. B. Barrett, and J. Berdegue. 2003. "The Rise of Supermarkets in Latin America and Asia: Implications for International Markets for Fruits and Vegetables." *American Journal of Agricultural Economics* 85 (5): 1140–1146.

Richards, P., T. Reardon, D. Tschirley, T. Jayne, J. Oehmke, and D. Atwood. 2016. "Cities and the Future of Agriculture and Food Security: A Policy and Programmatic Roundtable." *Food Security* 8 (4): 871–877. https://doi.org/10.1007/s12571-016-0597-3.

Rutstein, S. O., and K. Johnson. 2004. *The DHS Wealth Index.* DHS Comparative Reports 6. Calverton, Maryland: ORC Macro. https://doi.org/10.1017/CBO9781107415324.004.

Seto, K. C., and N. Ramankutty. 2016. "Hidden Linkages between Urbanization and Food Systems." *Science* 352 (6288): 943–945. https://doi.org/10.1126/science.aaf7439.

Sibhatu, K. T., and M. Qaim. 2017. "Rural Food Security, Subsistence Agriculture, and Seasonality." *PLoS ONE* 12 (10): e0186406. https://doi.org/http://dx.doi.org/10.1371/journal.pone.0186406.

Tawodzera, G. 2011. "Vulnerability in Crisis: Urban Household Food Insecurity in Epworth, Harare, Zimbabwe." *Food*

Security 3 (4): 503–520. https://doi.org/10.1007/s12571-011-0152-1.

Traill, W. B. 2006. "The Rapid Rise of Supermarkets?" *Development Policy Review* 24 (2): 163–174. https://doi.org/10.1111/j.1467-7679.2006.00320.x.

Tzioumis, E., and L. S. Adair. 2014. "Childhood Dual Burden of Under- and Overnutrition in Low- and Middle-Income Countries: A Critical Review." *Food and Nutrition Bulletin* 35 (2): 230–243. https://doi.org/10.1177/156482651403500210.

UN-Habitat (United Nations Human Settlements Programme). 2016. *Slum Almanac 2015/2016.* https://unhabitat.org/slum-almanac-2015-2016/.

UN (United Nations). 2018. *World Urbanization Prospects: The 2018 Revision, Online Edition.* New York. https://esa.un.org/unpd/wup/Download/.

Vaitla, B., J. Coates, L. Glaeser, C. Hillbruner, P. Biswal, and D. Maxwell. 2017. "The Measurement of Household Food Security: Correlation and Latent Variable Analysis of Alternative Indicators in a Large Multi-Country Dataset." *Food Policy* 68: 193–205. https://doi.org/10.1016/j.foodpol.2017.02.006.

Verpoorten, M., A. Arora, N. Stoop, and J. Swinnen. 2013. "Self-Reported Food Insecurity in Africa during the Food Price Crisis." *Food Policy* 39: 51–63. https://doi.org/10.1016/j.foodpol.2012.12.006.

Walsh, C. M., and F. C. van Rooyen. 2015. "Household Food Security and Hunger in Rural and Urban Communities in the Free State Province, South Africa." *Ecology of Food and Nutrition* 54 (2): 118–137. https://doi.org/10.1080/03670244.2014.964230.

Weeks, J. R., A. Getis, D. A. Stow, A. G. Hill, D. Rain, R. Engstrom, J. Stoler, et al. 2012. "Connecting the Dots Between Health, Poverty and Place in Accra, Ghana." *Annals of the Association of American Geographers* 102 (5): 932–941. https://doi.org/10.1080/00045608.2012.671132.

Weeks, J. R., A. Hill, D. Stow, A. Getis, and D. Fugate. 2007. "Can We Spot a Neighborhood from the Air? Defining Neighborhood Structure in Accra, Ghana." *GeoJournal* 69 (1–2): 9–22. https://doi.org/10.1007/s10708-007-9098-4.

