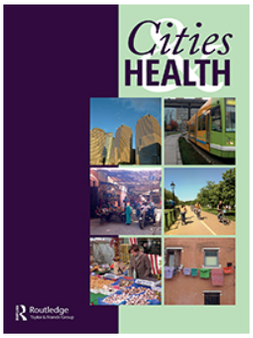

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Doing things their way? Food, farming and health in two Ugandan cities

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ABSTRACT

This paper presents new data on urban households' agriculture, food environments and non-communicable disease (obesity, diabetes, hypertension) in two intermediate-sized Ugandan cities (Mbale and Mbarara). Nutrition transition theory suggests that fast-foods, eating out and supermarket shopping, together with sedentary urban lifestyles and less agricultural activity, are drivers of growing non-communicable disease burden. We explore these claims using statistics from a 2015 socio-economic and anthropometric survey of 1995 households. Results indicate that these cities are already experiencing non-communicable diseases, despite a lack of advanced food system and nutritional transitions. Surveyed households generally had low or medium dietary diversity, and a diet pattern and an agricultural practice primarily geared towards staple foods. Food transfers (mainly staples) from rural relatives were common, particularly for agricultural households. These farming households also had better income status than non-farming households. Experience of food insecurity was relatively common. Nevertheless, high prevalence and strongly gendered patterns of obesity were identified. In contrast to some theorising of the farming practice of urban-based households, there was little evidence that such agriculture was fuelled by poverty, vulnerability or migrant status. Findings also imply that there are other drivers of epidemiologic change in these cities than those suggested by nutrition transition theory.

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KEYWORDS
Urban Uganda; urban health; urban food systems; dietary diversity; epidemiological transition; nutrition transition

Introduction

This paper contributes to debates regarding agriculture in relation to the urban food environment, and agriculture's contribution towards nutrition and health. It relates to the epidemiological and nutrition transitions purported to occur with urbanisation, and an increasingly evident double burden malnutrition, in sub-Saharan African cities. Research occurred in two intermediate-sized (defined by the wider three-country project of which this study was a part, as approximately 100,000–500,000 inhabitants, depending on the urban profile of the country) but growing cities of Uganda: Mbale and Mbarara. Knowledge is lacking at this city scale with most studies of agriculture and cities, or urban food systems, focusing on larger urban areas (Thornton 2008). The research investigates the role of agriculture for urban food systems in these cities, and explores the status of food and nutritional systems, and non-communicable disease (NCD) burden. Households' food and health environments were assessed by recording food sourcing and food growing activities, compiling household dietary diversity and food in security scores, and by measuring adult body mass indexes (BMI). The self-reported experience of NCDs such as hypertension, diabetes and heart disease were also noted. A specific contribution is that findings on the agricultural and food environment are considered together with epidemiological and health data rather than viewing these in isolation. The results, from this under-studied smaller city scale, suggest that the assumed causal links between urbanisation, food system change and epidemiological transition may need greater nuance. Findings contribute to understanding of the agriculture-nutrition-health nexus in growing urban areas of Sub-Saharan Africa.

Transitions commonly associated with urbanisation and development

Demographic, epidemiologic, nutrition and food system transitions are purported to occur with human societal development. The origins of these theorised transitions lie within modernisation theory, which is largely based on global northern experience, and eighteenth/nineteenth century writings (Hettne 2009, Peet and Hartwick 2015). This transitional thinking, and the implications

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in terms of diets, food systems and the urban condition were outlined in Barry Popkin's well-cited works as he looked to explain growing global obesity prevalence (Drewnowski and Popkin 1997, Popkin 2001). Without repeating this work a brief description of the transitions is given here (see Popkin's works and recent review (Popkin *et al.* 2012) for more detail).

Demographic transition as societies develop describes a movement from high fertility, high mortality to low fertility, low mortality (Popkin 1998). This occurs in tandem with, or because of, economic transitions from hunter-gatherer societies to intensive market-oriented agriculture and finally a service economy (Tipps 1973). The epidemiological transition predicts progression from problems of infectious diseases and undernutrition, to problems of chronic and NCD (such as diabetes, hypertension, heart problems, obesity) (Popkin 1998). Popkin coined the term 'nutrition transition' in his investigations of diet change (Drewnowski and Popkin 1997, Popkin 1998, 2001, Popkin *et al.* 2012). The central tenet encompasses a move from largely low diversity, low-fat diets towards high diversity and high-fat dietary patterns with increased consumption of meat, milk and dairy (Popkin 1998, Haggblade *et al.* 2015). This change in nutrition is sometimes claimed to be due to a switch to a 'Western pattern' diet (Pingali 2007). A lifestyle transition from physically active towards more sedentary, less energy-intensive activity patterns (ibid.) is associated with the demographic, epidemiologic and nutritional transitions. Related to these interconnected transitions is that of the wider food system which is theorised to move from small-scale food production units towards larger-scale production and more retailed and highly processed foods (Popkin *et al.* 2012). The changes conceptualised by Popkin and others as following from urbanisation and nutrition and food system and epidemiological transition entail an 'increased reliance upon processed foods, increased away-from-home food intake, and increased use of edible oils and sugar-sweetened beverages' (Popkin *et al.* 2012, p. 3). Steven Haggblade and colleagues summarise the thinking: 'Popkin's … classic exposition of the nutrition transition describes how dietary changes and reductions in physical activity associated with urban lifestyles together translate into growing rates of overweight, obesity and related non-communicable diseases' (Haggblade *et al.* 2015, p. 1). They further add a footnote that 'because of these causal links, overweight and obesity are often used as simple and accepted indicators for the adverse health consequences of nutrition transition' (ibid.).

Modernisation theory, and the transitions outlined above that it associates with development, has been critiqued for failing to recognise difference across space and time, and for its universalising assumptions (Tipps 1973, Hettne 2009, Peet and Hartwick 2015, Nhema and Zinyama 2016). Nevertheless, the transitions are relevant framing for this research because they are such a core component of diverse disciplines (from economics to planning, from agricultural sciences to public health) and the broader development discourse. This paper thus uses this concept of development-related transitions as a frame within which to consider the findings.

The next section describes some specificities of the African context and highlights research gaps. The methodology and study cities are then described. Results include data on the agricultural activity, dietary diversity, food security and NCD status of urban households (HHs) in these two secondary Ugandan cities. The discussion considers the implication that these cities have not progressed far in theorised food system and nutritional transitions, and yet seem to be already experiencing a burden of NCD. The paper concludes that there may be other drivers of epidemiological change than those commonly assumed by transition theory.

Research gaps

There are complex and uncertain links between agriculture, nutrition and health. Agriculture offers the food, fibres and materials necessary for shelter and livelihoods (Hawkes and Ruel 2006). Poor health reduces agricultural productivity by affecting the energy levels of the workforce, with obvious economic effects (Grote 2014). In addition, agriculture has implications for infectious disease, especially via animal husbandry (Jones *et al.* 2013), which has downstream impacts on nutrition and productivity. Agricultural interventions in Africa have generally focused on improving productivity or market access, and tended to assume such improvements would translate to nutrition and health benefits (Herforth *et al.* 2015). The evidence base for positive nutritional impact (reduction of child stunting, wasting or underweight) of agricultural interventions remains poor (Masset *et al.* 2012, Fanzo 2014). Some research finds farming families having better dietary diversity (Maxwell *et al.* 1998, Ruel *et al.* 1998, Cole *et al.* 2008, Prain 2010) than those not farming, others find no direct relationship or inconclusive results (Headey 2013, Kadiyala *et al.* 2014). Understanding of agriculture-nutrition impact pathways is essential for possible future improvement in the nutritional impact of agricultural initiatives (Webb 2013). The international development community has increasingly recognised this, calling for evidence (Fan and Pandya-Lorch 2012, CGIAR 2013, Haddad *et al.* 2015). Research gaps regarding who is most at risk of nutrition-related NCDs exist: in some contexts, it appears to be the poor (Shafique *et al.* 2007); in others, it may be wealthier groups (Steyn and Mchiza 2014).

Demographic trends in many countries now point to urban and peri-urban areas holding the balance of a nation's people (Satterthwaite, McGranahan, and Tacoli 2010), poverty (Mougeot 2006) and agricultural production (Thebo *et al.* 2014). This latter claim comes from a study assessing the global extent of crop

production (not livestock) using a 20 km buffer zone from urban boundaries. The authors concluded that 60% of the world's irrigated croplands, and 35% of its rain-fed agriculture, lie within this distance from urban areas. The reality of urban agriculture (UA) and of urban households farming in rural areas in the Global South has become increasingly apparent (Bon *et al.* 2010, Hamilton *et al.* 2013, Orsini *et al.* 2013). Some urban agriculture research makes claims for its nutritional, food security and even economic benefits for city residents, particularly in Africa and especially for the poor (Cole *et al.* 2008; Prain *et al.* 2010; Zezza and Tasciotti 2010). Acknowledging this literature leads Thebo *et al.* (2014) to conclude that there is 'growing justification for further study on the impact of urban and peri-urban crop production on … livelihoods and food security …' (ibid., p. 8). Nevertheless, despite the debates regarding the possible significance of UA, an inherent assumption of modernisation theorists, and many planners and economists, is that agriculture of significant impact to the nutritional, food security and economic well-being of a population takes place in rural areas. It is a countryside activity requiring scale. Yet, understanding of agriculture's exact role and implication (in terms of food security, dietary diversity, income generation) for urban households, is still lacking (Battersby 2013, Masvaure 2016). Debates regarding urban food security, and the role of agriculture in cities, were lent further weight following the 2008 food price riots that occurred in a number of cities throughout Africa, Asia, the Middle East and South America (Bush 2010). These riots are thought to have been fuelled by price hikes for staple food products, making these increasingly unaffordable to greater numbers of urban residents (Mougeot 2006, Bush 2010). Such events and debates emphasise the need for improved understanding of urban food systems (Bush 2010, Battersby 2013). This paper contributes to these research gaps by investigating the food, farming and health environments in the secondary Ugandan cities of Mbale and Mbarara.

