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Dietary quality and nutrition in Myanmar: Past progress, current and future challenges

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CONTENTS

TABLES

FIGURES

ABSTRACT

In the decade prior to the COVID-19 pandemic, Myanmar was in the midst of a dietary transition driven by rapid economic growth and urbanization. In this study, we first use national survey data to compare household diets in 2015 to the healthy diet recommendations of food-based dietary guidelines adapted for Myanmar, as well as estimated nutrient consumption relative to recommended intakes. We use these food group and nutrient consumption gaps to estimate a new measure of multidimensional dietary deprivation developed by Pauw et al. (2022), and a novel extension of that index to nutrient deprivation. Both deprivation indices are strongly negatively correlated with total household expenditure. We then use food demand estimation to estimate income and own price elasticities, which reveal strong preferences for animal-sourced foods, but weaker preferences for vegetables and pulses. Expenditure data also point to strong demand for oils/fats – a problem observed throughout developing Asia (Pingali and Abraham 2022) – and for food away from home, which partially explains the rising burden of overweight/obesity in Myanmar. Moreover, since most nutrient-dense foods are income- and price-elastic, estimated income elasticities suggest that recent declines in household income and increases in food prices in Myanmar will result in declining dietary diversity.

We show that this is indeed the case utilizing household phone surveys conducted in recent years. We first use a food vendor survey to show that the cost of a healthy diet increased by 61 percent between September 2021 and September 2022. Next, we analyze a rural Dry Zone panel survey implemented 10 times over 2020-2021 and find that maternal and child dietary diversity both declined significantly as Myanmar's economic situation deteriorated. Then, in a nationally representative phone survey conducted quarterly in 2022 over a period of rapid food inflation, we find further deterioration in diet quality among adults, but no deterioration among children 6-23 months of age, suggesting parents may be trying to insulate their children from the worst effects of the crisis.

Finally, we conclude the paper by discussing policy and program options in very difficult political circumstances. Malnutrition is a multidimensional problem requiring multisectoral solutions, but at present the breakdown in the provision of even basic services makes significant progress highly unlikely, and reversing the recent deterioration in dietary quality and nutrition will surely require resolution of Myanmar's political crisis. In the interim, we discuss three potentially effective types of interventions: (1) rice fortification to reduce micronutrient deficiencies; (2) homestead food production to improve dietary quality in farm households and rural and peri-urban communities; and (3) nutrition-sensitive social protection for vulnerable mothers and young children, with transfers ideally accompanied by nutrition education interventions.

Keywords: Diets; diet diversity; nutrition; Myanmar; dietary transition.

1. INTRODUCTION

Prior to the onset of the COVID-19 pandemic in 2020 and the military takeover in 2021, Myanmar was experiencing a period of rapid growth and transformation in the wake of economic and political liberalization, with average annual growth rates of 12 percent between 2000 and 2009 and 7 percent between 2010 and 2019. Strong growth was accompanied by a halving of the national poverty rate between 2005 and 2017 from 48.2 to 24.8 percent (MoPF, UNDP, World Bank 2019). However, the impacts of COVID-19 and political shocks led to an economic contraction, with GDP in 2022 estimated to be 13 percent lower than in 2019, while 2021 saw a disastrous 18 percent contraction in GDP (World Bank 2022). The impacts on poverty are surely even more dire, with a high-frequency panel phone survey from urban Yangon and the rural Dry Zone showing incomes collapsing during lockdowns and COVID-19 waves and further income losses in the wake of the February 2021 military takeover (Headey et al. 2022). Then in late 2021 through 2022, prices rose dramatically, with the consumer price index rising by 17 percent between March 2021 and March 2022 (World Bank 2022) while food prices rose by more than 50 percent between August 2021 and August 2022, and by more than 20 percent compared to May 2022 (WFP 2022; MAPSA 2022d). At the national level, a variety of different poverty indicators suggest that 40 to 50 percent of the population were living in poverty in 2022 (MAPSA 2021, 2022c; World Bank 2022); poverty rates similar to those found between 2005 and 2010.

This reversal in economic growth and poverty reduction gains, as well as sharp increases in food prices, has profound implications for dietary quality and hence malnutrition. An international literature shows strong connections between economic growth and reductions in key nutrition outcome indicators such as pre-schooler stunting (Headey 2013; Smith and Haddad 2002), while at the micro level increases in household wealth remains one of the strongest predictors of stunting reduction over time (Headey et al. 2016). Recent research also suggests that economic growth shocks and food inflation are important risk factors for child wasting (Headey and Ruel 2022a; 2022b).

While COVID-19 and the political crisis in Myanmar has precluded the implementation of anthropometric surveys, a deteriorating nutritional situation is to be expected. Dietary quality is strongly associated with household income or wealth. In good times, as incomes rise, smaller shares of household income are spent on food (Engels' law) while diet composition shifts from baskets heavy in starchy staples toward more diverse diets comprised of relatively more expensive foods (Bennett's law). Conversely, when incomes decline, dietary diversity tends to decline. One key explanation is that foods rich in micronutrients and high-quality protein – such as animal-sourced foods, fruits and vegetables – are typically expensive sources of calories (Headey and Alderman 2019). Thus, poor households concerned about basic hunger (calorie adequacy) tend to consume fewer nutrient-dense foods until their incomes decline, and lack of consumption of nutrient-dense foods results in low intake of micronutrients and high-quality protein, and rising deficiencies in key nutrients.

Numerous reports and studies implemented prior to COVID-19 document the poor state of nutrition in Myanmar, including high rates of stunting among pre-schoolers, overweight/obesity among adult women and micronutrient deficiencies across a range of demographic groups (Grover et al. 2019; MoH, WHO, and WDF 2015; MoHS 2017; MoHS and IFC 2017). During Myanmar's pre-COVID decade of sustained economic growth and development, stunting fell from 35 percent in 2010 to 26.7 percent in 2018 (MoH and MONPED 2010; MoHS 2017; Grover et al. 2019). However, around one quarter of adult women in Myanmar were overweight or obese in 2015, and there was evidence of growing levels of diet related non-communicable diseases prior to COVID-19 such as hypertension and type 2 diabetes, particularly in urban areas (e.g., Aung et al. 2018; Grover et al. 2019; MoH, WHO and WDF 2015; and Ueno et al. 2021). There are also huge regional disparities in nutrition outcomes and diet quality, with stunting especially high in remote areas such as Rakhine and Chin State where roughly one in two pre-schoolers were stunted in 2015-16.

Addressing malnutrition comprehensively, including undernutrition and overweight/obesity, requires an inclusive, multi-sectoral and nutrition-sensitive development strategy. It must be inclusive because poverty is a root cause of poor diets through the sheer inability to afford a healthy diet. It must be multi-sectoral because malnutrition is caused by both poor diets and a poor health environment, including poor access to health services, poor water, sanitation, and hygiene (WASH) conditions, as well as lack of education and caregiver knowledge. And it must be nutrition-sensitive in the sense that traditional approaches to development require new, nutritionally smarter strategies to agricultural and food systems as a whole, as well as health, WASH, family planning and other nutritionally relevant sectors. Unfortunately, Myanmar's economic, social and political crises are a significant barrier to developing and implementing an improved strategy to addressing malnutrition, and only a resolution to these crises will allow the country to resume meaningful progress.

In this study, we apply economic techniques to a wide range of surveys in Myanmar to look back at the food and diet situation prior to these crises, before turning to more recent evidence from surveys conducted during the COVID-19 and political crises, including a new nationally representative household survey conducted in 2022. The value added of such a study is that while many previous studies examine nutrition outcomes in Myanmar and a few study diet quality indicators in small sample surveys, very little previous research has examined diet quality at the national level, while documentation of diet quality during the COVID-19 and political crisis is very limited indeed.

The remainder of this study is structured as follows. Section 2 documents variation in household dietary quality indicators using past national economic surveys and explores the socioeconomic factors that explain variation in these indicators. Section 3 reports household food demand estimates to get a sense of food preferences, particularly to gauge household consumption responses to income and price changes. Section 4 looks at evidence on dietary quality indicators over 2020-2021 using the aforementioned panel survey of mothers of young children in Yangon and the rural Dry Zone as well as a new nationally representative phone survey of some 12,000 households. Section 5 concludes with a discussion of the policy priorities, both in the immediate term and the longer term, assuming resolutions to the political crisis can place Myanmar back on to a more progressive development path.

2. DIET QUALITY PRIOR TO THE CURRENT CRISIS

We use data from two national household surveys with modules designed to capture household food consumption and expenditure. The majority of the analysis is based on the 2015 Myanmar Poverty and Living Conditions Survey (MPLCS). We additionally use the Integrated Household Living Conditions Assessment Survey (IHLCA) from 2009/10 to explore dietary changes over time.[1]

In both the IHLCA and MPLCS, households report quantities of foods consumed during specified recall periods together with quantities and values of purchased food items. Methods for constructing quantities of food consumed, unit values, and household total and food consumption-expenditure variables are outlined in a technical report published by MoPF and the World Bank (2017c). Additionally, we calculate food quantities in edible portions, as well as the nutrient content of foods, with a number of results reported per adult equivalent.[2]

Evolution of household dietary patterns

We begin by exploring the evolution of food consumption by detailed food groupings. Between 2010 and 2015, the incidence of national poverty in the Myanmar population fell from 42.4 to 32.1 percent (MoPF and World Bank 2017a) and GDP per capita rose an average of 7 percent per year (MoPF and World Bank 2017b). Real household consumption-expenditure rose an average of 3 percent per year but was uneven with urban household consumption-expenditure increasing by 4.1 percent per year compared to only 2.9 percent in rural areas (MoPF and World Bank 2017b). During this time food expenditure shares decreased considerably by 2.9 percent on average per year (2.5 percent in urban areas and 3.5 percent in rural areas; authors' calculations), which is consistent with Engel's Law.

According to Bennet's Law (Bennet 1941), we would also expect to see a corresponding shift away from energy-dense staple foods to a relatively more expensive diverse set of foods, which we explore by examining changing dietary energy shares between 2010 and 2015 (Table 1). Total energy intake at the national, urban, and rural levels is quite similar between survey years, but consistent with Bennett's Law, energy shares of staple foods at home declined by 11 percent between 2010 and 2015 at the national level, a decline of 7.9 percentage points. One caveat is that we do not know the energy shares from staple foods in food consumed away from home (FAFH), and indeed, declining staple consumption at home was accompanied by increased FAFH consumption with its share rising by 4.8 percentage points.[3] In addition, consumption shares of added oils and fats rose by 2.3 points while discretionary foods (sugars and sweets, condiments, alcohol) rose by 1.4 points in aggregate. Since much FAFH may be unhealthy, this provides some suggestion of a nutrition transition toward relatively unhealthy foods, which has been observed elsewhere in Asia (Pingali and Abraham 2022). Increased shares of added fats in the diet were further driven by greater availability of cheaper imported oils, particularly palm oil, that accompanied

[1] An MPLCS poverty report (MoPF and World Bank 2017b) details important differences between the two surveys that could impact comparability including sampling and survey design as well as seasonality (IHLCA: December 2009/January 2010 and May 2010; MPLCS: January-April 2015). Key differences in the collection of food data include differences food lists, recall periods for some foods, and the method of collecting information on food consumed away from home.

[2] Food wastage factors and the energy and nutrient content of foods are obtained from the USDA food composition table (2016) and supplemented with information from Bangladesh (Shaheen et al. 2013), ASEAN (Institute of Nutrition 2014), Japan (MEXT 2015), West Africa (Stadlmayr 2012), and World Fish for Myanmar (Scott 2019). Wastage factors allow "as purchased" food quantities to be converted to edible portions. All food quantities are reported in edible portions. In calculating the nutrient content of foods, we apply USDA (2007) nutrient retention factors for typical cooking techniques in Myanmar. Some results are reported per adult equivalent, which we calculate using an adult equivalency scale derived from the daily age-sex energy needs of individual household members relative to that of a 30-year-old adult woman, 2,195 kilocalories following the methodology described by Waid et al. (2017) and outlined for Myanmar in Mahrt et al. (2019).

[3] The two surveys take quite different approaches to collecting data on food prepared and consumed outside the home, which impacts the comparability of these results. However, it is unclear whether either approach would have a relatively greater upward or downward bias.

a relaxing of import restrictions in 2011 (Belton and Win 2019) and the general global decline in palm oil prices.

Table 1. Evolution of dietary energy shares by detailed food groupings, 2010 and 2015 (percent)

Food group	Detailed food grouping	National			Urban			Rural		
		2010	2015	change	2010	2015	change	2010	2015	change
Staples	Rice	65.0	57.4	-7.7	57.7	50.9	-6.8	67.6	59.8	-7.8
	Other cereals	1.6	1.1	-0.5	2.4	1.4	-1.0	1.3	1.1	-0.3
	Roots and tubers	0.7	0.9	0.2	0.7	0.9	0.2	0.6	0.9	0.2
	Total staples	67.3	59.4	-7.9	60.8	53.2	-7.6	69.6	61.8	-7.8
Animal source foods	Fresh milk	0.1	0.1	0.0	0.2	0.3	0.1	0.0	0.0	0.0
	Eggs	0.8	1.0	0.2	1.1	1.4	0.3	0.7	0.8	0.1
	Small fresh fish	0.2	0.3	0.0	0.2	0.3	0.1	0.3	0.3	0.0
	Other fresh fish/seafood	1.1	1.0	0.0	1.4	1.2	-0.1	0.9	0.9	0.0
	Small dried fish/shrimp	0.3	0.3	0.0	0.4	0.3	0.0	0.3	0.3	0.0
	Medium/large dried fish	0.3	0.3	0.0	0.4	0.4	0.0	0.3	0.3	0.0
	Fish/shrimp products	0.4	0.4	0.0	0.3	0.3	0.0	0.4	0.4	0.0
	Poultry	0.8	1.3	0.6	0.9	1.9	1.0	0.7	1.1	0.4
	Other meat	2.8	2.0	-0.8	2.5	2.3	-0.3	2.9	1.9	-1.0
	Total ASFs	6.8	6.7	0.0	7.5	8.4	1.0	6.5	6.1	-0.5
Pulses	Pulses and products	3.7	3.3	-0.3	4.2	3.5	-0.7	3.5	3.3	-0.2
Vegetables	DGLV	0.6	0.3	-0.3	0.6	0.4	-0.2	0.6	0.3	-0.3
	Other vegetables	1.3	1.9	0.6	1.4	2.1	0.6	1.2	1.9	0.6
	Total vegetables	1.9	2.3	0.4	2.0	2.5	0.5	1.9	2.2	0.3
Fruits	Fruits	1.9	1.4	-0.5	2.1	1.9	-0.2	1.8	1.3	-0.6
Fats	Oils	9.3	12.0	2.7	10.9	12.9	2.0	8.7	11.6	2.9
	Nuts and seeds	1.5	1.1	-0.4	1.1	0.8	-0.2	1.6	1.2	-0.4
	Total Fats	10.7	13.1	2.3	12.0	13.7	1.7	10.3	12.8	2.5
Other foods	Sugars and sweets	2.1	2.7	0.6	3.0	3.2	0.2	1.8	2.5	0.7
	Seasonings	1.3	1.6	0.3	1.2	1.4	0.2	1.3	1.6	0.3
	Alcoholic beverages	0.4	0.9	0.5	0.3	0.7	0.4	0.4	1.0	0.6
	FAFH	3.8	8.6	4.8	6.7	11.3	4.6	2.8	7.6	4.8
	Total other foods	7.5	13.7	6.2	11.2	16.7	5.4	6.3	12.6	6.4
Kilocalories per adult woman equivalent		2,449	2,442		2,081	2,080		2,578	2,581	

Source: Authors' calculations based on the 2010 IHLCA and the 2015 MPLCS.

Nationally, the share of dietary energy from nutrient-dense animal source foods (ASFs) remained constant between 2010 and 2015, while energy shares increased in urban areas (13 percent) and declined in rural areas (-7 percent). Within ASFs, consumption shifted away from pork and beef toward eggs and poultry. Nationally, chicken consumption shares increased by 72 percent and more than doubled in urban areas. Increased consumption of chicken and eggs is consistent with the growth of commercial chicken farming during the same period (Belton et al. 2020). Though reported vegetable consumption increased and fruit and pulse consumption declined, seasonality is an important factor in the consumption of some of these foods, and the different timings of the 2010 and 2015 surveys make it imprudent to draw strong conclusions on seasonal foods.

