



MALAWI

STRATEGY SUPPORT PROGRAM | WORKING PAPER 30 (REVISED)

JULY 2020

Are Malawian Diets Changing?

An assessment of nutrient consumption and dietary patterns using household-level evidence from 2010/11 and 2016/17

Rachel Gilbert, Todd Benson, and Olivier Ecker

“Changes of diet are more important than changes of dynasty or even of religion ... it is curious how seldom the all-importance of food is recognized. You see statues everywhere to politicians, poets, bishops, but none to cooks or bacon-curers or market gardeners.”

George Orwell, *The Road to Wigan Pier* (1937)

Revisions were made to this Working Paper to correct inconsistencies found in the original calculation of point estimates in Tables 7, 8, and 12 and in the computation of the statistical significance of differences between the point estimates for 2010/11 and 2016/17 in Tables 5 and 11. An error in the column labels for Table 4 was also corrected.

The data files for replication of the tables on household nutrient consumption presented in this Working Paper can be accessed using a link that can be found at [IFPRI MaSSP WP30](#).

CONTENTS

Abbreviations	v
Abstract	vi
1 Introduction	1
2 Data and methods	2
2.1 Data sources	2
2.2 Estimating the quantity of foods and nutrients consumed	3
2.2.1 Data.....	3
2.2.2 Nutrient estimates.....	4
2.3 Analytical measures	5
2.4 Additional adjustments in the analysis	9
3 Results	13
3.1 Dietary diversity and food access	13
3.2 Calorie and protein consumption	16
3.3 Micronutrient consumption.....	20
3.4 Food group contribution to nutrient consumption	23
3.5 Source of nutrients	28
3.6 Nutrient adequacy	29
4 Discussion	32
Appendix: Non-standard units in food item records	34
About the Authors	35
Acknowledgments	35
References	35

TABLES

Table 1. Sampling frames of the Malawi Integrated Household Survey rounds for 2010/11 and 2016/17	2
Table 2. Overview of the food and nutrient consumption indicators estimated	5
Table 3. Recommended individual daily calorie and micronutrient intakes, by age and sex	8
Table 4. Analytical household sample size, by wealth quintile and region	10
Table 5. Average household dietary diversity measures, by wealth quintile and region.....	14
Table 6. Average calorie and protein consumption, by wealth quintile and region.....	16
Table 7. Average share of food expenditure on food away from home, by wealth quintile and region	18
Table 8. Share of protein from animal-source foods, by region	20
Table 9. Average per capita consumption of iron and zinc, by wealth quintile and region	21
Table 10. Average per capita consumption of vitamin A and folate, by wealth quintile and region ..	22
Table 11. Average food group contribution to nutrient consumption, per person per day, by region in 2010/11 and 2016/17	25
Table 12. Average share of nutrients from a given source in 2016/17, by region, percent.....	29
Table 13. Prevalence of calorie and micronutrient inadequacies, percent of households by region	30
Table 14. Poverty headcount, by region, percent of individuals.....	31
Table 15. Prevalence of nutrient deficiency by sex and age, 2015/16 Malawi Micronutrient Survey, percent.....	31

FIGURES

Figure 1. Conceptual framework of the determinants of an individual's nutritional status	1
Figure 2. National average protein consumption per capita from major food groups, 2010/11 and 2016/17	19
Figure 3. Average food group contribution to national nutrient consumption in Malawi, 2016/17	24

BOXES

Text Box 1. The role of iron, zinc, vitamin A, and folate in human nutrition.....	4
Text Box 2. Comparison of analytical methods used here with those of Verduzco-Gallo, Ecker, and Pauw (2014).....	12

ABBREVIATIONS

BMI	Body Mass Index
FCS	Food Consumption Score
HDDS	Household Dietary Diversity Score
HFVS	Household Food Variety Score
IHS	Integrated Household Survey
NSO	National Statistical Office of the Government of Malawi
RNI	Recommended Nutrient Intake

ABSTRACT

This paper provides an updated analysis of the dietary patterns of Malawian households and their consumption of select nutrients – calories, protein, iron, vitamin A, zinc, and folate – using data from the third (2010/11) and fourth (2016/17) rounds of the Malawi Integrated Household Survey (IHS). Changes in food and nutrient consumption patterns between the two survey periods are examined across household wealth categories and across regions.

Dietary diversity and patterns of food and nutrient consumption are found to differ significantly between rural and urban areas. Whereas urban households largely saw slightly increased or stable nutrient consumption between 2010/11 and 2016/17, most households in rural areas saw declines over this period. We also document small shifts in the relative amounts of foods consumed over this six-year period in both rural and urban households, with increased consumption of fish and pulses, legumes, and nuts, and decreases in meat, fruit, dairy, and root and tuber consumption. The contribution of animal-source foods as a share of total protein consumption remains low at between 10 and 20 percent, depending on the region, with the overall share of protein from animal-source foods falling slightly between the two surveys.

With regards to adequacy of household diets for meeting nutrient requirements, in the absence of nutrient supplementation, many individuals will be subject to iron, vitamin A, and folate inadequacies. Of particular concern, the poorest households have very low nutrient consumption per person and have diets that rely on only a few foods from a small number of food groups.

For all six nutrients, nationally just over half of the total amount of nutrient consumed came from food that was purchased. While we would expect this for urban households, even for rural households more than half of all calories and protein consumed came from foods that were purchased. For micronutrients consumed by rural households, between 40 and 50 percent came from purchased foods. While in the past, own production of food may have provided most Malawian households with most of the nutrients they consumed, this is no longer the case. For most Malawian households, including in rural communities, their food security and dietary nutritional needs now are equally tied to the market as to their own farming, if not more so.

Drawing lessons from the analysis here for improving the food consumption data collected in the IHS surveys, more detailed and further disaggregated data would be beneficial, particularly to help estimate nutrients derived from fortified and processed foods. Additional information on how food is shared within households would also allow for a better understanding of nutrient inadequacies at the individual level. Collecting more information on the content of the meals that household members eat away from home would also be helpful in removing some uncertainty in the nutrient consumption estimates made from the data. Finally, additional information on food gifts received could clarify aspects of household coping strategies, the performance of formal social safety nets, and food choice.

Keywords: dietary change, nutrient intake, nutrient deficiency, human nutrition, Malawi

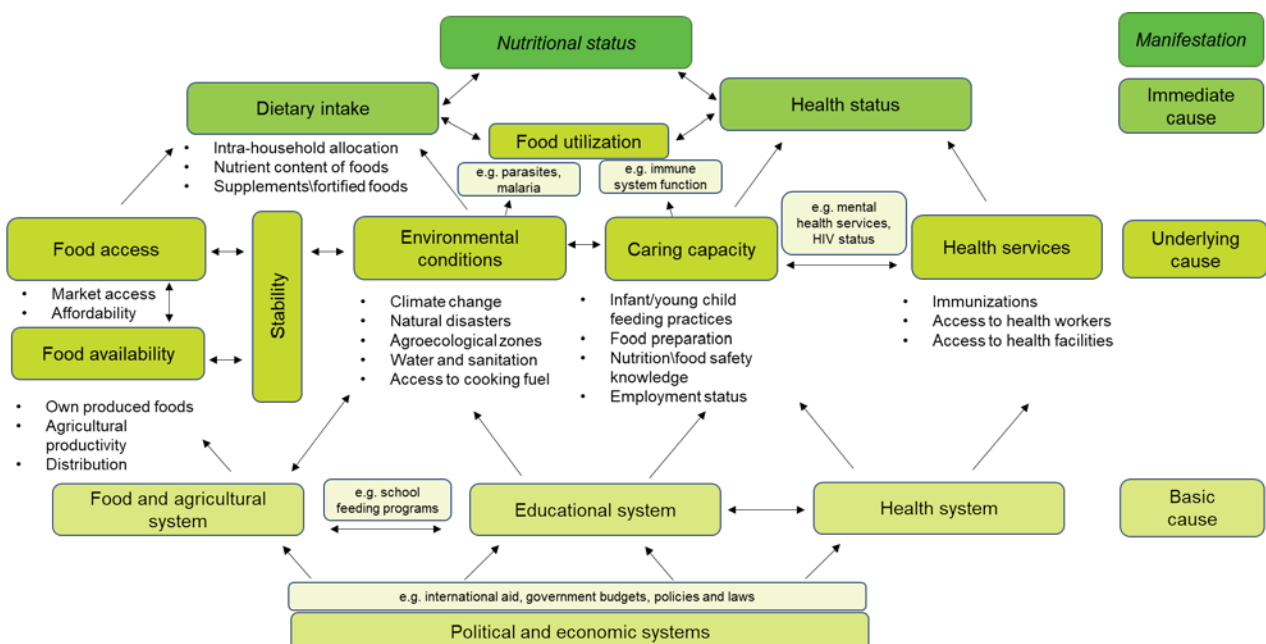
1 INTRODUCTION

To coordinate multi-sectoral efforts to address the wide-ranging nutrition challenges facing the country, in 2004 the Government of Malawi established the Department of Nutrition, HIV and AIDS. To guide these efforts for the years 2018 to 2022, the National Multi-Sector Nutrition Policy and a corresponding Strategic Plan were drafted (DNHA 2018). The Plan establishes priorities that range from tackling undernutrition to reducing obesity to making advances towards gender equality. With regard to nutrient deficiencies, it highlights the need to reduce iron-deficiency anemia and eliminate vitamin B12, folate, and zinc inadequacies. Enforcing mandated micronutrient fortification is part of the Strategic Plan – industrially-processed wheat flour and maize meal are required to be fortified with folic acid, iron, zinc, and vitamin A, while sugar and cooking oil must be fortified with vitamin A (Mejia, Kuo, and Beltran-Velazquez 2019). In addition, micronutrient supplementation programs, particularly for children aged 6 to 24 months, are to be intensified as part of the public health efforts of government.

Promoting food security, dietary diversity, and well-functioning food systems through agriculture is also a priority of Government. As most households rely on maize to meet most of their energy needs, increased maize production has been prioritized in programs like the flagship Farm Input Subsidy Program. However, attention is increasingly being paid to improving the consumption of a wider range of nutritious foods. The 2016 National Agriculture Policy calls for improving nutrition through production and consumption of such foods, including through aquaculture and livestock husbandry.

However, to systematically address nutrient deficiencies and improve the diversity of diets in Malawi, good information on the food consumption patterns of households and individuals is crucial. Conceptual frameworks on the determinants of an individual's nutritional status demonstrate that dietary intake of nutrients is an immediate determinant, alongside the health status of the individual (Figure 1). A good understanding of the changing contributions that the foods eaten by Malawians make to their nutritional status is needed for designing successful policies and programs to tackle nutritional problems among the country's citizens.

Figure 1. Conceptual framework of the determinants of an individual's nutritional status



Source: Adapted from Yang and Hanson (2009).

To contribute to meeting these information needs, this paper provides an updated analysis of the dietary patterns of Malawian households and their consumption of select nutrients – calories, protein, iron, vitamin A, zinc, and folate – using data from the third (2010/11) and fourth (2016/17) rounds of the Malawi Integrated Household Survey (IHS).¹ The analytical results reported here build on many of those from an earlier analysis by Verduzco-Gallo, Ecker, and Pauw (2014) of household-level food consumption and nutrient intake levels and trends from the second (2004/05) and the third IHS survey rounds.

As is apparent in Figure 1, nutritional status is a complex manifestation of many underlying issues that affect the health status or dietary intake of individuals. This analysis provides a descriptive analysis at the level of nutrient consumption in Malawian households, complemented by indicators of the diversity of their diets, food access, and nutrient adequacy. As access to nutrients for most individuals is mediated by the food consumption patterns of the household of which they are a member, this household-level analysis provides useful insights on the dietary intake patterns of individual Malawians. The results of our analysis are reported as national aggregates, by rural and urban areas, and within the rural areas by the three administrative regions of Malawi. In most tables for each population group, estimates are presented that have been further disaggregated by household wealth quintiles. The relative wealth status of the households is based on the estimated value of their consumption per capita.

The data sources and methodologies used in the analysis are described in the next section. Analytical results are presented in a series of tables and figures in Section 3. Section 4 concludes with a summary of the results and a discussion of their implications for future research and policy.

2 DATA AND METHODS

2.1 Data sources

This analysis of dietary patterns and nutrient consumption in Malawi draws from the third (IHS3) and fourth (IHS4) rounds of the Malawi IHS, which were conducted by the National Statistical Office (NSO) of the Government of Malawi. Details on the design of the sample for the two survey rounds are presented in Table 1. The IHS survey is designed to be representative of the population at national, district, and urban/rural levels. However, for consistency in the results presented here and reflecting that the IHS data was principally collected at household level, only household level sampling weights, rather than individual level sampling weights, are used to derive the estimates.

Table 1. Sampling frames of the Malawi Integrated Household Survey rounds for 2010/11 and 2016/17

	IHS3	IHS4
Sample households, number	12,271	12,447
Enumeration areas, number	768	779
Strata, number	31	32
Fieldwork period	March 2010 to March 2011	April 2016 to April 2017
Sampling frame	2008 Census	2008 Census

Source: National Statistical Office. **Note:** The strata are made up of the 28 districts of Malawi, plus separate strata for the four major urban centers of the country. The changes in the number of strata across the two survey rounds reflects the inclusion of Likoma district in the IHS4 sample design. For the IHS3, the population of this island district in Lake Malawi was not included in the sample.

¹ Energy, as measured in calories, is not a nutrient, but comes from several different components of the diet. However, like nutrients, energy is required by the body, including for metabolic processes, physiological functions, muscular activity, and for the formation and growth of new tissue. To simplify discussion in this paper, however, in most cases we include calories in our use of the term “nutrient”.

The IHS3 and IHS4 surveys both used a similar household questionnaire to collect information from sample households on a broad range of topics, including on all food consumed by household members over the seven days prior to the interview.

2.2 Estimating the quantity of foods and nutrients consumed

2.2.1 Data

The principal data on food consumption obtained in the IHS rounds is collected in a module in the household questionnaire in which about 150 food items commonly eaten in Malawi are listed. The respondent for the household is asked whether any member of the household consumed any of each of these foods over the previous seven days. If a food item was reported as having been consumed, questions are then asked on the total quantity consumed as well as the quantity from each of three sources – purchased, produced by the household, or received as gifts. For purchased foods, the cost of the food is also collected. The survey enumerator also has the option to specify “other” foods that the household reported consuming, but which are not listed in the questionnaire module.

Most of the food consumed was eaten within the household home. However, the food consumption module lists nine specific types of “cooked foods from vendors” commonly eaten outside the home. These foods are included in all analyses here. However, our nutrient analysis does not consider the nutrient content of any “meals eaten at restaurants”, which is another type of food asked about. No specific information was collected in the module on what exact foods were eaten in any restaurant meals reported consumed to permit estimates to be made of the amount of nutrients consumed.

Each entry on the quantity of a food reported consumed required specifying a measurement unit. These units were pre-coded and included both standard (metric) and common non-standard units (e.g., pail, tin, bunch, heap).