Additionally, some cities of the Global South are now facing the simultaneous and paradoxical challenges of undernutrition (stunting, wasting, micronutrient deficiencies) and communicable diseases (TB, malaria, cholera), with NCDs, such as diabetes, heart disease and obesity-related conditions (Ruel *et al.* 1999). This is referred to as double burden malnutrition. Double burden malnutrition was first described at the 1992 International Conference on Nutrition held by the world's two major bodies concerned with agriculture (the FAO) and with health (the WHO) (Shrimpton and Rokx 2013). These organisations have both raised concern in recent years about the impact of urban double burden malnutrition, and estimate significant global economic losses due to reduced productivity and direct healthcare costs (FAO 2013). Obesity is considered a primary contributor to NCD burden (ibid.). Our findings suggest that double burden malnutrition is already apparent in these two Ugandan cities.

This urbanisation of poverty, of food production, and a growing presence of double burden malnutrition emphasise the need for further investigation of the causal associations between food system, nutritional and epidemiologic change outlined earlier. Such complexity, combined with the prediction that much future urban growth will occur in secondary cities rather than large cities (Cohen 2004, Bon *et al.* 2010), illustrates the pertinence of this research in such cities as Mbale and Mbarara. Predictions of increasing African urban growth (natural population increase and/or reclassification) and urbanisation (share of a country's population living in urban areas) and growing urban–rural linkages (Satterthwaite *et al.* 2010) further emphasise the relevance of this work in smaller cities.

Methodology

The paper uses data from a household (HH) survey conducted in the cities of Mbale and Mbarara in Uganda during July–August 2015. It is one part of a larger survey of six intermediate-sized cities of Ghana, Kenya and Uganda, which took place between 2013 and 2015. It uses descriptive and inferential statistics to investigate household agricultural activity, food security status and other aspects of the wider food environment. It presents aspects of individual and household health using adult weight and height measurements and self-reported experience of NCD.

Data collection

Ethical approval for the research was obtained from the Regional Ethical Review Board, Umeå, Sweden and the Uganda National Council of Science and Technology. The cities were selected purposively to represent two intermediate-sized, rapidly growing cities. One city (Mbale, population 92,863) was known to have a relatively high degree of urban agricultural activity and the other (Mbarara, population 195,160 residents) was chosen to be slightly larger, with undocumented levels of urban agriculture.[1] Figure 1 shows Uganda and the study cites of Mbale and Mbarara (circled).

In the absence of good scale and resolution of local maps or imagery showing built-up neighbourhoods, 0.5 m resolution Pleiades satellite imagery were purchased to guide the sampling of urban residences. The Mbale image was captured on 8 March 2015 and the Mbarara image was taken on 14 January 2014. Random systematic sampling was then employed to sample 1025 households in Mbale and 970 in Mbarara over the course of 20 days using a 20-person team. The team received two days of training to ensure standardised data entry, and to instruct in the anthropometric measurement. Interviewer groups of 3–5 enumerators were dropped

Figure 1. Uganda and study cities (circled).
Source: UN, 2003 Reproduced with permission (url: http://www.un.org/Depts/Cartographic/map/profile/uganda.pdf accessed 20 December 2016.

at random multiple starting points then worked in all directions, interviewing every third household (every fourth in densely built areas). If no one was at home, or they refused to participate, or wished to arrange a different time, the interviewer made a note and continued with the sampling strategy. This method provided good coverage of the main residential areas of the two cities (refer to maps, Figures 2 and 3).

Each interviewer had a Samsung Galaxy tablet and the questionnaire was pre-uploaded using Open Data Kit software for direct and interactive data entry. Such an approach offered a way of standardising data entry and minimising recording errors. At the end of each day, all questionnaires were downloaded and a series of cross-variable validity and data cleaning algorithms were run as a standard data management procedure. Any errors or inconsistencies were then immediately cross-checked and corrected in discussion between the survey coordinator (one of the authors) and the specific interviewer. The evolution and testing of the survey, the sampling procedure, and the data management approach were adapted from, and with the permission and training of, the African Food Security Urban Network (AFSUN). See Frayne *et al.* (2010) and Crush *et al.* (2012) for further discussion of their survey methodology. While this sampling frame cannot eliminate all forms of sampling bias, we feel the procedure resulted in a sample that could be considered representative of urban households in each city. Some generalisation to each city is thus permissible. However, we do not claim external validity (that Mbale and Mbarara are representative of other intermediate-sized cities of Uganda, nor of other sub-Saharan African countries and cities). Thus, we do not generalise our findings beyond the study cities in our discussion and conclusion, though some insights may be of relevance to other cities that experience similar socio-economic, structural and morphological conditions.

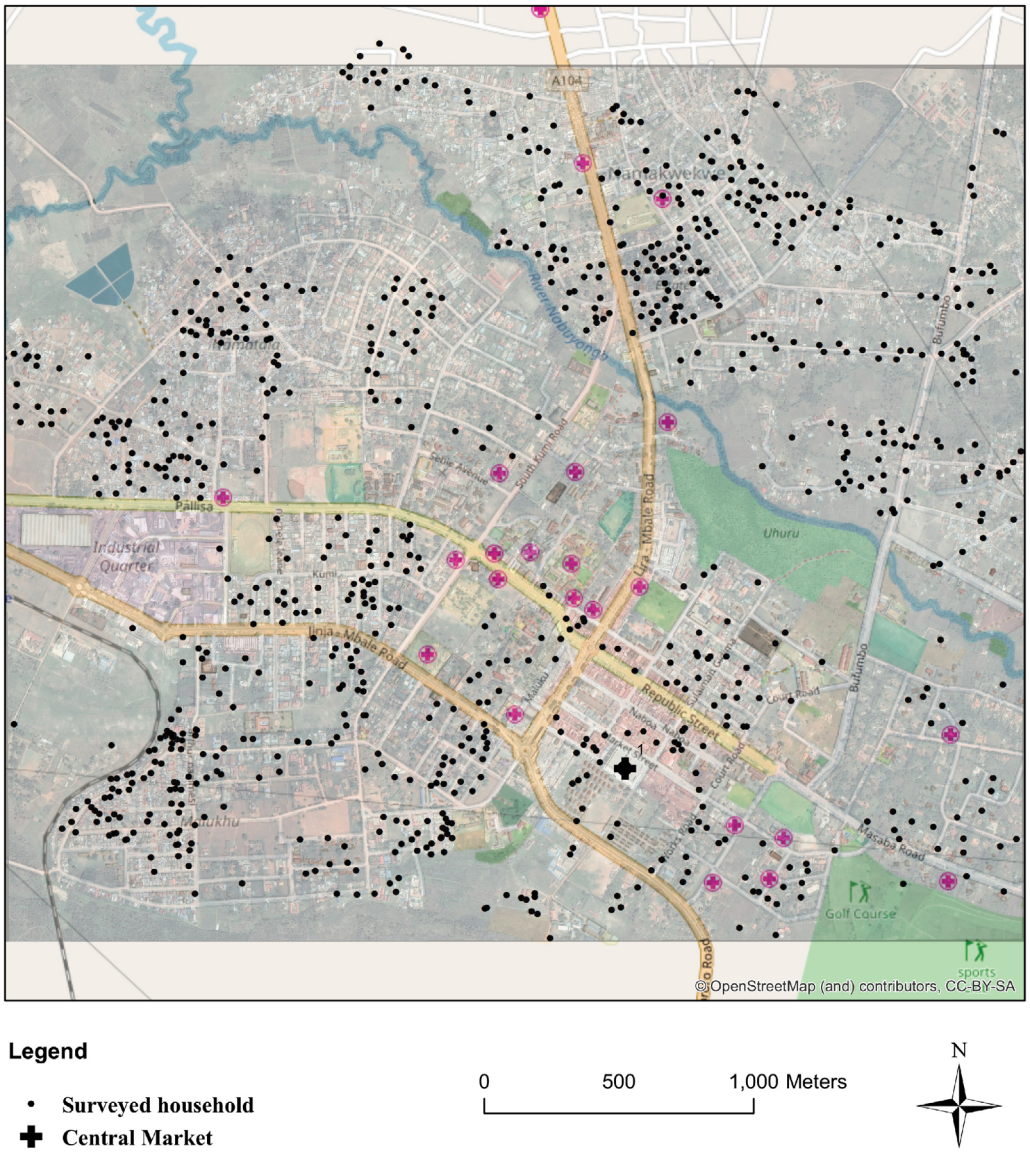

Figure 2. Map of the main urban area of Mbale showing survey coverage (2015).
Source: Created by H. Mackay using a geographic information system (GIS) with Open Source Street maps as a baseline and purchased high-resolution satellite imagery showing individual buildings superimposed. Includes material © CNES 2014 and 2015, Distribution Astrium Services/Spot Image corporation, USA, all rights reserved. Pleiades Satellite Image of Mbale taken on 8 March 2015. Image resolution 0.5 m, accuracy to 4.5 m.

Agriculture was defined as any form of farming activity during the preceding year: food crops (e.g. cereals, grains, tubers, fruit, vegetables) or cash crops (e.g. coffee, sugar, cashew nut), livestock or poultry, fish or eggs. All levels of production from subsistence to commercial, home gardening to market gardening were included. Farming location was recorded (as urban, rural or both) as well as the tenure of farmed land (public, private or institutional). No restrictions were applied regarding usage, meaning produce could be consumed, sold or given away (adapted from Quon 1999). Downstream processing, distribution or marketing activities were excluded.

The socio-economic characteristics of the household, income and expenditure data, main livelihood strategies, and aspects of the household's food environment (such as diet diversity, food security, food sources, food transfers) were recorded. Questions regarding involvement in agriculture, and health-related experiences, were included. Body weight (in kg to the nearest 0.1 kg) of the willing adult household members (18 years and above) was measured with a portable calibrated Secca® digital weighing scale, with the person in light clothing and no shoes. Body height was measured in metres (m) to the nearest centimetre (cm) with a portable metal height scale and the person standing without shoes.