Household dietary patterns by subnational household groups in 2015

Table 2 examines consumption patterns by consumption-expenditure quintiles and Table 3 presents the same set of results by agro-ecological zones and Yangon. The last column in Table 2 shows differences between the richest quintile (Q5) and the poorest quintile (Q1). As would be expected, energy shares of staple foods decline incrementally as quintiles increase. Households in the first quintile derive 67 percent of total energy from rice compared to 46 percent in the fifth quintile. Richer households make up for this smaller share of starchy staples with higher consumption of nutrient-dense foods, but also unhealthy foods. The poorest quintile derives 4 percent of total energy from

ASFs compared to 10 percent in the richest quintile; 1 percent from fruit compared to 2 percent; 1 percent from sugary foods compared to 4 percent; and 5 percent from FAFH compared to 13 percent. Appendix Figure A.1 illustrates the strong relationship between FAFH and total expenditure where FAFH is estimated to increase by 5 kyat with each 100 kyat increase in daily income (per adult equivalent).

Most other non-staple foods and food groupings also increase by quintile but to a lesser degree. Within ASFs, energy shares from small fresh fish decline with increasing quintiles while small-dried fish and fish/shrimp products holds steady. In contrast, all other ASFs increase by 2-5 fold between poorest and richest quintiles.

Table 2. Dietary energy shares by detailed food groupings and consumption-expenditure quintile, 2015 (percent)

Food group	Detailed food grouping	Q1 (poorest)	Q2	Q3	Q4	Q5 (richest)	Q5 - Q1 (gap)
Staples	Rice	67.2	63.1	57.7	52.7	45.9	-21.3
	Other cereals	0.8	0.8	0.9	1.4	1.8	1.0
	Roots and tubers	0.8	0.9	0.9	0.9	1.0	0.2
	Total staples	68.8	64.8	59.6	55.0	48.8	-20.0
Animal source foods	Fresh milk	0.1	0.0	0.0	0.1	0.3	0.2
	Eggs	0.6	0.9	0.9	1.1	1.3	0.7
	Small fresh fish	0.4	0.3	0.3	0.2	0.2	-0.2
	Other fresh fish/seafood	0.6	0.8	1.0	1.2	1.5	0.9
	Small dried fish/shrimp	0.4	0.3	0.3	0.3	0.4	0.1
	Medium/large dried fish	0.2	0.2	0.4	0.4	0.5	0.3
	Fish/shrimp products	0.3	0.4	0.4	0.4	0.4	0.0
	Poultry	0.6	1.0	1.2	1.7	2.2	1.6
	Other meat	0.9	1.5	2.1	2.2	3.2	2.3
	Total ASFs	4.1	5.4	6.4	7.6	10.0	5.9
Pulses	Pulses and products	3.0	3.2	3.2	3.7	3.5	0.5
Vegetables	DGLV	0.3	0.3	0.3	0.4	0.4	0.1
	Other vegetables	1.8	1.8	1.9	2.0	2.2	0.3
	Total vegetables	2.1	2.1	2.3	2.4	2.6	0.4
Fruits	Fruits	0.9	1.0	1.3	1.7	2.3	1.4
Fats	Oils	11.3	11.5	12.2	11.9	12.9	1.6
	Nuts and seeds	0.8	1.1	1.1	1.3	1.2	0.5
	Total Fats	12.1	12.6	13.4	13.2	14.1	2.0
Other foods	Sugars and sweets	1.4	1.8	2.7	3.6	3.8	2.4
	Seasonings	1.7	1.6	1.5	1.5	1.5	-0.2
	Alcoholic beverages	1.0	0.9	0.8	1.1	0.7	-0.3
	FAFH	4.9	6.6	8.8	10.2	12.6	7.8
	Total other foods	8.9	10.9	13.8	16.4	18.6	9.7
Kilocalories per adult woman equivalent		1,904	2,296	2,483	2,719	2,811	907

Note: Q1 to Q5 refer to consumption-expenditure quintiles that are estimated using spatially deflated total household consumption-expenditure per adult equivalent.
Source: Authors' calculations based on the 2015 MPLCS.

Regionally, staple shares are highest in Hills and Mountains, the Delta, and Coastal areas (Table 3), which is consistent with their higher poverty rates (MoPF and World Bank 2017a; Mahrt et al. 2022). Grains other than rice have more importance in Hills and Mountains, as do roots and tubers (also more important in the Dry Zone). Energy shares from ASFs are lowest in Hills and Mountains and the Dry Zone (where pulse consumption is relatively high), while fish and seafood are more important in the Delta, Coastal areas, and Yangon. Energy shares for oils are around 10 percent, which is likely an underestimate given high oil content in FAFH (which is not observable). The widespread use of palm oil likely means that oil consumption is a major risk for overweight/obesity and non-communicable diseases. In contrast, total fruit and vegetable shares are fairly similar across areas but relatively low (3.5 – 4.1 percent).

Table 3. Dietary energy shares by detailed food groupings and agro-ecological zone/Yangon, 2015 (percent)

Food group	Detailed food grouping	Hills	Dry	Delta	Coastal	Yan-gon
Staples	Rice	61.7	53.2	59.7	64.1	51.8
	Other cereals	1.8	1.0	1.0	0.6	1.2
	Roots and tubers	1.2	1.2	0.6	0.8	0.6
	Total staples	64.7	55.4	61.4	65.5	53.6
Animal source foods	Fresh milk	0.1	0.1	0.1	0.1	0.3
	Eggs	1.0	0.8	0.9	0.7	1.5
	Small fresh fish	0.2	0.2	0.3	0.8	0.3
	Other fresh fish/seafood	0.6	0.5	1.5	1.2	1.6
	Small dried fish/shrimp	0.2	0.3	0.3	0.9	0.3
	Medium/large dried fish	0.2	0.2	0.4	0.4	0.4
	Fish/shrimp products	0.2	0.3	0.5	0.3	0.4
	Poultry	1.2	0.9	1.4	1.0	2.3
	Other meat	2.2	2.0	1.9	1.5	2.3
	Total ASFs	5.9	5.2	7.3	6.9	9.3
Pulses	Pulses and products	3.5	4.7	2.8	1.0	2.8
Vegeta-bles	DGLV	0.3	0.4	0.3	0.3	0.4
	Other vegetables	2.1	2.1	1.7	2.2	1.8
	Total vegetables	2.3	2.5	2.0	2.5	2.2
Fruits	Fruits	1.4	1.4	1.4	1.2	1.9
Fats	Oils	9.6	15.1	11.1	8.2	12.3
	Nuts and seeds	1.0	1.6	1.0	1.2	0.5
	Total Fats	10.6	16.7	12.1	9.4	12.8
Other foods	Sugars and sweets	2.5	2.2	3.1	2.6	3.2
	Seasonings	1.3	1.4	1.9	1.7	1.6
	Alcoholic beverages	1.1	0.9	0.8	1.1	0.8
	FAFH	6.6	9.7	7.2	8.2	11.9
	Total other foods	11.5	14.0	13.0	13.5	17.4
Kilocalories per adult woman equivalent		2,235	2,500	2,672	2,465	2,123

Source: Authors' calculations based on the 2015 MPLCS.

Diet composition relative to healthy diet guidelines

Food-based dietary guidelines are national policy documents and educational tools that outline healthy dietary patterns designed to meet nutrient needs while factoring in non-nutrient health properties of foods (i.e., recommending foods known to reduce risks of non-communicable diseases). We assess dietary quality in Myanmar by evaluating how closely observed household food consumption adheres to healthy diet recommendations. The government of Myanmar developed preliminary food-based dietary guidelines for the general population which include six healthy food groups (starchy staples; vegetables; fruits; dairy; meat, fish, eggs, and legumes; nuts and oils) plus some allowance for sugary foods (MoHS 2016).[4] However, because Myanmar's guidelines do not specify a diet that is overtly quantified in grams per food group, we adapt the healthy diet guidelines from neighboring Bangladesh, where diets are broadly similar (Nahar et al. 2013) (Table 4). One additional adaptation pertains to dairy, which is often not consumed in Myanmar, whereas consumption of calcium-rich small freshwater or marine fish is common throughout the country.[5] We therefore combine ASFs into a single food group rather than having a

[4] The FAO recently released guidelines for pregnant and lactating women (Zaw, Thar, and Lee 2022b) that specify six food groups, staples, pulses/animal source foods, fruits, vegetables (with an emphasis on colorful fruits and vegetables), nuts/seeds, and fats. UNICEF also released guidelines for children aged 2-5 years old (Zaw, Thar, and Lee 2022a) which disaggregates milk products from the pulses/animal source foods group.

[5] In a report of a calcium taskforce assembled to assess global calcium deficiencies, Bourassa et al. (2022) present the merits of food-based interventions in populations with low calcium intake, including promoting the consumption of small fish with bones. Hansen et al. (1998) demonstrate that fish consumed with bones provide calcium absorption at levels comparable to calcium in milk. Furthermore, fish species from tropical areas contain higher concentrations of calcium, iron, and zinc relative to cooler areas (Hicks et al. 2019).

separate dairy group, which is consistent with the approach taken by Myanmar's guidelines for pregnant and lactating women (Zaw, Thar, and Lee 2022b).

Table 4. Bangladesh healthy diet guidelines adapted for Myanmar, daily amounts per person

Food Group	Sub-food group	Recommended number of servings Min.	Max.	Avg.	Serving size (grams)	Recommended average quantity (grams)	Reference macronutrient
Starchy staples		9	15	12	30	360	carbohydrates
Pulses		1	2	1.5	30	45	protein
Animal source foods	Meat/Fish/Eggs	1	4	2.5	40	100	protein
	Dairy	1	2	1.5	150	225	NA
Vegetables	Dark green leafy vegetables	1	2	1.5	100	150	NA
	Other vegetables	2	4	3	100	300	NA
Fruits		1	3	2	100	200	NA
Fats		3	6	4.5	7	30	fat

Note: Healthy diet serving sizes and quantities are specified in the key messages and the food pyramid of the guidelines. A food exchange list provides further clarity on serving sizes of pulse and animal source foods.
Source: Nahar et al. (2013)

Recommended average quantities applied to a typical Myanmar diet, closely align with the energy needs of a reference 30-year adult woman (2,195 kilocalories). Thus, for each food group, we compare daily per adult woman equivalent food group consumption measured in food group equivalent grams[6] to healthy diet average food group quantities. The household is considered deprived in a food group when consumption is less than the healthy diet quantity. However, since the extent of deprivation matters, food group gaps measure the percentage shortfall between consumption and the healthy diet quantity (where the shortfall equals zero in households who consume sufficient quantities).

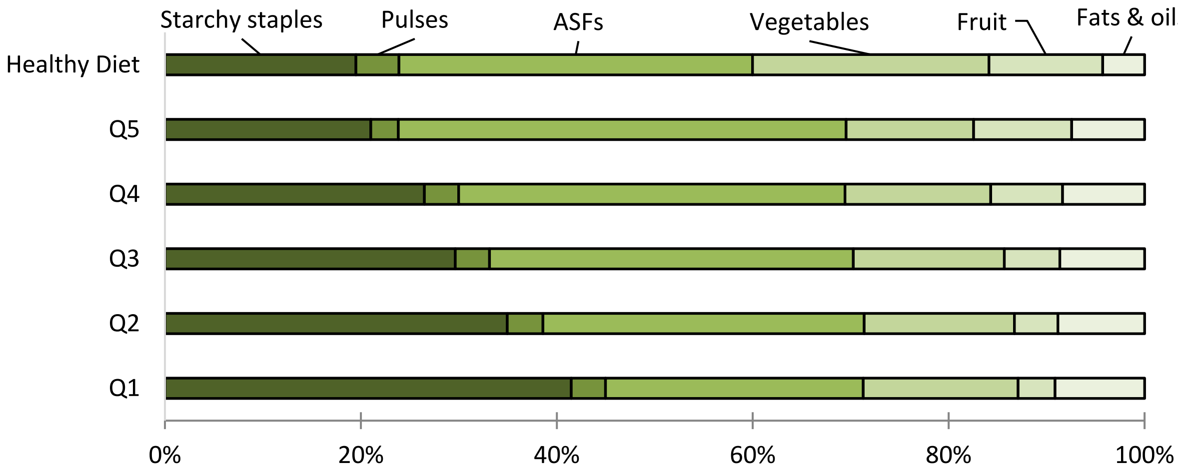
We begin by comparing the expenditure and energy composition of average household consumption of healthy diet food groups to the composition of the healthy diet guidelines (Figure 1),[7] focusing on the expected differences between richer and poorer households. The poorest quintile (Q1) spends 40 percent of its healthy food budget on starchy staples, amounting to 75 percent of its calorie consumption; in contrast, the richest quintile spends around 20 percent on staples, or 60 percent of its healthy diet calorie consumption. The richest quintile is therefore close to the 60 percent starchy staple share recommended in the healthy diet guidelines, but these better off households over-consume calories from fats and oils, which is a notable pattern observed across Asia (Pingali and Abraham 2022). The richest quintile roughly achieves the recommended intake of ASFs, but under-consumes fruits, vegetables, and pulses. The gaps for these nutrient-dense foods get progressively larger for poorer and poorer households, and the poorest quintiles also under-consume ASFs. From the differences in the share sizes between panel A (expenditures) and panel B (calories) one can also infer which foods are calorically expensive: ASFs, fruits and vegetables are expensive sources of calories, while oils fats and starchy staples are very cheap sources of calories, but sparse in key nutrients.

[6] Serving sizes apply to typical foods within each food group (e.g., dried rice, dried pulses, or fresh fish) but are not specified for atypical foods (e.g., potatoes, bean curd, or dried fish). We convert atypical food quantities to food group equivalent quantities using the ratio of a reference macronutrient contained in each item to the average macronutrient content among typical foods in the food group (Herforth et al. 2020; Mahrt et al. 2022). This process allows within food group quantity comparisons and aggregations.

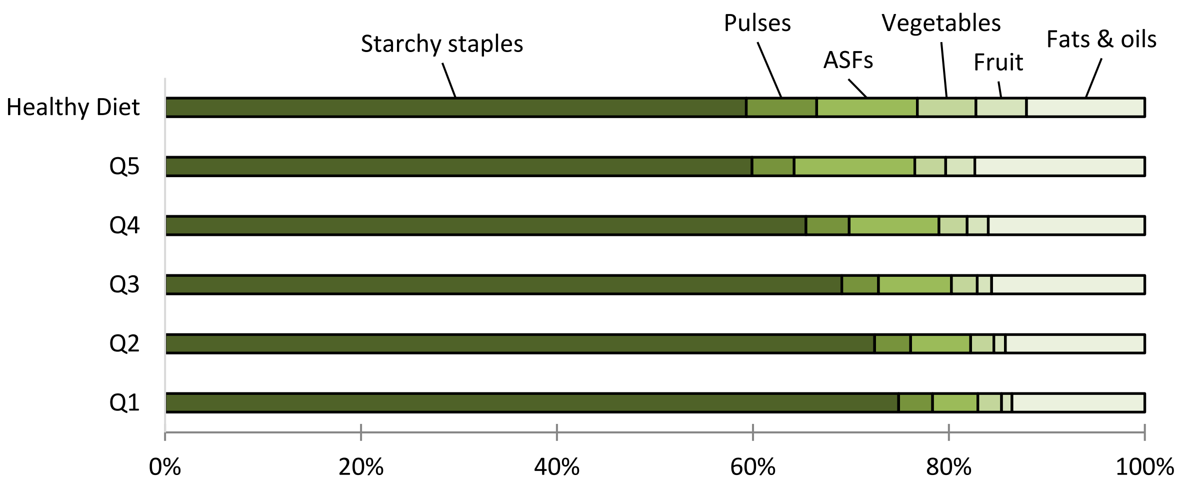
[7] We estimate the expenditure and energy composition of the healthy diet guidelines by assigning Myanmar specific foods to each food group following Mahrt et al. (2022). Using the MPLCS food consumption data, Mahrt et al. generate healthy diet food baskets aligned with recommended healthy diet food group quantities. Within each food group, foods consumed by poor and near poor households are weighted according to observed quantities consumed relative to the total food group quantity consumed measured in food group equivalent grams.