As with “other” food items, enumerators could also record “other” units that were not pre-coded but were reported by the respondent. NSO, with the assistance of the World Bank, conducted a survey in 48 retail markets across Malawi to determine the standard weight per non-standard unit of food items commonly sold in such units (NSO and World Bank 2013). Weight conversion factors for each of Malawi’s three administrative regions (Northern, Central, and Southern) were derived for many of the non-standard units in which the quantities of these foods were reported in the IHS. These conversion factors were used in the analyses here, as far as possible.

To quantify food consumption, all food quantities were converted into kilogram units. However, food items that were reported in non-standard units for which there were no corresponding conversion factors are not included in any estimations which require information on the food quantities consumed. This includes estimates of nutrient consumption (see Appendix).

As noted, households were asked about both the total quantity consumed and the quantity consumed from each food source (i.e., purchased, own-produced, or received as a gift). In cases where the total quantity initially reported did not equal the sum of the quantities from each source sub-group, source sub-group quantities were adjusted by creating an additional “miscellaneous” sub-group.² Food quantities reported were also cleaned to remove extreme outliers.

² Under the assumption that the total quantity reported is the most accurate, we adjust food consumption by source such that if the sum of the three “source” sub-categories (own-produced, purchased, received as a gift) do not add up to the total, a quantity equal to the difference is added in a fourth sub-category (“miscellaneous”). See Table 12.

2.2.2 Nutrient estimates

We focus on calories, protein, iron, zinc, vitamin A, and folate. (On the role of iron, zinc, vitamin A, and folate in human nutrition, see Text Box 1.) The nutrient content of the foods is obtained from food composition tables compiled by the Food and Agriculture Organization of the United Nations (FAO 2019). Known as the International Mini List, these tables provide nutrient values for foods commonly consumed in developing countries. For those foods that were reported consumed by IHS sample households that are not found in the International Mini List or in food composition tables for neighboring Tanzania (Lukmanji et al. 2008), the nearest nutritionally-similar product was taken from the United States Department of Agriculture nutrient database (USDA ARS 2018).

Text Box 1. The role of iron, zinc, vitamin A, and folate in human nutrition

While the importance of calories and protein for good nutrition and health are broadly recognized, less well known is why the micronutrients examined in this analysis – iron, zinc, vitamin A, and folate – are also important.

- ▶ Iron plays a crucial role in DNA synthesis and oxygen transport. Consequently, iron deficiency during pregnancy can increase the risk of maternal mortality and low birthweight babies. Iron-deficiency anemia, even in its mildest form, can impair cognitive development and compromise the immune system (Abbaspour, Hurrell, and Kelishadi 2014); NIH ODS 2019a). Pregnant and postpartum women and young children are particularly vulnerable to iron deficiencies, because of its important role in physical growth.
- ▶ Zinc supports immune functions, protein and DNA synthesis, and normal growth and development during pregnancy, childhood, and adolescence. Zinc deficiency can also cause diarrhea, a leading cause of child mortality. Daily intake of zinc is important because the body has no specialized system for storing it. Where much of the diet is comprised of cereals and legumes, like in Malawi, phytates in those foods make absorption of zinc difficult (NIH ODS 2019b).
- ▶ Vitamin A plays a role in immune system functioning, reproduction, organ formation, and vision. Deficiencies of vitamin A in pregnancy can increase risk of night blindness, low birthweight babies, and infant mortality. Post-partum, infants and young children whose mothers are vitamin A deficient are at risk due to insufficient stores in breastmilk (NIH ODS 2019c).
- ▶ Folate is a B vitamin crucial for DNA formation, proper cell functioning, and normal fetal development (WHO and FAO 2004). Low maternal folate can lead to stillbirth, pre-eclampsia, low birthweight babies, preterm delivery, and neural tube defects. Particularly for women of child-bearing age, recommended levels of folate consumption can be difficult to attain through diet alone (NIH ODS 2019b).

All four are micronutrients for which the number of Malawians with deficient consumption is of public health concern, All are targeted by government policy and interventions (NSO et al. 2017; NSO and ICF 2017). This analysis contributes to an overall understanding of micronutrient deficiencies in Malawi by establishing the level of micronutrient availability from the diet. However, the potential effects on nutrition of fortification of processed foods with these micronutrients cannot be captured here as the IHS does not collect enough information on the foods reported consumed by households to determine whether they were fortified.

For 53 of the foods in the food consumption module list, edible portion adjustments were needed to account for components of foods which contribute to the weight of the harvested or purchased food but which are not consumed by humans (e.g. cereal bran, nut shells, banana peels, fruit pits (stones), etc.). Nutrient retention factors also are applied for foods which are not consumed raw to account for nutrient losses which result from food preparation (USDA ARS 2007).

2.3 Analytical measures

We analyze changes in diets and in food and nutrient consumption in Malawi over time along four dimensions with several indicators for each (Table 2). Here we discuss some of these indicators in more detail.

Table 2. Overview of the food and nutrient consumption indicators estimated

Dimension	Indicator	Unit of measurement
Dietary diversity	Household dietary diversity score (HDDS) *	food groups / household / week
	Household food variety score (HFVS) *	food items / household / week
	Food consumption score (FCS)	weighted food groups / household / week
Dietary patterns	Protein consumption per food group	g / group / day
	Share of protein from animal-source foods	% of protein per capita per day
	Calorie consumption per food group	kcal / group / day
	Share of expenditure on food away from home	% household food expenditure
Nutrient consumption	Calorie consumption per capita	kcal / capita / day
	Protein consumption per capita	g / capita / day
	Iron consumption per capita	mg / capita / day
	Zinc consumption per capita	mg / capita / day
	Vitamin A consumption per capita	RAE mcg / capita / day
	Folate consumption per capita	DFE mcg / capita / day
Nutrient adequacy	Calorie adequacy	% of population
	Iron adequacy	% of population
	Zinc adequacy	% of population
	Vitamin A adequacy	% of population
	Folate adequacy	% of population

Source: Adapted from Verduzco-Gallo, Ecker, and Pauw (2014).

Note: g = grams; mg = milligrams, mcg = micrograms, kcal = kilocalories, RAE = retinol activity equivalent, DFE = dietary folate equivalent.

* HDDS and HFVS scores are adapted from their original formulations due to the constraints of the Integrated Household Survey food consumption module. Our adapted scores are based on the detailed module on food consumption by household members over the past seven days, rather than a 24-hour food frequency questionnaire.

Dietary diversity indicators are simplified food consumption measures which are based on counts of food groups or food items consumed, rather than specific quantities consumed. They are used both as a measure of diversity in diets and as a proxy for access to sufficient energy (Leroy et al. 2015). Dietary diversity has a demonstrated ability to predict dietary quality and to measure food and nutrition security in developing countries. Validation studies show that dietary diversity indicators are consistently and strongly associated with household calorie consumption (Ruel 2003) and the nutrient adequacy of children's and women's diets (Steyn et al. 2006). Other studies demon-

strate positive associations between dietary diversity indicators and children and women's nutritional status measured by anthropometry (Ruel et al. 2013). Finally, such indicators demonstrate responsiveness to economic shocks and are less prone to measurement error than quantity specific measures (Headey and Ecker 2013; Ruel 2003).

The IHS food consumption module allows for the construction of a modified household dietary diversity score (HDDS) based on the validated measure developed by the Food and Nutrition Technical Assistance project (Swindale and Bilinsky 2006). While the original HDDS is based on using the previous 24-hours as a reference period for household food consumption, here we use the IHS data, which is based on a recall period of the previous seven days. Our modified HDDS counts the number of different food groups consumed by any household members in the seven days prior to the survey interview date, using the full food consumption module as opposed to a more simplified food group frequency questionnaire.³ Our HDDS indicator uses the same 12 groups originally proposed by Swindale and Bilinsky (2006): cereals; roots and tubers (including plantains); pulses/legumes and nuts; vegetables; fruits; meat (including offal) and poultry; fish and seafood; eggs; milk and dairy products (including infant formula); oil and fats (including butter and margarine); sugar, honey, and sweets; and miscellaneous (including condiments).

The Household Food Variety Score (HFVS) counts the number of food items, rather than food groups (as used for the HDDS), that one or more household member consumed in the past seven days (Hatloy, Torheim, and Oshaug 1998). In computing a HFVS from the IHS data, we use a condensed version of the full list of foods in the IHS food consumption module, namely 118 food items.⁴ The HFVS measure has been validated in some contexts to be predictive of nutrient adequacy (Ruel 2003). The score is best used in one context, rather than across countries, and any comparisons should be made using data from surveys with a similar level of disaggregation of food items. This makes the tool useful in Malawi using the IHS3 and IHS4, as the surveys employed comparable food lists.

The Food Consumption Score (FCS) indicator is quite similar in concept to the HDDS, but is based on eight food groups, rather than 12, and, more importantly, adds a nutritional quality weight to each food group. Developed by the World Food Programme, the FCS brings together in a single measure both quality and quantity dimensions of household diets (WFP 2008). The eight food groups used and their weights are: staples (includes cereals, roots, tubers, and plantains; weight = 2); pulses (3); vegetables (1); fruits (1); meat and fish (4); milk products (4); sugar (0.5); and oils and fats (0.5). The score is simply the sum for the eight food groups of the number of days over the past seven that foods from that group were consumed, times the weight for the food group. The FCS ranges from 0 to 112. The FCS can then be used to categorize households as having "poor", "borderline", or "acceptable" food consumption based on specific FCS thresholds for each category.⁵ The FCS has been validated as a proxy for caloric sufficiency, but has not been validated for adequacy of other nutrients (INDDEX Project 2018; Leroy et al. 2015).

³ While the IHS questionnaire does include a food group consumption frequency module, it disaggregates consumption into only ten food groups. As such, we categorize individual food items from the full food consumption module into the 12 food groups used to compute the HDDS.

⁴ Note that similar foods that were disaggregated in the food consumption module of the IHS are aggregated into a single food item for this measure – for example, various forms of maize, such as maize flour, green maize, and roasted maize, are counted only as a single food item (maize).

⁵ The standard FCS-based food consumption category thresholds developed by WFP are ≤ 21 FCS for poor, 21.5 to 35 for borderline, and > 35 for acceptable consumption. However, WFP notes that the "thresholds need to be tested and possibly modified based on the context and dietary patterns of the population in question" (WFP 2008, p. 9). Malawi-specific thresholds have been developed by Lovon and Mathiassen (2014). In urban areas these thresholds are ≤ 52 FCS for poor, 52 to 56 for borderline, and > 56 for acceptable consumption. In rural areas, the thresholds are ≤ 41 FCS for poor, 41 to 44 for borderline, and > 44 for acceptable consumption. However, these thresholds were developed primarily to correlate FCS scores to calorie consumption adequacy at household level. Given the broader dietary quality objectives of our analysis here, we do not categorize households based on these FCS threshold values, but only report average scores by population group.

For constructing the FCS for each IHS household, we use data from the food group consumption frequency module, which is different from the full dietary recall module used for the HDDS and HFVS. This module asks about the number of days over the previous seven days for which foods from each of ten food groups was consumed by one or more household members.⁶

One of the **dietary pattern** measures examined is the share of household food expenditure spent on food away from home. The denominator for this indicator is derived from the total household consumption and expenditure measure calculated by the NSO as part of the poverty and wealth analyses of the IHS data (NSO and World Bank 2018a). This is an estimate of the per capita value of all food and non-food expenditures a household made throughout the year as well as the value of housing and assets (NSO 2019; 2017). Food expenditures within this overall household wealth indicator include the reported values of purchased foods and the estimated value of all food consumed in the household that came from the household's own production or as a gift.

A variety of specific foods commonly sold by vendors, i.e., roasted maize or meat, potato or cassava chips, boiled eggs, and meals eaten at restaurants, are included in the food aggregate. We present the share of total food expenditure that the household spent on these foods away from home to show changes in such consumption over time. As the composition of mixed meals eaten at restaurants is not asked about in the food consumption module, if increasing amounts of food consumed by household members is eaten away from home, the nutrient estimates of all foods consumed by households will be prone to greater underestimation.

In looking at dietary patterns, we also examine calorie and nutrient consumption by food groups, with a closer look at protein and the share of protein from animal-source foods. Animal-source foods contain higher quality protein than plant-based food sources as they contain all the essential diet-sourced amino acids required by the body to synthesize proteins. Moreover, these foods contain significantly higher levels of micronutrients than do plant-based foods, and these nutrients are in forms that generally are more bioavailable, so are more readily absorbed by the body. Increased levels of consumption of animal-source foods by children in Malawi has been shown to be associated with improved linear growth (Elmadfa and Meyer 2017; Kaimila et al. 2019).

⁶ While it has been suggested that foods for which only small quantities were consumed (<15 grams) be excluded from these calculations (Leroy et al. 2015; Lovon and Mathiassen 2014), information on the specific quantities of food consumed in each of the ten food groups was not included in the IHS food group consumption frequency module.

Because the "staples" food group for the FCS is comprised of two food groups in the IHS food group consumption frequency module ("cereals and grains" and "roots, tubers and plantains"), we simply sum the number of days for both food groups and replace all values greater than 7 days with a maximum of 7. While this may inaccurately estimate the frequency of food group consumption in some cases, this is unlikely to have a considerable effect on the indicator as 94 and 90 percent of households reported consuming "cereals and grains" all seven days in 2010/11 and 2016/17, respectively.

Although the IHS food group consumption frequency module collected information on consumption of spices and condiments, these data are not used in computing the FCS.

Table 3. Recommended individual daily calorie and micronutrient intakes, by age and sex

	Age/sex	Calories (kcal)	Iron (mg)	Zinc (mg)	Vitamin A (µg RAE)	Folate (µg DFE)
Infants	0–6 months	580–750	0.0*	6.6	180	100
	7–12 months	700–860	9.3	8.4	190	90
Children	1–3 years	860–1250	5.8	8.3	200	150
	4–6 years	1240–1570	6.3	9.6	200	200
	7–9 years	1550–1980	8.9	11.2	250	300
Adolescent females	10–14 years	2000–2450	8.9–14.0	14.4	330	400
	14–18 years	2300–2500	29.4–31.0	14.4	330	400
Adolescent males	10–18 years	2150–3410	8.9–18.8	17.1	330	400
Adult females	19–49 years	2300–2330	29.4	9.8	270	400
	50–65 years	2070–2330	11.3	9.8	270	400
Adult males	19–65 years	2370–2920	13.7	14.0	300	400
Elderly females	65+ years	2070	11.3	9.8	300	400
Elderly males	65+ years	2370	13.7	14.0	300	400
Lactating females, additional requirement		500	15.0	7.7 to 10.1, depending on infant's age	180	100

Source: Adapted from WHO and FAO 2004; FAO, WHO, and UNU 2001.

Note: RAE = retinol activity equivalent, DFE = dietary folate equivalent.

Nutrient requirements for pregnant women differ from those reported for pre-menopause (age 19 to 49 years) adult women. However, the IHS questionnaires do not collect data that would enable an assessment to be made of the pregnancy status of women of childbearing age in the survey households.

In computing nutrient requirements for the household for the analysis here, adjustments for lactating females were applied if there was a child in the household aged under 12 months.

Iron and zinc requirements assume low bioavailability of these nutrients in typical Malawian diets.