Data analysis

Analysis consists of descriptive and inferential statistical analysis, such as analysis of variance (ANOVA) and Games–Howell *post-hoc* tests. ANOVA is a test of whether group means are statistically significantly different from each other, but do not give details on which groups (Ruxton and Beauchamp 2008). Post-hoc tests, such as Games–Howell, further investigate the difference in group means to identify which groups are statistically significantly different, and in what way (Ruxton and Beauchamp 2008). Food environment was assessed using

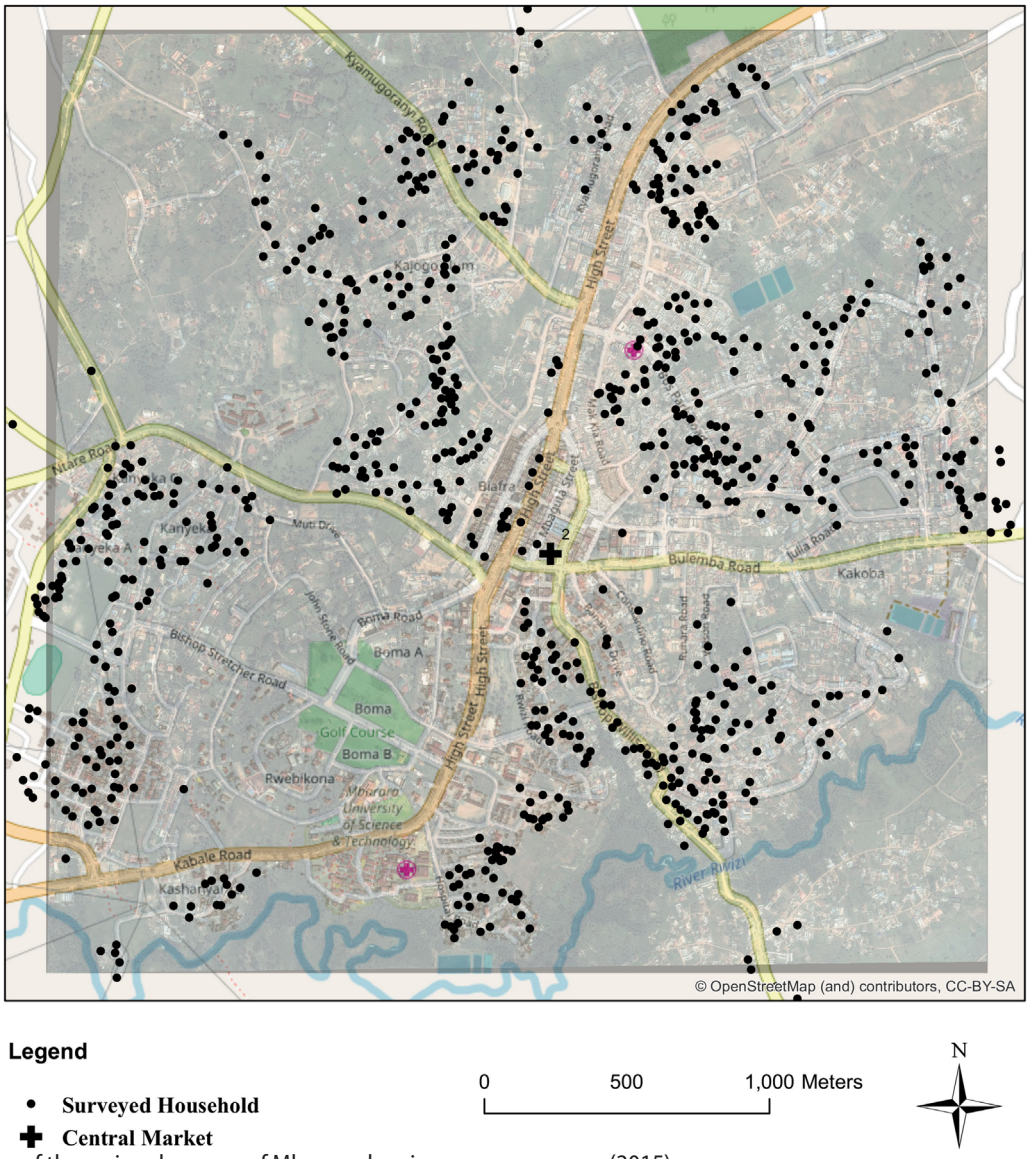

Figure 3. Map of the main urban area of Mbarara showing survey coverage (2015).
Source: Created by H. Mackay using a geographic information system (GIS) with Open Source Street maps as a baseline and purchased high-resolution satellite imagery showing individual buildings superimposed. Includes material © CNES 2014 and 2015, Distribution Astrium Services/Spot Image corporation, USA, all rights reserved. Pleiades Satellite Image of Mbarara taken on 14 January 2014. Image resolution 0.5 m, accuracy to 4.5 m.
Note: The large gap in the sampling to the south west of centre in Mbarara is the area of the university campus, the golf course and the hospital buildings. There were few permanent households living in these areas so that vicinity was not surveyed.

internationally tested measures of the Household Food Insecurity Access Scaled Score (HFIASS), the Household Food Insecure Access Prevalence (HFIAP) (based on nine Likert scale questions) and the Household Dietary Diversity Score (HDDS), assessed using 24 h recall of 12 different food groups.[2] The HFIASS is a continuous scaled measure of the frequency of occurrence of food access and runs from 0 (no food insecurity) to 27 (extreme food insecurity) (Coates *et al.* 2007). HFIAP is a categorical variable assessing the prevalence of food insecurity experience, split in four categories of food secure, mildly food insecure, moderately food insecure, and severely food insecure, across the geographic area (Coates *et al.* 2007). The HDDS measures the diversity of a household's diet (Swindale and Bilinsky 2006) and runs from a minimum of 0 (consumed nothing the previous day) to a maximum of 12 (eaten from all 12 food groups). The HDDS may also be classified as low (≤3 food groups), medium (4–6) and high (≥6 food groups) dietary diversity in accordance with FAO guidelines (FAO 2011).

BMI in kg/m^2 was calculated during data cleaning by dividing the weight (in kg) by the height in metres squared. The cut-off points for underweight (<18.5 kg/m^2), normal weight (18.5–24.99 kg/m^2), overweight (≥25 kg/m^2) and obesity (≥30 kg/m^2) are taken from WHO recommendations (WHO 2006).

In describing the gross monthly income data for the sample, three HHs in Mbarara and 10 in Mbale were treated as outliers and removed, due to being beyond four standard deviations from the mean, (they represented a very high value of above UGX 17 million per month (equivalent to US$5541), and may have been entry errors). The gross monthly income depicts household

income, not net of expenses. It included income from all sources (including any agricultural produce sales) and additionally includes self-reported cash equivalent estimates of gifts or non-cash remittances.

Study cities

By Ugandan definitions, the country has only one city: the capital Kampala with 1.5 million residents (UBoS 2016). The urban category below this is the 'municipality', which includes peri-urban settlements and rural villages. The study cities, Mbale (92,863 residents) and Mbarara (195,160 residents), are both municipalities with population data only available at this level (UBoS 2016). The actual population of the main areas surveyed is thus lower than these figures. The authors make an estimation, based on local knowledge, of these as 70,000 Mbale, 90,000 Mbarara at the time of survey.

Mbale is the administrative centre for the Eastern Region, located near Mount Elgon national park towards the Kenyan border, 225 km from Kampala (Habitat 2011). The town is experiencing high rates of growth and in-migration with associated housing, employment and servicing problems (Habitat 2011). There is a lack of formal employment with many relying on informal means (ibid.). Mbarara is an important urban area in the south-west 270 km from the capital whose population is expected to increase by 50% by 2050 (Habitat 2012). The city is a political and administrative hub with an economy based around farming, marketing and informal activities (ibid.). Figures 4–7 present some views of Mbale and Figures 8–11 present Mbarara.

Results

Table 1 provides an overview of the demographic and socio-economic characteristics of surveyed households – in total 1995 households (1025 in Mbale, 970 in Mbarara), and comparative national data where available. The male-female ratio of the sample, mean household size (approximately 4 people) that roughly a third of households were single-headed, the educational attainment and levels of relatively high unemployment were all broadly in accord with national data (Table 1). Within the parameters described under methods, the mean gross monthly household income amounted to UGX 832,979 (US$ 247) in Mbale and UGX 972,267 (US$ 288) in Mbarara (Table 1). However, a wide data range and standard deviation (UGX 1,462,750 (US$ 434) in Mbale and UGX 1,708,917 (US$ 507) in Mbarara) were indicative of large inequalities. Income percentiles (25/50/25) split the data at UGX 200,000/400,000/900,000 in Mbarara and UGX 150,000/450,000/835,000 in Mbale. The mean of the lowest 25% was just UGX 75,797 or

Figures 4–7. Views of Mbale. Figure 4 (top left): Kizungu area, traditionally a lower income neighbourhood but now becoming more mixed. Figure 5 (top right): area outside Dream Palace Hotel in a wealthier residential area showing urban agriculture of maize on undeveloped plots. Figure 6 (bottom left): another type of urban agriculture, though much less common – a goat pen on a house roof. Figure 7 (bottom right): Mbale Central Market Hall where 85% of surveyed households said they shopped, just prior to reopening (the market was reconstructed and upgraded by the Government of Uganda in 2014) (Image F. Mugagga).
Source: All images by H. Mackay unless otherwise stated.

Figures 8–11. Views of Mbarara. Figure 8 (top left): street and wide pavement outside the university area with a street advert for sweetened fruit juice. Figure 9 (top right): a typical food stall in Mbarara Central Market. Figure 10 (bottom left): a small shop/stall in a residential area selling some tomatoes, onions, matooke among other things. Figure 11 (bottom right): a typical hotel lunch plate showing the large portion sizes, including three different types of carbohydrate (matooke and potatoes and chapatti) served with a plate of bean stew.
Source: All images by H. Mackay unless otherwise stated.

Table 1. Characteristics of surveyed households.

