Secondary Towns – The Nutritional Sweet Spot. A study of East Africa

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Recent literature has drawn attention to the importance of secondary towns in development. Urbanization has been extensively covered in its effect on food security, however, secondary towns and their effects on diets are largely absent. This paper analyses dietary patterns for rural areas, secondary towns and megacities using DHS maternal and child nutritional outcomes and nighttime light data, as well as detailed food consumption data. Across East Africa, we find a clear pattern that secondary towns are a nutritional ‘sweet spot’. Maternal and child nutritional outcomes are optimal in secondary towns and the best consumption of macro- and micronutrients is at the secondary town level. Rural households consume too little, although their diet composition is good. Households in megacities consume enough, yet still face high levels of micronutrient deficiencies. Time constraints and market access may be the main factors which make secondary towns an ideal nutritional hub.

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Abstract

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Key words – Secondary towns, Urbanization, Malnutrition, Dietary Patterns, Time Constraints, Market Access

1. INTRODUCTION

Sub-Saharan Africa is urbanizing rapidly at about 3.5% per year (UN Habitat, 2014). This causes entire regions to change in socio-economic climate affecting food consumption and production decisions (Nguyen et al., 2013). Some scholars argue that urbanization can aid the eradication of undernourishment (Delgado, 2003). Urban dwellers tend to consume higher amounts of meat, dairy products and fruits (Bouis & Huang, 1996). This is crucial as malnutrition also includes the inadequate intake of vitamins and minerals. Other studies warn that urbanization may actually lead to overconsumption, with more energy intensive diets, dominated by processed ‘fast-food’ and higher oil and sugar intakes (Popkin, 1999; 2004). Nevertheless, various studies that may suggest this type of transitional diet find that traditional diets are simply being supplemented with imported foods (Sodjinou

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1 The urban population of Africa is expected to increase from 329 million to 748 million, while the rural population is projected to increase from 521 to 650 million.
2 These patterns have previously appeared in the study of American-Indian diets undergoing commercialization (Szathmary et al., 1987, Ritenbaugh et al., 1996).
et al., 2009). However, empirical evidence remains largely inconclusive. In addition, the majority of the literature continues to focus on quantity rather than the quality of food consumption. As a result, the implications of urbanization from a micronutrient perspective are still poorly understood.

Initially, most studies on urbanization focused on major cities. However, a simple rural vs urban indicator impedes micro-level analysis of the implications of urbanization (Christiaensen and Todo 2014; Amare et al., 2017) and thus restricts a full understanding of the relationship between urbanization and malnutrition. Therefore, recent literature has been looking at urbanization as a continuous variable.

In particular, the literature on secondary towns has bloomed. Secondary towns are found to be positively associated with economic growth (Dorosh & Thurlow, 2013), inclusive growth (Christiaensen & Todo, 2014), employment opportunities for the poor (Glasser & Raich, 2008), poverty reduction (Christiaensen & Kanbur, 2017; Barrett et al., 2017; Mellor, 2017) and improved agricultural outputs for surrounding farmers (Vandercasteelen et al., 2017).

Less studies have however focused on the link between secondary towns and malnutrition. Amare et al. (2017) find that child nutritional outcomes improve with urbanization in Nigeria, however also find a small peak in stunting and wasting at the higher levels of urbanization. Furthermore, it was found that households living in Ethiopian secondary towns consume more fruits and vegetables and their diet is less focused on processed cereals than in Addis Ababa, the capital (Worku et al., 2016). Lastly, Cockx et al. (2017) also find that diet diversity improves for households living in secondary towns. Nevertheless, none of these studies specifically identifies dietary evolutions at various levels of urbanization and the importance of secondary towns. Our study will contribute to the literature by not only identifying a strong trend in dietary patterns along the stages of urbanization but will also explain how these patterns may take place. By first establishing maternal and child nutritional outcomes in East