Figure 1. Food expenditure and energy shares by food group: actual consumption compared to the healthy diet shares by consumption-expenditure quintiles (income proxy)

Panel A – Food group expenditure shares



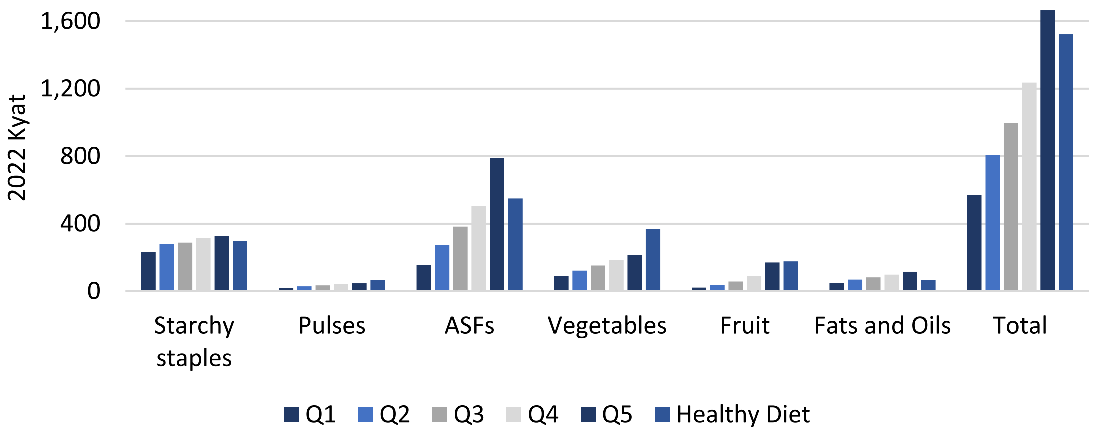
Panel B – Energy consumption shares



Note: Q1 to Q5 refer to consumption-expenditure quintiles that are estimated using spatially deflated total household consumption-expenditure per adult equivalent. The figures excludes consumption of FAFH and foods not classified into healthy diet food groups.
Source: Authors' calculations based on the 2015 MPLCS and the Bangladesh food-based dietary guidelines (Nahar et al. 2013).

Figure 2 explores household healthy food group expenditure levels in comparison to the estimated cost of a healthy diet. Overall household expenditure on healthy food groups is about two-thirds the total cost of acquiring a healthy diet, and only one-third in the poorest households. Households spend about half the healthy diet costs of pulses, vegetables, and fruits, and three-quarters the cost of animal source foods. In all food groups, expenditure increases by consumption-expenditure quintile. The poorest households spend less than a third the expenditure that the richest households allocate to healthy food groups, with the poorest spending less than one-fifth the expenditure of the richest quintile on ASFs and fruits. Even upper quintile households underspend on pulses and vegetables.

Figure 2. Healthy diet costs compared to reported expenditure (August 2022 kyat) by food groups and consumption-expenditure quintiles (income proxy).



Note: Q1 to Q5 refer to consumption-expenditure quintiles that are estimated using spatially deflated total household consumption-expenditure per adult equivalent. The figure excludes expenditure on FAFH and foods not classified into healthy diet food groups. 2015 kyat are adjusted for inflation based on the official food price index (January 2015-April 2021; CSO 2021) and price data collected by IFPRI (May 2021-August 2022; MAPSA 2022a 2022d).
Source: Authors' calculations based on the 2015 MPLCS and the Bangladesh food-based dietary guidelines (Nahar et al. 2013).

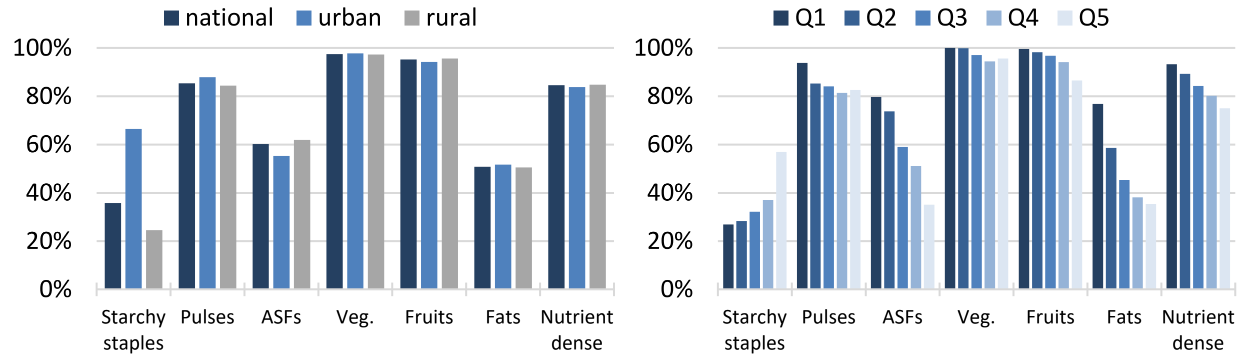
Diet shortfalls

Figure 3 displays the percentage of the population living in households that consume less than the recommended healthy diet quantity of each food group (Panel A), and, for those with insufficient consumption levels, the percentage shortfalls (Panel B), with results disaggregated not only by quintile but also by location. The final set of columns in each panel measures mean shortfalls across nutrient dense food groups: animal source foods, fruits, vegetables, and pulses. Nationally, nearly the entire population lives in households that under-consume vegetables and fruits (95 and 97 percent) by large margins (65 and 75 percent less than recommended). The majority of the population also report consuming too few pulses (85 percent), animal source foods (60 percent), and added fats (51 percent) with shortfalls of 70, 51, and 35 percent respectively. However, added fat consumption is likely underreported due to a survey design that does not include many processed foods or the composition of foods consumed away from home, which are often high in fat. Percentage shortfalls in non-staple food groups are 5-10 percentage points lower in urban areas compared to rural areas, which are poorer on average. Both deprivation rates and percentage shortfalls decline incrementally by quintile, in most cases.

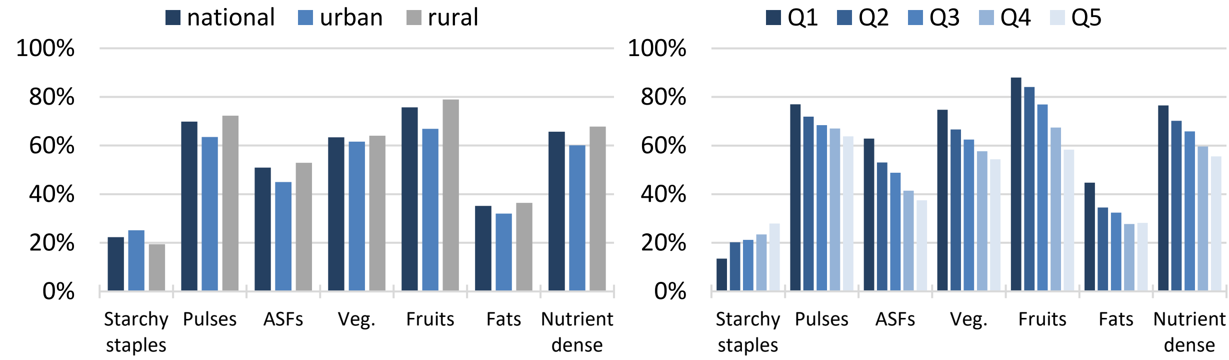
Consumption of staple foods follows a different pattern whereby urban areas and better off quintiles appear to have greater deprivations both in terms of the share of the population with shortfalls and the percentage shortfall. Again, however, it is likely that lower reported staple consumption in urban and higher-quintile households is in part related to the survey not adequately capturing processed foods and the composition of foods consumed away from home. Although there is no way to verify this with the data, urban and better off individuals tend to be more time-constrained (higher opportunity cost of time) and less income-constrained, making processed foods and FAFH more attractive. But more research is needed on these issues in Myanmar.

Figure 3. Food group consumption shortfalls, by urban rural areas and consumption-expenditure quintiles

Panel A: Share of the population living in households that under-consume each food group (percent)



Panel B: Average household deficiency in households that under-consume each food group (percent)

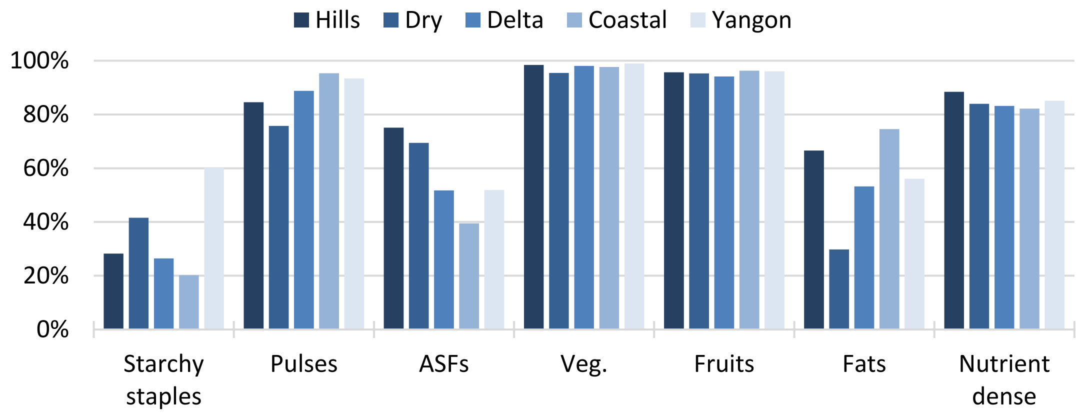


Note: Household consumption in daily food group equivalent grams per adult woman equivalent relative to total daily grams per food group in the healthy diet guidelines (Table 4). Q1 to Q5 refer to consumption-expenditure quintiles that are estimated using spatially deflated total household consumption-expenditure per adult equivalent.
Source: Authors' calculations based on the 2015 MPLCS and the Bangladesh food-based dietary guidelines (Nahar et al. 2013).

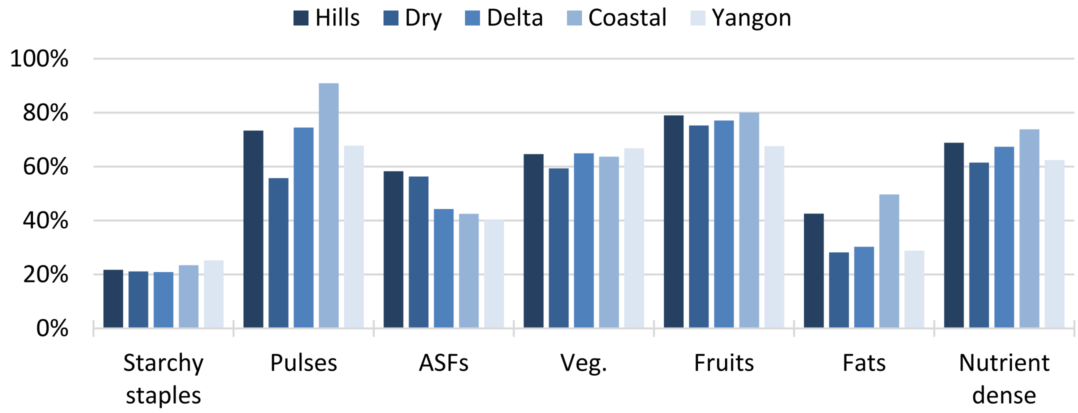
Shortfalls by agro-ecological zone and Yangon separately are reported in Figure 4. Most notably, the share of the population living in households that under-consume animal source foods is considerably higher in Hills and Mountains and the Dry Zone (79 and 65 percent) compared to the Delta, Yangon, and Coastal areas (52, 52, and 39 percent). The percentage shortfall is also higher in Hills and Mountains and the Dry Zone (58 and 56 percent) compared to the Delta, Yangon, and Coastal areas (44, 42, and 40 percent). As would be expected, households in the Dry Zone, face lower deprivations in pulse consumption.

Figure 4. Food group consumption shortfalls, by agro-ecological zone and Yangon

Panel A: Share of the population living in households with inadequate nutrient intake (percent)



Panel B: Average household deficiency in households with inadequate nutrient intake (percent)



Note and source: Figure 3

Nutrient shortfalls

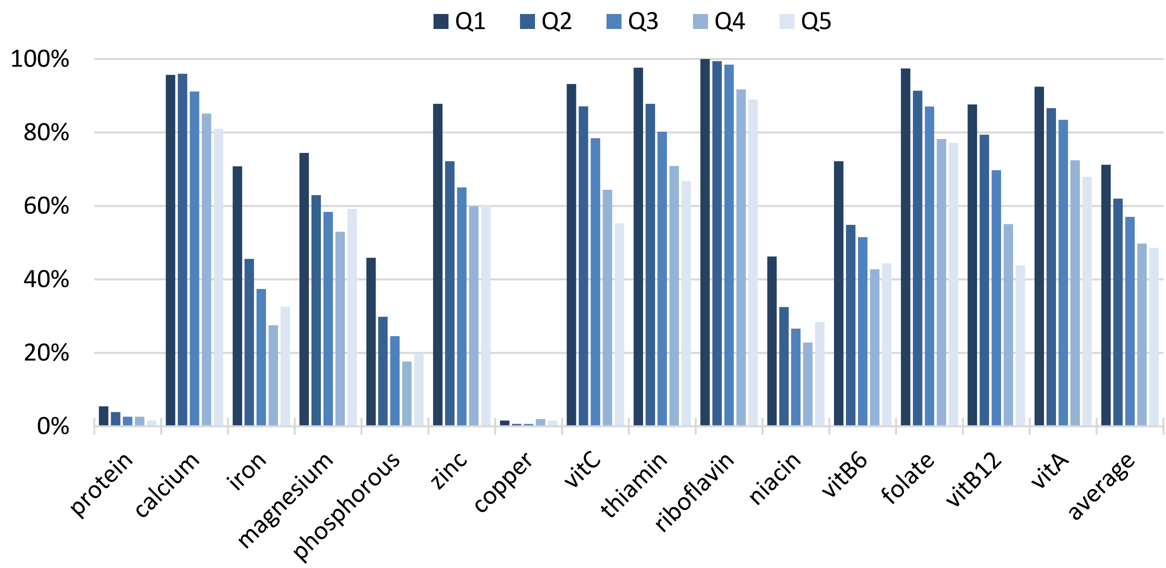
As noted, recommended healthy diets strive to specify diets consistent with good health both in terms of nutrient intake and other food properties necessary for good health. In addition to assessing food group level consumption relative to healthy diet guidelines, we directly evaluate intake of 14 nutrients relative to estimated average requirements (EARs) specified in Allen et al. (2020).[8] For each nutrient, we compare the nutrient content of daily total household consumption, adjusted for typical food preparation methods (USDA 2007), to the sum of the age-sex specific EARs across household members. The household is considered deprived in the nutrient if the total adjusted household quantity is less than the household specific total EAR, and the nutrient gap is measured as the percentage shortfall, where the shortfall equals zero in households that consume sufficient quantities. We again emphasize the important caveat that FAFH is excluded from these analyses. Another limitation is that we do not observe individual level consumption or factor in intra-household inequalities in consumption, which is another key area for future research.

[8] EARs are estimates of the nutrient intake that satisfies the nutrient needs of half the healthy individuals in a population of specified gender age group and sex (IOM 2006). The reference population (30-year-old adult woman) is the same used in global analyses (Herforth et al. 2020, FAO et al. 2020). Nutrient composition of foods relies on the following assumptions: 1) The protein EAR is calculated based 0.66 g/kg/day and a median weight for attained height of 49.4 kg; 2) Iron takes the assumption of a moderate-absorption diet; 3) Zinc takes the assumption of a semi-undefined diet. 4) Foods are prepared using typical cooking methods.