Wenban-Smith, H., A. Faße, and U. Grote. 2016. "Food Security in Tanzania: The Challenge of Rapid Urbanisation." *Food Security* 8 (5): 973–984. https://doi.org/10.1007/s12571-016-0612-8.

WFP (World Food Programme). 2008. *FCS Technical Guidance*. http://documents.wfp.org/stellent/groups/public/documents/manual_guide_proced/wfp197216.pdf.

———. 2015. *Consolidated Approach for Reporting Indicators of Food Security (CARI) Guidlines.* https://resources.vam.wfp.org/sites/default/files/CARI_Final_0.pdf.

Wiesmann, D., L. Bassett, T. Benson, and J. Hoddinott. 2009. *Validation of the World Food Programme's Food Consumption Score and Alternative Indicators of Household Food Security.* IFPRI Discussion Paper 870. Washington, D.C.: International Food Policy Research Institute.

About the Author(s)

Cascade Tuholske is a PhD student with the Department of Geography at the University of California, Santa Barbara, CA, USA. **Kwaw S. Andam** is a Research Fellow in DSGD of IFPRI working in the Ghana Strategy Support Program (GSSP), based in Accra. **Jordan Blekking** is a PhD student with the Department of Geography at Indiana University, Bloomington, IN, USA. **Tom Evans** is a Professor with the School of Geography and Development at the University of Arizona, Tucson, AZ, USA. **Kelly Caylor** is a Professor with the Department of Geography at the University of California, Santa Barbara, CA, USA.

Acknowledgments

U.S. Borlaug Fellows in Global Food Security Program, funded by the United States Agency for International Development (USAID), the Earth Research Institute at the University of California, and NSF grant number #1801251 provided the primary funding for this paper. This research was funded in part by grant number R01 HD054906 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) ("Health, Poverty and Place in Accra, Ghana," John R. Weeks, Project Director/Principal Investigator). Additional funding was provided by Hewlett/PRB ("Reproductive and Overall Health Outcomes and Their Economic Consequences for Households in Accra, Ghana," Allan G. Hill, Project Director/Principal Investigator). The 2003 Women's Health Study of Accra was funded by the World Health Organization, USAID, and the Fulbright New Century Scholars Award (Allan G. Hill, Principal Investigator). The Health and Welfare Study of Accra (HAWS) was funded in part by a grant from the Department of Economics, Harvard University. Financial support for Kwaw Andam came from USAID through funding for the Ghana Strategy Support Program (GSSP) and the CGIAR Research Program on Policies, Institutions, and Markets (PIM) led by the International Food Policy Research Institute (IFPRI).

The authors thank the survey enumerators for excellent field work, and Karl Pauw and Todd Benson for helpful comments and suggestions on an earlier draft. The content is solely the responsibility of the authors and does not necessarily represent the official view of the NICHD (or the National Institutes of Health), PIM, IFPRI, CGIAR, or USAID.

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE | 1201 Eye Street, NW | Washington, DC 20005-3915 USA
T: +1.202.862.5600 | F: +1.202.862.5606 | Email: ifpri@cgiar.org | www.ifpri.org

IFPRI-ACCRA | c/o IWMI, PMB CT 112 • Cantonments, Accra, Ghana | CSIR Campus (Opposite Chinese Embassy) • Airport Residential Area | T: +233 (0) 302 780 716 • F: +233 (0) 302 784 752 | gssp.ifpri.info

The Ghana Strategy Support Program (GSSP) is managed by the International Food Policy Research Institute (IFPRI) and is financially supported by the United States Agency for International Development (USAID). The research presented here was conducted as part of the CGIAR Research Program on Policies, Institutions, and Markets (PIM), which is led by IFPRI. This publication has been prepared as an output of GSSP and has not been independently peer reviewed. Any opinions expressed here belong to the author(s) and do not necessarily reflect those of IFPRI, USAID, PIM, or CGIAR.