	Uganda[a]	Mbale (*N* = 1025 households)	Mbarara (*N* = 970 households)
Demographics	Individuals [*N* (%)] [unless stated]	Individuals [*N* (%)] [unless stated]	Individuals [*N* (%)] [unless stated]
Male (includes children)	17,060,832 (49)	1896 (44)	1415 (43)
Female (includes children)	17,573,818 (51)	2392 (56)	1837 (57)
Total	34,634,650 (100)	4288 (100)	3253 (100)
Mean age	Not available	24.3 years	23.6 years
Socio-economic status			
Household structure			
Mean household size	5 (4 in urban)	3.7 individuals	4.6 individuals
Female-headed (may include children, other adults)	2,197,000 (31)	210 (21)	215 (22)
Male-headed (may include, children, other adults)	4,900,000 (69) [note: all other categories]	97 (10)	112 (11)
Nuclear family (two adults, with/without children)		440 (43)	481 (50)
Extended family (two partners, children, other relatives)		238 (23)	131 (13)
Missing data		40 (4)	31 (3)
Education (adults 18 years and above only)	Percentage	*N* = 2615 adults	*N* = 2056 adults
No education	19	151 (5.8)	81 (3.9)
Completed primary school (7 years education)	58	144 (5.5)	206 (10)
Completed secondary school (13 years education)	18	403 (15.4)	370 (18)
Completed vocational training (14–16 years education)	Not available	326 (12.5)	281 (13.7)
Completed university (16–19 years education)	4	375 (14.3)	251 (12)
Other (some years education but never completed)	–	439 (44.7)	825 (40.1)
Refused, don't know, missing	–	46 (1.8)	42 (2)
Employment status (adults 18 years and above)		*N* = 2855 valid data	*N* = 2274 valid data
Working full-time (paid employment)	71% (working)	1436 (50)	1311 (58)
Working part-time/casual		312 (11)	186 (8)
Unemployed and looking for work	28.9% (not working)	289 (10)	192 (8)
Unemployment but not looking for work		622 (22)	393 (17)
Refused or Missing		196 (7)	192 (8)
Income (gross monthly income, all sources including self-reported cash equivalent of gifts, or non-cash remittances)		Mean in Ugandan Shillings (UGX) (US $ equivalent)[b]	Mean in Ugandan Shillings (UGX) (US $ equivalent)
Mean	Not available	832,979 (247)	972,267 (288)
No agriculture households	Not available	452,555 (145)	454,250 (135)
Rural agriculture households	Not available	584,008 (173)	868,799 (258)
Urban agriculture households	Not available	588,508 (175)	1,032,588 (306)
Households doing both rural and urban agriculture	Not available	1,081,510 (321)	1,141,646 (339)

[a]National data from Uganda National Population and Housing Census 2014 UBoS (2016).
[b]Exchange rate of 1USD to 3372 UGX, as at 1 September 2016.

US$20 ($N$ = 167) in Mbale, and UGX 87,481 or US$24 ($N$ = 142) in Mbarara. The mean of the middle 50% was UGX 288,283 or US$79 in Mbale ($N$ = 173), and UGX 570,995 or US$157 ($N$ = 196) in Mbarara. The mean of the highest 25% income group was UGX 2,485,236 or US$685 ($N$ = 189) in Mbale and UGX 2,950,774 or US$813 ($N$ = 181) in Mbarara.

Agricultural practice of urban households

More than half of urban households (65% Mbale, 51% Mbarara) had farmed in a rural area, an urban area or both during the preceding year (Table 2). Most common was rural agriculture. Proportionally fewer HHs farmed both rural and urban areas (6% Mbarara HHs, 15% Mbale HHs). Interestingly however, when asked about occupation only 5.5% of Mbale adults and 3.3% Mbarara described themselves as farmers, indicative of agriculture generally being a supplementary livelihood strategy. Agricultural households were also larger in size (5.1 in Mbale, 4.4 in Mbarara) than non-agricultural HHs (3.7 Mbale, 3.3 Mbarara) (Table 2). Similarly and probably relatedly, looking at the structure of the household, more than twice the number of multiple adult HHs farmed compared to single-headed HHs (Table 2), suggesting that single-headed HHs are more dependent on the market for food. A greater proportion of HHs farming in both rural and urban areas was multiple-adult HHs (Table 2). In Mbale, single-parent households (which were 70% female-headed) were more represented in households that practiced urban agriculture (Table 2).

There were also differences across agricultural HHs in the length of time that the household head had lived in the city: those whose heads had lived less than 5 years in the city were more commonly represented in the non-agricultural (45% Mbale, 57% Mbarara) HHs (Table 2). Agriculture within the city (UA) was more common for HHs whose heads had lived longest (>10-years) in the cities (Table 2). In both cities more than 60% of respondents said they farmed land owned by self, and 35% family land (data not shown). The produce was predominantly for home consumption with more rural-grown produce being sold (data not shown). Analysis of most common crops grown confirmed staple foods' importance: cereals (largely maize) were grown by 52% of HHs in Mbale, 22% Mbarara; beans by 22% Mbale, 18% Mbarara; and matooke (cooking bananas) by 6% Mbale and 35% Mbarara.

Households that engaged in agriculture had higher mean gross monthly incomes than those not farming (US$28–176 higher in Mbale, and US$123–204 higher in Mbarara, Table 1). Post-hoc Games–Howell tests revealed that income differences were statistically significant: In Mbale, between the no agriculture group and each of the other groups; and in Mbarara, between the rural and urban agriculture group and all the other groups (details in Table 3).

Food environment

The dietary diversity in Mbale and Mbarara can be classified (according to FAO categories) as medium overall with a mean HDDS across all HH groups of 5.22 in Mbarara and 4.4 in Mbale (Table 4). The prevalence of HHs in the three dietary diversity categories is shown in Figure 12, with around a third of households having a medium-level diet diversity and a full 40% in Mbale falling into the lowest category eating mainly maize the preceding day. Figure 12 also shows the most commonly consumed food groups in each category (foods consumed by ≥50% HHs in the category): mainly cereals (largely maize), roots and tubers (largely matooke or potatoes), and legumes/nuts/seeds (predominantly beans). Eighteen per cent Mbale HHs and 22% Mbarara had consumed fruit the preceding day. Thirty four per cent of Mbarara HHs and 44% Mbale said they had consumed some vegetables the preceding day.

Analysing differences in mean HDDS by agricultural engagement indicated that agriculture may influence the diversity of a household's diet but only to a small degree (Table 4, and Table S1 supplemental). Post-hoc Games–Howell tests revealed a small but statistically significant higher mean HDDS for the rural and urban farming households compared to those farming only in the urban area, as well as those not practicing agriculture in Mbale (Table S1 supplemental). In Mbarara, the non-agricultural households had lower mean HDDS than HHs that practiced agriculture in a rural area, as well as households that practiced both rural and urban agriculture (Table S1 supplemental).

Supporting this picture of low-medium dietary diversity was a feeling of food insecurity. The experience of food insecurity, measured by HFIAP, was widespread with 36% Mbarara and 51% Mbale HHs experiencing severe food insecurity (Figure 13). Just under a third felt food secure (Figure 13), and more than half felt either moderately or severely food insecure in the preceding month (Figure 13). The HFIASS (0 = food secure, 27 = extreme food insecurity) did vary by the agricultural engagement of the household. Similar to the dietary diversity data is the finding that the least food insecure were those HHs that farmed both rural and urban areas, mean 6.09 HFIASS in Mbale, and just 3.34 in Mbarara (Table 5). Post-hoc Games–Howell tests revealed that HHs practicing urban agriculture had 1.8 points (p-value: 0.015) lower food insecurity than the non-agricultural households in Mbale (Table S2 supplemental). Mbale's rural and urban agriculture households were also 2.358 points (p-value: 0.001) less food insecure than the city's urban agricultural households (Table S2 supplemental). The only statistically significant difference in mean HFIASS in Mbarara was between the non-agricultural households and the rural and urban agriculture households, with the non-farm HHs having 1.98 points (p-value: 0.006) greater food insecurity score (Table S2 supplemental).

Table 2. Agricultural activity of urban-based households, 2014–2015.

	Mbale			Mbarara		
Household (HH) Size	Individuals					
Mean HH size in Non-Agriculture households (HHs)	3.7 people			3.3 people		
Mean HH size in Agricultural HHs	5.1 people			4.4 people		
Agricultural involvement	Households [*N* (%)]					
Overall involvement in agriculture (any location)	663 (65)			493 (51)		
Breakdown by location of agriculture	*N* (%)			*N* (%)		
HHs NOT involved in any agriculture	343 (34)			465 (48)		
HHs involved in RURAL agriculture	278 (27)			310 (32)		
HHs involved in URBAN agriculture	228 (22)			124 (13)		
HHs in agriculture in BOTH urban & rural areas	157 (15)			59 (6)		
No data	19 (2)			12 (1)		
Agricultural Involvement by HH structure	Multiple-adult (Nuclear & Extended)	Single-parent (70% female-headed)		Multiple-adult (Nuclear & Extended)	Single-parent (60% female-headed)	
No agriculture	222 (33)	120 (39)		282 (46)	177 (54)	
Agricultural HHs (any location)	454 (67)	188 (61)		330 (54)	149 (46)	
Most commonly practicing (comparing proportional representation)	Rural & Urban	Urban area		Rural and Urban	Rural area Urban area	
Time in city crosstab agriculture	Mbale households (*N* = 877) *N* (%)			Mbarara households (*N* = 846) *N* (%)		
Number of years HH head had lived in the city	<5	5–10	>10	<5	5–10	>10
Non-agricultural HHs (*N* = 305 Mbale, 399 Mbarara)	76 (45)	40 (42)	189 (31)	138 (57)	55 (44)	206 (43)
Rural agriculture HHs (*N* = 239 Mbale, 283 Mbarara)	55 (33)	31 (32)	153 (25)	84 (34)	52 (42)	147 (31)
Urban agriculture HHs (*N* = 195 Mbale, 107 Mbarara)	26 (15)	15 (16)	154 (25)	16 (7)	10 (8)	81 (17)
Rural & Urban agriculture HHs (*N* = 138 Mbale, *N*=57 Mbarara)	12 (7)	10 (10)	116 (19)	6 (2)	7 (6)	44 (9)
Total	169 (100)	96 (100)	612 (100)	244 (100)	124 (100)	478 (100)

Table 3. Variation in mean gross monthly income (all sources) by agricultural group.