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3 Hunger and malnutrition are still prominent issues in Sub-Saharan Africa. From 2014 to 2016, approximately 25% of the population, were hungry (FAO, 2016). On top of this, the Sub-Saharan region has made the least progress toward reducing hunger, where more than one in four people remain undernourished. This is the highest prevalence of any region in the world. Entire generations thus suffer from cognitive and physical issues, more severe illnesses and in some cases premature death (Peeling & Smart 1994; Pollitt, 1995; Grantham-McGregor, 2000; Berkman et al., 2002). These issues in turn lead to educational difficulties (Lozoff et al., 2000; Glewwe et al., 2001; Caulfield et al., 2006; Luo et al., 2012), lower future incomes (Bobonis et al., 2006; Halterman et al., 2001) increased health costs (Shorr et al., 2008) and decreased life expectancies, each highly affecting the economic climate of the country. Furthermore, although food systems are improving in developing countries, many populations are yet to receive the means to a healthy diet (Allen & De Brauw, 2017).
Africa and then disentangling diet composition at the level of macro- and micronutrients in Tanzania, we find that households living in secondary towns have the most healthy and fulfilling diets. Rural households underconsume and households living in megacities consume enough yet still face undernourishment at the micronutrient level. This paper then tackles the question of what makes secondary towns such an ideal location nutritionally speaking. We find that a combination of optimal time use and market access could explain these patterns. This research could be of great importance to policy makers as it is one of the first to identify dietary differences across various levels of urbanization thus portraying where the problems of malnutrition lie and secondly, highlights some important channels through which these patterns may exist. These channels could hence be individually tackled rather than using untargeted, broad spectrum interventions to solve the issue of malnutrition.

Section 2 gives an overview of the data used in this study while Section 3 establishes the stylized facts we are willing to portray. Section 4 explores the channels through which these patterns may occur and Section 5 presents a heterogeneity analysis.

2. DATA

This study combines several datasets. Firstly, the 2015 Demographic and Health Surveys (DHS) in East Africa\(^4\) will focus on maternal and child nutrition outcomes and urbanization. They will include 79,788 women and 81,668 children. In order to establish the relationship between nutrition and urbanization, we use satellite nighttime light data as a proxy for urbanization. Throughout the literature, the appropriate measure of urbanization has been disputed yet recent studies focus more on continuous and disaggregated indexes allowing the capture of micro-level variations due to the urbanization process (Van de Poel et al., 2012). Nighttime light data has the ability to capture urbanization as it is expected that light intensity increases from rural to urban areas (Henderdon et al., 2003; Sutton et al., 2010). This nighttime data originally comes from the National Oceanic and Atmospheric Administration. The current geographic data from DHS has included some of these geophysical indicators, under which nighttime light composites and thus these will be used in our analysis. Nighttime lights are matched with

\(^{4}\) Countries included in this study are Burundi, Kenya, Malawi, Mozambique, Rwanda, Tanzania, Uganda, Zambia, Zimbabwe
the DHS dataset at the cluster level, meaning that variations within megacities exist and so not all households living in for example a capital city are grouped together as one level of urbanization.

Throughout the literature and like in DHS, most datasets simply provide aggregate nutritional information yet this lacks the necessary level of nutritional decomposition to investigate the quality of a diet. In order to provide a more elaborate overview of nutrient deficiencies in rural and urban areas a highly detailed dataset is needed. The second dataset used in this paper derives from the Survey of Household Welfare and Labour in Tanzania (SHWALITA) diary surveys carried out by Beegle et al. (2012) in Tanzania. The survey diaries give detailed information on what 1,498 households ate during the two weeks of surveying. The diary modules cover all products coming into the household through harvests, purchases, gifts and stock reductions and subtract all items not consumed by the household through sales, stock increases and gifts.

To avoid unit conversion errors, households completed the food consumption diaries in local units, which are then converted into standard measures using item and region-specific food composition tables. These tables also take into account the edible portion of the food consumed. The original diaries include records on 58 food groups. Previous literature often simplifies food groups into representative groups such as cereals, starches, fruit, vegetables, meat and dairy. Throughout the SHWALITA survey, households also documented the Swahili names for the specific foods consumed, making it possible to disaggregate these 58 food groups even further by translating the Swahili words into English. Our final dataset now contains 100 different food groups.

To determine macro- and micro- nutrient intakes we constructed a food composition table for each food group including information on calories, protein, protein from meat, carbohydrates, fat, saturated fat, and micronutrient content. For full meals, it is now also possible to include methods of preparation and oils used.