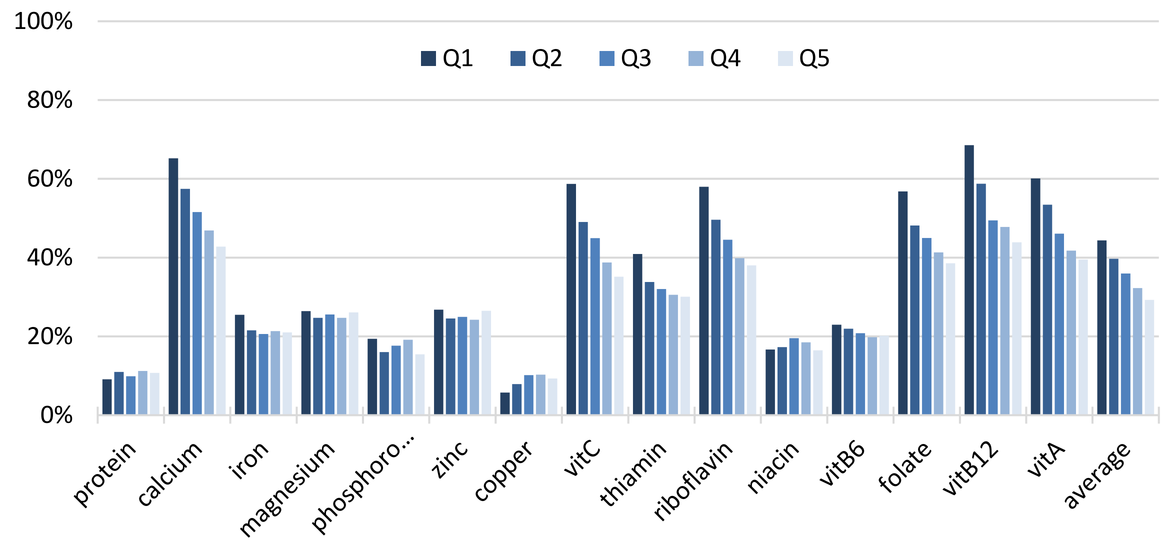
Figure 5 presents the percentage of the population living in households that consume less than the household specific EAR of each nutrient (Panel A), and, for those with insufficient consumption levels, the percentage shortfalls (Panel B). We also present the mean nutrient shortfall faced by each household with any shortfall. Nationally, 3 percent of the population lives in households that consume inadequate levels of protein and 1 percent consumes too little copper. In contrast, more than three-quarters of the population lives in households that consume too little riboflavin (96 percent), calcium (90 percent), folate (86 percent), vitamin A (81 percent), thiamin (81 percent), vitamin C (76 percent), and vitamin B12. On average, nutrient intake levels are 36 percent less than the household specific EAR. For most nutrients, shortfalls decline incrementally as consumption-expenditure quintiles increase, though it is striking that there are still sizable shortfalls for households in the richest quintile.

Figure 5. Nutrient intake shortfalls, by consumption-expenditure quintiles

Panel A: Share of the population living in households with inadequate nutrient intake (percent)



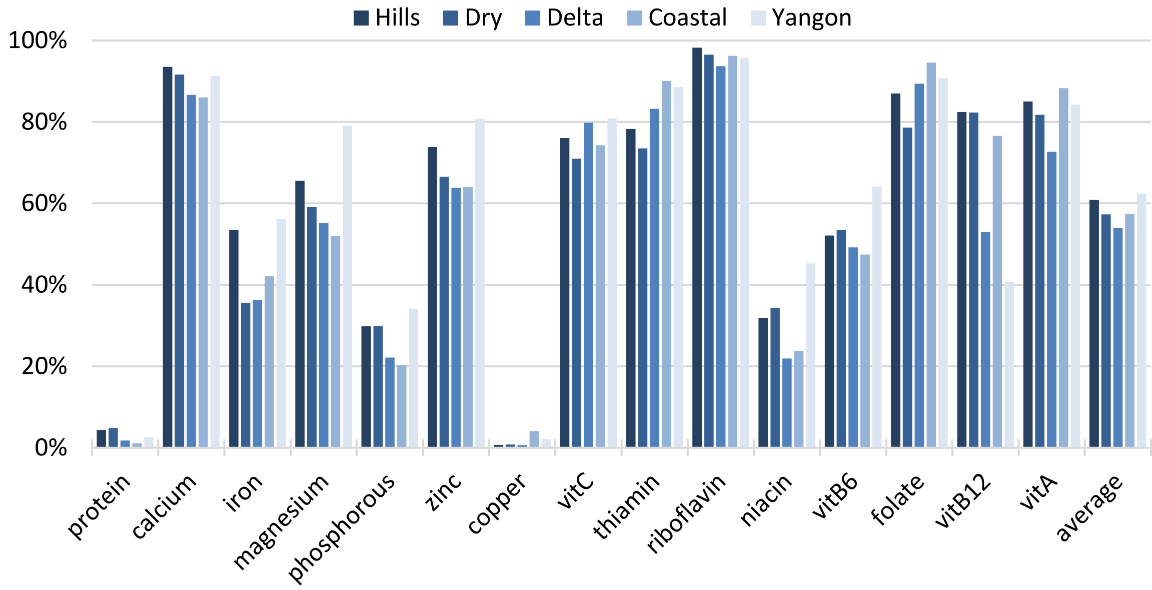
Panel B: Average household deficiency in households with inadequate nutrient intake (percent)



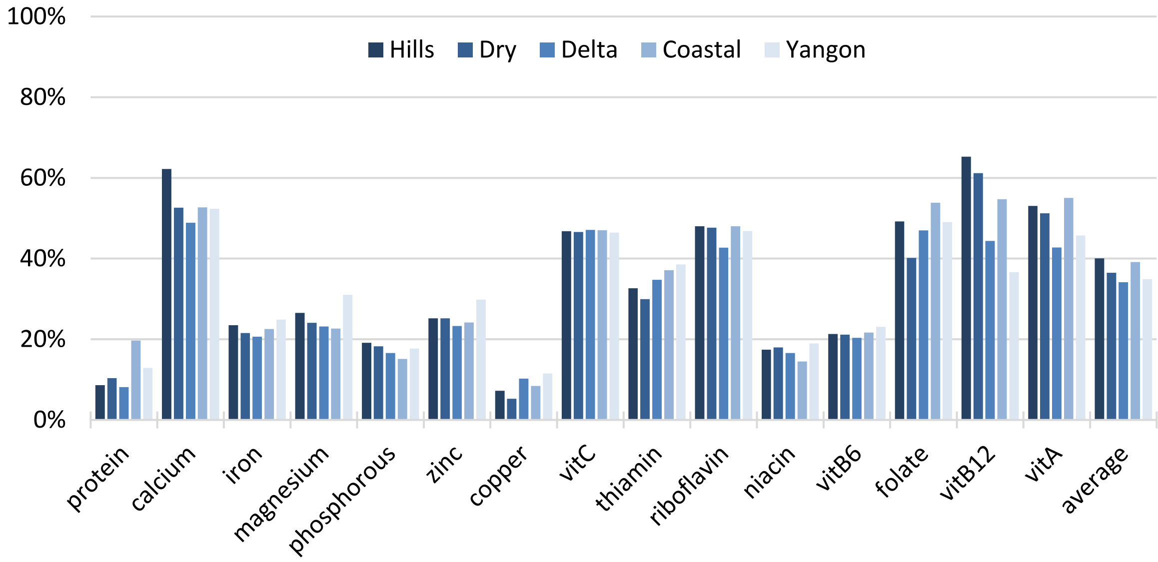
Note: Q1 to Q5 refer to consumption-expenditure quintiles estimated using spatially deflated total household consumption-expenditure per adult equivalent.
Source: Authors' calculations based on the 2015 MPLCS, EARs from Allen et al. (2020), various food composition tables (Stadlmayr et al. 2012; Shaheen et al. 2013; Institute of Nutrition 2014; MEXT 2015; USDA 2016; Scott 2019), and food retention factors from (USDA 2007).

Figure 6. Nutrient intake shortfalls, by agro-ecological zone and Yangon

Panel A: Share of the population living in households with inadequate nutrient intake (percent)



Panel B: Average household deficiency in households with inadequate nutrient intake (percent)



Note and source: See Figure 5

Results by agro-ecological zone and Yangon are presented in Figure 6 and urban rural results are presented in Appendix Figure A2 Regional differences are nuanced and vary by nutrient. However, one unusual feature in Myanmar is that micronutrient deficiencies are often quite high in Yangon. This is also consistent with poor dietary diversity in Yangon observed in different surveys and different demographic groups, including young children (Headey et al. 2022).

Diet deprivation indices

While it is useful to examine the incidence and extent of diet deprivations by food group and nutrient, it may be difficult to see a clear picture of how *overall* diet quality compares across subnational regions or household groups. Existing dietary diversity measures – such as maternal, child and household dietary scores – have the major limitation that they do not measure the extent of deprivation of any specific food group, only simple yes/no measures of consumption.

To facilitate more holistic comparisons of diet quality that capture the quantitative extent of deprivation, we generate two multidimensional diet deprivation indices which are aggregations of the deprivations described in the previous two sections: (1) deprivations in healthy diet food group consumption and (2) deprivations in nutrient intake. The indices are adaptations of the reference diet deprivation (ReDD) index developed by Pauw et al. (2021), who provide a dietary version of the multidimensional poverty index developed by Alkire and Foster (2011). Pauw et al. developed the index in the context of food group deprivations relative to a reference diet. We extend the approach by also generating an index for nutrient intake shortfalls relative to EARs.

The indices capture three aspects of multidimensional diet deprivation: incidence, intensity, and depth. Incidence of multidimensional healthy diet (nutrient) deprivation (*H*) measures the share of the population living in households that consume insufficient quantities in at least *k* food groups (nutrients) relative to the recommended healthy diet quantities (EARs).[9] We consider a deprivation in any food group (nutrient) as unacceptable and set *k* equal to one dimension. In other words, panel A of Figures 2 and 3 measures the incidence of deprivations in each food group (nutrient) whereas H measures whether a household has a deprivation in any food group (nutrient). However, *H* does not increase as the number of deprivations increases (intensity) or as the extent of deprivations increase (depth) and therefore provides a limited perspective on diet deprivations. Thus, the second aspect of multidimensional diet deprivation, intensity of deprivation (*A*), measures the share of food groups (nutrients) with deprivations in deprived households. Finally, the depth of deprivation (*G*) captures the average consumption shortfalls across deprived food groups (nutrients), where the shortfall is measured as the percentage difference between the food group (nutrient) consumption and the recommended healthy diet quantity (nutrient EAR).

The multidimensional deprivation index is the product of *H*, *A*, *G* and jointly reflects the incidence (*H*), intensity (*A*), and depth (*G*) of diet deprivations.[10] Table 5 presents the healthy diet and nutrient intake deprivation indices.[11] Households are considered healthy diet deprived if they do not consume adequate quantities of any of the six food groups and nutrient deprived if they do not consume adequate quantities of any of the 14 nutrients. This is a strict standard and nearly all households, even in the highest quintiles, are deemed deprived in both healthy diet and nutrient terms.

The intensity of healthy diet deprivation measures the share of inadequately consumed food groups in healthy diet deprived households, which on average is about 4.25 of the 6 food groups (71 percent). Intensity of deprivation is 7 percentage points higher in urban areas (76 percent) compared to rural areas (69 percent). The average depth of healthy diet deprivation is 59 percent; in other words, household consumption in food groups with shortfalls is 59 percent lower than the healthy diet food group quantity. In contrast to intensity, the depth of deprivation is 9 percentage points lower in urban areas (52 percent) compared to rural areas (61 percent). That is, households in urban areas are deprived in a larger number of food groups, but on average these deprivations are lower than those faced by rural households.

[9] The Alkire Foster multidimensional index and the ReDD index allow each dimension to be assigned weights that sum to one across dimensions. In this application we give equal weights to each dimension.

[10] The mean adequacy ratio (MAR) is a commonly applied indicator used to summarize nutrient adequacy in a set of nutrients (Hatløy et al. 1998). MAR is the average across nutrients of the ratio of each nutrient's intake level to a nutrient reference value (EARs in this study). Our application of the multidimensional nutrient index, where dimensions are equally weighted and the cut-off *k* is set at one dimension, is a special case in which the multidimensional nutrient index equals 1- MAR.

[11] For ease of interpretation we present the index, which falls in the range of 0-1, as a percentage of the highest possible score (1) – the value in a population where all households meet all food group (nutrient) requirements.

Table 5. Diet deprivation indices by household groups

	Healthy diet deprivation				Nutrient intake deprivation			
	Incidence (%)	Intensity (%)	Depth (%)	Index (%)	Incidence (%)	Intensity (%)	Depth (%)	Index (%)
National	100	71	59	42	98	59	39	23
Urban	100	76	52	40	98	63	37	23
Rural	100	69	62	42	99	57	40	22
Hills	100	75	62	47	99	61	42	25
Dry	100	68	56	38	98	58	39	22
Delta	100	69	60	41	97	55	37	20
Coastal	100	71	67	47	98	58	41	24
Yangon	100	76	54	41	98	63	38	24
Q1	100	79	68	54	100	71	45	32
Q2	100	74	62	46	100	62	41	25
Q3	100	69	59	40	100	57	38	22
Q4	100	66	54	35	96	52	35	17
Q5	99	66	50	32	95	51	33	16

Note: Q1 to Q5 refer to consumption-expenditure quintiles that are estimated using spatially deflated total household consumption-expenditure per adult equivalent.
Source: Authors' calculations based on the 2015 MPLCS, the Bangladesh food-based dietary guideline (Nahar et al. 2013); EARs from Allen et al. (2020); various food composition tables (Stadlmayr et al. 2012; Shaheen et al. 2013; Institute of Nutrition 2014; MEXT 2015; USDA 2016; Scott 2019), and food retention factors from (USDA 2007).

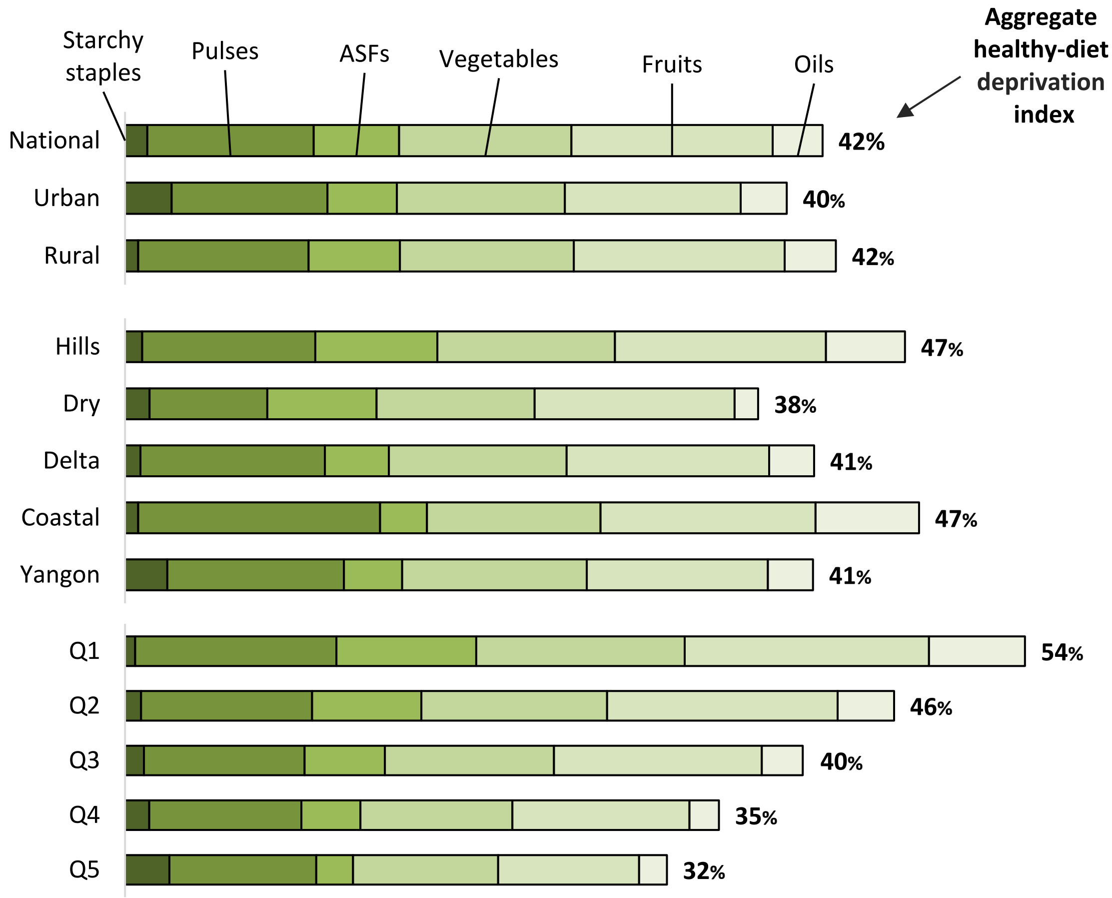
The healthy diet deprivation index, which jointly accounts for the incidence, intensity, and depth of deprivation, is 42 percent nationally. The large differences in intensity and depth between urban and rural areas nearly balance out with an index of 40 percent in urban and 42 percent in rural areas, which highlights how similar deprivation index values may result from very different structures of deprivation.

Agro-ecological zones also experience different structures of deprivation as seen in various combinations of intensity and depth of healthy diet deprivations, specifically: Coastal – moderate intensity, high depth; Hills and Mountains – high intensity and high depth; Yangon –high intensity, low depth; Delta – moderate intensity and depth; Dry – low intensity, low depth. Intensity, depth, and the healthy diet deprivation index are highest in households in the bottom consumption-expenditure quintile and decline as quintiles increase.