City	Post-hoc Games–Howell test		Mean difference (I-J) (US$)	SE	Sig.	95% Confidence interval	
						Lower bound	Upper bound
Mbale	No agriculture	Rural area	−124.364*	32.693	0.001	−208.64	−40.09
		Urban area	−173.501*	59.832	0.022	−329.06	−17.95
		Rural & urban agriculture	−206.219*	60.890	0.006	−366.75	−45.68
Mbarara	Rural & urban agriculture	Rural area	149.251*	52.944	0.027	12.19	286.31
		Urban area	147.901*	54.097	0.034	7.92	287.88
		No agriculture	188.687*	50.493	0.001	57.78	319.59

*The mean difference is significant at the 0.05 level.

Table 4. Variation in household dietary diversity score by agricultural engagement.

City	Household engagement in agriculture	*N*	Mean HDDS	SD	SE	95% Confidence interval, mean		Min	Max
						Lower bound	Upper bound		
Mbale	No agriculture	343	4.27	2.22	0.12	4.04	4.51	0	12
	Rural area	277	4.46	2.25	0.14	4.20	4.73	1	11
	Urban area	228	4.17	2.16	0.14	3.89	4.45	1	11
	Rural & urban agriculture	157	4.93	2.09	0.17	4.60	5.26	0	11
	Total	1005	4.40	2.21	0.07	4.27	4.54	0	12
Mbarara	No agriculture	465	4.94	1.73	0.08	4.78	5.10	0	11
	Rural area	310	5.47	2.08	0.12	5.24	5.71	0	11
	Urban area	124	5.33	2.04	0.18	4.97	5.69	0	12
	Rural & urban agriculture	59	5.92	1.93	0.25	5.41	6.42	2	10
	Total	958	5.22	1.92	0.06	5.10	5.35	0	12

Notes: ANOVA Mbale *p*-value: 0.005; Mbarara *p*-value: <0.001.

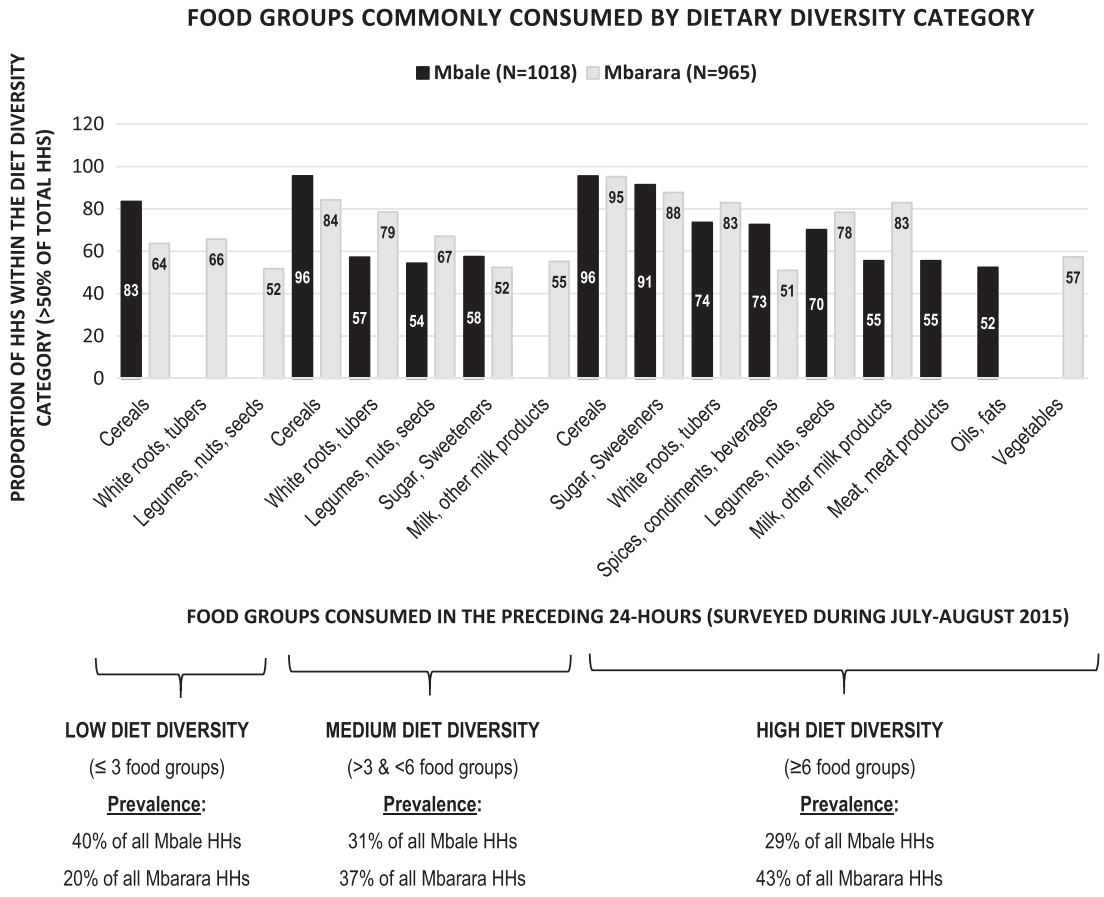

Figure 12. Dietary diversity categories and commonly consumed food groups.
Source: Created by H. Mackay.
Note: Columns are blank where the food group was not consumed during the preceding 24-h. HHs denotes households.

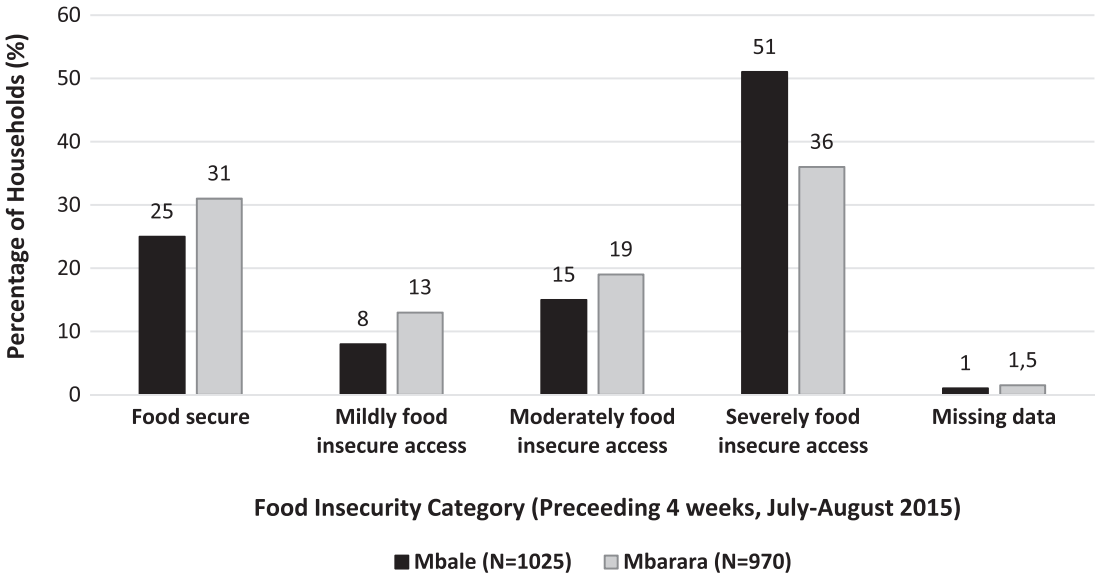

Figure 13. Distribution of household food insecurity access prevalence (HFIAP).
Source: Created by H. Mackay.

Table 5. Household food insecure access scaled score by agricultural engagement.

City		*N*	Mean	SD	SE	95% Confidence interval for mean		Min	Max
						Lower bound	Upper bound		
Mbale	No agriculture	335	6.67	6.945	0.379	5.92	7.41	0	27
	Rural area	269	6.97	6.253	0.381	6.22	7.72	0	22
	Urban area	222	8.43	6.888	0.462	7.52	9.34	0	27
	Rural and urban agriculture	155	6.09	5.465	0.439	5.22	6.96	0	21
	Total	981	7.06	6.569	0.210	6.65	7.47	0	27
Mbarara	No agriculture	460	5.31	5.706	0.266	4.79	5.83	0	27
	Rural area	306	4.70	5.012	0.287	4.13	5.26	0	23
	Urban area	124	5.07	5.697	0.512	4.06	6.09	0	23
	Rural and urban agriculture	53	3.34	3.823	0.525	2.29	4.39	0	16
	Total	943	4.97	5.411	0.176	4.62	5.31	0	27

Notes: 0 denotes no food insecurity; maximum of 27 depicts most severely food insecure.
ANOVA Mbale *p*-value = 0.002 Mbarara *p*-value = 0.059.

In terms of food sourcing, the most common method of acquiring food (for 85% Mbale, and 89% Mbarara HHs) was at the traditional food markets (city centre or local neighbourhoods) (Table 6). These were open-air stalls, or covered buildings with individual market stalls trading in fruit, vegetables, staples, meat and other products. Only 23% of Mbale and 24% Mbarara HHs said they obtained some food from a supermarket (Table 6). In line with the data presented earlier confirming the commonness of farming, 38% Mbale HHs, 35% Mbarara, said they grew food to contribute to HH needs (Table 6). HHs also sourced food from the category of 'small shops, restaurants, take-aways' (63% of Mbale and 76% Mbarara HHs, Table 6). The phrasing of this category, however, limits interpretation since a small shop may have been interpreted as a street stall, a market stall or a small store, and these are somewhat different from a take-away or a restaurant.

Food transfers were another important source of food for urban households. Around half of surveyed HHs received food transfers (62% Mbale, 49% Mbarara) during the previous year (Table 6). Dominant were transfers from rural-based relatives (73% of transfer-receiving HHs in Mbale, 86% Mbarara). The most common foodstuffs transferred were cereals/grains (mainly maize), and roots/tubers (mainly cassava and sweet potatoes). This again confirms the role of staple foods in the local diet and food environment. Non-farming households were less in receipt of food transfers than farming HHs (Table 6), implying greater market dependence.