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5 For example, a bunch of plantains leaves behind a considerable amount of non-edible stuffs and so this is acknowledged in the conversion tables.
6 Conversion tables from Beegle et al. (2012)
7 Translations available upon request
8 After separating the different types of full meals and snacks this disaggregation proved important. Rural areas tend to consume more nutritional rice meals containing higher levels of vitamins and minerals whereas urban dwellers tend to consume more calorie-dense porridges and street foods. Moreover, “snacks” also vary vastly in terms of calories and micronutrient content. For full meals, it is now also possible to include methods of preparation and oils used.
cholesterol, fibre, sugar, vitamins (A, B1, B2, B3, B6, B9, B12, C, E) and minerals (calcium, phosphorus, iron, sodium, magnesium, zinc and potassium). We compare actual consumption with daily-recommended nutrient intakes from Smith et al. (2006) taking into account age, sex, breastfeeding and labour for each individual member in the household. From this the mean per capita required calorie intake is computed per household.

3. STYLIZED FACTS

When looking into nutritional patterns, it is useful to have both a regional and local analysis. First of all, this study will examine dietary outcomes across various levels of urbanization in East Africa. Then we will zoom into key nutrient consumption levels in Tanzania. This study analyses both actual nutrient consumption as well as dietary outcomes.

3.1. East Africa

To ascertain the dietary patterns of East Africans living in various stages of urbanization, we will use nonparametric and unconditional regressions to characterize the relationship between urbanization, proxied by nighttime lights, and maternal and child nutritional outcomes. We use this form to set aside the assumption of a linear relationship between urbanization and consumption, and establish a true evolution. These polynomial associations will furthermore control for wealth and electricity availability as nighttime lights may simply be capturing these effects rather than urbanization.

Our analysis will capture the following polynomial regression model

\[
y_i = \alpha + \beta_1 \text{Nightlight Composite} + \beta_2 \text{Nightlight Composite}^2 + \cdots + \beta_n \text{Nightlight Composite}^n + \delta \text{Wealth}_i + \gamma \text{Electricity}_i + \epsilon_i
\]

where \( y_i \) represents our maternal and child nutritional outcomes such as diet diversity, anaemia, height-for-age and weight-for-height. \( \epsilon_i \) is the error term. Diet diversity is measured by the amount of food groups consumed by a child in the last 24 hours, divided by the total number of food groups. It must be noted that children between the age of 0 and 1 are excluded from our sample as they may skew our
results. First of all children this age are often still breastfed and are more likely to be anaemic due to natural reasons.

Figure 1 presents the results of the polynomial regressions for child nutritional indicators. Diet diversity is found to improve by about 7% for households living in secondary towns compared to households living in rural areas, but then diet diversity decreases again for households living in larger cities. Anaemia levels seem to improve with the degree of urbanization. Overall levels remain high as 4 represents severe anaemia and so even in large cities, many children are still found to have moderate levels of anaemia. Height-for-age, namely stunting, remains relatively similar throughout various levels of urbanization, however weight-for-age increases. This indicates that although children in cities may be eating more and may be even becoming slightly overweight, they are still not consuming adequate amounts of micronutrients such as vitamins and minerals.

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10 A substantial amount of children are still breastfed until the age of two. The polynomial regression patterns remain the same when excluding these children yet on average more children are underweight.
Recently, the literature has indicated that anaemia may also have non-dietary causes such as intestinal worms and other sources of internal blood loss (Smith & Brooker, 2010; Casey et al., 2011). Therefore, we run some polynomial regressions looking at every food group consumed at different stages of urbanization. From this it is evident that households living in secondary towns seem to consume the best diet. A higher level of vegetables, animal products and seafood is consumed in secondary towns compared to rural areas and megacities. It is thus also implied that anaemia levels may not be improving due to more meat or green leafy vegetable consumption (both iron rich foods), but possibly due to better health care and less issues of intestinal worms.

For children it thus seems that those living in secondary towns fare best in terms of a varied and fulfilling diet. Next, we explore some nutrition indicators linked to mothers. Figure 3 presents the results of the polynomial associations between anaemia, weight-for-height and urbanization. Here it is observed that anaemia levels tend to decrease as urbanization increase, however, we can also see a small upwards trend towards the higher levels of urbanization\textsuperscript{11}. This indicates that women living in smaller towns and

\textsuperscript{11} We also controlled for pregnant women in this polynomial regression as pregnant women are more at risk of being anaemic and so may skew the results.
cities have the lowest levels of anaemia. Further, weight-for-height tends to increase with urbanization, and is increasingly positive, indicating that women living in larger cities have a higher chance of being overweight than those living in small towns or rural areas.