* Neonatal iron stores are sufficient to meet iron requirements for the first 6 months in full-term infants (WHO and FAO 2004).

Estimates of dietary **nutrient adequacy** used for the analysis are listed in Table 3.⁷ Calorie requirements differ for persons of the same age and sex according to their activity level. To compute calorie requirements and adequacy, we use recommended mean energy intakes (RMEI) needed to maintain a normal lifestyle with moderate physical activity level (FAO, WHO, and UNU 2001). Median body mass is calculated using sex-disaggregated data from the 2015/16 Malawi Demographic and Health Survey (NSO and ICF 2017).

Dietary adequacy levels for iron, zinc, vitamin A, and folate are calculated based on recommended nutrient intakes (RNIs). The RNI is the daily intake which meets the nutrient needs of 97.5 percent of apparently healthy individuals in each age- and sex-specific population group (WHO and FAO 2004). For all nutrients, requirements for females of childbearing age differ depending on whether an individual is pregnant or lactating. While we do not have information on pregnancy status, we assume that all households with children under 6 months have a lactating mother and allocate additional nutrients for these women as needed. RNIs also differ depending on the bioavailability of a given nutrient in the diet. For iron and zinc requirements, we assume low bioavailability in the diet due to the high phytate levels in the cereal and legume-heavy foods consumed in most households – phytate binds iron and zinc, inhibiting absorption of those nutrients in digestion.

⁷ Estimates of nutrient adequacy for protein were not computed. Recommended nutrient intakes for protein typically are based on body mass, rather than age and sex (WHO, FAO, and UNU 2007). The Malawi IHS collects body mass information only on children under five years of age.

We estimate the prevalence at household level of dietary inadequacy in nutrient consumption by comparing aggregated recommended nutrient intake for all household members relative to the total nutrient consumption by the household. Given that food consumption is reported at household level, and not at individual level, an important necessary assumption in our analysis is that the food reported consumed within the household was distributed according to the specific nutrient intake requirements of the individual household members. This is necessary because IHS does not collect information on the intra-household allocation of the food the household reported consuming.

2.4 Additional adjustments in the analysis

To adjust for household size, our estimates of nutrient consumption are presented on a per capita basis based on the number of household members, defined as those who normally eat their meals together in the household. We use per capita estimates, rather than adult-equivalent estimates, for comparability with previous work (Verduzco-Gallo, Ecker, and Pauw 2014) and because there is considerable disagreement about the best way to account for household composition using adult equivalence scales (Deaton and Zaidi 2002; Coates et al. 2017).

To generate population representative estimates at national, rural-urban, and rural regional levels, we use household sampling weights provided by the NSO.

All estimates are also reported by wealth quintiles, which are derived by ranking survey households by their real per capita household expenditures. We use the consumption and expenditure aggregates for the survey households as published by the NSO to do so. Real expenditures are used to rank households. These were computed by adjusting for intra-survey spatial and temporal price differences the expenditure values that were reported in nominal terms by the survey households. For wealth quintile estimates for the full sample, national-level quintiles are used, whereas for quintile estimates at the rural-urban levels and for rural regions, each household is assigned to a quintile based only on the particular population subgroup. The wealth quintile approach allows us to assess associations between nutrient consumption or nutrient inadequacy prevalence and the relative wealth of households across the country (Table 4).⁸

⁸ Equal numbers of sample households are not found in each quintile in Table 4 due to household weights being used in determining the wealth quintile category of each sample household.

Table 4. Analytical household sample size, by wealth quintile and region

	2010/11 (IHS3)					2016/17 (IHS4)				
	Full sample	Low calorie outliers	High calorie outliers	Analytical sample count	Analytical sample Share full sample, %	Full sample	Low calorie outliers	High calorie outliers	Analytical sample count	Analytical sample Share full sample, %
National	12,270	37	102	12,131	98.9	12,447	35	28	12,384	99.5
Poorest quintile	2,457	30	2	2,425	98.7	2,501	31	0	2,470	98.8
2nd	2,552	5	4	2,543	99.6	2,476	4	0	2,472	99.8
3rd	2,551	1	8	2,542	99.6	2,482	0	1	2,481	100.0
4th	2,438	1	17	2,420	99.3	2,443	0	2	2,441	99.9
Wealthiest quintile	2,272	0	71	2,201	96.9	2,545	0	25	2,520	99.0
Rural	10,037	36	55	9,946	99.1	10,175	34	19	10,122	99.5
Poorest quintile	1,951	26	2	1,923	98.6	2,040	30	0	2,010	98.5
2nd	2,065	8	0	2,057	99.6	2,028	4	0	2,024	99.8
3rd	2,039	1	2	2,036	99.9	2,029	0	1	2,028	100.0
4th	2,008	1	7	2,000	99.6	2,038	0	0	2,038	100.0
Wealthiest quintile	1,974	0	44	1,930	97.8	2,040	0	18	2,022	99.1
Urban	2,233	1	47	2,185	97.9	2,272	1	9	2,262	99.6
Poorest quintile	472	1	7	464	98.3	422	1	0	421	99.8
2nd	540	0	2	538	99.6	404	0	0	404	100.0
3rd	406	0	9	397	97.8	432	0	2	430	99.5
4th	380	0	13	367	96.6	490	0	3	487	99.4
Wealthiest quintile	435	0	16	419	96.3	524	0	4	520	99.2

	2010/11 (IHS3)					2016/17 (IHS4)				
	Full sample	Low calorie outliers	High calorie outliers	Analytical sample		Full sample	Low calorie outliers	High calorie outliers	Analytical sample	
				count	Share full sample, %				count	Share full sample, %
Northern rural	1,758	1	7	1,750	99.5	1,899	2	3	1,894	99.7
Poorest quintile	352	1	0	351	99.7	356	2	0	354	99.4
2nd	347	0	0	347	100.0	376	0	0	376	100.0
3rd	335	0	0	335	100.0	373	0	0	373	100.0
4th	359	0	0	359	100.0	397	0	0	397	100.0
Wealthiest quintile	365	0	7	358	98.1	397	0	3	394	99.2
Central rural	3,484	16	27	3,441	98.8	3,484	17	9	3,458	99.3
Poorest quintile	626	11	1	614	98.1	735	14	0	721	98.1
2nd	693	4	0	689	99.4	686	3	0	683	99.6
3rd	735	1	4	730	99.3	683	0	1	682	99.9
4th	709	0	6	703	99.2	685	0	1	684	99.9
Wealthiest quintile	721	0	16	705	97.8	695	0	7	688	99.0
Southern rural	4,795	19	21	4,755	99.2	4,792	15	7	4,770	99.5
Poorest quintile	966	16	1	949	98.2	924	12	0	912	98.7
2nd	1,003	2	0	1,001	99.8	943	2	0	941	99.8
3rd	971	0	0	971	100.0	973	1	0	972	99.9
4th	947	1	1	945	99.8	961	0	0	961	100.0
Wealthiest quintile	908	0	19	889	97.9	991	0	7	984	99.3

Source: Authors' calculations based on a weighted analysis of the survey datasets.

Note: Survey households were dropped from the analysis if their levels of calorie consumption were greater than 8,000 (high calorie outlier) or below 200 (low) calories per person per day. These levels of calorie consumption were considered implausible. For the IHS3 in 2010/11, 12,271 households were surveyed. However, no food consumption information was collected for one household. Consequently, this household was not included at any stage in the analysis here.

We did an additional level of data cleaning given our focus on nutrient consumption by excluding from our analysis survey households that reported implausibly high or low per capita calorie consumption. The threshold for excluding households from the analysis with extremely high calorie consumption was set at 8,000 kilocalories per person per day while the threshold for extremely low consumption was set at 200 kilocalories (Table 4). Household survey weights were adjusted after households were dropped to ensure the continued representativeness of the estimates.

To determine whether changes in various indicators are practically and statistically significant over the period between surveys (2010/11 and 2016/17), we use both descriptive and statistical measures. The changes between 2016/17 and 2010/11 for each indicator are presented as percent changes (% Δ) between the average (mean) value of the indicator in 2010/11 and 2016/17. In some instances, percentage point changes (% pt. Δ) are used. We also present the results of Wald tests on the significance of these differences in means for nutrient consumption and inadequacy prevalence between the two survey years for each category of households.

This paper builds on the work of Verduzco-Gallo, Ecker, and Pauw (2014). However, it differs methodologically in several ways. These differences are described in Text Box 2. Such differences in the details of the analytical methods used will be important to bear in mind if examining in detail any trends in dietary nutrient intake across the IHS2 and IHS3 analyses in the 2014 paper and the IHS3 and IHS4 analyses here.

Text Box 2. Comparison of analytical methods used here with those of Verduzco-Gallo, Ecker, and Pauw (2014)

Conversion factors. The 2014 report relied on a different set of national-level non-standard unit conversion factors. This report uses the NSO's updated regional-level non-standard unit conversion factors.

Calculation of household size. Verduzco-Gallo, Ecker, and Pauw (2014) excluded servants and lodgers from household membership. The analysis here uses a simple count of all those listed in the household roster, based on the definition of a "household" as described in the IHS questionnaire.

Survey weights. Both analyses use survey household sample weights supplied by the NSO for all estimations, given that the survey was designed to be nationally-representative. However, given the differences in quantity conversion factors and in the definition of household used, households dropped based on high or low calorie per person per day values may have been different in the two surveys, meaning slight differences in the survey weight adjustments could also have occurred in the respective analyses of the IHS3 dataset.

Miscellaneous "source" sub-group. In cases where the total quantity of a food item reported consumed did not match the sum of the sub-group categories (own-produced, purchased, or gifted food items), a miscellaneous category was created under the assumption that the first quantity reported is the most accurate. Verduzco-Gallo, Ecker, and Pauw (2014) do not adjust the food quantities by source in this way.

Calorie requirements. While the 2014 report uses lower bound estimates of calorie requirements based on a light physical activity level and a low Body Mass Index (BMI), the analysis here uses requirements based on moderate physical activity levels and a median BMI.

3 RESULTS

3.1 Dietary diversity and food access

Based on the HDDS, as a general pattern and as expected, dietary diversity increases as households become wealthier, and urban households have more diverse diets than rural households in the same wealth category (Table 5). Urban households consume food from an average of 9 to 10 food groups per week compared with 7 to 8 food groups for rural households. Dietary diversity overall declined somewhat between 2010/11 and 2016/17 – the change is significant at the 10 per cent statistical significance level. A more significant decline ($p < 0.01$) in the average HDDS for rural households is seen between the two surveys. This was across all rural wealth quintiles, except the poorest. However, urban households showed a smaller ($p < 0.10$) change in dietary diversity. The overall decline in the national average HDDS between 2010/11 and 2016/17 is primarily due to reduced dietary diversity in rural households in the middle wealth quintiles, particularly in central and southern Malawi.

Turning to the HFVS, urban households in 2016/17 consumed an average of 21 types of food weekly compared to 13 foods for rural households. But we note large differences in average HFVS between households in the poorest and wealthiest wealth quintiles – on a national basis, the wealthiest households consumed on a weekly basis 50 percent more types of foods than did the poorest households. The change in the national average HFVS between 2010/11 and 2016/17 was statistically significant ($p < 0.05$). Among rural households, those in the third and fourth wealth quintiles showed the strongest relative decline in HFVS over the inter-survey period. In contrast, the poorest rural households consumed on average a slightly greater number of food items weekly in 2016/17 than in 2010/11.

Somewhat different patterns are seen across population groups and time in the FCS compared to the HDDS and HFVS (Table 5). As the FCS considers nutritional quality, we see a significant decline in the FCS for all rural wealth quintiles between the two surveys. In contrast, no significant change is seen in the average FCS of urban households. It is specifically among rural households in the Central and Southern regions that average FCS scores fell significantly between 2010/11 and 2016/17, regardless of wealth quintile. Certainly contributing to this change is that these regions are where the 2016/17 food insecurity crisis was most severe.

Table 5. Average household dietary diversity measures, by wealth quintile and region

	Household Dietary Diversity Score (food groups/week)				Household Food Variety Score (food items/week)				Food Consumption Score (weighted food groups/week)			
	2010/11	2016/17	%Δ		2010/11	2016/17	%Δ		2010/11	2016/17	%Δ	
Total	7.9	7.8	-1.7	*	13.8	14.2	3.0	**	47	44	-6.4	***
Poorest quintile	5.7	5.6	-2.3		8.4	8.8	5.0	***	35	32	-9.3	***
2nd	7.1	6.8	-4.7	***	11.3	11.2	-1.4		40	37	-8.3	***
3rd	8.2	7.6	-6.7	***	14.1	13.3	-5.4	***	47	41	-12.9	***
4th	8.8	8.7	-2.1	**	16.1	16.2	0.5		51	48	-7.1	***
Wealthiest quintile	10.0	10.1	1.9	**	20.3	21.7	7.0	***	63	62	-2.1	
Rural	7.6	7.3	-4.1	***	12.9	12.6	-2.1		44	40	-10.1	***
Poorest quintile	5.5	5.4	-2.0		8.0	8.4	5.5	***	34	31	-9.6	***
2nd	6.8	6.5	-3.3	***	10.5	10.7	1.3		39	36	-8.3	***
3rd	7.7	7.2	-7.4	***	12.8	12.1	-5.7	***	44	38	-12.1	***
4th	8.4	7.9	-5.9	***	14.9	14.0	-5.9	***	49	42	-13.6	***
Wealthiest quintile	9.3	9.2	-1.7	*	18.2	17.8	-2.0		56	52	-7.2	***
Urban	9.7	9.9	2.5	*	19.0	21.2	11.7	***	59	60	1.2	
Poorest quintile	8.0	7.9	-1.9		13.8	14.2	2.8		42	42	-0.3	
2nd	9.4	9.5	0.9		17.5	19.1	8.7	***	53	53	-1.4	
3rd	9.9	10.3	3.6	***	19.4	21.7	11.9	***	59	61	3.4	
4th	10.3	10.7	4.2	***	20.9	23.9	14.4	***	67	67	0.4	
Wealthiest	10.9	11.1	1.5		24.3	27.1	11.3	***	79	77	-2.1	

	Household Dietary Diversity Score (food groups/week)				Household Food Variety Score (food items/week)				Food Consumption Score (weighted food groups/week)		
	2010/11	2016/17	%Δ		2010/11	2016/17	%Δ		2010/11	2016/17	%Δ
Northern rural	7.9	7.6	-4.0	**	12.8	12.4	-3.0		44	44	-0.6
Poorest quintile	6.2	5.6	-9.9	***	8.9	8.3	-6.6	**	34	34	0.8
2nd	7.3	6.8	-7.0	**	10.9	10.4	-5.1	*	39	39	-1.1
3rd	8.0	7.6	-5.6	**	12.7	12.2	-4.0		43	43	2.0
4th	8.7	8.4	-4.2	*	14.8	14.0	-5.4	*	50	47	-6.4
Wealthiest quintile	9.3	9.6	3.5		16.7	17.2	2.7		55	56	1.9
Central rural	7.6	7.4	-3.6	**	13.3	12.8	-3.5		44	39	-11.0
Poorest quintile	5.3	5.5	3.7		7.7	8.7	12.7	***	32	29	-9.0
2nd	6.8	6.5	-3.5	*	10.8	10.7	-0.6		38	34	-9.7
3rd	7.8	7.2	-7.5	***	13.1	12.3	-6.1	***	44	37	-15.4
4th	8.6	8.1	-5.6	***	15.5	14.3	-7.9	***	49	43	-13.3
Wealthiest quintile	9.6	9.4	-2.9	**	19.3	18.0	-6.6	***	57	52	-7.7
Southern rural	7.4	7.1	-4.3	***	12.6	12.4	-0.9		45	40	-10.9
Poorest quintile	5.5	5.3	-4.0	*	8.0	8.2	2.5		36	31	-11.8
2nd	6.6	6.5	-2.2		10.2	10.6	4.0	*	40	36	-9.2
3rd	7.6	7.1	-6.4	***	12.6	12.1	-4.5	**	44	39	-10.6
4th	8.2	7.7	-6.3	***	14.6	13.8	-5.1	**	49	42	-13.9
Wealthiest quintile	9.1	8.9	-2.3	*	17.4	17.5	0.8		56	51	-9.4

Source: Authors' calculations. Household sampling weights are used.