The nutrient deprivation index is nearly the same for the nation (23 percent) and urban (22 percent) and rural (22 percent) areas. Nutrient deprivations generally follow the same patterns as healthy diet deprivations. However, nutrient deprivations are lower than healthy diet deprivations, particularly the depth of deprivation. Furthermore, the rural-urban difference in depth of nutrient deprivation is about a third that of the healthy diet deprivation (3 versus 10 percentage points).

Intensity and depth of deprivation are important in understanding the deprivation index in subnational household groups, as seen in in the case of urban-rural areas and agro-ecological zones. The contribution of each food group (nutrient) to the healthy-diet (nutrient) deprivation index is also useful in understanding differences in subnational deprivations (Figure 7). Nationally, pulses, vegetables, and fruits account for about three-quarters of the deprivation index (78 percent). Food group contributions are quite similar between urban and rural areas with the exception of fruit, which contributes more to the deprivation index in rural areas. Notably, there is hardly any contribution of deprivations in starchy staples.

Figure 7. Absolute food group contributions to the aggregate healthy diet deprivation index



Note: Staples contribute .01-.03 points to the indices; values are not displayed. Q1 to Q5 refer to consumption-expenditure quintiles that are estimated using spatially deflated total household consumption-expenditure per adult equivalent.
Source: Authors' calculations based on the 2015 MPLCS and the Bangladesh food-based dietary guidelines (Nahar et al. 2013).

Across agro-ecological zones and Yangon, the contribution of animal source foods to the deprivation index is largest in Hills and Mountains and in the Dry Zone, while the contribution of pulses is lowest in the Dry Zone and highest in Coastal areas. With the exception of staples, the contribution of each food group declines as consumption-expenditure quintiles increase.

Table 6. Absolute nutrient contributions to the nutrient deprivation index

	National (%)	Urban (%)	Rural (%)
Protein	0.0	0.0	0.0
Calcium	3.2	3.1	3.3
Iron	0.6	0.8	0.6
Magnesium	1.0	1.5	0.9
Phosphorous	0.3	0.4	0.3
Zinc	1.2	1.6	1.0
Copper	0.0	0.0	0.0
Vitamin C	2.4	2.0	2.5
Thiamin	1.8	2.0	1.7
Riboflavin	3.0	3.0	2.9
Niacin	0.4	0.6	0.3
VitB6	0.8	1.0	0.7
Folate	2.7	2.6	2.7
Vitamin B12	2.5	1.8	2.8
Vitamin A	2.6	2.5	2.7
Index	22.5	23.0	22.3

Source: Authors' calculations based on the 2015 MPLCS; EARs from Allen et al. (2020); various food composition tables (Stadlmayr et al. 2012; Shaheen et al. 2013; Institute of Nutrition 2014; MEXT 2015; USDA 2016; Scott 2019), and food retention factors from (USDA 2007).

Table 6 presents the absolute contributions of the 14 nutrients to the nutrient deprivation index for the nation and urban and rural areas. The largest contributors are, in declining order, calcium, riboflavin, folate, vitamin A, vitamin B12, vitamin C, and thiamin. Agro-ecological zones and consumption-expenditure quintiles generally follow the same patterns, though the contribution of each nutrient declines as quintiles increase.

Regression analysis

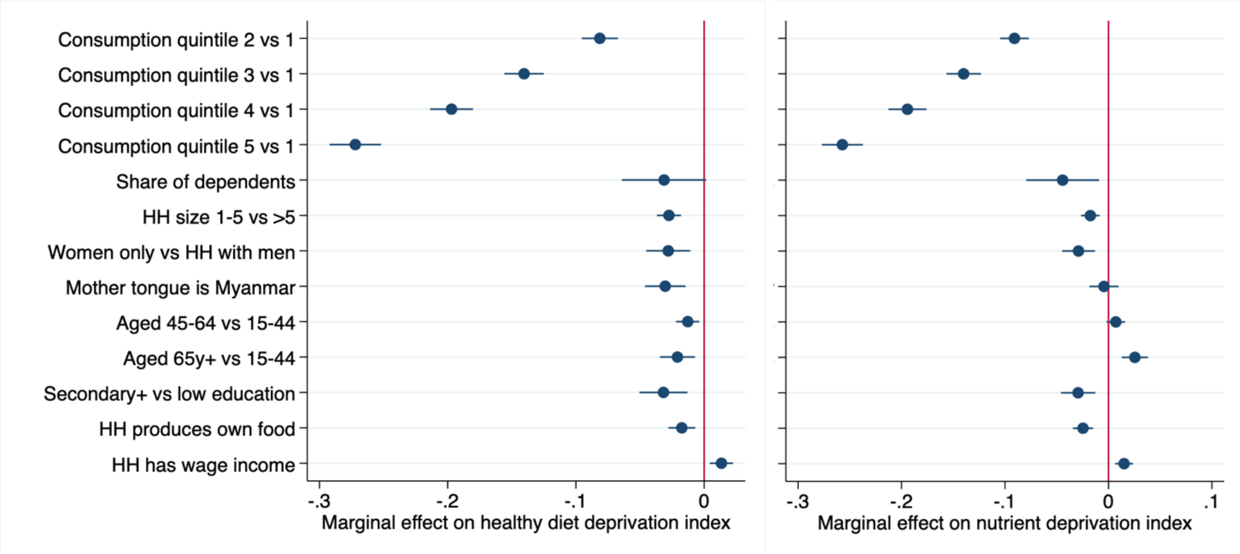
Finally, we use regression analysis to identify household characteristics that explain variation in dietary quality measures—the healthy diet deprivation index, the nutrient deprivation index and shortfalls in each food group. As each measure of dietary quality can take values ranging from 0 to 1, we perform fractional logit regressions of dietary quality, but we interpret the coefficients in percentage point terms for ease of understanding.[12] In each regression we model dietary quality as a function of standard household economic and demographic characteristics known to predict diet quality (in some sense, extensions of Bennett's law): consumption-expenditure, asset ownership, sources of income, household composition, household head age, education, mother tongue. However, since farm households can also source food from their own farm as well as markets, the rural regressions additionally control for farm size, use of irrigation, and community distance from a market.

Figure 8 displays the marginal effects of key statistically significant explanatory variables (95 percent confidence intervals in either model) on the healthy diet and nutrient deprivation indices. Consumption expenditure – an income proxy – easily has the largest association with both indices, with the extent of deprivation among the richest households around 26-27 percentage points lower than among the poorest households, for both diet and nutrient deprivation indices. Having fewer household members, women-only adults, a head who has completed secondary school, an older head, and own-produced food consumption lowers each of these indices by 2-3 percentage points, which are small effects relative to consumption expenditure. Healthy diet deprivation is also lower when the head is older and the head's first language is Myanmar, whereas nutrient deprivation is higher when the head is older. The indices are slightly higher when the household has wage income (about 1.5 percentage points). Non-farm business and remittance income were included in the model but had no significant association with either index when other economic controls are in the model, except in the urban sub-sample where remittances reduce the risk of dietary deprivation by around 2.3 percentage points (Appendix Tables A2 and A3).

Finally, to understand the relationship between household characteristics and the subcomponents of the healthy diet deprivation index, we also performed the model on shortfalls in the pulse, animal source foods, vegetable, and fruits food groups (Appendix Tables 4 and 5). There are a few interesting differences across food groups. First, lower fruit and vegetable shortfalls are associated with owning a vehicle or communication device, smaller and women-only households, education, and own food production, while lower ASF deprivation is linked to refrigerator ownership, which may indicate some benefits to cold storage (particularly important for milk, but also eggs and fresh meat/fish). Second, there is a much stronger deprivation-expenditure gradient (negative), with the richest households having a 44 percentage points higher index score than the poorest, as compared to 20-25 point Q5-Q1 gaps for pulses, fruits and vegetables. This indicates stronger household preferences for ASFs compared to other healthy food groups, as we discuss more in the next section.

[12] Regressions are performed in STATA using the command fracreg logit. To check for robustness, we also implement the same analyses using ordinary least squares, and tobit models in the case of food group shortfalls, which are censored at zero. Results are very similar irrespective of the model.

Figure 8. Marginal effects of key explanatory variables with 95 confidence intervals in regression models exploring associations between diet deprivation indices and household characteristics



Note: Results of fractional logistic models with standard errors clustered at the enumeration area level. N=3,024. Consumption-expenditure quintiles are estimated using spatially deflated total household consumption-expenditure per adult equivalent.
Source: Authors' calculations based on the 2015 MPLCS, the Bangladesh food-based dietary guideline (Nahar et al. 2013); EARs from Allen et al. (2020); various food composition tables (Stadlmayr et al. 2012; Shaheen et al. 2013; Institute of Nutrition 2014; MEXT 2015; USDA 2016; Scott 2019), and food retention factors from (USDA 2007).

3. ELASTICITIES OF FOOD DEMAND

While the availability, accessibility, desirability, and convenience of foods all drive food choices, analyses presented in the previous sections highlighted the important role of affordability in determining dietary quality in Myanmar, which is unsurprising given relatively low levels of development. In this section we use a standard economic approach to understanding food demand, which estimates elasticities of food consumption with respect to real expenditure (an income proxy) and relative food prices. These income and price elasticities can be useful for designing effective policies and programs to improve diets, such as social protection, behavioral change interventions (to shift preferences), food taxes and subsidies, and agricultural supply interventions. Income and price elasticities of food demand also provide some indication of how consumers' food choices are likely to respond to real income and food price changes, including longer term economic growth or contractions, but potentially also economic shocks.

Income and price elasticities of food demand are estimated using the 2015 MPLCS and methods described in Ecker and Comstock (2021a, 2021b, 2021c).[13] Table 7 presents estimated income and own price elasticities of food demand for urban and rural areas in 2015, which measure how much food consumption is expected to change with a 1 percent increase in income or prices, respectively. The income elasticity of total food demand suggests that a 10 percent increase in real household income predicts a 5.6 percent increase in total food consumption in urban areas and a 6.3 percent increase in rural areas. The price elasticity estimates of total food demand suggest that a 10 percent increase in food prices decreases total food consumption on average by approximately 5.5 percent in urban areas and 6 percent in rural areas. Thus, rural households' food consumption is more

[13] A two-stage estimation approach is used to estimate household-specific, unconditional income and Marshallian (or uncompensated) price elasticities for 15 food groups as part of a complete food demand system modeling framework. In the first stage, a Working-Leser model (Leser 1963; Working 1943) produces elasticities for total food demand relative to aggregate demand for nonfood consumption. The second stage implements a censored complete food demand system model to estimate income and price elasticities for the 15 food groups. Specifically, the within-food budget allocation is modeled separately using a quadratic almost ideal demand system (QUAIDS) while allowing for full substitutability between all food groups conditional on the available food budget (Banks et al. 1997; Shonkwiler and Yen 1999). For more methodological details, refer to Ecker and Comstock (2021c).

sensitive to income and price changes than that of urban households, which is unsurprising given the lower income levels of rural households (i.e., Engel's law).

As income changes, the results suggest that households make relatively small adjustments to their consumption of rice and oils/fats and large adjustments to consumption of fruit and ASFs. In rural areas, in addition to rice and fats/oils, adjustments to fresh fish consumption are also expected to be small. In contrast, red meat has an elasticity greater than one in rural areas, meaning that changes in income results in even higher percentage changes in consumption. In addition, poultry has a relatively high elasticity close to one. In urban areas, the elasticities of red meat and fruit are not close to one, but together with fresh fish, still have elasticities higher than other food groups. Dark green leafy vegetables are less income elastic than fruit and other vegetables, which is unfortunate given their high nutrient density and health benefits.

In urban and rural areas, food group specific price changes result in relatively large changes in consumption of ASFs (and roots/tubers in rural areas) but small changes in oil and fat consumption. This is relevant given the recent inflation in edible oil prices especially, which suggest that consumers are likely to cut back relatively little, and instead cut back on nutrient-dense foods such as ASFs. Additionally, elasticities suggest that urban households would not change rice consumption by large degrees. As with the income elasticity, dark green leafy vegetables are less price elastic than fruit and other vegetables. The relatively large (negative) price elasticity of rice in rural areas, which is greater than the overall price elasticity of food in total, could be the result of combing all rice varieties into a single food grouping. If disaggregated, there likely would be varieties that respond little to price changes and vice versa. Another explanation may be that many rural households source rice from their own production, making these estimates somewhat unreliable for the rural sample. Appendix Figure A3 also shows results for each consumption-expenditure quintile. In general, income elasticities for different foods tend to decline gradually as households get richer, as one would expect given Engel's law.

Table 7. Income and own price elasticities of total food demand and major food groups

	Income Elasticities				Own Price Elasticities			
	Urban		Rural		Urban		Rural	
Total food	0.56	***	0.63	***	-0.55	***	-0.60	***
Rice	0.26	***	0.50	***	-0.37	***	-0.67	***
Pulses & nuts	0.62		0.17		-0.54	***	-0.70	***
Starchy roots & tubers	0.55	***	0.75	***	-0.52	***	-0.91	***
Poultry	0.60	***	0.95	***	-1.11	***	-0.88	***
Dairy & eggs	0.55	***	0.83	***	-1.32	***	-1.07	***
Red meat	0.68	***	1.32	***	-0.73	***	-1.48	***
Fresh fish	0.71	***	0.50	***	-0.78	***	-0.83	***
Preserved fish	0.63	***	0.73	**	-0.83	***	-0.85	***
Dark green leafy vegetables	0.54	***	0.71	***	-0.42	***	-0.61	***
Other vegetables	0.62	***	0.76	***	-0.49	***	-0.75	***
Fruits	0.88	***	1.80		-0.65	***	-0.15	
Oils & fats	0.33	***	0.55	***	-0.21	***	-0.44	***

Note: Elasticities are presented for healthy food groups. Total food includes non-healthy foods such a sugars, condiments, snacks, and beverages. Due to the need to combine a small number of disparate foods, the results for these food groups are unreliable and therefore not presented. Stars denote significance of estimates at * p<0.10; ** p<0.05; ***p<0.01.
Source: Ecker and Comstock (2021a)

Based on patterns of demand observed in 2015, we would expect that with large reductions in real income coupled with high food inflation, as occurred in 2021 and 2022 following political instability, the composition of household diets would shift toward greater shares of rice and fat consumption. Rural households and lower income quintiles would likely suffer greater pressure on overall diet quality. Consumption of animal source foods is particularly vulnerable, though fresh fish consumption in rural areas may be more resilient. Pulses and vegetables (particularly dark green leafy vegetables) have moderate to low income and price elasticities and may prove to be important sources of micronutrients in times of stress, though in some cases the bioavailability of nutrients from these foods is relatively low.

Table 8 presents selected results from a recent study (Ecker et al. 2023), which uses the same dataset to simulate dietary impacts of Myanmar's severe economic shocks in 2022 stemming mainly from the military takeover as well as COVID-19 disruptions. The table first reports energy and micronutrient consumption gaps among households in the bottom two quintiles in the 2015 baseline (column 1), which are roughly 50 percent for calcium, iron, vitamin A and folate. With a severe economic shock in 2022 – amounting to close to a 20 percent contraction in GDP at the aggregate level – these gaps increase by 6-10 percentage points (column 2). The study then reports the expected impacts of $13/month per household social protection transfers through three alternative modalities: cash (column 3), plain rice (column 4) and fortified rice (column 5). Strikingly, this size cash transfer – which approximates the transfers implemented in 2020 under the democratic regime – have little impact on micronutrient gaps because gaps are so large at baseline and the transfers is relatively small and spent on nonfood as well as food items. Transferring plain rice also has little impact – only a modest "real income" effect similar to cash – but transferring fortified rice has a major impact in closely all micronutrient gaps except calcium, since rice is not fortified with calcium. These results suggest much promise for rice fortification in times of crisis, although the study by Ecker et al. (2023) makes the strong assumption that all fortified rice is consumed – i.e., that there are no quality, wastage, or consumer preference constraints.