Overall, in East Africa it is found that dietary patterns vary greatly across different levels of urbanization. First of all, households living in rural areas seem to have a relatively diverse diet but do not consume enough. Secondly, households living in large cities seem to consume a lot but not enough nutrient dense foods and thus may still face micronutrient deficiencies. Finally, our analysis indicates that diets in secondary towns seem to do best, with a more diverse consumption and less issues with undernourishment, or overweightness.

3.2. Tanzania

Moving on from a general analysis, we use detailed micro-level data collected in Tanzania to ascertain true nutrient consumption and thus establish changes in dietary health across various levels of urbanization. To gain an insight into the average dietary patterns of households living in rural areas, secondary towns and megacities, in this case, Dar Es Salaam, Figure 4 presents the consumption distribution of calories, good and bad nutrients. Good nutrients include all vitamins and minerals, protein, carbohydrates, fat and fibre. It must be noted that when some of these elements are overconsumed in high amounts, namely carbohydrates, proteins and fats, they can also lead to issues of overweightness and heart disease. Bad nutrients include sugar, cholesterol and saturated fats. The zero
point represents the daily recommended consumption of these nutrients and over and underconsumption is in percentages. For calories, good and bad nutrients, rural households underconsume yet for good nutrients they underconsume in less extremes, indicating that diet composition is relatively good. The distributions for households living in secondary towns is shifted slightly to the right of rural households, meaning they face less issues of underconsumption and undernourishment as their diet composition remains the same. Households in megacities then again consume more on average yet it must be noted that the distribution is far more spread out than then previous locations. This indicated much more variability in diets within megacities. Lastly, although urban households consume more bad nutrients than rural households and secondary towns, note that this is still not alarmingly high.

In order to gain an idea of the extent to which households are malnourished, we look at macro- and micronutrient deficiencies across various levels of urbanization. On average we find a trend that macronutrient deficiencies tend to decrease when moving from rural areas to secondary towns and then tend to increase again when moving to Dar Es Salaam. For harmful nutrients such as saturated fats, cholesterol and sugars, we find that ‘deficiencies’ continue to decrease when moving along the urbanization scale, meaning that households living in megacities eat more of these harmful substances. Paired with the fact that good nutrient consumption decreases in megacities, we can see that diets in large cities are lacking in composition and therefore nutrient fulfillment. These trends continue for Figure 6 and 7 where we can find deficiencies of vitamins and minerals decreasing from rural areas to secondary towns and then increasing again for megacities.
Figure 5 | Macronutrient Deficiencies by Urban classification

Figure 6 | Vitamin Deficiencies by Urban classification
Looking at diets at this level of disaggregation, shows us where exactly problems of undernourishment may lie. For example, we can observe that over 70% of the rural population is vitamin B12 deficient and although this improves along the levels of urbanization, 50% of urban households still underconsume vitamin B12. A lack of vitamin B12 is linked to anaemia, unfavorable birth outcomes and slow cognitive development and repair (De Benoist, 2008). We can also disentangle rural undernourishment from urban malnutrition. Here we see that policies in rural areas and megacities may coincide. For example, vitamin B’s should be targeted in both areas, as well as iron, magnesium and phosphate. Then for rural households, policies should furthermore focus on vitamin A and Zinc whilst in urban areas more focus should be given to vitamin E, vitamin C and potassium. Each vitamin or mineral deficiency is paired with its own effects on bodily functions and development, making it imperative that policies target the correct micronutrient deficiency.

Now that we have established what a typical diet looks like in rural areas, secondary towns and megacities across Tanzania, we will aim to disentangle whether these patterns hold and which factors may influence them. Firstly, additional income can ensure higher diet diversity and improvements in the
quality of food bought (Regmi & Meade, 2013). Moreover, poor households tend to lack appropriate cooking, refrigeration and storage facilities (Crush & Frayne, 2011) thus tempering their ability to prepare sufficiently healthy meals. Income will be proxied for by household expenditures on food and non-food items. A control for month interviewed was added to account for seasonal income differences. Moreover, Chernichovsky and Meesook (1984) suggest that customary diets may be distorted by the differences in prices between rural and urban areas. To take this into account, a price index was created at the district level\textsuperscript{12}.