Note: %Δ = percent change. Household Dietary Diversity Score is based on consumption of foods from 12 food groups over the past week. Household Food Variety Score is based on consumption of a condensed number of food items (N=125) from the full list of foods asked about (N=149) in the food consumption module in the two surveys. Food Consumption Score (FCS) is based on consumption of foods from eight food groups over the past week, with weights applied to each food group based on nutrient quality considerations. FCS scores can range from 0 to 112. The statistical significance of the results of Wald tests on differences between the two survey years are presented as asterisks: * = p < 0.10, ** = p < 0.05, *** = p < 0.01.

3.2 Calorie and protein consumption

Per capita calorie and protein consumption decreased between 2010/11 and 2016/17 among rural households across all wealth quintiles, while little change is seen among urban households overall (Table 6). The poorest households in the rural north saw the largest relative declines, with average declines in both calorie and protein consumption of approximately 12 percent. The poorest 40 percent of rural households have similar caloric consumption regardless of region – these households consumed between 1,100 and 1,700 calories per person per day. Protein consumption declined for rural households, although not as sharply as for calories. There were no statistically significant changes in protein consumption among urban households. Reported calorie and protein consumption for the wealthiest quintile of households is more than double that of households in the poorest quintile in all regions.

Table 6. Average calorie and protein consumption, by wealth quintile and region

	Calories (kcal/person/day)			Protein (g/person/day)		
	2010/11	2016/17	%Δ	2010/11	2016/17	%Δ
Total	2,342	2,162	-7.7 ***	57.9	55.3	-4.5 ***
Poorest quintile	1,378	1,217	-11.6 ***	33.6	29.5	-12.1 ***
2nd	1,869	1,717	-8.2 ***	45.3	41.9	-7.3 ***
3rd	2,272	2,106	-7.3 ***	54.9	52.7	-4.1 ***
4th	2,760	2,476	-10.3 ***	68.5	63.5	-7.3 ***
Wealthiest quintile	3,642	3,294	-9.6 ***	92.7	88.8	-4.2 **
Rural	2,274	2,054	-9.7 ***	56.0	51.9	-7.3 ***
Poorest quintile	1,322	1,164	-12.0 ***	32.1	28.1	-12.4 ***
2nd	1,806	1,636	-9.4 ***	43.7	39.9	-8.7 ***
3rd	2,152	1,987	-7.7 ***	52.0	49.4	-5.0 ***
4th	2,611	2,366	-9.4 ***	63.6	59.9	-5.9 ***
Wealthiest quintile	3,494	3,116	-10.8 ***	88.8	82.1	-7.6 ***
Urban	2,708	2,620	-3.3	68.1	69.6	2.3
Poorest quintile	1,626	1,615	-0.7	40.9	39.8	-2.5
2nd	2,225	2,126	-4.4	56.4	53.9	-4.5
3rd	2,833	2,534	-10.6 ***	69.8	67.8	-2.9
4th	3,160	3,058	-3.2	79.7	83.8	5.1
Wealthiest quintile	3,992	3,783	-5.2	100.6	103.4	2.8

	Calories (kcal/person/day)			Protein (g/person/day)		
	2010/11	2016/17	%Δ	2010/11	2016/17	%Δ
Northern rural	2,404	2,125	-11.6 ***	59.4	52.1	-12.4 ***
Poorest quintile	1,518	1,312	-13.5 ***	36.3	29.9	-17.6 ***
2nd	2,015	1,710	-15.1 ***	48.7	39.3	-19.3 ***
3rd	2,328	2,045	-12.1 ***	56.5	50.2	-11.0 ***
4th	2,672	2,403	-10.0 ***	65.7	58.7	-10.6 ***
Wealthiest quintile	3,521	3,162	-10.2 ***	91.1	82.4	-9.6 ***
Central rural	2,234	2,046	-8.4 ***	56.8	52.8	-7.0 ***
Poorest quintile	1,290	1,220	-5.4 **	31.9	29.6	-7.3 ***
2nd	1,814	1,642	-9.5 ***	44.9	41.2	-8.2 ***
3rd	2,137	1,983	-7.2 ***	53.6	50.5	-5.7 **
4th	2,554	2,318	-9.3 ***	65.1	60.2	-7.5 ***
Wealthiest quintile	3,393	3,067	-9.6 ***	89.1	82.8	-7.1 ***
Southern rural	2,273	2,049	-9.9 ***	54.3	50.9	-6.2 ***
Poorest quintile	1,298	1,079	-16.8 ***	31.4	26.5	-15.6 ***
2nd	1,744	1,602	-8.1 ***	41.6	38.7	-7.0 ***
3rd	2,120	1,978	-6.7 ***	49.6	48.4	-2.5
4th	2,583	2,409	-6.7 ***	60.0	59.5	-0.9
Wealthiest quintile	3,628	3,172	-12.6 ***	89.0	81.5	-8.5 ***

Source: Authors' calculations. Household weights are used.

Notes: %Δ = percent change. Nutrient calculations do not include mixed meals eaten at restaurants, as quantities and composition are not adequately captured by the survey. The statistical significance of the results of Wald tests on differences between the two survey years are presented as asterisks: * = p < 0.10, ** = p < 0.05, *** = p < 0.01.

While this suggests a trend of decreasing food consumption, we cannot rule out that these patterns reflect an increase in restaurant meals eaten away from home. While a selection of foods from vendors are included in our nutrient consumption estimates, the specific food category “meals eaten in restaurants” is not. Using a relative measure of food expenditure on mixed meals eaten at restaurants and on foods purchased from vendors, we see that the share of food expenditure rose across all regions and in nearly all wealth quintiles between 2010/11 and 2016/17 (Table 7). These increases were significant in rural areas, notably among poorer households in Central and Southern regions. The largest percentage point increases in expenditures on food away from home are seen among poorer households, regardless of region. Unsurprisingly, wealthier households allocate the largest portion of their food expenditures to food away from home, although this is still under 2.5 percent nationally. While these trends do not tell us about the caloric or nutrient contributions of purchased foods consumed outside the home, they suggest a slowly increasing reliance on these foods.

Table 7. Average share of food expenditure on food away from home, by wealth quintile and region

	Share of expenditure on food away from home (%)			Households consuming food away from home (%)		
	2010/11	2016/17	% pt Δ	2010/11	2016/17	% pt Δ
Total	1.44	1.68	0.2 ***	35.2	41.6	6.4 ***
Poorest quintile	0.69	1.18	0.5 ***	14.6	22.0	7.4 ***
2nd	1.10	1.49	0.4 ***	29.0	34.8	5.8 ***
3rd	1.50	1.65	0.2	38.7	41.9	3.3 *
4th	1.63	1.85	0.2 **	45.2	51.4	6.2 ***
Wealthiest quintile	2.46	2.23	-0.2	51.5	57.8	6.3 ***
Rural	1.26	1.49	0.2 ***	32.3	37.3	4.9 ***
Poorest quintile	0.63	1.08	0.5 ***	12.5	19.6	7.1 ***
2nd	0.99	1.36	0.4 ***	24.8	31.6	6.8 ***
3rd	1.27	1.53	0.3 **	34.2	37.9	3.8 **
4th	1.49	1.56	0.1	41.2	43.3	2.1
Wealthiest quintile	1.94	1.92	0.0	49.1	53.8	4.7 **
Urban	2.41	2.49	0.1	50.9	60.0	9.1 ***
Poorest quintile	1.77	2.48	0.7 **	43.3	52.6	9.4 *
2nd	2.19	2.34	0.2	54.3	62.0	7.7
3rd	1.93	2.96	1.0 ***	55.4	72.8	17.4 ***
4th	2.77	2.15	-0.6	57.9	60.3	2.4
Wealthiest quintile	3.49	2.52	-1.0	45.8	52.3	6.4
Northern rural	0.95	0.98	0.0	24.3	27.0	2.7
Poorest quintile	0.46	0.83	0.4 *	9.9	14.7	4.8
2nd	0.70	0.68	0.0	17.6	18.0	0.4
3rd	0.75	0.89	0.1	22.6	26.8	4.3
4th	1.31	1.07	-0.2	33.7	32.9	-0.8
Wealthiest quintile	1.56	1.45	-0.1	38.4	42.8	4.4
Central rural	1.50	1.72	0.2 **	36.9	40.5	3.7 **
Poorest quintile	0.61	1.30	0.7 ***	12.8	23.5	10.7 ***
2nd	1.15	1.60	0.4 ***	30.4	35.1	4.7
3rd	1.62	1.85	0.2	39.1	42.7	3.6
4th	1.89	1.73	-0.2	46.3	44.6	-1.7
Wealthiest quintile	2.24	2.12	-0.1	55.9	56.8	0.9

	Share of expenditure on food away from home (%)			Households consuming food away from home (%)		
	2010/11	2016/17	% pt Δ	2010/11	2016/17	% pt Δ
Southern rural	1.14	1.36	0.2 ***	30.6	35.9	5.3 ***
Poorest quintile	0.67	1.01	0.3 **	13.0	16.9	4.0 *
2nd	0.97	1.28	0.3 **	23.1	31.6	8.4 ***
3rd	1.17	1.36	0.2	34.1	37.2	3.1
4th	1.23	1.39	0.2	38.6	41.4	2.8
Wealthiest quintile	1.66	1.76	0.1	44.1	52.5	8.4 ***

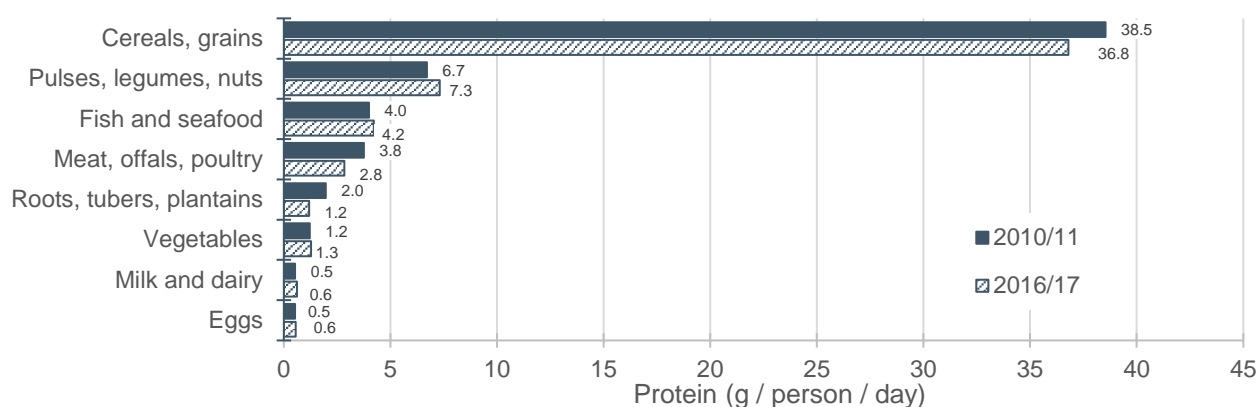
Source: Authors' calculations. Household weights are used.

Note: % pt Δ = percentage point change (2016/17 – 2010/11). The statistical significance of the results of Wald tests on differences between the two survey years are presented as asterisks: * = p < 0.10, ** = p < 0.05, *** = p < 0.01.

Moreover, more households consume some food away from home in 2016/17 than in 2010/11. The share of households doing so increased by 6 percentage points. While 60 percent of urban households do so, over a third of rural households also now consume food away from home. In urban areas, a greater percentage of households in the middle wealth quintile eat food outside of the home and the share of households in this quintile doing so rose the most across wealth quintiles. In contrast, while it is the wealthiest rural households that are most likely to consume food out of the home, the greatest increase between 2010/11 and 2016/17 in the share of rural households doing so is seen in the poorest quintiles.

In both 2010/11 and 2016/17, most of the protein consumed in the average Malawian household came from cereals and grains, followed by pulses, legumes, and nuts (Figure 2). Meats, offal, and poultry combined contributed more protein to household consumption than fish in 2010/11, but this pattern was reversed by 2016/17. Protein consumption from meat decreased between 2010/11 and 2016/17, while the average amount of protein obtained from fish increased. Per capita protein consumption from roots and tubers declined, while consumption from milk and dairy products and from vegetables increased between the two surveys. Eggs make only a small contribution to available protein and only a slight increase is seen in eggs as a source of protein between the two survey years. All other food groups contributed less than half a gram of protein per person per day on average.

Figure 2. National average protein consumption per capita from major food groups, 2010/11 and 2016/17



Source: Authors' calculations. Household sampling weights used.

Note: Only food groups contributing more than 0.5 grams of protein per capita per day are included in the figure, eliminating the fruits, sugars, oils and fats, and miscellaneous food groups. Nutrient calculations do not include mixed meals eaten at restaurants, as quantities and composition are not adequately captured by the survey.

To better understand protein consumption, we also examine the relative share of protein which is derived from animal-source foods and thus likely to be higher quality (Table 8). On average, households in urban areas obtain about one-fifth of their protein from animal-source foods, with little change in this share between 2010/11 and 2016/17. Households in the rural north obtained about 18 percent of the protein they consumed from animal-source foods in 2016/17, a level similar to what they obtained in 2010/11. However, households in the Central rural and Southern rural only obtain 11 percent of the protein they consume from animal-source foods, and this share has dropped since 2010/11.

Table 8. Share of protein from animal-source foods, by region

	Share of protein consumed that comes from animal-source foods (%)			Households consuming animal-source foods (%)		
	2010/11	2016/17	% pt. Δ	2010/11	2016/17	% pt. Δ
Total	14.1	13.4	-0.74 ***	86.4	83.7	-2.7 ***
Rural	12.8	11.3	-1.51 ***	84.5	80.5	-4.0 ***
Urban	21.3	22.3	0.95	96.9	97.4	-0.4
Northern rural	17.6	17.8	0.16	87.1	81.6	-5.5 ***
Central rural	12.1	10.6	-1.54 ***	82.6	80.3	-2.3 ***
Southern rural	12.1	10.8	-1.25 ***	85.4	80.5	-4.9 ***

Source: Authors' calculations. Household sampling weights used.