Table 8. Nutrient consumption gaps among the bottom 40% at baseline and under the simulation scenarios

	(1)	(2)	(3)	(4)	(5)
			Shocks + $13/month worth of social protection		
	Baseline (2015)	Economic shocks with no social protection	$13 of cash transfers	$13 of plain rice	$13 of fortified rice
Calories	-4.7	-11.6	-9.3	-7.3	-7.7
Calcium	-52.1	-60.0	-57.6	-57.2	-57.9
Iron	-48.4	-58.7	-55.4	-55.0	-19.5
Vitamin A	-50.8	-61.9	-58.5	-57.9	-13.4
Folate	-55.0	-64.1	-61.4	-60.9	-0.8

Note: The simulation results depict a hypothetical situation for the third quarter of 2021 (July – September) when Myanmar was experiencing the COVID-19 Delta wave and intensifying political stability. Iron consumption gaps assume a moderate-absorption diet.
Source: Ecker et al. (2023)

4. THE IMPACTS OF RECENT ECONOMIC SHOCKS ON DIET QUALITY IN MYANMAR

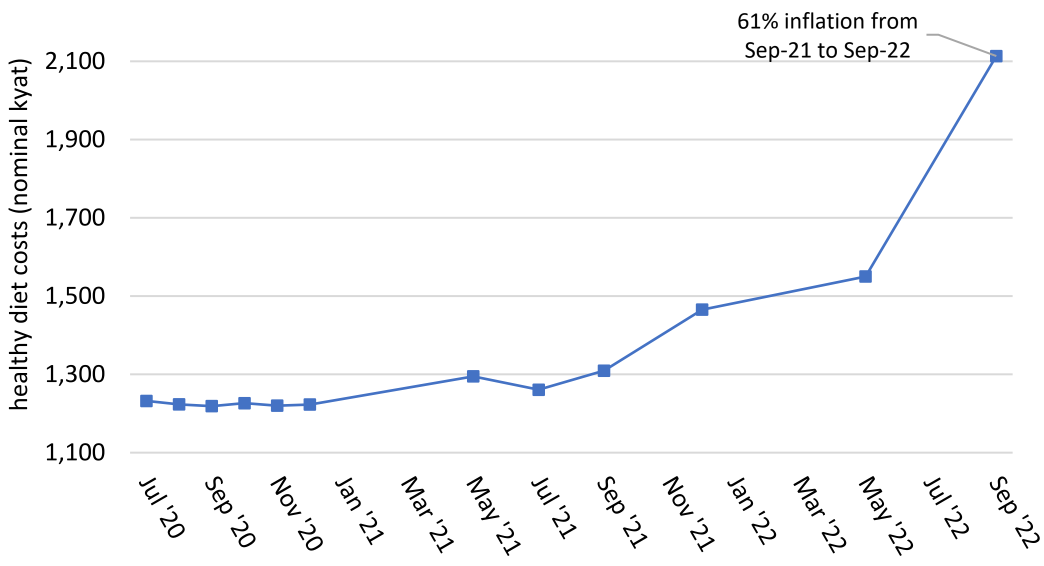
Results from the previous section are all drawn from household surveys conducted prior to the severe economic and political crises that Myanmar experienced over 2020-2022. As in-person surveys – with detailed consumption-expenditure modules – could not be implemented in this situation, we instead analyze data from various phone surveys conducted by IFPRI in recent years. We first report trends in the cost of healthy diets from a food vendor survey conducted in several hundred communities on a regular basis through 2020-2022 (MAPSA 2022a). Second, we report maternal and child dietary diversity results from the rural Dry Zone sub-sample of the Rural Urban Food Security Survey (RUFSS), a 10-round panel of mothers of young children (Headey et al.

2022).[14] Third, we report trends in dietary diversity for men and women, as well as young children, for the first three quarters of 2022 using the nationally representative Myanmar Household Welfare Survey (MAPSA 2022e).

Trends in the cost of healthy diets over 2020-2022

While the COVID-19 pandemic and the military takeover both resulted in rising poverty rates, there was initially relatively little change in food prices because of the resilience of the agricultural sector, and supply restrictions being offset by lower food demand. However, in late 2021 international food, fuel, and fertilizer prices began increasing, including palm oil, which is a very important imported food in Myanmar. To track food inflation through a nutritional lens, we follow Mahrt et al. (2022) and MAPSA (2022b) in measuring the cost of a healthy diet food basket aligned with food-based dietary guidelines adapted for Myanmar, using a special food vendor survey implemented 13 times between June/July 2020 and August/September 2022 (MAPSA 2022a).[15] Figure 9 shows healthy diet costs rose just 7 percent between September 2020 and September 2021, but skyrocketed by 61 percent between September 2021 and 2022. A decomposition of the inflation of the healthy diet food basket shows that inflation in vegetables had the largest impacts on healthy diet costs (37 percent of the total), followed by ASFs (21 percent), oils (17 percent) and starchy staples (17 percent), with pulses and fruits seeing very small price increases.

Figure 9. Changing costs of a healthy diet from June 2020–May 2022 (nominal kyat)



Source: Authors' estimates from food vendor surveys (MAPSA 2022a). Also see Mahrt et al. (2022) and MAPSA (2022b).

Dietary diversity trends of mothers and young children in the rural Dry Zone in 2020 and 2021

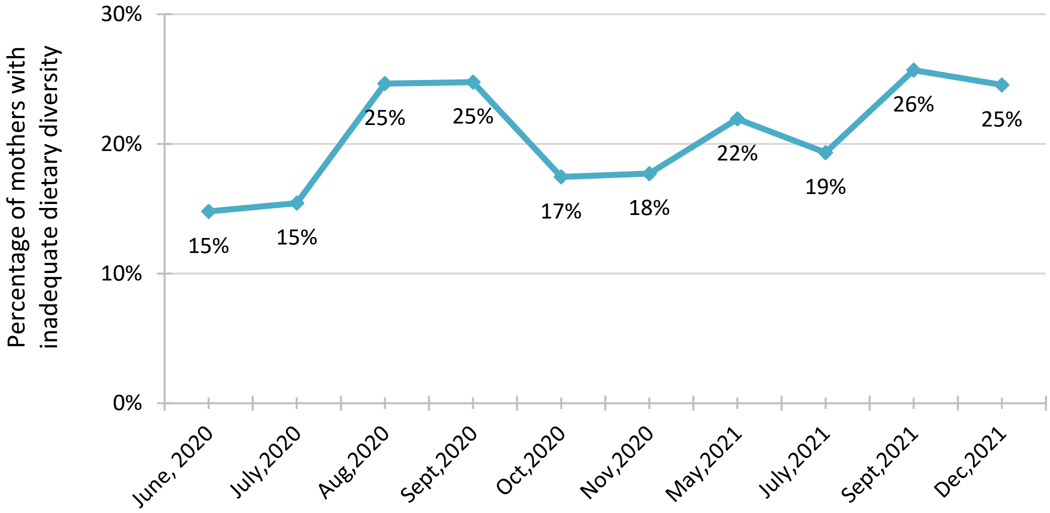
Figure 10 examines trends in inadequate maternal dietary diversity (where fewer than 5 of 10 food groups were consumed in the previous 24 hours) for the rural Dry Zone from the RUFSS sub-sample.

[14] We do not report results for the urban sub-sample of RUFSS because that sample was derived from mothers who were pregnant in early 2020. We found that mothers who had just given birth abstained from eat a number of foods, making an analysis of trends in their diets complicated from the standpoint of inferring impacts from the COVID-19 economic shock. Likewise the sample of children in the urban sample of RUFSS is very young and only being given breastmilk in many of the RUFSS rounds.

[15] The surveys collect data on the cheapest commonly consumed varieties of rice, potatoes, pulses, bananas, dark green leafy vegetables, onions, chicken, fresh and dried fish, and oil. The cost of each item equals its price times the recommended food group quantity in Table 4; and, each food group cost equals the average item cost, weighted according to within food group consumption shares obtained from the 2015 MPLCS.

The figure shows indications of seasonality in dietary diversity among mothers (August and September are typically lean-season months) but also evidence of a more secular deterioration in dietary diversity between 2021 and 2022. By December 2021 – 10 months after the military takeover – 25 percent of mothers had poor dietary diversity compared to 18 percent at the end of 2020 in the rural Dry Zone.

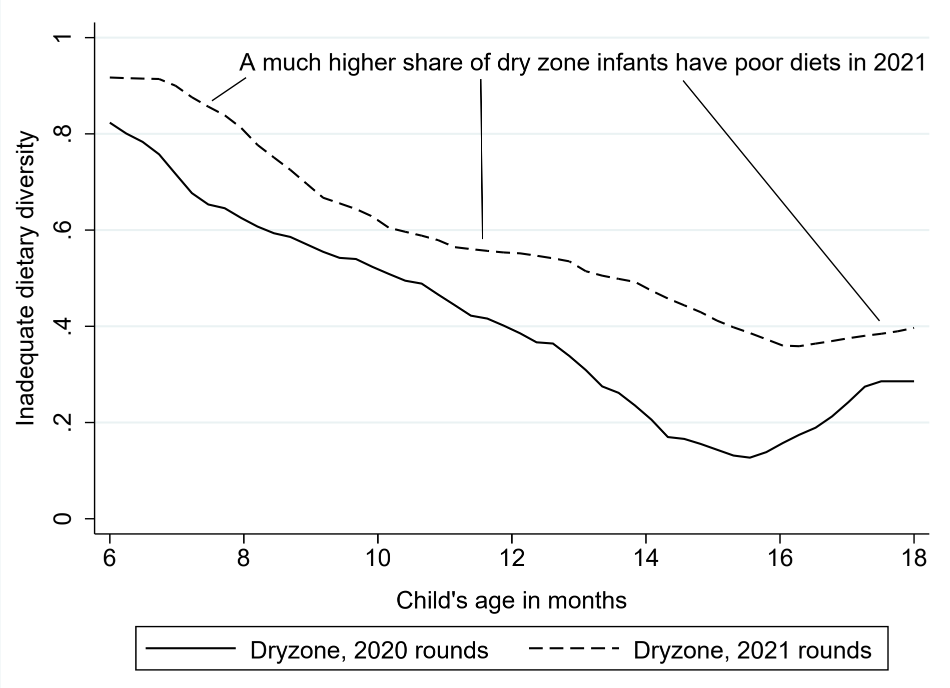
Figure 10. Trends in inadequate dietary diversity among mothers from the rural Dry Zone in 2020-2021



Source: Authors' estimates from RUFSS-various rounds.

In Figure 11, we present evidence of a deterioration in the dietary diversity of infants 6-18 months of age also, as measured by consuming fewer than 4 of 7 food groups in the past 24 hours. The share of children with poor dietary diversity is very high for the youngest children just being introduced to complementary foods (and too slowly introduced), but then improves. However, in 2021, there was a higher share of children with poor quality diets throughout the 6-18 month age range. This is deeply worrying, as good nutrition in utero and the first few years of life is critically important for both physical and cognitive development, and the impacts of these nutritional insults is unlikely to be fully reversible.

Figure 11. Comparisons of inadequate dietary diversity among children 6-18 months of age in the rural Dry Zone sample in 2020 and 2021, by child age



Source: Authors' estimates from RUFSS-various rounds.

National level results from the 2022 Myanmar Household Welfare Survey

For 2022, MHWS provides evidence from nationally representative data on the prevalence of poor dietary diversity of both men and women 18 years and older, and children 6-23 months of age.

During 2020 and 2021, household were predominantly hit by income losses as the economy contracted due to COVID-19 and the military takeover, but in late 2021 food prices started to increase rapidly (especially palm oil, which is imported), and this continued into 2022 as food, fuel and fertilizer prices increased. Table 9 explores the proportion of adults not achieving minimum diet diversity for each of the first three quarters of 2022, a period of deteriorating household budgets and rising costs of healthy diets (Figure 9). There is a large and statistically significant increase in the prevalence of inadequate diet diversity amongst adults from 20.6 percent in Q1 to 27.6 percent in Q3, though most of the increase occurs between Q1 and Q2 when food prices started increasing rapidly. In terms of spatial patterns, adults in rural areas have a somewhat higher prevalence of inadequate diet diversity than urban adults (28.8 percent vs 24.6 percent in Q3) along with a larger rate of increase between Q1 and Q3 (7.5 percentage points vs 5.7 percentage points). Women are somewhat more likely to have poor dietary diversity than men, which is worrying because poor diet quality can put mothers at risk as well as adversely affect the health and long-term cognitive ability of their children. We also find that asset-poor households (who own 0-3 of 10 possible assets) are much more likely to have poor dietary diversity than asset-low (4-6 assets) or asset-rich (7-10 assets) households, but diet quality deteriorated for all three economic groups, as it did for both income-poor and non-poor households. Appendix Tables A6 and A7 report further results by state/region.

Table 9. Percentage of adults with inadequate diet diversity (fewer than 5 out of 10 food groups)

		Q1 (Dec-Feb 22)	Q2 (Apr-Jun 22)	Q3 (Jul-Aug 22)	Difference: Q3 – Q1
	Overall	20.6	27.1	27.6	7.0***
National	Male	21.0	25.3	26.7	5.7***
	Female	20.2	28.6	28.4	8.2***
	Overall	21.2	28.3	28.8	7.5***
Rural	Male	21.3	25.9	27.9	6.6***
	Female	21.2	30.3	29.6	8.4***
	Overall	18.9	24.1	24.6	5.7***
Urban	Male	20.2	23.8	23.6	3.4*
	Female	17.7	24.4	25.5	7.8***
	Asset-poor (0-3 asset)	30.5	39.7	37.2	6.7***
National	Asset-low (4-6 assets)	18.4	24.3	25.3	6.9***
	Asset-rich (7-10 assets)	12.6	16.9	19.4	6.8***
National	Income poor	23.7	32.5	31.1	7.4***
	Income not poor	16.6	19.9	22.3	5.6***
No. of observations		*12,100*	*12,142*	*12,128*	

Note: Asterisks refer to the level of statistical significance in the difference in means across Quarter 3 and Quarter 1: * p < 0.10, ** p < 0.05, *** p < 0.01.
Source: Authors' calculations based on the MHWS rounds 1-3.

What about children 6-23 months of age? Here we find that more than a third of all children aged 6-23 months had poor diet quality by the third quarter of 2022, although unlike adults, there is no evidence of increasing rates of poor dietary diversity among young children (Table 10). It may be that parents are trying to insulate their children from any further deterioration in diet quality by sacrificing their own diet quality to some extent.

Table 10. Percentage of children (6-23 months) with inadequate diet diversity (fewer than 4 out of 7 food groups)

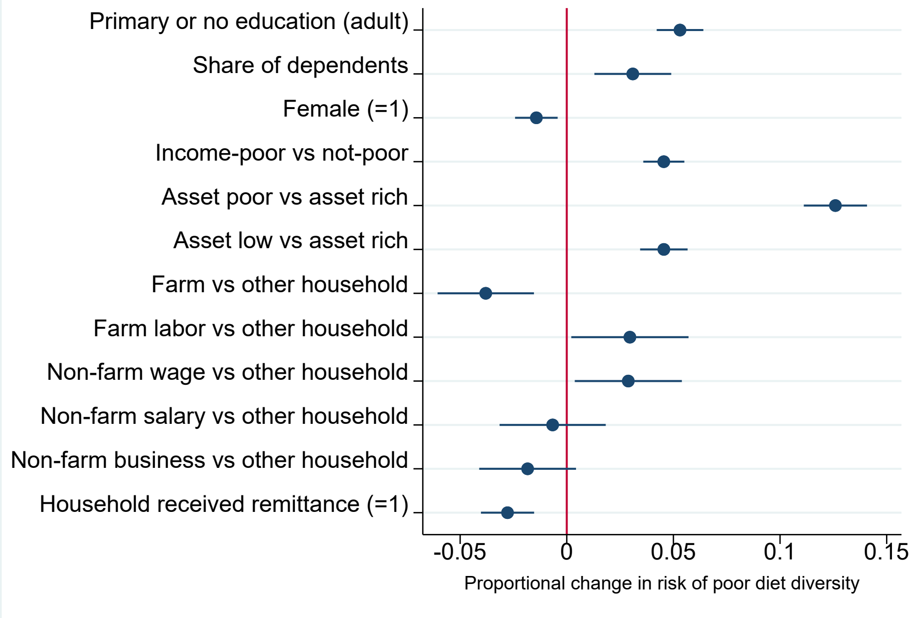
	Q1 (Dec-Feb 22)	Q2 (Apr-Jun 22)	Q3 (Jul- Aug 22)	Difference Q3 – Q1
Overall	40.7	40.0	37.2	-3.5
Boys	39.9	37.4	37.2	-2.7
Girls	41.5	42.6	37.1	-4.4
No of observations	*684*	*601*	*739*	

Note: Asterisks refer to the level of statistical significance in the difference in means across Quarter 3 and Quarter 1: * p < 0.10, ** p < 0.05, *** p < 0.01.
Source: Authors' calculations based on the MHWS rounds 1-3.