Additionally, household food consumption cannot fully be explained without looking at supply side factors affecting food availability and diversity. Through the process of globalisation, supermarkets have become popular (Weatherspoon & Reardon, 2003), increasing variety and decreasing prices of food. These supply-side determinants will be proxied for by the distance to markets, at the cluster level. This variable will also encompass the general consumption atmosphere in a cluster. This is a key element to explore as traditional eating patterns in Africa have been disrupted by mass media (De Nigris, 1997). Crush and Frayne (2011) further argue that in Southern Africa media enhances the way in which food preferences are shaped, especially for poor urban households.

Moreover, factors such as having a day care centre close by could affect female opportunity costs. Gender related factors must therefore be included in our regressions as conveniently consumed food has a higher demand in urban areas where both parents mostly work away from home and the cost of household help is greater than rural areas (Huang & David, 1993).

The regressions will be run according to the following format

\[ y_i = \alpha + \beta_1 SecondaryTowns_i + \beta_2 Dodoma_i + \beta_3 DarEsSalaam_i + \gamma X_i + \epsilon_i \]

where \( y_i \) is the percentage consumption of the calories or nutrient of interest, each urban category is represented by a dummy with rural households as the references category, \( X_i \) includes all controls variables and \( \epsilon_i \) is the error term.

\textsuperscript{12} Variations of price within a districted were tested and these do not differ substantially.
The result of these regressions can be found in Table 1. From this table it is found that on average households living in secondary towns consume more than rural households. For example, rural households consume around 40% less fat than is recommended while households living in secondary towns consume about 30% more fat meaning that on average, they are reaching their daily recommended intakes. Now looking at households living in Dar Es Salaam, a megacity, they do not consume more fats than rural households. They do however consume more calories which mainly come from a higher consumption of proteins and carbohydrates. In terms of vitamins, households living in secondary towns consume more than rural households. Households living in megacities also consume more vitamins associated with a higher meat consumption, namely vitamin B1, B2 and B3. However, these households do not fare better than rural households for other vitamin consumption. At the mineral level, urban households in general consume more than rural households. It must be noted however that households living in megacities also consume too much sodium, linked to a high salt intake, and also underconsume potassium, a key nutrient regulating blood pressure and muscular functions.

From the full regressions\textsuperscript{13} we also find that having a female households head and a higher education both lead to higher nutrient intakes across the board. Being interviewed later on in the year meant slightly less healthy nutrient consumption and slightly more unhealthy nutrient consumption. Having an older households head and having a higher share of children between the age of 6 and 15 also decreased nutrient consumption. And, when the household has a higher share of member above the age of 65, nutrient intakes increase.

\textsuperscript{13} Available upon request, not included due to limited space
### Table 1: Categorical Urban Classification OLS regression results: percentage consumption relative to daily recommended intake