Note: % pt. Δ = percentage point change (2016/17 – 2010/11). Nutrient calculations do not include mixed meals eaten at restaurants, as quantities and composition are not adequately captured by the survey. The statistical significance of the results of Wald tests on differences between the two survey years are presented as asterisks: * = p < 0.10, ** = p < 0.05, *** = p < 0.01.

Over 80 percent of households in 2016/17 reported consuming animal-source foods in the week before they were interviewed. Consumption of animal-source foods is most common among urban households, with little change between 2010/11 and 2016/17 in the share of urban households doing so. However, the share of households in rural areas consuming animal-source foods dropped by 4 percentage points between 2010/11 and 2016/17. A similar trend is seen in the share of total protein rural households consume that comes from animal sources. Access by rural households in Malawi to animal-source foods appears to be dropping over time, primarily in the Central and Southern regions.

3.3 Micronutrient consumption

As shown for iron and zinc in Table 9 and for Vitamin A and folate in Table 10, consistent patterns in changes in micronutrient consumption between 2010/11 and 2016/17 are seen for rural households. These households consistently saw a decline in micronutrient consumption for all four micronutrients considered. Declines in consumption for both iron and zinc were largest for the poorest rural households, while declines in Vitamin A consumption were larger for wealthier households. It is not clear why there should have been a decline in consumption of Vitamin A rich foods, particularly fruits and vegetables, among these wealthier households. For folate consumption, there is no clear pattern in the size of reductions by wealth quintile of rural households. However, it should be highlighted that poorer households consistently have lower micronutrient consumption levels than wealthier households.

In contrast, urban households saw no significant change in their levels of consumption of any of the four micronutrients. The only exception is a puzzling decline in Vitamin A consumption among the wealthiest urban households, although their average consumption level remains well above

recommended daily intakes for the micronutrient. As with rural households, poorer urban households consistently have lower micronutrient consumption levels than wealthier urban households.

Table 9. Average per capita consumption of iron and zinc, by wealth quintile and region

	Iron (mg)				Zinc (mg)			
	2010/11	2016/17	%Δ		2010/11	2016/17	%Δ	
Total	19.3	18.4	-4.6	***	10.5	10.0	-5.5	***
Poorest quintile	13.1	11.7	-10.5	***	6.7	6.0	-10.9	***
2nd	16.7	15.9	-4.8	***	8.8	8.3	-5.8	***
3rd	19.3	19.0	-1.6		10.3	10.0	-3.6	**
4th	22.5	21.0	-6.6	***	12.3	11.4	-8.0	***
Wealthiest quintile	26.0	24.3	-6.3	***	15.3	14.2	-6.9	***
Rural	19.4	18.3	-5.7	***	10.4	9.7	-7.1	***
Poorest quintile	12.6	11.2	-10.9	***	6.5	5.7	-11.1	***
2nd	16.4	15.3	-6.7	***	8.6	7.9	-7.8	***
3rd	18.8	18.2	-3.2	*	10.0	9.5	-4.8	***
4th	21.9	21.0	-3.9	**	11.8	11.1	-5.7	***
Wealthiest quintile	27.2	25.5	-6.2	***	15.4	14.2	-8.1	***
Urban	18.8	18.9	0.7		11.0	11.1	0.3	
Poorest quintile	13.6	14.1	3.6		7.1	7.4	3.2	
2nd	16.6	16.9	1.7		9.4	9.3	-1.1	
3rd	20.5	18.7	-8.7	*	11.7	10.9	-7.3	
4th	21.3	21.6	1.5		12.6	12.8	1.6	
Wealthiest quintile	23.6	23.3	-1.1		15.4	15.1	-1.9	
Northern rural	19.9	17.5	-11.8	***	10.6	9.2	-13.3	***
Poorest quintile	13.8	11.9	-13.5	***	7.0	5.9	-15.6	***
2nd	17.6	14.6	-16.7	***	9.1	7.4	-18.4	***
3rd	19.8	17.4	-11.8	***	10.4	9.0	-13.8	***
4th	21.3	19.6	-7.8	**	11.5	10.3	-10.4	***
Wealthiest quintile	27.1	23.9	-11.6	***	15.2	13.4	-11.8	***
Central rural	19.3	18.3	-4.8	***	10.3	9.7	-6.1	***
Poorest quintile	12.5	11.6	-6.6	**	6.4	6.0	-6.2	**
2nd	16.7	15.5	-7.2	***	8.7	8.0	-7.9	***
3rd	18.9	18.4	-2.5		10.0	9.6	-4.1	
4th	21.7	20.6	-4.8	*	11.7	10.9	-6.4	***
Wealthiest quintile	26.7	25.5	-4.6	*	15.1	14.1	-6.4	**

	Iron (mg)			Zinc (mg)		
	2010/11	2016/17	%Δ	2010/11	2016/17	%Δ
Southern rural	19.3	18.3	-5.1 ***	10.5	9.8	-6.8 ***
Poorest quintile	12.6	10.7	-15.0 ***	6.5	5.5	-15.3 ***
2nd	15.8	15.2	-3.6	8.3	7.9	-5.3 **
3rd	18.5	18.2	-1.8	9.9	9.6	-3.2
4th	21.6	21.5	-0.6	11.7	11.4	-2.6
Wealthiest quintile	28.2	26.0	-7.5 ***	16.0	14.5	-9.6 ***

Source: Authors' calculations. Household sampling weights used.

Note: %Δ = percent change. Nutrient calculations do not include mixed meals eaten at restaurants, as quantities and composition are not adequately captured by the survey. The statistical significance of the results of Wald tests on differences between the two survey years are presented as asterisks: * = p < 0.10, ** = p < 0.05, *** = p < 0.01.

Table 10. Average per capita consumption of vitamin A and folate, by wealth quintile and region

	Vitamin A (μg RAE)			Folate (μg DFE)		
	2010/11	2016/17	%Δ	2010/11	2016/17	%Δ
Total	476	402	-15.6 ***	226	212	-6.1 ***
Poorest quintile	272	254	-6.4	123	113	-7.9 ***
2nd	376	335	-11.0 ***	175	166	-5.1 ***
3rd	484	412	-15.0 ***	225	209	-6.8 ***
4th	585	469	-19.8 ***	278	252	-9.2 ***
Wealthiest quintile	701	539	-23.1 ***	352	322	-8.6 ***
Rural	478	399	-16.6 ***	223	205	-8.2 ***
Poorest quintile	263	250	-5.1	117	108	-7.5 ***
2nd	367	324	-11.8 **	168	158	-5.8 ***
3rd	456	386	-15.4 ***	212	198	-6.4 ***
4th	584	465	-20.4 ***	265	242	-8.8 ***
Wealthiest quintile	722	569	-21.1 ***	356	318	-10.7 ***
Urban	465	414	-10.9 *	243	245	0.8
Poorest quintile	268	298	11.2	147	147	0.0
2nd	366	357	-2.5	203	196	-3.6
3rd	454	419	-7.6	249	241	-3.1
4th	586	470	-19.9	294	300	1.9
Wealthiest quintile	707	529	-25.2 ***	349	343	-1.6

	Vitamin A (µg RAE)			Folate (µg DFE)		
	2010/11	2016/17	%Δ	2010/11	2016/17	%Δ
Northern rural	441	377	-14.5 *	221	208	-5.6 *
Poorest quintile	239	242	1.4	131	126	-3.9
2nd	349	309	-11.5	178	169	-5.0
3rd	384	401	4.3	206	213	3.1
4th	526	416	-20.8 **	251	237	-5.6
Wealthiest quintile	715	517	-27.6 ***	340	297	-12.7 ***
Central rural	475	391	-17.8 ***	217	198	-8.9 ***
Poorest quintile	263	234	-10.9	111	101	-9.1 ***
2nd	370	313	-15.4 **	169	153	-9.2 ***
3rd	482	390	-19.1 ***	209	191	-8.8 **
4th	594	451	-24.1 ***	258	237	-8.2 **
Wealthiest quintile	672	567	-15.6 ***	341	308	-9.7 ***
Southern rural	491	410	-16.4 ***	229	210	-8.0 ***
Poorest quintile	258	266	3.0	116	109	-6.7 *
2nd	380	323	-14.8 *	164	159	-3.6
3rd	451	403	-10.7 *	213	201	-5.7 *
4th	596	466	-21.8 ***	271	249	-8.2 ***
Wealthiest quintile	769	593	-22.8 ***	379	334	-11.8 ***

Source: Authors' calculations. Household sampling weights used.

Note: %Δ = percent change; RAE = retinol activity equivalent, DFE = dietary folate equivalent. Nutrient calculations do not include mixed meals eaten at restaurants, as quantities and composition are not adequately captured by the survey. The statistical significance of the results of Wald tests on differences between the two survey years are presented as asterisks: * = p < 0.10, ** = p < 0.05, *** = p < 0.01.

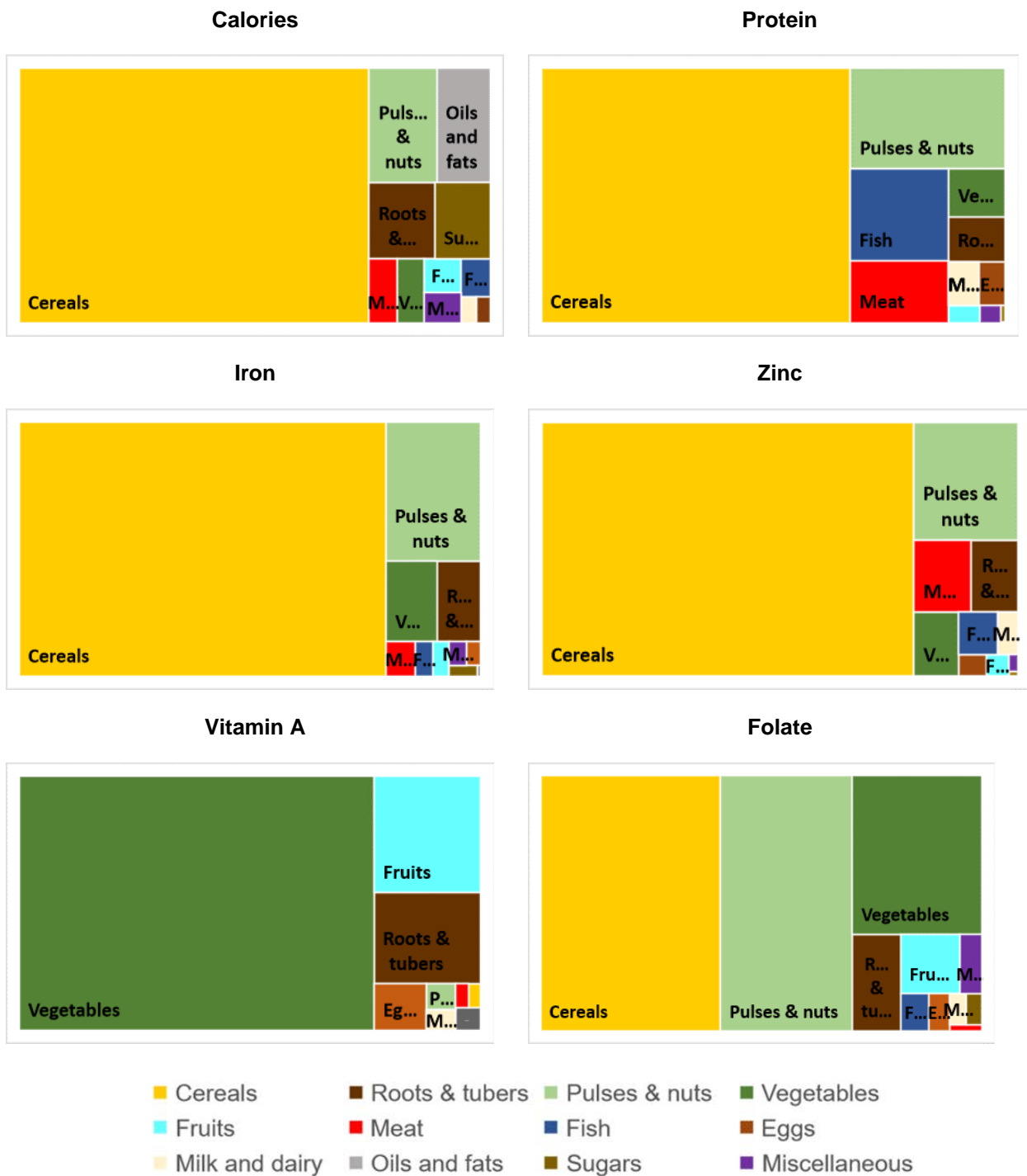
3.4 Food group contribution to nutrient consumption

Figure 3 charts the contribution of each food group to national nutrient consumption in 2016/17. Additional information is presented in tabular form in Table 11, disaggregated by region and showing trends in nutrient availability by food group between 2010/11 and 2016/17.

Important differences exist across regions regarding the contribution each food group makes to nutrient consumption. Given that our estimates do not consider fortification of food products, it is also interesting to explore which food groups, or individual foods, might have driven changes in micro-nutrient consumption. Several important trends can be observed:

- ▶ Nutrient contributions from pulses, legumes, and nuts; vegetables; and fish generally increased between 2010/11 and 2016/17, although whether the increases were statistically significant varied by nutrient.
- ▶ However, relatively consistent drops in the nutrient contributions of cereals; roots and tubers; fruits; and meats are seen between the two surveys. As cereals are the principal source for five of the six nutrients considered, it is particularly the reduction in per capita consumption of cereals between the two surveys that accounts for the drop in intake levels of these nutrients.

Figure 3. Average food group contribution to national nutrient consumption in Malawi, 2016/17



Source: Authors' calculations. Household sampling weights used.

- ▶ Roots and tubers could be a significant source of calories, but we see a sharp decline of almost 40 percent nationally between 2010/11 and 2016/17 in calories coming from these foods. This decline is seen even for households in the Northern rural region where cassava is a more important secondary staple (to maize) than elsewhere in Malawi. As orange-fleshed sweet potatoes are an important source of Vitamin A, we also see a significant drop in the amount of Vitamin A obtained from the roots and tubers food group. The reduction in consumption of roots and tubers is more significant for rural households than urban.