In addition, when asked about the place of main meal for each HH member the previous day, almost 90% said they ate their main meal at home (Table 6). Of those not eating at home, 9% Mbale and 7% Mbarara individuals had eaten in either school or the workplace. Just 2% in both cities claimed to have eaten out the previous day in a small shop, restaurant or take-away (Table 6). Table 6 also shows the self-reported consumption of fried snacks by any household member during the previous week. Fried snacks in Uganda refers to fried potato chips, fried sweet potatoes, fried cassava (mostly Mbale), fried chicken (enkoko ensiike), fried beef or goat meat (mostly Mbarara), fried salted wheat chapattis, chapatti mixed with fried eggs (rolex) or fried sugary

Table 6. Other aspects of urban food environment (2014–2015).

	Mbale (*N* = 1025)	Mbarara (*N* = 970)
Food sources [multiple responses possible therefore > 100%]	Households *N* (%)	
Traditional food markets (city centre and neighbourhood)	868 (85)	866 (89)
Supermarket	237 (23)	233 (24)
Grow It	389 (38)	342 (35)
Small shops, restaurants, take-aways	652 (63)	739 (76)
Food transfers (within previous year)	Households *N* (%)	
Proportion households receiving	631 (62)	473 (49)
Proportion of receiving from RURAL-based RELATIVES	462 (73)	406 (86)
Proportion Non-Agricultural HHs NOT receiving	236 (67)	309 (66)
Proportion AGRICULTURAL HHs NOT receiving	319 (48)	248 (50)
Eating in or out (main meal previous day)	Household Members (Mbale *N*= 4242; Mbarara *N*=3231) *N* (%)	
Own home	3712 (87)	2881 (89)
School or workplace	366 (9)	231 (7)
Restaurant, shop or take-away	90 (2)	73 (2)
Snacks and sugar consumption (previous week)	Households *N* (%)	
Fried snacks (someone consumed daily or more) Total	175 (17)	114 (12)
Proportion of total in no agriculture households	44.6%	59.6%
Proportion of total in rural agriculture households	25.7%	25.4%
Proportion of total in urban agriculture households	17.7%	10.5%
Proportion of total in rural and urban agriculture households	12%	4.4%
Sugar (someone consumed daily or more)	758 (74)	640 (66)
Sugar-sweetened beverages [someone consumed daily or more)	91 (9)	87 (9)
Proportion of total in no agriculture households	48.4%	56.3%
Proportion of total in rural agriculture households	20.9%	29.8%
Proportion of total in urban agriculture households	15.4%	10.3%
Proportion of total in rural and urban agriculture households	15.4%	3.4%

doughnuts (mandaazi). While this survey indicates that snacking was not common, it is interesting to note that still 12% of Mbarara HHs, 17% Mbale reported someone within the HH consuming such snacks on a daily or more basis (Table 6). It was also apparent that 44% of the more regular snacks consumers in Mbale, 60% in Mbarara were the non-agricultural HHs. These were the HHs most dependent on the market for sourcing food. Sugar was commonly consumed, mainly in tea/coffee (Table 6). Just 9% of HHs claimed someone consumed a sugar-sweetened beverage on a daily basis (Table 6). Of these regularly consuming HHs, a higher proportion again were the non-agricultural HHs (48% Mbale, 56% Mbarara).

Health environment

This section focuses upon the NCDs, analysing the BMI data regarding weight-related NCDs, and the self-reported data on experience of hypertension and diabetes. The data suggests a somewhat concerning prevalence of higher BMIs, and slightly higher prevalence than national data (Table 7a). In Mbale, 26% of measured adults (male and female) were classed as overweight, 28% in Mbarara. Obesity prevalence was 14% Mbale and 22% Mbarara (Table 7a). This data shows strong gender differences: 60% or more of the underweight adults were males, whilst 69% Mbarara and 74% Mbale of the overweight classification were female (Table 7a). At the highest end of the scale, 83% of the obese group were female (Table 7a). The prevalence of female-only obesity was 18% Mbale (143 females) and 27% Mbarara (175 females) (Table 7a). Interestingly, 60% of all surveyed adults, in both cities, reported that they were happy with their weight. When split by weight category, proportionally more in the obese category (56% of Mbale's obese, 62.5% of Mbarara's obese, both genders) expressed being unhappy with their current weight. In all the other weight categories, there were proportionally fewer stating that they were unhappy with their weight (Mbale: underweight 44.9%, normal weight 30.6%, overweight 33.7% unhappy; Mbarara: underweight 37.5%, normal weight 29.9%, overweight 33.8% unhappy). The pattern was similar when disaggregated by gender, but with an even greater proportion of females in the obese group reporting being unhappy with their weight.

Table 7b explores variation in mean gross monthly cash income by HH BMI category. It shows a clear positive trend: higher BMI categories had higher mean incomes. HHs with a mean of measured adults falling into the obese category had the highest mean gross monthly income (US$240 in Mbale, $325 in Mbarara, Table 7b). Post-hoc Games–Howell tests show these differences to be statistically significant only in Mbarara however, and only between the underweight and obese groups (underweight having $221 lower mean gross monthly cash income than those households in the obese BMI category, p-value: 0.028) (details not shown).

There was an increase in mean BMI by age group (ANOVA p-value < 0.001, both cities, Table S3 supplemental). A cross tabulation of BMI categories by age group also suggested that mature adults (<56 years) were more represented in the overweight group (32.1%) and the obese group (37.5%) in Mbarara, and comprised 34.1% of the overweight group in Mbale (Table S4 supplemental). Younger adults (18–30 years) were less represented in the overweight and obese categories in both cities, though their prevalence is higher in Mbarara than

Table 7a. Indicators of non-communicable disease presence: body mass index data.

	Mbale		Mbarara		Uganda*
Mean BMI	All: 24.8 kg/m^2 (N = 1260 SD: 5.3)†		All: 26.3 kg/m^2 (N = 956 SD: 5.9)		Men: 21.7 kg/m^2
	Men: 23.2 kg/m^2 (N = 442, SD = 4.7)		Men: 24.3 kg/m^2 (N = 313, SD = 4.9)		
	Women: 25.6 kg/m^2 (N = 818, SD = 54)**		Women: 27.3 kg/m^2 (N = 643, SD = 6.1)**		Women: 23.4 kg/m^2
BMI (kg/m^2)	Measured Adults (N %)				Both Sexes, Urban (%)
	(Mbale N = 1248; Mbarara N = 948 adults)				
Underweight (<18.5 kg/m^2)	70 (6)		32 (3)		4.3
Normal weight (18.5–24.99 kg/m^2)	679 (54)		440 (47)		63.5
Overweight (25–29.99 kg/m^2)	326 (26)		266 (28)		22.6
Obese (>30 kg/m2)	173 (14)		210 (22)		9.6
Gendered Prevalence within BMI Categories	Male (N = 438) (%)	Female (N = 810) (%)	Male (N = 312) (%)	Female (N = 636) (%)	
Underweight (<18.5 kg/m^2) (N = 70 Mbale, N = 32 Mbarara)	60	40	62	38	Not available
Normal Weight (18.5–24.99 kg/m^2) (N = 679 Mbale; N = 440 Mbarara)	41	59	39	61	
Overweight (25–29.99 kg/m^2) (N = 326 Mbale; N = 266 Mbarara)	26	74	32	69	
Obese (>30 kg/m^2) (N = 173 Mbale; N = 210 Mbarara)	17	83	17	83	
Prevalence of female overweight/obesity	N of Women = 810 N (%)		N of Women = 636 N (%)		Urban Women (N = 556) (%)
Overweight (25–29.99 kg/m^2)	240 (30)		182 (29)		28.8
Obese (>30 kg/m^2)	143 (18)		175 (27)		15.6

†N = Number; SD = Standard Deviation.

*Ugandan data from NonCommunicable Disease Risk Factor Baseline Survey (STEPS 2014). The STEPs report conducted a multi-stage cluster sample to produce a nationally representative sample of 3987 respondents, aged 18–69 years. They collected socio-demographic and behavioural information and physical and biochemical measurements to assess BMI, cholesterol levels, blood pressure and blood glucose levels; **Gender difference statistically significant (ANOVA both cities p-value:<0.001).

Table 7b. Indicators of non-communicable disease presence: variation in cash income by BMI category of household.

	Mbale	Mbarara
BMI category of HH (mean BMI of all the measured adults in the HHs)	Mean Gross Monthly Income* (US$) **	Mean Gross Monthly Income (US$)**
Underweight HHs (<18.5 kg/m^2)	127 (SD:225 *N*=39)	104 (SD: 248 *N*=23)
Normal weight HHs (18.5–24.99 kg/m^2)	162 (SD: 322 *N*=484)	184 (SD: 359 *N*=358)
Overweight HHs (25–29.99 kg/m^2)	206 (SD: 382 *N*=242)	264 (SD:490 *N*=237)
Obese HHs (>30 kg/m^2)	240 (SD: 366 *N*=103)	325 (SD: 712 *N*=149)

*Mean Gross Monthly Household Income (cash only income, includes sales from agricultural produce); **Exchange rate of 1USD to 3372 UGX, as at 1 September 2016.; ANOVA Mbale *p*-value = 0.118; Mbarara *p*-value = 0.009.

Table 7c. Indicators of non-communicable disease presence: communicable and non-communicable disease.

		Households claiming a member diagnosed with	
Communicable and non-communicable diseases (Self-reported)	Uganda (Note: % of population, not of households) *	Mbale *N* (%)	Mbarara *N* (%)
Diabetes (Valid data *N* = 989 Mbale, 925 Mbarara)	STEPS: 3.3% and 4.8% in urban areas	128 (12.5)	78 (8)
High blood pressure (hypertension) (Valid data *N* = 993 Mbale, 925 Mbarara)	4.3% STEPS: 24.3%	224 (21.9)	110 (11.3)
Heart attack, stroke, heart disease (Valid data *N* = 1009 Mbale, 957 Mbarara)	4%	112 (10.9)	56 (5.8)
Anaemia (Valid data *N* = 1014 Mbale, 963 Mbarara)		92 (9)	42 (4.3)
Tuberculosis (Valid data *N* = 1012 Mbale, 962 Mbarara)		34 (3.3)	18 (1.9)
HIV/Aids (Valid data *N* = 1012 Mbale, 962 Mbarara)	6.4%	69 (6.7)	57 (5.9)
Cancer (Valid data *N* = 1012 Mbale, 962 Mbarara)		17 (1.7)	17 (1.8)
Malaria/fever	19.6%		

*National data compiled from the Uganda National Household Survey 2012/2013 (UBoS 2014), the State of Uganda Population Report, 2007 (UBoS 2007) and the STEPS report (2014).

in Mbale (Table S4 supplemental). The variation in mean BMI by the agricultural involvement of the household to which the individual belonged suggests that there were statistically significant differences only in Mbale and only between its urban agricultural households and the rural farming households (Table S3, supplemental).