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>% kcal</th>
<th>% Protein</th>
<th>% Animal Protein</th>
<th>% Carbohydrates</th>
<th>% Fat</th>
<th>% Sat Fat</th>
<th>% Cholesterol</th>
<th>% Fibre</th>
<th>% Sugar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary Towns</td>
<td>34.25***</td>
<td>45.47***</td>
<td>11.07***</td>
<td>36.25***</td>
<td>30.38***</td>
<td>27.55*</td>
<td>1.308</td>
<td>26.22***</td>
<td>-4.874</td>
</tr>
<tr>
<td>Dar Es Salaam</td>
<td>35.68***</td>
<td>49.31***</td>
<td>-18.83***</td>
<td>38.68***</td>
<td>1.405</td>
<td>-68.37***</td>
<td>-11.09***</td>
<td>87.41***</td>
<td>-116.6***</td>
</tr>
<tr>
<td></td>
<td>(7.993)</td>
<td>(12.80)</td>
<td>(7.221)</td>
<td>(9.685)</td>
<td>(10.51)</td>
<td>(23.63)</td>
<td>(3.493)</td>
<td>(14.49)</td>
<td>(12.07)</td>
</tr>
<tr>
<td>Rural Mean</td>
<td>12.15</td>
<td>30.29</td>
<td>-59.92</td>
<td>54.38</td>
<td>-38.25</td>
<td>11.96</td>
<td>-84.45</td>
<td>66.29</td>
<td>6.97</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>% Vitamin A</th>
<th>% Vitamin B1</th>
<th>% Vitamin B2</th>
<th>% Vitamin B3</th>
<th>% Vitamin B6</th>
<th>% Vitamin B9</th>
<th>% Vitamin B12</th>
<th>% Vitamin C</th>
<th>% Vitamin E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary Towns</td>
<td>7.673</td>
<td>35.69***</td>
<td>-4.205</td>
<td>51.11***</td>
<td>28.44***</td>
<td>11.52*</td>
<td>58.33**</td>
<td>39.84***</td>
<td>-12.81</td>
</tr>
<tr>
<td>Dar Es Salaam</td>
<td>-97.15***</td>
<td>61.70***</td>
<td>218.2***</td>
<td>54.89***</td>
<td>14.22</td>
<td>-0.497</td>
<td>8.697</td>
<td>-30.59*</td>
<td>49.44***</td>
</tr>
<tr>
<td>Rural Mean</td>
<td>3.07</td>
<td>28.07</td>
<td>107.69</td>
<td>30.79</td>
<td>82.29</td>
<td>6.56</td>
<td>-9.69</td>
<td>70.76</td>
<td>-13.78</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>% Calcium</th>
<th>% Phosphate</th>
<th>% Magnesium</th>
<th>% Iron</th>
<th>% Sodium</th>
<th>% Potassium</th>
<th>% Zinc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary Towns</td>
<td>8.206*</td>
<td>64.45***</td>
<td>25.71***</td>
<td>21.89***</td>
<td>-1.012</td>
<td>10.46**</td>
<td>24.19***</td>
</tr>
<tr>
<td></td>
<td>(4.207)</td>
<td>(10.93)</td>
<td>(6.018)</td>
<td>(5.975)</td>
<td>(3.238)</td>
<td>(4.349)</td>
<td>(5.365)</td>
</tr>
<tr>
<td>Dar Es Salaam</td>
<td>17.18**</td>
<td>114.9***</td>
<td>30.88***</td>
<td>59.84***</td>
<td>22.04***</td>
<td>-20.60***</td>
<td>1.053</td>
</tr>
<tr>
<td>Rural Mean</td>
<td>-46.85</td>
<td>94.07</td>
<td>24.13</td>
<td>1.22</td>
<td>-64.93</td>
<td>10.77</td>
<td>-5.65</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Household and community controls are included in all regressions
Number of Observations for each regression is 1304
3.3. Stylized Facts

From our analysis in East Africa and a more detailed diet decomposition in Tanzania we find three main observations. First, that rural households tend to have a good diet composition but that they underconsume. Second, that households living in secondary towns consume enough and also have a good diet composition. And third, that households living in megacities may consume enough on average but still face various micronutrient deficiencies and thus do not have a good diet composition. To visualize these findings, Figure 8, presents a rough outline of the trends we have discovered.

Figure 8 | Dietary Adequacy per Degree of Urbanization

4. CHANNELS

Now that we have highlighted the differences in dietary patterns between various levels of urbanization the question remains why this is the case. What is it about secondary towns that provides the optimal location for nutritional sufficiency? Why do households living in these areas tend to consume a more fulfilling and micronutrient dense diet? What are the channels driving these differences?

Throughout the literature it has been widely accepted that prices and income have strong effects on food consumption. Higher prices have a negative effect on food consumption and higher incomes have a positive effect on food consumption. In Figure 9, we model that as urbanization increases, prices and
income both increase. Now, assuming price increases are proportionally less than income increases, urban households will still have a higher relative income than rural households. This should thus indicate that as urbanization and thus income increases, diets should improve and less issues of malnutrition should be present. However, as seen from our analysis, this is not the case. The aim is thus to find a channel that counteracts the evolution of income and brings the curve back down again after passing the urbanization level of secondary towns.

**Figure 9 | Hypotheses of the Partial Effects of Urbanization on Diet Adequacy**

![Diagram showing partial effects of urbanization on diet adequacy]

4.1. Culture

Culture is an important aspect in both the demand and supply side of food systems. Firstly, culture influences how foods are produced (Alonso et al., 2017) and secondly, it decides which foods are included in an average diet (Helman, 2007). Culture is dynamic in nature, meaning that it is inherently evolving by changing political, economic, and social environments (Alonso et al., 2017). This means that as urbanization evolves, bringing with it a host of changes in the social-economic climate of a region, culture changes and in turn food consumption patterns may change.