Table 11. Average food group contribution to nutrient consumption, per person per day, by region in 2010/11 and 2016/17

	Calories (kcal)			Protein (g)			Iron (mg)			Zinc (mg)			Vitamin A (µg RAE)			Folate (µg DFE)		
	10/11	16/17	%Δ	10/11	16/17	%Δ	10/11	16/17	%Δ	10/11	16/17	%Δ	10/11	16/17	%Δ	10/11	16/17	%Δ
National																		
Cereals	1,691	1,606	-5.0 ***	38.5	36.8	-4.5 ***	15.2	14.6	-3.9 ***	8.2	7.8	-4.7 ***	1	1	--	92	87	-5.6 ***
Roots & tubers	148	90	-39.1 ***	2.0	1.2	-39.5 ***	0.9	0.5	-40.9 ***	0.5	0.3	-39.3 ***	67	33	-49.9 ***	15	9	-42.8 ***
Pulses & nuts	135	140	3.7	6.7	7.3	8.9 **	2.0	2.1	5.9 *	1.0	1.0	2.9	2	3	--	61	63	4.5
Vegetables	30	31	4.1	1.2	1.3	4.6 *	0.6	0.6	3.5	0.2	0.2	8.3	298	309	3.5	40	39	-1.9
Fruits	36	22	-40.2 ***	0.4	0.2	--	0.1	0.1	--	0.1	0.0	--	95	43	-55.0 ***	11	7	-38.5 ***
Meat	42	32	-23.6 ***	3.8	2.8	-24.4 ***	0.2	0.2	-24.0 ***	0.4	0.3	-21.5 ***	2	1	--	1	0	--
Fish	18	20	--	4.0	4.2	5.8 *	0.1	0.1	--	0.1	0.1	27.6 ***	0	0	--	2	2	--
Eggs	7	7	--	0.5	0.6	--	0.1	0.1	--	0.0	0.0	--	8	8	4.5	1	1	--
Milk and dairy	7	8	--	0.5	0.6	15.5	0.0	0.0	--	0.1	0.1	--	2	2	--	1	1	--
Oils and fats	100	110	10.5 ***	0.0	0.0	--	0.0	0.0	--	0.0	0.0	--	0	1	--	0	0	--
Sugars	102	76	-25.7 ***	0.0	0.0	--	0.1	0.0	--	0.0	0.0	--	1	1	--	0	1	--
Miscellaneous	27	20	-24.9 ***	0.2	0.2	--	0.0	0.1	--	0.0	0.0	--	0	0	--	3	2	-18.0 ***
TOTAL	2,342	2,162	-7.7 ***	57.9	55.3	-4.5 ***	19.3	18.4	-4.6 ***	10.5	10.0	-5.5 ***	476	402	-15.6 ***	226	212	-6.1 ***
Rural																		
Cereals	1,686	1,582	-6.2 ***	38.4	36.2	-5.8 ***	15.5	14.7	-4.6 ***	8.2	7.7	-5.6 ***	1	1	--	92	85	-7.6 ***
Roots & tubers	148	84	-43.3 ***	1.9	1.0	-47.1 ***	0.9	0.5	-44.4 ***	0.5	0.3	-44.3 ***	65	32	-51.2 ***	16	8	-47.0 ***
Pulses & nuts	132	137	3.6	6.4	6.9	8.1 *	1.9	2.0	6.2	1.0	1.0	3.2	2	2	--	60	62	4.6
Vegetables	29	30	4.3	1.2	1.2	4.6	0.6	0.6	2.9	0.2	0.2	8.6	302	313	3.6	38	37	-2.6
Fruits	35	19	-46.3 ***	0.4	0.2	--	0.1	0.1	--	0.1	0.0	--	99	43	-56.1 ***	10	5	-46.1 ***
Meat	35	22	-36.4 ***	3.1	2.0	-36.4 ***	0.2	0.1	-36.4 ***	0.4	0.2	-33.9 ***	1	1	--	0	0	--
Fish	17	17	--	3.6	3.6	-2.1	0.1	0.1	--	0.1	0.1	17.3 ***	0	0	--	2	2	--
Eggs	5	4	--	0.4	0.4	--	0.0	0.0	--	0.0	0.0	--	6	5	-12.8 ***	1	1	--
Milk and dairy	5	4	--	0.4	0.3	--	0.0	0.0	--	0.0	0.0	--	2	1	--	1	0	--
Oils and fats	73	83	13.2 ***	0.0	0.0	--	0.0	0.0	--	0.0	0.0	--	0	0	--	0	0	--
Sugars	84	56	-33.9 ***	0.0	0.0	--	0.0	0.0	--	0.0	0.0	--	0	0	--	0	0	--
Miscellaneous	27	17	-35.0 ***	0.2	0.1	--	0.0	0.0	--	0.0	0.0	--	0	0	--	3	2	-31.4 ***
TOTAL	2,274	2,054	-9.7 ***	56.0	51.9	-7.3 ***	19.4	18.3	-5.7 ***	10.4	9.7	-7.1 ***	478	399	-16.6 ***	223	205	-8.2 ***

	Calories (kcal)			Protein (g)			Iron (mg)			Zinc (mg)			Vitamin A (µg RAE)			Folate (µg DFE)		
	10/11	16/17	%Δ	10/11	16/17	%Δ	10/11	16/17	%Δ	10/11	16/17	%Δ	10/11	16/17	%Δ	10/11	16/17	%Δ
Urban																		
Cereals	1,716	1,710	-0.4	39.1	39.3	0.6	13.8	14.0	1.6	7.8	7.9	0.3	0	0	--	89	93	3.9
Roots & tubers	146	116	-20.9 **	2.4	2.0	-16.7 **	0.9	0.7	-24.9 ***	0.5	0.4	-21.3 **	78	41	-47.0	15	11	-23.6 ***
Pulses & nuts	149	152	2.2	8.6	9.1	6.3	2.3	2.3	1.2	1.1	1.1	-0.2	2	4	--	66	67	2.4
Vegetables	36	36	-0.3	1.5	1.5	0.4	0.7	0.7	3.3	0.2	0.2	8.1	278	292	5.0	46	45	-1.9
Fruits	45	35	-23.0 **	0.5	0.4	--	0.2	0.2	--	0.1	0.1	--	72	39	-45.7 **	14	11	-17.4
Meat	84	76	-9.4	7.1	6.4	-9.6	0.4	0.4	-9.2	0.8	0.8	-7.2	3	3	--	1	1	--
Fish	28	34	22.5 ***	5.9	7.1	19.2 ***	0.1	0.2	--	0.2	0.2	44.4 ***	1	1	--	3	3	21.4 ***
Eggs	15	17	--	1.2	1.4	16.3 **	0.1	0.1	--	0.1	0.1	16.3 **	18	21	16.3 **	3	4	16.3 **
Milk and dairy	19	24	--	1.4	1.9	34.9 *	0.0	0.0	--	0.2	0.2	33.9 *	8	7	-9.8	2	3	29.3
Oils and fats	245	228	-7.0	0.0	0.0	--	0.0	0.0	--	0.0	0.0	--	2	3	--	0	0	--
Sugars	198	161	-18.7 ***	0.0	0.0	--	0.1	0.1	--	0.0	0.0	--	2	2	--	2	3	50.4 **
Miscellaneous	28	32	15.8	0.2	0.4	--	0.1	0.2	93.4 ***	0.0	0.1	--	0	1	--	3	4	37.9 **
TOTAL	2,708	2,620	-3.4	68.1	69.6	2.2	18.8	18.9	0.7	11.0	11.1	0.3	465	414	-12.2 *	243	245	0.8
Northern rural																		
Cereals	1,681	1,403	-16.5 ***	37.9	31.5	-16.8 ***	15.3	12.6	-17.3 ***	8.1	6.8	-16.8 ***	0	0	--	89	73	-17.7 ***
Roots & tubers	285	303	6.6	2.5	2.1	-15.5	1.7	1.8	5.9	0.7	0.7	6.4	100	51	-48.7 ***	31	29	-7.0
Pulses & nuts	114	123	8.1	6.9	7.5	9.1	1.7	1.9	12.4	0.8	0.9	9.3	1	1	--	48	54	13.3 *
Vegetables	25	27	6.7	1.1	1.2	13.6 *	0.6	0.7	10.8	0.2	0.2	11.6	281	284	1.2	40	40	0.9
Fruits	19	19	--	0.2	0.2	--	0.1	0.1	--	0.0	0.0	--	46	29	-36.4 *	6	6	-5.8
Meat	46	28	-40.2 ***	4.0	2.4	-39.1 ***	0.2	0.1	-40.8 ***	0.5	0.3	-42.5 ***	1	1	--	1	0	--
Fish	27	29	9.9	5.8	6.1	5.7	0.1	0.1	--	0.2	0.2	23.4 **	1	1	--	3	3	9.6
Eggs	6	5	--	0.5	0.4	--	0.0	0.0	--	0.0	0.0	--	8	6	-19.9 ***	1	1	--
Milk and dairy	8	6	--	0.5	0.4	--	0.0	0.0	--	0.1	0.1	--	4	3	--	1	1	--
Oils and fats	73	104	42.1 ***	0.0	0.0	--	0.0	0.0	--	0.0	0.0	--	0	0	--	0	0	--
Sugars	107	70	-34.6 ***	0.0	0.0	--	0.0	0.0	--	0.0	0.0	--	0	0	--	0	0	--
Miscellaneous	14	7	--	0.1	0.0	--	0.0	0.0	--	0.0	0.0	--	0	0	--	1	1	--
TOTAL	2,404	2,125	-11.6 ***	59.4	52.1	-12.4 ***	19.9	17.5	-11.8 ***	10.6	9.2	-13.3 ***	441	377	-14.5 *	221	208	-5.6 *

	Calories (kcal)			Protein (g)			Iron (mg)			Zinc (mg)			Vitamin A (µg RAE)			Folate (µg DFE)		
	10/11	16/17	%Δ	10/11	16/17	%Δ	10/11	16/17	%Δ	10/11	16/17	%Δ	10/11	16/17	%Δ	10/11	16/17	%Δ
Central rural																		
Cereals	1,708	1,605	-6.1 ***	38.9	36.5	-6.1 ***	15.6	15.0	-4.3 ***	8.3	7.9	-5.3 ***	0	1	--	94	86	-8.6 ***
Roots & tubers	107	68	-36.0 ***	1.5	1.0	-36.8 ***	0.7	0.4	-35.9 ***	0.3	0.2	-35.5 ***	44	31	-30.3 **	11	7	-37.5 ***
Pulses & nuts	123	132	7.1	7.6	8.0	5.1	1.9	2.0	6.9	0.9	0.9	7.3	2	3	--	55	59	6.3
Vegetables	30	29	-2.5	1.2	1.2	-4.1	0.7	0.6	-6.4 *	0.2	0.2	0.1	334	310	-7.3	42	36	-9.4
Fruits	28	15	-48.0 ***	0.3	0.2	--	0.1	0.0	--	0.0	0.0	--	85	40	-52.7 ***	8	4	-54.4 ***
Meat	39	25	-35.3 ***	3.6	2.3	-36.1 ***	0.2	0.1	-36.5 ***	0.4	0.3	-32.9 ***	2	1	--	0	0	--
Fish	13	14	--	2.8	2.9	4.0	0.1	0.1	--	0.1	0.1	--	0	0	--	1	1	--
Eggs	5	4	--	0.4	0.4	--	0.0	0.0	--	0.0	0.0	--	6	5	-12.1 *	1	1	--
Milk and dairy	4	4	--	0.3	0.4	--	0.0	0.0	--	0.0	0.0	--	1	1	--	0	1	--
Oils and fats	71	71	0.9	0.0	0.0	--	0.0	0.0	--	0.0	0.0	--	0	0	--	0	0	--
Sugars	78	57	-27.2 ***	0.0	0.0	--	0.0	0.0	--	0.0	0.0	--	0	0	--	0	0	--
Miscellaneous	29	21	-25.5 ***	0.2	0.1	--	0.0	0.0	--	0.0	0.0	--	0	0	--	3	2	-29.2 ***
TOTAL	2,234	2,046	-8.4 ***	56.8	52.8	-7.0 ***	19.3	18.3	-4.8 ***	10.3	9.7	-6.1 ***	475	391	-17.8 ***	217	198	-8.9 ***
Southern rural																		
Cereals	1,668	1,592	-4.6 ***	38.2	36.7	-3.8 **	15.4	14.9	-2.9 *	8.1	7.8	-4.0 ***	1	2	--	91	86	-5.4 *
Roots & tubers	146	59	-59.2 ***	2.0	0.8	-58.9 ***	1.0	0.4	-60.2 ***	0.5	0.2	-59.3 ***	73	29	-60.2 ***	16	6	-60.9 ***
Pulses & nuts	145	144	-0.6	5.2	5.7	10.8 *	1.9	2.0	3.8	1.1	1.1	-1.2	2	2	--	67	67	0.8
Vegetables	29	32	8.9	1.1	1.3	10.7 **	0.6	0.6	10.6 **	0.2	0.3	14.4	280	321	14.5 **	35	38	8.2 *
Fruits	44	22	-50.0 ***	0.5	0.3	--	0.1	0.1	--	0.1	0.0	--	126	49	-61.0 ***	13	7	-45.4 ***
Meat	27	18	-35.2 ***	2.5	1.6	-35.0 ***	0.1	0.1	--	0.3	0.2	-30.5 ***	1	1	--	0	0	--
Fish	18	18	--	3.8	3.7	-1.2	0.1	0.1	--	0.1	0.1	--	0	0	--	2	2	--
Eggs	5	4	--	0.4	0.3	--	0.0	0.0	--	0.0	0.0	--	6	5	-9.6	1	1	--
Milk and dairy	5	3	--	0.4	0.2	--	0.0	0.0	--	0.0	0.0	--	1	1	--	1	0	--
Oils and fats	75	89	19.5 ***	0.0	0.0	--	0.0	0.0	--	0.0	0.0	--	0	0	--	0	0	--
Sugars	83	52	-37.5 ***	0.0	0.0	--	0.0	0.0	--	0.0	0.0	--	0	0	--	0	0	--
Miscellaneous	29	15	-46.3 ***	0.2	0.1	--	0.0	0.0	--	0.0	0.0	--	0	0	--	3	2	-37.6 ***
TOTAL	2,273	2,049	-9.9 ***	54.3	50.9	-6.2 ***	19.3	18.3	-5.1 ***	10.5	9.8	-6.8 ***	491	410	-16.4 ***	229	210	-8.0 ***

Source: Authors' calculations. Household sampling weights used. **Note:** RAE = retinol activity equivalent, DFE = dietary folate equivalent. Nutrient calculations do not include mixed meals eaten at restaurants. The statistical significance of the results of Wald tests on differences between the two survey years are presented as asterisks: * = p < 0.10, ** = p < 0.05, *** = p < 0.01. Where the nutrient contribution of a food group is less than one percent of total nutrient consumption in both years, percentage change (and significance level) is not reported. The percentage change for these cases is indicated by "--".

- ▶ Fruit consumption also shows a sharp decline between the two surveys, with a more significant drop among rural households. As fruit is the second most important source of Vitamin A in the diets of Malawian households, if sustained, this reduction in fruit consumption could increase the risk of more individuals experiencing health problems related to Vitamin A deficiency.
- ▶ Vegetables are the dominant source of Vitamin A in the diets of Malawians. However, the amount of Vitamin A obtained from vegetables did not change significantly between 2010/11 and 2016/17, except for rural households in the Southern region where Vitamin A intake from vegetables increased.
- ▶ There is a noticeable shift away from meat as a source of nutrients, with a significant shift towards fish in urban areas. While more calories still were obtained from meat in 2016/17 on average, more protein came from fish than from meat.
- ▶ While some significant shifts in the levels of consumption of eggs and milk and dairy are seen for some groups, these changes are from very low levels. These food groups remain an unimportant source of dietary nutrients for Malawians, despite being quite nutritious.
- ▶ Per capita consumption of oils and fats increased between 2010/11 and 2016/17, while consumption of sugar decreased. Nationally, the total calories obtained per person from the two food types declined between the two surveys by about 8 percent on average.