Regarding the presence of other diseases, our survey only asked whether anyone in the households had been diagnosed with any of the ailments shown in Table 7c. Findings suggests there may be cause for concern, particularly regarding the claimed experience of hypertension and diabetes. Eleven per cent of Mbarara HHs and 22% Mbale claimed to have someone diagnosed with hypertension, and 8% Mbarara HHs, 12.5% Mbale claimed someone suffered from diabetes (Table 7c). The experience of communicable diseases such as TB, HIV was lower. There are obvious limitations with this kind of data and further research is necessary. It is not possible to compare directly this percentage of households data with national data collected at the individual level, but it may facilitate in making some estimations.

Discussion

The findings presented in this paper suggest that Mbale and Mbarara may already be experiencing an NCD burden. This, in conjunction with ongoing (although diminishing) problems associated with undernutrition, stunting, wasting and communicable disease (UBoS 2007, 2017), suggest that a city-level double burden of malnutrition is apparent. This overweight, obesity and NCD experience is occurring in spite of the continuing relevance of agriculture, of staple foods, of home cooking, of local markets and of urban–rural relations, to the urban food system and local diets. Both cities appear to have not very advanced nutrition and food system transitions, at least in the form conceptualised by Popkin and others (described earlier) as encompassing increased consumption of processed foods, increased eating out, fast-foods, oils and sweetened drinks.

Comparing the overall picture in the two cities, the most apparent difference was that Mbale residents were poorer, experienced higher unemployment and greater food insecurity, had lower mean dietary diversity, greater farming involvement and a poorer health situation, than Mbarara. In this discussion, we further consider these findings with reference to ongoing debates around links between urbanisation and agriculture, nutrition and health.

Agriculture: common, and geared towards staples

The finding that 65% of Mbale, 51% of Mbarara HHs were involved in agriculture (Table 2) indicates that some farming is quite common in these intermediate cities. Findings from two sister-projects to this research

present a similar picture of the common role of agriculture for urban households in medium-sized Ghanaian and Kenyan cities (Ayerakwa 2017, Omondi *et al.* 2017). That the Ugandan households involved in agriculture had larger household size (Table 2) fits with a study from 2010 showing that larger families have the labour resources to engage in agriculture (Mugagga *et al.* 2010). Our data also suggests that agricultural households had slightly higher mean household dietary diversity scores, slightly lower food insecurity status and higher mean gross monthly incomes than non-farming households. HHs engaging in agriculture in both rural and urban areas had the best status in all indicators (Tables 3–5).

The finding that practicing urban agriculture (on its own or in combination with rural farming) actually became more common for households whose heads had lived longest (>10-years) in the cities is an important finding and contrasts with earlier theorising that UA is an activity of recent migrants (Mougeot 2006, Prain *et al.* 2010, Hamilton *et al.* 2013, Masvaure 2015). Our findings from this study imply that time is a critical factor in urban agriculture. Time is required to gain in-depth understanding of the specificities of the city environment, its social networks, and to decipher local land ownership practices and gain access. Other research has also begun to note that farming in the city may require access, land, capital or all three and thus may be rather more associated with wealth and/or long-term residence (Bakker *et al.* 2000, Frayne *et al.* 2014, Mbiba 2001, Mackay 2018). This leads to speculation about the impact urbanisation, with its associated in-migration, might have on patterns of urban agriculture and upon the diets, food environments and health of urban residents. Newcomers are likely to face greater disadvantage in accessing land, and may thus be even more dependent upon food markets.

The finding that farming HHs had higher mean incomes than non-farm HHs (Table 3) does not indicate a causal link. The highest income rural and urban farming households may have been wealthier in the first place; or agriculture may have contributed to their wealth. These findings are pertinent however since they do not support theorising of agricultural activity by urban households as symptomatic of poverty or failed urban development (Mougeot 2006, Drechsel and Dongus 2009, Zezza and Tasciotti 2010). Other research accord more with our finding that higher socio-economic status urban HHs farm at least as much as, and perhaps benefit more, than poorer HHs (Armar-Klemesu 2000, Bon *et al.* 2010, Frayne *et al.* 2014).

That the greatest proportion of these urban-based HHs undertook agriculture in rural areas (Table 2) is an indication of continued strong links between urban and rural (Bah *et al.* 2003), and a significant characteristic of the food environment of these smaller cities. Urban households use their own labour, and hired labour, and/or familial resources on rural land and take the produce to the city, mainly to supplement the household food basket, but also to sell (field notes from follow-up qualitative research in the cities). The commonness of rural-urban food transfers was also found by research in Southern Africa (Frayne 2010).

The agricultural practice of these intermediate-sized Ugandan cities was dominated by small home gardens of staple (carbohydrate-dense) food crops, or rearing of a few livestock or poultry, for consumption. Findings from two Ghanaian intermediate-sized cities present a similar picture (Mackay 2018). This probably relates to the preponderance of staples in local diet preferences and traditions (Figure 12). This staple food dominance is likely also due to such food crops' role in providing calorific food security and feelings of satiation (Mattei *et al.* 2015).

Food & nutritional environment: low diversity, high insecurity, traditional, home grown

The high prevalence of food insecurity in the study cities (Figure 13) is concerning and is similar to that found in AFSUN's study of 11 Southern African cities (Frayne and McCordic 2015). Nevertheless, the 25% of Mbale's surveyed households, 31% Mbarara, that felt food secure was higher than that found in Southern African cities with only 15.9% food secure (Frayne and McCordic 2015). The data on food insecurity scores by agricultural engagement of the household (Table 5) suggests that agriculture may be associated with reduced food insecurity. Those HHs, in particular, who were farming in both rural and urban areas were most food secure. This food security role of own food production is supported by some studies (Armar-Klemesu 2000, Prain 2010) and disputed by others (Aidoo *et al.* 2013, Frayne *et al.* 2014). Our findings are notable for the light they shed on urban-based households' relation to agriculture. Further modelling, controlling for socio-economic and household factors, is required as a next step.

The urban food environment (in terms of both production and consumption) in Mbale and Mbarara reveals the local dominance of the starchy staple foods (mainly maize, matooke, sweet potatoes), as well as beans, in both the low and medium dietary diversity groups (Figure 12). This finding is supported by other studies which describe a low diversity monotonous diet as quite common in Uganda (Fanta 2010, Acham *et al.* 2013). Indeed Haggblade *et al.* (2015), in their paper considering how to bend the curve of nutrition transition, use Uganda as the case for a country in the early stages of food system transformation. Their study also recognises that relationships among the various transitions associated with urbanisation and development are not always clear-cut or progressive; supporting our assertions based on our survey. Haggblade and colleagues do note that 'some countries at low levels of food system development have begun to experience perceptible movement

into Stage 2 Degenerative Diseases such as overweight, hypertension problems, particularly among vulnerable population groups' (Haggblade *et al.* 2015, p. 3). The reference to Stage 2 degenerative diseases is to Barry Popkin's description of the phases of nutritional and epidemiological transition (UNC 2017). Our findings suggest this stage of 'degenerative' diseases is already present even in these secondary Ugandan cities, despite being in association with a relatively low diversity diet. However, our data does not evidence this as being limited to vulnerable populations. Further studies are necessary.

In addition to the starch/beans dietary focus, it is possible to question the nutritional benefit of some of the foods that were added with the move from low to medium dietary diversity (Figure 12), such as sugar. This questionable nutritional gain may also apply to the move from medium to high dietary diversity where additions included spices/condiments/beverages in Mbarara, and oils/fats in Mbale (Figure 12) (Popkin *et al.* 2012, Edwards *et al.* 2016).

The finding that non-agricultural urban households less commonly received food transfers (Table 6) suggests that they are more dependent on the market for their entire food requirements. They may have less connection to rural areas, less connection/access to land or simply more urban-based social networks. That these more market-dependent non-agricultural HHs seemed to comprise a greater proportion of the most regular snack consumers (59.6% in Mbarara were in non-agricultural households; 44.6% in Mbale, see Table 6) is notable. The same is true of the regular consumers of SSBs (56.3% in Mbarara were non-agricultural households; 50.6% in Mbale, Table 6). This is perhaps somewhat contrary to the finding that these same non-agricultural households tended to have lower mean BMI than the agricultural households. It could be that the non-agricultural households are so resource-constrained that they end up snacking more on cheap, energy-dense fatty food products (Awosan *et al.* 2014, Huffman *et al.* 2014, Singh *et al.* 2015). This may imply that poorer households in these cities may show greater obesity and NCD burden over time. Indeed, signs of this burden shift towards the poor is supported by recent studies (Shrimpton and Rokx 2013, Katende and Donnelly 2016) though others caution that it is still the communicable diseases and undernutrition that disproportionately affect the poor (Gwatkin 2013). Our study did not investigate the composition of snacks (sugar, fat and salt contents), portions sizes, or frequency of eating, nor gather data on the nutritional quality of staple crops (suggested as being relevant to rising diabetes levels (Mattei *et al.* 2015) and perhaps rising obesity prevalence).

Modernisation theory tends to assume that urban growth and societal development will follow patterns of global northern cities whereby, as outlined earlier, the food and nutritional systems progress away from agriculture, own food production, traditional foods and eating within the home. This changed food and nutritional environment, the theory suggests, combines with reduced physical activity to create an epidemiological transition towards NCD. Our cross-sectional survey does not allow any conclusions regarding trends (Popkin *et al.* 2012). What it does show, however, is that during 2015, the populations of these smaller but growing cities were quite commonly involved with agriculture, own food production, traditional staple foods and eating at home, and many received some level of staple food crop transfers from rural-based relatives. The next section reveals that, despite this lack of evidence for advanced food system and nutrition transitions, an NCD burden (particularly of overweight and obesity) is already apparent, and of possible concern.