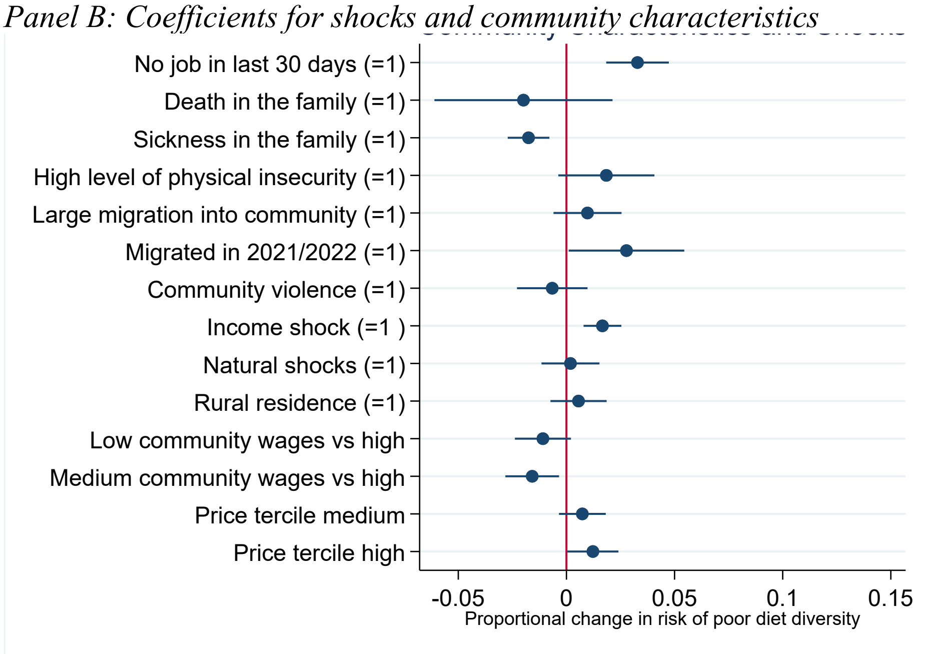
Finally, Figure 12, reports results on some of the most important predictors of inadequately diverse diets among adults. Low income and limited assets are a significant risk for inadequate diet diversity. Farm households are less likely to have inadequate diet diversity while wage worker households are more at risk of inadequate diet diversity. Adults in low-wage communities are more likely to be less at risk of inadequate diets, but adults in high price communities have a greater risk of inadequate diets. Remittance-receiving households have a lower likelihood having adults with inadequately diverse diets. Remittances seem to offer substantial resilience in this sense. However, recent migrants are more at risk of poor dietary diversity. Self-reported income shocks increase the likelihood of having inadequate diet diversity. Similarly, not having a job in the 30 days prior to the survey has a negative effect for adults and reproductive aged women. In summary, these results show that both chronic characteristics of poverty (low assets, low education, high shares of dependents) and more recent economic and conflict-related shocks are strong predictors of poor dietary diversity among Myanmar's adult populations.

Figure 12. Linear probability model regressions of household and community level predictors of the proportional change in the risk of inadequate diet diversity among adults

Panel A: Coefficients for economic and demographic characteristics



Panel B: Coefficients for shocks and community characteristics



Note: Additional controls not presented in the figures are age, survey months and state fixed effects.
Source: Authors' calculations based on the MHWS.

5. DISCUSSION

Myanmar made significant economic progress in the decade prior to 2020, when COVID-19 first paralyzed the economy, before a military takeover in early 2021 resulted in an unprecedented 18 percent contraction in GDP. In 2022, economic stagnation continued and household food and nutrition security was further threatened by high rates of food and nonfood inflation.

In this study we explored the characteristics of Myanmar's food consumption patterns through a nutrition lens, first focusing on novel consumption and nutrient deprivation indices, and then income and own price elasticities, followed by phone survey evidence on patterns and trends in dietary diversity indices from 2020 to 2022. The main findings are as follows.

First, most of the Myanmar population had poor quality diets relative to the country's (adapted) national dietary guidelines, with very low consumption of pulses, fruits, vegetables and animal sourced foods, and large consumption gaps for a range of key micronutrients and protein. Food group and nutrient gaps diminish as household income (consumption-expenditure) increases, though gaps diminish faster for ASFs than for fruits, vegetables, and pulses. Income elasticities also indicate strong demand for ASFs, moderately strong demand for fruits, and somewhat weaker preferences for vegetables and pulses. We further suspect that edible oil consumption is excessively high among better off households, which may be a risk for obesity and NCDs. In addition to income as a strong predictor of dietary quality, other social, economic and demographic characteristics have some explanatory power, though economic drivers seem predominant. However, simulation evidence on the impact of social protection transfers on nutrient consumption gaps, in the context of the huge economic shocks that Myanmar has faced, points very clearly to a critical role for fortification of rice; otherwise, cash or unfortified rice transfers have little impact on nutrient intake or on closing the gap between actual diets and recommended diets (Ecker et al. 2023).

Second, dietary quality among adults and children in the rural Dry Zone clearly deteriorated in 2020 and 2021, while national phone survey evidence showed further in deterioration in 2022 during a period of high food inflation and rising costs of a healthy diet. Regression evidence indicated that chronic predictors of poor diet quality, such as wealth levels, education, and demographic conditions in the household, but also the influence of a variety of shocks pertaining to income and job losses, price increases, conflict, and migration at the household and community level. The negative association between migration and diet quality likely emerges from many households being forced to migrate, the high costs of migration, and the paucity of employment opportunities. In contrast, households receiving remittances had individuals with somewhat better diet quality, suggesting remittances are a source of nutritional resilience.

What are the policy and programmatic implications of these findings?

First, improving diets will clearly require Myanmar to return to a path of sustained and inclusive economic growth, which will in itself require conflict resolution. At the same time, while consumption of some food groups increase quite rapidly with income growth over 2010-2015 (particularly ASFs), vegetable and pulse consumption only increased modestly. Nutrition education campaigns might be effective in improving consumer awareness of the nutritional benefits of these foods. In other Asian countries, such as Vietnam, programs have experimented with incorporating nutrition education in schools (Nguyen et al. 2021), which may be a promising avenue for improving nutritional knowledge at scale. Another intervention with some potential in Myanmar may be Enhanced Homestead Food Production (EHFP) programs, of the kind pioneered by Helen Keller International in neighboring countries (Haselow et al. 2016). Phone survey research consistently finds that farm-owning households in Myanmar have better food security and dietary diversity than other rural households. Many parts of Myanmar have relatively good access to water for homestead gardens or irrigated fruit and vegetable production, while homestead poultry production may also have potential for scaling up. More commercially oriented diversification of the food system is surely also warranted and could yield high pay-offs in terms of rural income generation and improving diets, but may also require renewed stability, a more favorable policy environment, and investments in agricultural research and development as well as critical infrastructures.

Second, while multiple forms of social protection is highly desirable in the context of the multiple economic shocks hitting Myanmar’s population, for nutritional reasons there are strong justifications for: (a) scaling up the fortification of rice and improving access to fortified rice for the poorest segments of the population; and (b) directing scarce financial resources at mothers and young children, perhaps through maternal and child cash transfers, which have been shown to be highly effective in Myanmar when coupled with nutrition education interventions (Field and Maffioli 2021; Maffioli et al. 2023).

Myanmar's progress against malnutrition has certainly been halted, and likely reversed, with deteriorating dietary quality a likely sign of rising micronutrient deficiencies and increased risks of stunting and wasting; risks further compounded by disruption to other nutritionally important services, such as health, water, sanitation, and education. Reversing this deterioration in nutrition will clearly require the “macro” solutions of conflict resolution, democratization, and economic reforms. Yet in the short run, judicious and innovative “micro” interventions can also play a role in protecting nutritionally vulnerable groups from the worst impacts of Myanmar’s multiple crises.

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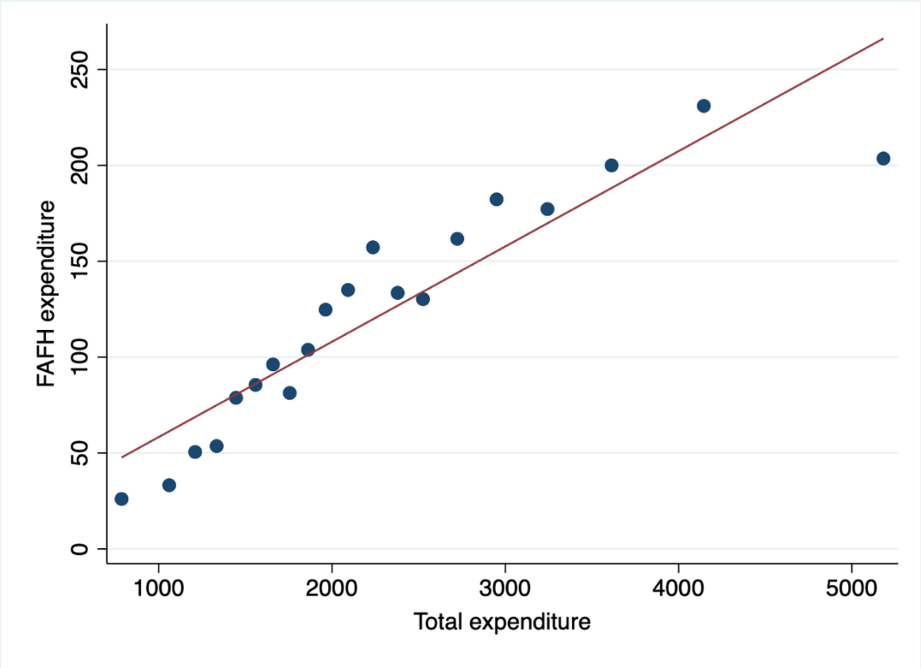
APPENDIX

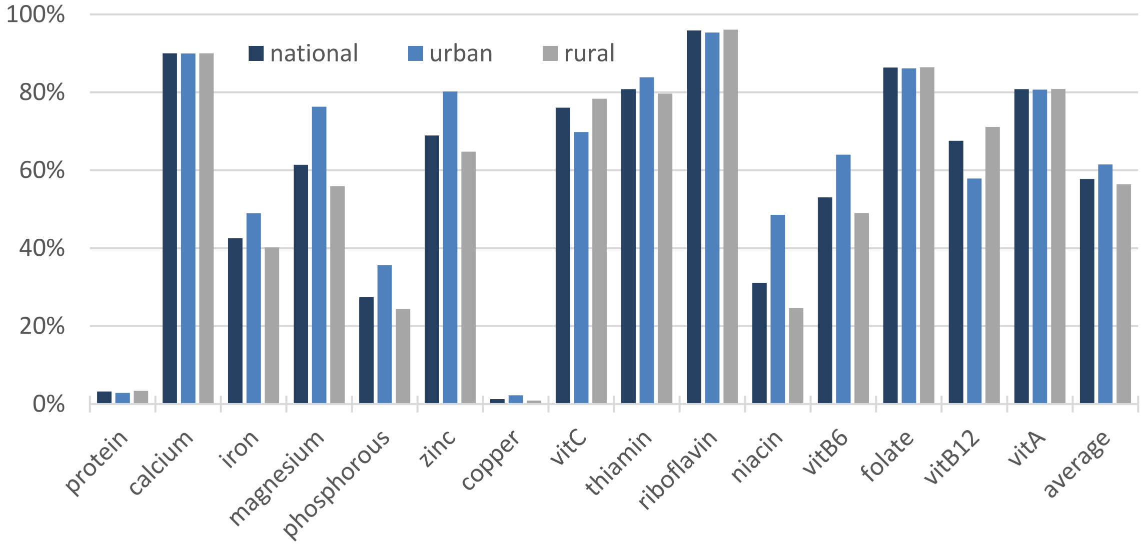
Figure A.1 Relationship between expenditure on food away from home and total consumption-expenditure per adult woman equivalent per day (2022 kyat)



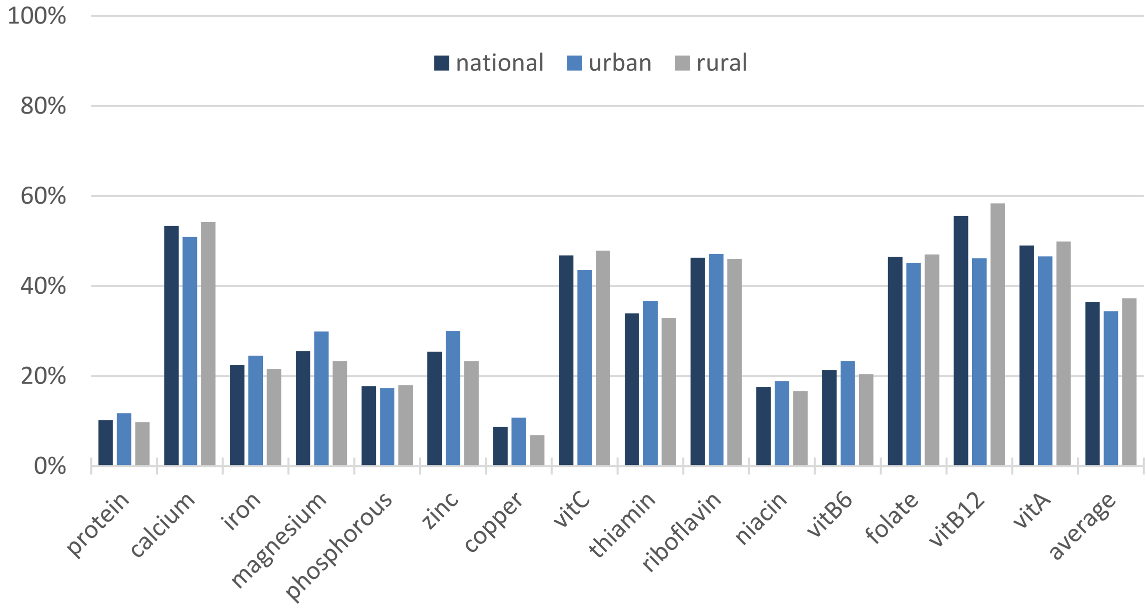
Note: Binned scatter and a fitted line with a slope of .05, significant at p<.01. 2015 kyat are adjusted for inflation based on the official food price index (January 2015-April 2021; CSO 2021) and price data collected by IFPRI (May 2021-August 2022; MAPSA 2022a 2022d).
Source: Authors' calculations based on the 2010 IHLCA and the 2015 MPLCS.

Figure A.2 Nutrient intake shortfalls, by urban rural areas

Panel A: Share of the population living in households with inadequate nutrient intake (percent)



Panel B: Average household deficiency in households with inadequate nutrient intake (percent)



Source: Authors' calculations based on the 2015 MPLCS, EARs from Allen et al. (2020), various food composition tables (Stadlmayr et al. 2012; Shaheen et al. 2013; Institute of Nutrition 2014; MEXT 2015; USDA 2016; Scott 2019), and food retention factors from (USDA 2007).

Table A.1 Marginal effects of explanatory variables in regression models exploring associations between diet deprivation indices and household characteristics

		Healthy diet deprivation index		Nutrient deprivation index	
		marginal effect	SE	marginal effect	SE
Consumption-expenditure quintiles:	Q2	-0.082***	0.007	-0.091***	0.007
(base: Q1)	Q3	-0.141***	0.008	-0.141***	0.009
	Q4	-0.198***	0.009	-0.196***	0.009
	Q5	-0.273***	0.010	-0.259***	0.010
Food expenditure share		-0.004***	0.000	-0.004***	0.000
Any expenditure on FAFH		0.043***	0.005	0.052***	0.005
Owns a refrigerator		-0.009	0.008	-0.003	0.008
Owns any type of vehicle		-0.009*	0.005	-0.011**	0.005
Owns a communication device		-0.009	0.006	-0.003	0.006
Share of dependents in household		-0.031*	0.017	-0.044**	0.018
Share of employed working age adults		-0.013	0.008	-0.009	0.008
More than 5 household members		-0.027***	0.005	-0.017***	0.005
All adults are women		-0.028***	0.009	-0.029***	0.008
Head’s mother tongue Myanmar		-0.031***	0.008	-0.005	0.007
Age of household head	45-64y	-0.014***	0.005	0.006	0.005
(base: 15-44 years)	65y+	-0.022***	0.007	0.025***	0.007
Education of household head	Complete primary	-0.008	0.005	-0.003	0.005
(base: no education or incomplete primary	Complete secondary	-0.033***	0.010	-0.031***	0.009
HH produces own food		-0.018***	0.006	-0.023***	0.005
HH has wage income		0.014***	0.005	0.015***	0.004
HH has non-farm business income		-0.000	0.005	0.001	0.005
HH has remittance income		-0.007	0.005	-0.007	0.005
Agro-ecological zone	Dry	-0.061***	0.010	-0.038***	0.010
(base: Hills and Mountains)	Delta	-0.004	0.011	-0.024**	0.010
	Coastal	-0.000	0.010	-0.027**	0.011
	Yangon	-0.022*	0.012	-0.040***	0.010
Urban/Rural	Rural landless	-0.008	0.008	-0.011	0.009
(base: Urban)	Rural landed	-0.002	0.008	-0.009	0.008

Note: Results of fractional logistic models with standard errors clustered at the enumeration area level. N=3,024. Consumption-expenditure quintiles are estimated using spatially deflated total household consumption-expenditure per adult equivalent.
Source: Authors’ calculations based on the 2015 MPLCS, the Bangladesh food-based dietary guideline (Nahar et al. 2013); EARs from Allen et al. (2020); various food composition tables (Stadlmayr et al. 2012; Shaheen et al. 2013; Institute of Nutrition 2014; MEXT 2015; USDA 2016; Scott 2019), and food retention factors from (USDA 2007).