3.5 Source of nutrients

For policy and program decision makers to address calorie and micronutrient inadequacies, it is also helpful to understand whether households obtain most of these nutrients from purchases, own production, or through gifted foods. While there are small differences between regions and across nutrients, about half of all nutrients consumed come from purchased foods in rural regions, compared to between 80 and 85 percent in urban areas (Table 12). These estimates provide additional evidence that the food security and nutritional needs for most Malawian households now are equally tied to the market as to their own farming, if not more so.

There are also interesting differences in the amount of food households receive as gifts. A smaller portion of the nutrients consumed in urban areas come from food obtained as gifts (5 to 9 percent) compared to households in rural areas (13 to 20 percent). In particular, the rural Southern and rural Central regions obtained a considerable amount of the nutrients they consumed from gifted food: In southern rural households, between a quarter and a third of most nutrients were obtained through foods that the households received as gifts. Gifts include food aid distributed by government or its development partners. This high level of reliance on gifted food to meet nutrient needs among rural households in the Southern region in 2016/17 is likely linked to the large food insecurity response that was carried out following a severe drought in Southern and parts of Central region. However, it should be noted that different modalities for assisting vulnerable households were used in the food insecurity response program, including both direct food distribution and the provision of food vouchers and cash (Babu et al. 2018). It likely was only food assistance received through direct distribution that was recorded as gifted food in the IHS4.

Table 12. Average share of nutrients from a given source in 2016/17, by region, percent

	All	Rural	Urban	Northern rural	Central rural	Southern rural
Calories						
Purchased	58.3	49.4	85.0	49.2	47.5	51.7
Own-produced	29.6	36.4	9.2	43.8	41.4	29.9
Gift	11.2	13.3	4.9	6.2	10.4	17.3
Miscellaneous	0.9	0.9	0.9	0.8	0.7	1.0
Protein						
Purchased	58.8	49.7	84.8	53.3	47.0	53.0
Own-produced	28.6	35.7	8.5	37.7	40.7	29.1
Gift	11.6	13.7	5.6	7.9	11.5	16.8
Miscellaneous	1.0	0.9	1.2	1.1	0.8	1.1
Iron						
Purchased	53.1	45.3	81.2	47.4	43.0	48.0
Own-produced	33.3	39.4	11.6	45.4	44.8	32.3
Gift	12.6	14.5	6.1	6.4	11.4	18.7
Miscellaneous	0.9	0.8	1.2	0.8	0.7	1.0
Zinc						
Purchased	54.6	46.2	82.6	48.7	44.2	48.5
Own-produced	32.2	38.7	10.5	44.0	43.9	32.1
Gift	12.2	14.2	5.7	6.6	11.1	18.4
Miscellaneous	0.9	0.9	1.2	0.8	0.8	1.0
Vitamin A						
Purchased	47.6	36.9	85.8	36.9	35.0	39.3
Own-produced	33.1	41.1	4.5	43.2	42.4	39.3
Gift	14.8	16.9	7.2	15.2	16.8	17.2
Miscellaneous	4.5	5.1	2.5	4.7	5.8	4.2
Folate						
Purchased	52.3	42.5	82.3	43.3	40.3	45.1
Own-produced	30.3	37.6	7.9	44.0	42.8	30.9
Gift	16.0	18.4	8.7	10.9	15.5	22.3
Miscellaneous	1.4	1.5	1.2	1.7	1.4	1.7

Source: Authors' calculations. Household sampling weights used.

Note: Sources are purchased foods, own-produced foods, foods received as a gift, and a miscellaneous category which captures extra consumption that was reported in the initial total of food reported consumed by the household but was not accounted for in subsequent disaggregation by source category. Nutrient calculations do not include mixed meals eaten at restaurants, as quantities and nutrient composition for these meals are not adequately captured by the survey.

3.6 Nutrient adequacy

Calorie inadequacy rates for 2016/17 suggest that 59 percent of households in Malawi did not consume enough food on average to meet their energy needs (Table 13). The prevalence of inadequate calorie consumption is considerably lower among households in urban centers than in rural areas. In terms of trends, prevalence rates of calorie inadequacy increased considerably among rural households between 2010/11 and 2016/17. The rural north, in particular, experienced the greatest increase in the share of households consuming inadequate calories over this period. In

contrast, the prevalence of inadequate calorie consumption for households in urban areas did not change significantly over this period.

Table 13. Prevalence of calorie and micronutrient inadequacies, percent of households by region

	Calories			Iron			Zinc		
	2010/11	2016/17	% pt Δ	2010/11	2016/17	% pt Δ	2010/11	2016/17	% pt Δ
Total	52.3	59.0	12.8 ***	39.5	42.8	8.4 ***	67.8	71.5	5.5 ***
Rural	53.7	62.6	16.4 ***	38.1	42.2	10.6 ***	67.9	72.8	7.3 ***
Urban	44.7	43.9	-1.8	46.7	45.5	-2.5	67.5	65.9	-2.3
Northern rural	47.7	60.8	27.6 ***	33.3	44.5	33.5 ***	67.0	76.2	13.7 ***
Central rural	55.0	63.8	16.0 ***	38.1	39.8	4.5	68.3	74.1	8.4 ***
Southern rural	54.3	61.7	13.5 ***	39.5	44.0	11.4 ***	67.7	71.1	4.9 **

	Vitamin A			Folate		
	2010/11	2016/17	% pt Δ	2010/11	2016/17	% pt Δ
Total	44.7	46.1	3.2 ***	84.7	88.2	4.2 ***
Rural	45.2	47.7	5.3 *	84.8	89.0	5.0 ***
Urban	41.6	39.6	-5.0	84.1	84.7	0.8
Northern rural	46.9	48.1	2.6	87.0	91.4	5.1 ***
Central rural	40.4	47.5	17.6 ***	85.9	90.1	4.9 ***
Southern rural	49.0	47.7	-2.5	83.2	87.5	5.2 ***

Source: Authors' calculations. Household sampling weights used.

Note: % pt Δ = percentage point change (=2016/17 – 2010/11). Nutrient calculations do not include mixed meals eaten at restaurants, as quantities and composition are not adequately captured by the survey. The statistical significance of the results of Wald tests on differences between the two survey years are presented as asterisks: * = p < 0.10, ** = p < 0.05, *** = p < 0.01.

Micronutrient inadequacies are estimated based on the simplifying assumptions that micronutrients are derived solely from minimally-processed foods, i.e., ignoring nutrient supplementation or food fortification programs, and that individuals within a household are able to utilize these nutrients and access them in proportion to their needs. Under these assumptions, the prevalence of rural households with inadequate consumption of iron, zinc, and folate increased significantly between 2010/11 and 2016/17, while the share of rural households with inadequate consumption of Vitamin A rose, but not as markedly as for the other micronutrients (Table 13). With respect to the prevalence levels of inadequate micronutrient intake, almost all rural households do not consume enough folate to meet their nutritional needs. A similar situation is seen with zinc, for which almost three-quarters of rural households consume insufficient amounts.

By region, rural households in the Central region show the lowest levels of inadequate consumption of iron and saw no significant increase in prevalence rates between the two surveys. In contrast, for Vitamin A, while rural households in the other two regions did not see a significant shift in prevalence of inadequate intake between 2010/11 and 2016/17, those in Central region saw a large increase.

Among urban households, the prevalence of households with deficient consumption of nutrients stayed relatively constant between 2010/11 and 2016/17. Prevalence rates for inadequate consumption of calories are almost 20 percent lower for urban households than for rural households. Prevalence rates for zinc, Vitamin A, and folate are all between 4 and 8 percent lower for urban

households. However, the prevalence rate for inadequate consumption of iron is slightly higher among urban households than rural households by about 3 percent.

As a check on the validity of these calorie inadequacy prevalence rates, we compare the household prevalence of calorie inadequacy to estimates of the prevalence of absolute poverty in Malawi based on a basic needs poverty line. We expect our calorie inadequacy rates to broadly track the poverty rates, given that the poverty line in Malawi is designed so that it defines the cost of a basket of basic foods which meet the calorie needs of individuals, plus some non-food goods.⁹ The national household calorie inadequacy rates (Table 13) from our analysis of 52 percent in 2010/11 and 59 percent in 2015/16 are slightly higher than the NSO estimates of the share of the population of Malawi that is poor (Table 14), but show the same trends.

Table 14. Poverty headcount, by region, percent of individuals

	All	Rural	Urban	Northern rural	Central rural	Southern rural
2010/11	50.7	56.6	17.3	59.9	48.7	63.3
2016/17	51.5	59.5	17.7	59.9	53.6	65.2

Source: Adapted from (NSO and World Bank 2018a; 2018b).

We also compare our nutrient inadequacy rates to estimates from the nationally-representative 2015/16 Malawi Micronutrient Survey (NSO et al. 2017) (Table 15). It should be noted that the estimates in the Micronutrient Survey and those presented in this analysis from the IHS are difficult to compare due to the fundamentally different analytical methods used. The Malawi Micronutrient Survey was a biomedical study that used blood samples and biomarkers to determine deficiency and sufficiency rates. Our analysis looks only at the estimated nutrient content of the foods reported consumed by members of the survey households over the previous seven days. Our approach estimates the relative adequacy of nutrient intake which might occur without fortification or supplementation and in the absence of disease. The IHS does not collect sufficient data on the health status of household members to assess how their health might affect their nutrient status. In contrast, the Micronutrient Survey aims to capture nutrient insufficiencies or deficiencies regardless of their cause, whether dietary, health-related, or otherwise.

Table 15. Prevalence of nutrient deficiency by sex and age, 2015/16 Malawi Micronutrient Survey, percent

	Iron	Zinc	Vitamin A	Folate Insufficiency	Folate Deficiency
Children (6–59 months)	21.7	60.4	3.6	-	-
Children (5–14 years)	4.9	60.2	0.9	-	-
Women, not pregnant (15–49 years)	15.1	62.5	0.3	81.4	7.6
Men (20–55 years)	1.4	65.7	0.1	-	-

Source: Adapted from the 2016-17 Malawi Micronutrient Survey (NSO et al. 2017).

Note: Iron deficiency estimates are based on inflammation-adjusted serum ferritin levels. Zinc deficiency is based on serum zinc concentrations. Vitamin A deficiency is based on the concentration of retinol binding protein. Folate insufficiency is based on red blood cell folate concentration, while folate deficiency is based on serum folate concentration. Folate insufficiency is associated with an increased risk of neural tube defects, while folate deficiency is associated with increased risk of megaloblastic anemia, a bone marrow disorder affecting the production of red blood cells.

⁹ The NSO set calorie needs at 2,400 calories per person per day for poverty line estimation (NSO and World Bank 2018a, 14). Our age- and sex-specific estimates average slightly lower, at approximately 2,150 calories per person per day.

Nutrient deficiencies are considerably lower in the 2015/16 Malawi Micronutrient Survey than the nutrient inadequacy rates estimated in the analysis here. This may be due, at least in part, to supplementation or fortification efforts. The Government of Malawi mandates various fortification programs: wheat flour and maize meal which are industrially processed are fortified with various vitamins and minerals, including folic acid, iron, zinc, and vitamin A, while sugar and cooking oil are also fortified with vitamin A (Mejia, Kuo, and Beltran-Velazquez 2019). Unfortunately, the IHS surveys do not collect enough information to take fortification into account in assessing the adequacy of nutrient intake. Furthermore, the 2015/16 Micronutrient Survey suggests that fortification levels are variable and often inadequate for certain products. For example, only 12 percent of households surveyed had adequately fortified oil, while 58 percent had adequately fortified sugar (NSO et al. 2017).¹⁰

4 DISCUSSION

Our analysis suggests that while dietary diversity across households in Malawi seems to be improving slightly, households still rely on a relatively small number of foods and food groups to meet their energy and nutrient needs. Maize still dominates the dietary patterns of Malawians across regions and across the rural-urban divide. Although the calorie, protein, iron, zinc, and folate contributions of cereals decreased by about 5 percent nationally between 2010/11 and 2016/17, cereals still provide an average of three-quarters of all calories consumed and two-thirds of protein. Cereals also provide about 80 percent of both the iron and the zinc consumed by Malawian households on average. Encouragingly, the protein contribution of pulses, legumes, and nuts increased between 2010/11 and 2016/17. However, calories obtained from roots and tubers fell.

With regard to animal-sourced foods, dietary patterns seem to be shifting away from meat nationally, and towards fish in urban areas. Dairy contribution to nutrient consumption was low and stagnant between the two surveys, while egg consumption increased among urban households, but from a low base. The relative proportion of protein from animal-source foods decreased by a small, but statistically significant, amount between 2010/11 and 2016/17. However, rural households obtain a substantially smaller share of their protein from animal-sourced foods – 11 percent in the rural Central and Southern regions and 18 percent in Northern region – than do urban households. Over one-fifth of the protein urban households consume comes from animal-sourced foods.

Regarding fruits and vegetables, changes between the two surveys were of a relatively small magnitude in most regions, with slight increases in vegetables and more substantial decreases in fruit consumption. Fruit consumption has an important impact on vitamin A consumption, as does root and tuber consumption; so, vitamin A consumption declined in nearly all wealth quintiles and rural regions between 2010/11 and 2016/17.

For the targeting of programs to address nutrient consumption, this analysis points out an important divergence between urban and rural households. Those living in urban areas have more diverse diets, on average, than those in rural areas and allocate a greater share of their food expenditures to meals and foods prepared and eaten outside the home. Urban households also rely considerably more on purchased foods than do rural households: around 80 percent of calories are obtained from purchased foods by households in urban centers compared to about 50 percent in rural areas.

The prevalence of households with nutrient inadequacies is lower in urban areas, except for iron. However, the consumption of micronutrients is not substantially greater, on average, for urban households than for rural households. This suggests that household composition and nutrient

¹⁰ The Malawi Micronutrient Survey report defines adequately fortified sugar as having 4 mg or more of vitamin A per kilogram. Adequately fortified oil has 20 mg or more of vitamin A per kilogram (NSO et al. 2017).

needs differ between them. However, based on the greater share of purchased foods eaten in urban areas, it is possible that more of the food reported in urban areas is processed and fortified, which could shift nutrient consumption upward for urban households from what is estimated in this study. In future research on food consumption in Malawi, it would be useful to differentiate processed food items, like maize flour, from unprocessed items so that nutrient consumption can be better estimated. The larger share of food eaten outside the home in urban areas may also contribute to higher nutrient consumption, although without a specialized survey the nutrient-density of meals eaten outside the home will remain unknown but is likely to be highly variable.

Given this caveat, dietary consumption from the largely unprocessed and unfortified foods included in the IHS modules suggests that food consumption alone leaves considerable gaps between needs and consumption for iron, vitamin A, and folate. This suggests that the fortification programs mandated by the Government of Malawi may be important for achieving nutrient adequacy, as could the provision of nutrient supplementation to nutritionally vulnerable groups, including pregnant women and adolescent girls. Our inadequacy estimates drawn from household level data may mask important inequities in food allocation in the household that would result in individual household members having deficient nutrient consumption even if the household as a whole is estimated to consume enough nutrients.