Heath situation: obesity presence and suggestion of other NCDs

In terms of NCDs, our survey found prevalence of 26% surveyed Mbale adults, 28% Mbarara classed as overweight, and 14% Mbale, 22% Mbarara classed as obese (Table 7a). In comparison WHO's database on NCDs report 2008 obesity levels of: 4.2% Kenya, 7.5% Ghana, 18.6% Sweden, and 33% USA (WHO 2011). A 2011 survey in Eastern Uganda of 1656 adults (35–60 years) found slightly lower but still concerning overweight (12.3%) and obesity (5.3%) prevalence (Mayega *et al.* 2012). Our survey additionally shows a strong gender component with 69% of the Mbarara overweight group, 74% Mbale and 83% (both cities) of the obese group being female (Table 7a). This finding, and our 18% Mbale and 27% Mbarara female obesity (Table 7a), is supported by statistics from the World Obesity Federation which cites a female obesity prevalence of 13.7% in Kenya, 14.4% in Sweden and 40% in the USA (WOF 2016). The 2011 Demographic and Health survey for Uganda cites significantly lower 4% female obesity prevalence than our survey (UBoS and ICF 2012). The STEPS survey based on a nationally representative sample found 15.6% urban female obesity (STEPS 2014). The gender differential is concerning and requires further exploration, both qualitatively and quantitatively. Haggblade and colleagues, in their study of African regions, suggest that 'Adult women, across all regions, have proven most vulnerable to weight gain during the nutrition transition given biological differences in how women and men metabolize fat' (Haggblade *et al.* 2015, p. 4). Our survey is not equipped to assess this statement but there is a clear need for further multidisciplinary investigation.

Findings suggest that there is cause for concern. There are clearly some processes occurring within Mbale and Mbarara (perhaps the nation as a whole) that deserve further investigation. Interesting, however, was the data showing that a greater proportion of the obese group

stated they were unhappy with their weight. This is in contrast to research which has suggested that people in Africa want to be fat, that fat is happy/beautiful/healthy (Puoane *et al.* 2005), or that African women aim to be 'traditionally-built' (Janzon *et al.* 2015). Other studies suggest that, if such attitudes ever were prevalent in the past, they may now be changing, particularly in youth, possibly as a result of Western media influences, but also due to improved health education (Keding *et al.* 2013, Gitau *et al.* 2014). Important qualifying data on perceptions of food, of body sizes, of daily urban life and of health awareness were also not part of this survey. We have now initiated follow-up qualitative research to investigate such aspects.

The finding that higher BMI categories had higher incomes (Table 7b) has been found in other research (Ziraba *et al.* 2009, Neuman *et al.* 2013). Table 7b depicts close to a doubling of mean income between underweight and obese groups in Mbale, and a tripling in Mbarara. The suggestion that obesity is connected to wealth is in contrast to findings from the Global North where it is predominantly the poor who have obesity-related problems (Popkin *et al.* 2012, Shrimpton and Rokx 2013), although there are signs the poor in the Global South are increasingly affected (Ziraba *et al.* 2009, Popkin *et al.* 2012, Shrimpton and Rokx 2013).

Contextualising the findings on household experience of diagnosed diabetes and hypertension (Table 7c), a 2011 literature review of NCD prevalence in Africa quote diabetes prevalence ranging from 0 to 16% of the population (Dalal *et al.* 2011). A survey conducted during 2012–2013 found just 2–4% diabetes among Ugandan adults (Kavishe *et al.* 2015). Official reporting in Uganda however puts overall diabetes prevalence at 0.4% (UBoS 2014). Regarding hypertension, East Ugandan prevalence was put at 20.5% (Mayega *et al.* 2012), and Kavishe and colleagues found prevalence ranged from 19 to 26% (Kavishe *et al.* 2015). A 2011 study from rural Uganda recorded 22% hypertension prevalence, and found that higher BMI and elevated blood sugar were strong independent predictors of hypertension (Maher *et al.* 2011).

NCDs are increasingly recognised as a threat to public health in Uganda, and were considered responsible for 27% of Ugandan deaths during 2014 (STEPS 2014). The data in this paper suggest that the NCD-side of the epidemiological spectrum is already apparent in these smaller cities. They are not just a phenomenon of larger cities with more 'Westernised' food outlets and dietary patterns and large-city lifestyles (as implied by transition theory [Popkin 1998, 2001, Popkin *et al.* 2012]). This Mbale–Mbarara NCD presence is concurrent with known (though diminishing) epidemiology of infectious disease and undernutrition (Fanta 2010, UBoS and ICF 2012, UBoS 2014), and is thus evidence of population-level double burden malnutrition.

The presence of double burden malnutrition within Mbale and Mbarara populations is not a complete paradox. Indeed, recognition of the co-existence of obesity and stunting within the same household (Ruel *et al.* 1999), what Caballero termed a 'nutrition paradox' (Caballero 2005), may be relevant to understanding our findings of obesity and self-reported NCDs in a context of still relatively low dietary diversity and common food insecurity. David Barker's foetal origins theory suggested that foetal or infant nutritional insults stimulate permanent metabolic changes that later in life, especially if faced with assumed urban transitions, predispose these individuals to obesity (Barker 1997). Such mechanisms may partly explain the NCD and obesity prevalence in Mbale and Mbarara: many individuals, regardless of current household economic status and food environment, may have had childhood or in utero exposure to food scarcity or other nutritional insults. Indeed, Barker's work suggests that obesity-related problems may be a consequence of the same poverty processes as undernutrition, rather than of genetics, overeating or the hypothesised 'Westernisation' of diets earlier assumed (Pingali 2007, Haggblade *et al.* 2015). Both Barker and Popkin began highlighting the role of wider socio-environmental contexts, and the importance of looking at the family, the city and the society (Bray 2004; Popkin and Hawkes 2015; Warin 2015).

Agriculture, nutrition and health linkages

The data on dietary diversity and variation by agricultural household (Figure 12 and Table 4) suggest that, in these Ugandan cities, the difference in dietary diversity between the farm and non-farm HHs amounted to just one food group. Other studies have associated higher dietary diversity with the socio-economic status of a household (Hatløy *et al.* 2000; Hoddinott and Yohannes 2002). The findings from Mbale and Mbarara lend some support to this: the highest diversity HHs were the HHs that had the highest gross incomes, i.e. those practicing both rural and urban agriculture. Yet, the diversity difference was small. This finding suggests either that agriculture does not have a strong impact on diet diversity in these cities or that the kind of agriculture occurring is focused upon the same food groups that are commonly eaten by all, even those dependent on purchased food. We suspect this is the case, explained by the dominance of the staples of maize, beans and matooke in both the agricultural practices and diet preferences. Agriculture geared towards staple food production largely for calorific and food security purposes may not support diversity and thus may not provide the broadest nutritional benefits, but such farming can still play a role in food security, as our data suggests. Some development projects that make claims for the nutritional benefit of agriculture often rather mean a

small diversified home garden (see review by Galhena *et al.* [2013] or intensive patio-type or horticultural initiatives [Orsini *et al.* 2013]). The agricultural practices of these Ugandan cities are different from this. Thus, claims that HHs producing their own food will have better dietary diversity, and thereby glean nutritional and health benefits (Ekesa *et al.* 2016, Faber *et al.* 2016), should be viewed cautiously. The kind of food produced, as well as the usage pathway (consumed or sold, and to which degree) obviously influence the nutritional and health benefits that may be possible (Kadiyala *et al.* 2014, Sibhatu *et al.* 2015). If urban households were engaged in diversified agriculture, particularly fruit and vegetables, for home consumption, such farming may have more positive implications for nutrition/health outcomes. Growing, or consuming, fruit and vegetables were not so common for these households.

Conclusion

This study considered the role of agriculture for urban food, farming and health environments in two intermediate-sized, rapidly urbanising cities of Uganda. The paper explored the status of nutritional, food system and epidemiological transitions. Findings indicate that agriculture remains a relatively common practice for these urban-based households, occurring in the urban or in the rural area. The agriculture was mainly of a household food supplementation nature, and did not contribute strongly to a more diverse diet, but did imply slightly better food security. Urban agricultural practice was more common with greater duration of residence of the household head. Food production and consumption practices focused primarily on staple food crops. Eating out at restaurants or fast-food venues was not common. Snacking on energy-dense fatty foods was also not common, though slightly more so for non-agricultural households. The main food sources were traditional marketplaces rather than supermarkets, and transfers from rural areas (largely staples) were common. Findings suggest that claims regarding agriculture's impact on diets and nutrition in urban environments should be specific and contextualised.

Experience of NCDs (obesity, hypertension, diabetes) in a context with ongoing (although declining) presence of undernutrition and communicable disease, indicated that double burden malnutrition at the population level is already being felt in these smaller cities. The concerning prevalence of adult obesity, particularly for women, highlight the importance of further study. In contrast to experience from the Global North, data presented here suggest it was wealthier households in medium-sized urban Uganda that were both farming more, and had greater prevalence of high BMIs. Panel data over time is clearly of urgency.

Findings suggest that nutritional and food systems are not advanced in theorised transitions to 'westernised' diet and distribution systems. Yet, there was evidence that the cities are already struggling with double burden malnutrition. Results imply that there are other drivers of epidemiological change at play. We might speculate that such drivers lie in feast/famine eating patterns, total energy consumption in the form of large carbohydrate portion sizes. Other influences may include different views of health, of desirable body sizes, and varying perceptions of, and access to, physical activity, as well as to healthcare services. Future research should investigate such parameters to further understanding and better position Mbale and Mbarara along the continuum of nutrition, food system and health change.

Notes

1. Population statistics from UBoS (2016), see comment on urban population statistics in the Study Cities section.
2. (1) cereals/grains (2) roots and tubers (3) vegetables (4) fruit (5) meat or meat products, including poultry and game (6) eggs (7) fish, shellfish, fish products (8) legumes, nuts, seeds (9) milk or other dairy products (10) oil, fat, butter (11) sugar, honey or sweeteners (12) condiments, spices, tea, coffee.

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