It may be for example that status influences your food consumption decisions more in urban areas than rural areas, meaning that your food preferences shift to modern and attractive foods rather than traditional and nutrition-dense foods. An example of this can be found in Ethiopia where urban
households consume more white teff, which is seen as a superior teff variation, yet contains less nutrients than red teff which is consumed more rurally (Minten et al., 2016).

As culture changes according to variations in political, economic, social and ecological environments, we could nevertheless say that culture is an adjustment to a new lifestyle in urban areas. In this case, lifestyle changes linked to urbanization are substantial and it would be worth disentangling these rather than using culture as an over-arching explanation for the change in dietary patterns.

4.2. Market Access

The first example of a lifestyle change associated with urbanization is market access. Throughout the literature, market access is often portrayed as a positive evolution. Abay and Hirvonen (2017) find that children living closer to food markets consume more diverse diets than those living farther away. Further, it was found that nutrition-sensitive agricultural interventions including market integration measures are more likely to be effective in reducing malnutrition than policies promoting supply side measures (Hirvonen & Hoddinott, 2017). These findings are in line with market access in secondary towns, where households located closer to markets have better diets (Stifel & Minten, 2015), and their food consumption is less dependent on their own agricultural production (Hirvonen & Hoddinott, 2016; Hoddinott et al., 2015).

Nevertheless, urban areas in developing countries are experiencing an ongoing emergence of supermarkets and fast food chains making access to ready-made, processed foods which are less nutrient dense easier (Weatherspoon & Reardon, 2003). On top of this is the growing reliance on street foods (Maxwell et al., 2000; Maruapula et al., 2011) and imported foods which are also widely available in urban areas (Ijumba et al., 2015; Tschirley et al., 2015). It must be noted that this transformation is only just taking off in secondary cities, most notably via an increase in small supermarkets (Ijumba et al., 2015).

In this case market access is positive with regards to diet diversity in secondary towns yet market access in megacities means that households have an easier connection to fast- and street foods. Having supermarkets in close proximity furthermore means a closer proximity to pre-packaged and processed
foods, which are not available in rural areas. Linking market access to our findings, we would assume that in rural areas, food availability is limited. In secondary towns, there are more markets and small shops, possibly providing a more stable flow of diverse foods. Then when moving to megacities, there are more fast-food chains, supermarkets and street vendors. So according to this theory of market access, rural households would underconsume, secondary town households would have foods available to create a healthy and fulfilling diet and urban households would be more exposed to less nutrient-dense, unhealthy foods.

4.3. Time

A second example of lifestyle changes with respect to urbanization is time constraints. Urbanization goes paired with more shops, roads, schools and services in general. However, commuting times to work also increase. Due to the sheer size of megacities as well as underdeveloped institutions and human resources, there are excessive costs to urbanization, including time losses to long commutes as well as traffic jams (Ingram, 1998; Henderson, 2002). Thus, the need to commute generates diseconomies of city life and creates time constraints, not previously found at lower levels of urbanization. Time is scarcer in an urban setting, because households are more likely to engage in work far away from home (Ruel et al., 2008).

Throughout the literature time constraints have been linked to a decreasing quality of food consumption. The greater consumption of processed and prepared foods in urban areas is largely driven by the opportunity cost of women's time (Atkinson, 1992; Tinker, 1997), especially as consumers perceiving time-scarcity try to reduce time intensive household tasks, such as cooking (Celnik et al., 2012). Furthermore, a significant negative correlation has been found between height-for-age z-scores of children and the number of hours per day mothers worked outside the home (Kulwa et al., 2006). It is seen that time is the main reason people give for not partaking in exercise or healthy eating (Strazdins et al., 2011).

Lastly, people in rural areas are found to contribute more time to households maintenance and shopping than people in urban areas (Fotana & Natali, 2008). Here we can assume that as urbanization increases,
households tend to have more time constraints, which in turn weigh heavily in their opportunities to consume healthy meals. It is thus also easier for people to resort to ready-made meals, easily available at the supermarket rather than prepare a home-cooked meal.