Furthermore, the poorest households in all regions deserve attention, including in urban areas. Poor households have very low nutrient consumption per person and rely on a very small number of foods from a few food groups: the average HFVS for the poorest households is less than 9 types of food per week. It is clear that many poor households in Malawi cannot meet their basic nutrient needs, particularly for micronutrients, given the maize-dominated diets they consume.

Our analysis suggests several areas for future research. A better understanding is required of the nutrient content and consumption patterns associated both with meals eaten away from home and with fortified processed foods. Information on this is difficult to derive from the IHS survey datasets. In implementing dietary recall survey modules in the future in Malawi, it would also be useful to gather additional information about the consumption of micronutrient-fortified staple foods. Questions on the participation of household members in nutrient supplementation programs, such as those promoting the addition of micronutrient powders to the meals and snacks of young children, could also be added relatively easily to the IHS household questionnaire.

It would be valuable to look more deeply at the households who relied heavily on gifts of food to meet their nutrient needs, disaggregating those gifts between those received from relatives and neighbors from those received from humanitarian response programs of government and its partners. In a similar vein, one could examine the nutrient consumption of households who relied heavily on their own-produced foods. This could shed light on whether those most dependent on farming are the most at risk of nutrient inadequacies and may point to other household characteristics that are closely associated with inadequate nutrient consumption. Additional analyses could explore other unique characteristics of households with lower than recommended average nutrient consumption levels, in addition to residence and wealth category, as has been descriptively examined in this paper.

Finally, increased attention is needed to effectively implement policies and programs that seek to increase the consumption of nutrient-dense foods. Substantial declines in the consumption of fruit and meat between 2010/11 and 2016/17 and low and stagnant consumption of eggs and milk and other dairy products are indicators of failure in nutrition policy implementation. Improving access of households, particularly in rural Malawi, to animal-source foods, fruits, and vegetables will improve nutrient intake by the nutritionally vulnerable in Malawi.

APPENDIX: NON-STANDARD UNITS IN FOOD ITEM RECORDS

In the food consumption module of the IHS, survey enumerators were able to record “other” foods and quantity units reported by the respondent which were not in the pre-coded list of foods or units provided in the survey questionnaire. Many of the food items or units of measurement which were listed as “other” actually corresponded to a food item or unit pre-coded for the survey, so these were corrected in cleaning the data sets. Of the food items that were reported by survey households but were not pre-coded, for the analysis here reasonably equivalent food items were used for most to derive estimates of their nutrient content.

However, there remained some food items reported that could not be associated with equivalent food items, often due to having been reported using a highly-local term for the item. A more important problem was simply not having a way to convert a non-standard unit of measurement in which a food item was reported into a standard unit due to the unit being stated in context-specific or relative terms. Table A1 reports the number of records of food items consumed by survey households that could not be brought into the analysis here due to these problems.

Table A1. Food item records which could not be converted to standard quantity units

	IHS3		IHS4	
Records for which the specific food item could not be identified*	475	0.2%	648	0.3%
Records for which food quantities could not be converted to standard units	16,261	8.2%	10,401	5.3%
Total records of food items consumed by survey households	197,643	100.0%	196,304	100.0%

Source: Authors' calculations.

Note: * For the IHS3 and IHS4 respectively, 224 (47%) and 286 (44%) of the food items which could not be specifically identified were “meals at restaurants.”

The food items most commonly reported in non-standard units that could not be converted to kilogram units were slightly different in 2010/11 and 2016/17. In 2010/11, white beans, cowpea (*khobwe*), pumpkin leaves (*nkhwani*), Chinese cabbage, salt, yeast or baking powder, sweets, and dried and fresh fish all had more than 200 observations for which the quantities could not be converted. In 2016/17, the most problematic food items in this regard were soybean, salt, spices, yeast or baking powder, sweets, and tea.

ABOUT THE AUTHORS

Rachel Gilbert is a Research Analyst with the Development Strategy and Governance Division (DSGD) of the International Food Policy Research Institute (IFPRI), based in Washington, DC. Ms. Gilbert was a Leland International Hunger Fellow with IFPRI's Malawi Strategy Support Program, based in both Lilongwe and Washington, DC, while conducting most of the research for this report.

Todd Benson and **Olivier Ecker** are both Senior Research Fellows in DSGD at IFPRI, based in Washington, DC.

ACKNOWLEDGMENTS

The authors thank Bob Baulch for helpful comments on earlier drafts of this paper.

REFERENCES

- Abbaspour, N., R. Hurrell, and R. Kelishadi. 2014. "Review on iron and its importance for human health." *Journal of Research in Medical Sciences: The Official Journal of Isfahan University of Medical Sciences* 19 (2): 164–74.
- Babu, S., A. Comstock, B. Baulch, A. Gondwe, C. Kazembe, K. Kalagho, N.L. Aberman, P. Fang, O.P. Mgemezulu, and T. Benson. 2018. *Assessment of the 2016/17 Food Insecurity Response Programme in Malawi*. IFPRI Discussion Paper 01713. Washington D.C.: International Food Policy Research Institute.
- Coates, J., B.L. Rogers, A. Blau, J. Lauer, and A. Roba. 2017. "Filling a dietary data gap? Validation of the adult male equivalent method of estimating individual nutrient intakes from household-level data in Ethiopia and Bangladesh." *Food Policy*, 72: 27–42. <https://doi.org/10.1016/j.foodpol.2017.08.010>
- Deaton, A., and S. Zaidi. 2002. *Guidelines for Constructing Consumption Aggregates for Welfare Analysis*. Living Standards Measurement Study Working Paper No. 135. Washington, DC: World Bank.
- Elmadfa, I., and A.L. Meyer. 2017. "Animal proteins as important contributors to a healthy human diet." *Annual Review of Animal Biosciences*, 5 (1): 111–131. <https://doi.org/10.1146/annurev-animal-022516-022943>
- FAO (Food and Agriculture Organization of the United Nations). 2019. *FAO/INFOODS Databases*. Rome: FAO. Accessed March 13, 2019. <http://www.fao.org/infoods/infoods/tables-and-databases/faoinfoods-databases/en/>.
- FAO (Food and Agriculture Organization of the United Nations), WHO (World Health Organization), and UNU (United Nations University). 2001. *Human Energy Requirements*. Report of a Joint FAO/WHO/UNU Expert Consultation, Rome, 17-24 October 2001. Food and Nutrition Technical Report Series 1. Rome: FAO.
- DNHA (Department of Nutrition, HIV and AIDS). 2018. *National Multi-sector Nutrition Strategic Plan 2018–2022*. Lilongwe: Government of Malawi.
- Hatloy, A., L.E. Torheim, and A. Oshaug. 1998. "Food variety – a good indicator of nutritional adequacy of the diet? A case study from an urban area in Mali, West Africa." *European Journal of Clinical Nutrition*, 52: 891–898. <https://doi.org/10.1038/sj.ejcn.1600662>
- Headey, D., and O. Ecker. 2013. "Rethinking the measurement of food security: from first principles to best practice." *Food Security* 5 (3): 327–343. DOI: [10.1007/s12571-013-0253-0](https://doi.org/10.1007/s12571-013-0253-0)
- INDDEx (International Dietary Data Expansion) Project. 2018. "Data4Diets: Building Blocks for Diet-Related Food Security Analysis." Medford, MA, USA: Tufts University. <https://inddex.nutrition.tufts.edu/data4diets>.
- Kaimila, Y., O. Divala, S. Agapova, K. Stephenson, C. Thakwalakwa, I. Trehan, M. Manary, and K. Maleta. 2019. "Consumption of animal-source protein is associated with improved height-for-age z scores in rural Malawian children aged 12 - 36 months." *Nutrients* 11 (2): 480. <https://doi.org/10.3390/nu11020480>
- Leroy, J. L., M. Ruel, E.A. Frongillo, J. Harris, and T.J. Ballard. 2015. "Measuring the Food Access Dimension of Food Security: A Critical Review and Mapping of Indicators." *Food and Nutrition Bulletin* 36 (2): 167–195. <https://doi.org/10.1177%2F0379572115587274>
- Lovon, M., and A. Mathiassen. 2014. "Are the World Food Programme's food consumption groups a good proxy for energy deficiency?" *Food Security* 6 (4): 461–470. DOI: [10.1007/s12571-014-0367-z](https://doi.org/10.1007/s12571-014-0367-z)
- Lukmanji, Z., E. Hertzmark, N. Mlingi, V. Assey, G. Ndossi, and W. Fawzi. 2008. *Tanzania Food Composition Tables*. Dar es Salaam, Tanzania and Boston, MA, USA: Muhimbili University of Health and Allied Sciences, Tanzania Food and Nutrition Centre, and Harvard School of Public Health.
- Mejia, L.A., W.-Y. Kuo, and F. Beltran-Velazquez. 2019. "Provision of micronutrients in coexisting public health programs and risk of excessive intake: Regulatory considerations." *Annals of the New York Academy of Sciences* 1446 (1): 66–80.
- NIH ODS (National Institutes of Health, Office of Dietary Supplements). 2019a. "Iron - Fact sheet for health professionals." Accessed August 2019. <https://ods.od.nih.gov/factsheets/Iron-HealthProfessional/>.
- . 2019b. "Zinc - Fact sheet for health professionals." Accessed July 2019. <https://ods.od.nih.gov/factsheets/Zinc-HealthProfessional/>.
- . 2019c. "Vitamin A - Fact sheet for health professionals." Accessed July 2019. <https://ods.od.nih.gov/factsheets/VitaminA-HealthProfessional/>

- NSO (National Statistical Office). 2017. "Malawi Third Integrated Household Survey 2010-2011 Data File: IHS3fc2M_consumption." The World Bank Microdata Library. Accessed October 2017. https://microdata.worldbank.org/index.php/catalog/1003/data-dictionary/F85?file_name=ihs3fc2M_consumption.
- . 2019. "Malawi Fourth Integrated Household Survey 2016-2017 Data File: IHS4 Consumption Aggregate." The World Bank Microdata Library. Accessed January 2019. https://microdata.worldbank.org/index.php/catalog/2936/data-dictionary/F99?file_name=IHS4%20Consumption%20Aggregate.
- National Statistical Office (NSO), Community Health Sciences Unit (CHSU), Centers for Disease Control and Prevention (CDC), and Emory University. 2017. *Malawi Micronutrient Survey 2015-16*. Final report (December 2017). Zomba and Lilongwe, Malawi and Atlanta, Georgia, USA: NSO, CHSU, CDC, and Emory University.
- NSO (National Statistical Office) and ICF. 2017. *Malawi Demographic and Health Survey 2015-16*. Zomba, Malawi and Rockville, MD, USA: NSO and ICF.
- NSO (National Statistical Office) and World Bank, Poverty and Equity Global Practice. 2018. "Methodology for Poverty Measurement in Malawi (2016/17)." Zomba and Washington, DC: NSO and World Bank.
- . 2018b. "Malawi: Poverty Measurement Using the Fourth Integrated Household Survey 2016/17 (IHS4)." Lilongwe, Malawi: National Statistical Office and The World Bank Group.
- Ruel, M.T. 2003. "Operationalizing dietary diversity: A review of measurement issues and research priorities." *The Journal of Nutrition* 133 (11, Suppl. 2): 3911S–3926S. <https://doi.org/10.1093/jn/133.11.3911S>
- Ruel M.T., H. Alderman, and the Maternal and Child Nutrition Study Group. 2013. "Nutrition-sensitive interventions and programs: How can they help accelerate progress in improving maternal and child nutrition?" *Lancet* 382: 536–551. [https://doi.org/10.1016/S0140-6736\(13\)60843-0](https://doi.org/10.1016/S0140-6736(13)60843-0)
- Steyn, N.P., J.H. Nel, G. Nantel, G. Kennedy, and D. Labadarios. 2006. "Food Variety and Dietary Diversity Scores in Children: Are They Good Indicators of Dietary Adequacy?" *Public Health Nutrition* 9 (5): 644–650. <https://doi.org/10.1079/PHN2005912>.
- Swindale, A., and P. Bilinsky. 2006. *Household Dietary Diversity Score (HDDS) for Measurement of Food Access: Indicator Guide (v.2)*. Washington DC: Food and Nutrition Technical Assistance Project (FANTA).
- USDA ARS (U.S. Department of Agriculture, Agricultural Research Service). 2007. *USDA Table of Nutrient Retention Factors Release 6*. Beltsville, MD, USA: USDA ARS. <https://data.nal.usda.gov/dataset/usda-table-nutrient-retention-factors-release-6-2007>.
- . 2018. *USDA Food and Nutrient Database for Dietary Studies 2015-2016*. Beltsville, MD, USA: USDA ARS. Food Surveys Research Group Home Page, www.ars.usda.gov/nea/bhnrc/fsrg. Accessed November 2018.
- Verduzco-Gallo, I., O. Ecker, and K. Pauw. 2014. *Changes in food and nutrition security in Malawi: Analysis of recent survey evidence*. Malawi Strategy Support Program Working Paper 06. Lilongwe: International Food Policy Research Institute.
- WFP (World Food Programme). 2008. *Food consumption analysis: Calculation and use of the Food Consumption Score in food security analysis*. Technical Guidance Sheet, Vulnerability Analysis and Mapping Branch. Rome: WFP.
- WHO (World Health Organization) and FAO (Food and Agriculture Organization of the United Nations). 2004. *Vitamin and Mineral Requirements in Human Nutrition*. Second edition. Report of a Joint FAO/WHO Expert Consultation, Bangkok, Thailand, 21-30 September 1998. Geneva and Rome: WHO and FAO.
- WHO (World Health Organization), FAO (Food and Agriculture Organization of the United Nations), and UNU (United Nations University). 2007. *Protein and Amino Acid Requirements in Human Nutrition*. Report of a Joint WHO/FAO/UNU Expert Consultation on Protein and Amino Acid Requirements in Human Nutrition, Geneva, 9-16 April 2002. WHO Technical Report Series 935. Geneva: WHO.
- Yang, R.-Y and P.M. Hanson. 2009. "Improved food availability for food security in Asia-Pacific Region." *Asia Pacific Journal of Clinical Nutrition* 18 (4): 633–637.

The Malawi Strategy Support Program (MaSSP) is managed by the International Food Policy Research Institute (IFPRI) and is financially made possible by the generous support of the American people through the United States Agency for International Development (USAID) and the UK Department for International Development (DFID). This publication has been prepared as an output of MaSSP and has not been independently peer reviewed. Any opinions expressed here belong to the authors and are not necessarily representative of or endorsed by IFPRI, the US, the UK government's official policies, or CGIAR.

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

A world free of hunger and malnutrition

IFPRI Malawi, Area 14 Office, Plot 14/205, Lilongwe, Malawi | Mailing Address: PO Box 31666, Lilongwe 3, Malawi

T +265-1-771-780 | Email: IFPRI-Lilongwe@cgiar.org | <http://massp.ifpri.info>

© 2019, copyright remains with the authors. All rights reserved.