To go in a bit more depth, we looked at some important patterns found in our Tanzania data. Figure 10 shows polynomial associations between transport expenditures, prices and income, and urbanization. As we do not have information on time use, we have used transport expenditures as an indicator variable for commuting time. Households living in rural areas often walked to nearby plots of land for their work\textsuperscript{14} whilst households living in urban areas took more time to travel to their work locations and thus are more likely to spend more on transportation. Also, shops and markets are in closer proximity to urban households so transport expenditures are less likely to be used for these purposes. It can be seen that in we transform transport expenditures into time constraints, we achieve a downward sloping curve along the levels of urbanization. This in turn translates into the theory explained in Figure 9 and could thus time constraints could explain the evolution of dietary patterns along various levels of urbanization. This also means that countries with sufficient and working institutions and traffic controls may have a different dietary evolutions as time constraints may play less of a role.

\textsuperscript{14} It could be argued that people living in rural areas may not be time constrained due to commuting times but do work longer hours and thus may face similar time constraints. The literature however finds that this is not the case and that agricultural workers often work shorter hours than those employed in non-agricultural jobs (McCullough, 2017). Within our sample, we also compared consumption distributions of households interviewed in harvesting or sowing season with those interviewed in resting seasons. The results are shown in Figure 1A and show that food consumption did not differ much between the two.
5. HETEROGENEITY ANALYSIS

5.1. Income

So far, our study has developed a dietary evolution for the average households living at various stages of urbanization. Nevertheless, these patterns may not hold when looking at households of different income levels. Table 1A, in the appendix, presents the results of regressions run at various income levels. Here it is found that urban households have a more fulfilling diet than rural households or a poor or middle income. However, rich rural households tend to overconsume in extreme amounts, whilst rich urban households have a diet close to that suggested by the daily recommended guidelines. These findings indicate that our previously established patterns hold for poor to middle income households but do not hold for rich households. It may be that for rich households culture plays a more important role than time constraints in explaining these patterns. Rural households may be more accustomed to a “getting out of poverty” mindset with overconsumption as a reaction to having “made it” whereas urban households may be more in contact with Western health fads such as clean diets and extensive exercising.
6. CONCLUSION

Recent literature has focused on secondary towns and their positive effects on poverty reduction, inclusive growth and employment opportunities for the poor. Nevertheless, a gap still remains in the exploration of the effect secondary towns have on diets, which is exacerbated by the already inconclusive knowledge there is on urbanization and malnutrition at a detailed level. This paper provides an overview of nutritional outcomes at a macro level for East Africa and dietary pattern as a micro level in Tanzania. From both of these analyses it is found that households living in secondary towns have the most fulfilling and healthy diets whilst households in rural areas and megacities are falling behind.

Our study highlights the importance of differentiating between various levels of urbanization when it comes to dietary patterns and explains how these patterns may occur. It is found that market access differentiates greatly between small towns and large cities. Secondary town households are presented with a more diverse steady availability of foods which is likely to improve their diets whereas people living in megacities are presented with a wide variety of ready-made meals and processed foods. The availability and in turn need for these items can be enhanced by a heightened time pressure in megacities. Tiresome commuting times and deficient traffic institutions lead to large time constraints. Moreover, as the opportunity cost of staying at home is larger in these cities, in many households both women and men work, meaning that time remaining for household chores such as cooking is minimal.

The findings in this paper my furthermore be crucial for policy implications. For regions where micronutrient deficiencies are prevalent genetic bio-fortification can be used to increase calcium levels in the leaves of Brassica spp., onion, spinach and the roots of carrots, cassava and plantain (White and Broadley, 2011). Furthermore, Broadley and White (2010) add that specific grain fertilization could alleviate some zinc deficiencies. Overall, interventions such as the promotion of breastfeeding, increased child and development programmes and nutritional supplements to schoolchildren are seen to be highly beneficial (Behrman et al., 2004). Nonetheless, dietary diversification would not address the entire problem of nutritional deficiencies, as can be found in some urban regions, where supermarkets are more numerous yet micronutrient deficiencies are still evident. In areas such as Dar Es Salaam, knowledge based interventions on the importance of traditional food and supermarket transformations from
processed foods to fresh foods are more likely to have an impact. Lastly, as time constraints and market access are important channels in the food consumption decision, these can also drive targeted policies in aiming to reduce malnutrition in large urban regions.
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Figure 1A | Nutrient Intakes by Agricultural Work Intensity
Table 1A | OLS regression results: percentage consumption relative to daily recommended intake

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<th>% kcal</th>
<th>% Protein</th>
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<th>% Carbohydrates</th>
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<th>% Sat Fat</th>
<th>% Cholesterol</th>
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<tr>
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Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1