Table A.2 Marginal effects of explanatory variables in regression models exploring associations between the healthy diet deprivation index and household characteristics in urban vs rural areas

		Urban		Rural	
		marginal effect	SE	marginal effect	SE
Consumption-expenditure quintiles:	Q2	-0.078***	0.016	-0.080***	0.008
(base: Q1)	Q3	-0.124***	0.016	-0.141***	0.009
	Q4	-0.173***	0.017	-0.201***	0.010
	Q5	-0.261***	0.019	-0.270***	0.012
Food expenditure share		-0.004***	0.000	-0.003***	0.000
Any expenditure on FAFH		0.053***	0.009	0.038***	0.006
Owns a refrigerator		-0.015	0.011	-0.009	0.014
Owns any type of vehicle		-0.019**	0.009	-0.002	0.006
Owns a communication device		-0.001	0.014	-0.009	0.007
Share of dependents in household		0.004	0.030	-0.050***	0.019
Share of employed working age adults		-0.022	0.017	-0.013	0.009
More than 5 household members		-0.037***	0.009	-0.023***	0.006
All adults are women		-0.016	0.016	-0.036***	0.010
Head’s mother tongue Myanmar		-0.040***	0.013	-0.020**	0.010
Age of household head	45-64y	-0.015*	0.008	-0.012**	0.006
(base: 15-44 years)	65y+	-0.031**	0.012	-0.015*	0.009
Education of household head	Complete primary	-0.002	0.009	-0.009	0.006
(base: no education or incomplete primary	Complete secondary	-0.032***	0.012	-0.030**	0.014
HH produces own food		-0.025***	0.008	-0.015**	0.007
HH has wage income		0.019**	0.008	0.012**	0.005
HH has non-farm business income		-0.000	0.009	0.003	0.006
HH has remittance income		-0.026***	0.009	0.004	0.006
Agro-ecological zone	Dry	-0.027	0.017	-0.084***	0.013
(base: Hills and Mountains)	Delta	0.036**	0.018	-0.024*	0.014
	Coastal	0.019	0.018	-0.011	0.011
	Yangon	-0.008	0.017	-0.040**	0.016

Note: Results of fractional logistic models with standard errors clustered at the enumeration area level. N=3,024. Table omits additional small and statistically insignificant rural controls. Consumption-expenditure quintiles are estimated using spatially deflated total household consumption-expenditure per adult equivalent.
Source: Authors’ calculations based on the 2015 MPLCS, the Bangladesh food-based dietary guideline (Nahar et al. 2013); EARs from Allen et al. (2020); various food composition tables (Stadlmayr et al. 2012; Shaheen et al. 2013; Institute of Nutrition 2014; MEXT 2015; USDA 2016; Scott 2019), and food retention factors from (USDA 2007).

Table A.3 Marginal effects of explanatory variables in regression models exploring associations between the nutrient deprivation index and household characteristics in urban vs rural areas

		Urban		Rural	
		marginal effect	SE	marginal effect	SE
Consumption-expenditure quintiles:	Q2	-0.075***	0.019	-0.089***	0.007
(base: Q1)	Q3	-0.117***	0.019	-0.137***	0.009
	Q4	-0.169***	0.020	-0.192***	0.010
	Q5	-0.253***	0.022	-0.245***	0.011
Food expenditure share		-0.005***	0.000	-0.004***	0.000
Any expenditure on FAFH		0.055***	0.009	0.051***	0.005
Owns a refrigerator		-0.013	0.010	0.008	0.012
Owns any type of vehicle		-0.024***	0.009	-0.004	0.006
Owns a communication device		-0.006	0.014	-0.001	0.006
Share of dependents in household		-0.024	0.035	-0.056***	0.019
Share of employed working age adults		-0.013	0.014	-0.011	0.009
More than 5 household members		-0.030***	0.008	-0.011*	0.006
All adults are women		-0.024*	0.014	-0.034***	0.010
Head’s mother tongue Myanmar		-0.005	0.011	0.000	0.009
Age of household head	45-64y	0.012	0.009	0.005	0.006
(base: 15-44 years)	65y+	0.028**	0.011	0.024***	0.008
Education of household head	Complete primary	0.010	0.009	-0.008	0.005
(base: no education or incomplete primary	Complete secondary	-0.026**	0.011	-0.026	0.017
HH produces own food		-0.027***	0.010	-0.021***	0.006
HH has wage income		0.019**	0.009	0.013**	0.005
HH has non-farm business income		0.003	0.009	0.003	0.006
HH has remittance income		-0.023***	0.008	0.003	0.006
Agro-ecological zone	Dry	-0.028*	0.017	-0.047***	0.012
(base: Hills and Mountains)	Delta	0.005	0.014	-0.038***	0.012
	Coastal	0.003	0.025	-0.038***	0.011
	Yangon	-0.032**	0.014	-0.053***	0.015

Note: Results of fractional logistic models with standard errors clustered at the enumeration area level. N=3,024. Table omits additional small and statistically insignificant rural controls. Consumption-expenditure quintiles are estimated using spatially deflated total household consumption-expenditure per adult equivalent.
Source: Authors’ calculations based on the 2015 MPLCS, the Bangladesh food-based dietary guideline (Nahar et al. 2013); EARs from Allen et al. (2020); various food composition tables (Stadlmayr et al. 2012; Shaheen et al. 2013; Institute of Nutrition 2014; MEXT 2015; USDA 2016; Scott 2019), and food retention factors from (USDA 2007).

Table A.4 Marginal effects of explanatory variables in regression models exploring associations between food group shortfalls and household characteristics

		% gap relative to healthy diet guidelines			
		Pulses		Animal source foods	
		marginal effect	SE	marginal effect	SE
Consumption-expenditure quintiles:	Q2	-0.043*	0.022	-0.168***	0.021
(base: Q1)	Q3	-0.097***	0.023	-0.267***	0.022
	Q4	-0.131***	0.025	-0.365***	0.022
	Q5	-0.205***	0.030	-0.443***	0.023
Food expenditure share		-0.004***	0.001	-0.007***	0.000
Any expenditure on FAFH		0.066***	0.015	0.051***	0.011
Owns a refrigerator		0.004	0.021	-0.065***	0.018
Owns any type of vehicle		-0.015	0.015	-0.010	0.012
Owns a communication device		-0.032*	0.017	-0.037***	0.013
Share of dependents in household		-0.090**	0.046	-0.070*	0.040
Share of employed working age adults		-0.063***	0.022	0.016	0.018
More than 5 household members		-0.022	0.016	-0.005	0.012
All adults are women		0.022	0.025	-0.016	0.017
Head's mother tongue Myanmar		-0.063**	0.026	-0.028*	0.016
Age of household head	45-64y	-0.039***	0.014	-0.021*	0.012
(base: 15-44 years)	65y+	-0.072***	0.019	-0.024	0.015
Education of household head	Complete primary	-0.017	0.015	-0.014	0.010
(base: no education or incomplete primary	Complete secondary	-0.039	0.027	-0.062***	0.022
HH produces own food		0.000	0.017	-0.021	0.013
HH has wage income		-0.006	0.013	0.029**	0.011
HH has non-farm business income		0.008	0.014	-0.017	0.011
HH has remittance income		-0.010	0.016	-0.024**	0.012
Agro-ecological zone	Dry	-0.129***	0.037	-0.049*	0.026
(base: Hills and Mountains)	Delta	0.103***	0.039	-0.123***	0.026
	Coastal	0.293***	0.031	-0.274***	0.023
	Yangon	0.095***	0.035	-0.173***	0.025
Urban/Rural	Rural landless	0.050**	0.023	-0.024	0.017
(base: Urban)	Rural landed	0.038	0.025	-0.021	0.017

Note: Results of fractional logistic models with standard errors clustered at the enumeration area level. N=3,024. Table omits additional small and statistically insignificant rural controls. Consumption-expenditure quintiles are estimated using spatially deflated total household consumption-expenditure per adult equivalent.
Source: Authors' calculations based on the 2015 MPLCS, the Bangladesh food-based dietary guideline (Nahar et al. 2013); EARs from Allen et al. (2020); various food composition tables (Stadlmayr et al. 2012; Shaheen et al. 2013; Institute of Nutrition 2014; MEXT 2015; USDA 2016; Scott 2019), and food retention factors from (USDA 2007).

Table A.5 Marginal effects of explanatory variables in regression models exploring associations between food group shortfalls and household characteristics, continued

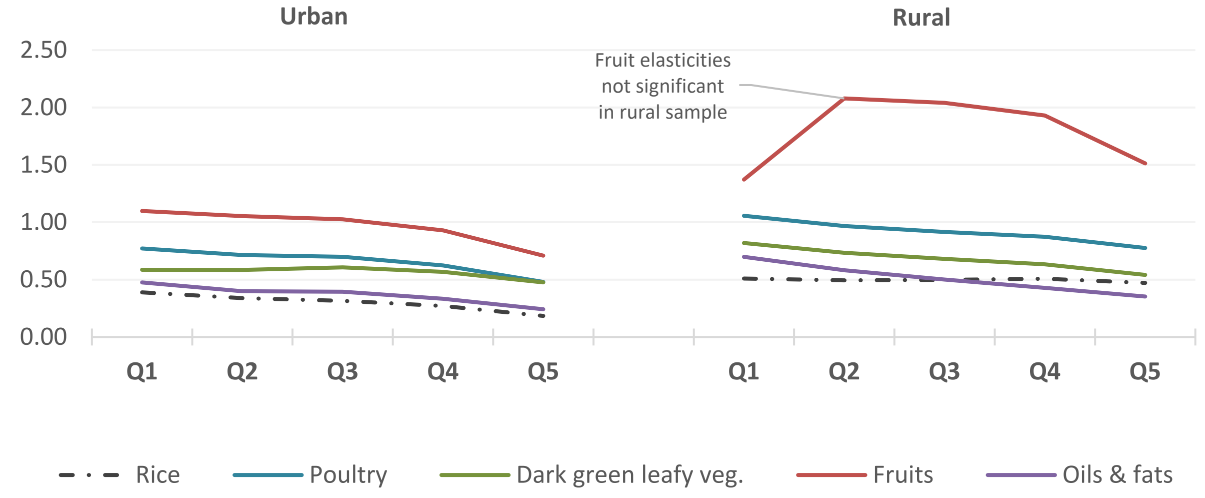
		% gap relative to healthy diet guidelines			
		Vegetables		Fruit	
		marginal effect	SE	marginal effect	SE
Consumption-expenditure quintiles:	Q2	marginal effect	SE	marginal effect	SE
(base: Q1)	Q3	-0.085***	0.010	-0.057***	0.013
	Q4	-0.154***	0.012	-0.143***	0.013
	Q5	-0.230***	0.014	-0.249***	0.015
Food expenditure share		-0.335***	0.016	-0.422***	0.020
Any expenditure on FAFH		-0.005***	0.000	-0.005***	0.000
Owns a refrigerator		0.051***	0.009	0.022*	0.012
Owns any type of vehicle		-0.005	0.015	-0.029*	0.015
Owns a communication device		0.002	0.010	-0.024**	0.012
Share of dependents in household		0.029***	0.011	0.019	0.015
Share of employed working age adults		0.004	0.027	-0.009	0.037
More than 5 household members		0.003	0.014	0.010	0.019
All adults are women		-0.045***	0.009	-0.003	0.012
Head's mother tongue Myanmar		-0.067***	0.015	-0.072***	0.018
Age of household head	45-64y	-0.005	0.014	-0.014	0.017
(base: 15-44 years)	65y+	-0.011	0.008	-0.012	0.012
Education of household head	Complete primary	-0.009	0.013	-0.023	0.016
(base: no education or incomplete primary	Complete secondary	-0.010	0.008	-0.016	0.012
HH produces own food		-0.037**	0.016	-0.078***	0.020
HH has wage income		-0.018*	0.011	-0.049***	0.012
HH has non-farm business income		0.024***	0.009	0.021*	0.011
HH has remittance income		-0.006	0.009	-0.013	0.011
Agro-ecological zone	Dry	-0.007	0.009	-0.005	0.011
(base: Hills and Mountains)	Delta	-0.070***	0.020	-0.025	0.022
	Coastal	0.039**	0.019	0.002	0.020
	Yangon	-0.025	0.021	-0.002	0.021
Urban/Rural	Rural landless	0.036*	0.021	-0.053**	0.022
(base: Urban)	Rural landed	0.011	0.016	0.023	0.017

Note: Results of fractional logistic models with standard errors clustered at the enumeration area level. N=3,024. Table omits additional small and statistically insignificant rural controls. Consumption-expenditure quintiles are estimated using spatially deflated total household consumption-expenditure per adult equivalent.

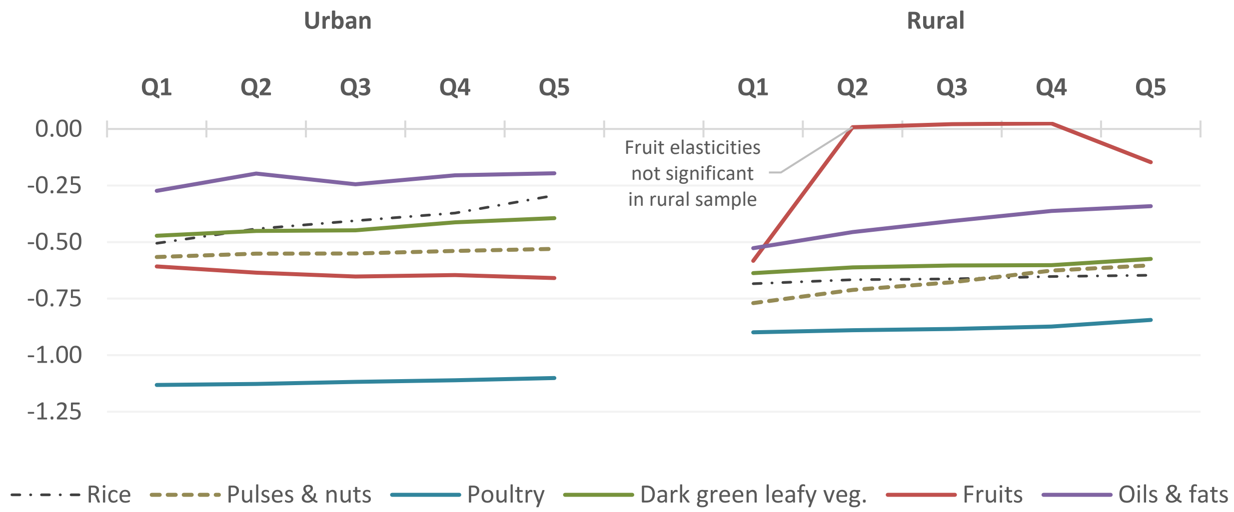
Source: Authors' calculations based on the 2015 MPLCS, the Bangladesh food-based dietary guideline (Nahar et al. 2013); EARs from Allen et al. (2020); various food composition tables (Stadlmayr et al. 2012; Shaheen et al. 2013; Institute of Nutrition 2014; MEXT 2015; USDA 2016; Scott 2019), and food retention factors from (USDA 2007).

Figure A.3 Elasticities of demand for key food groups by quintile and rural/urban area, with Q1 the poorest quintile and Q5 the richest

Panel A – Income elasticities



Panel B – Price elasticities



Note: Q1 to Q5 refer to national consumption-expenditure quintiles that are estimated using spatially deflated total household consumption-expenditure per capita.
Source: Ecker and Comstock (2021a).

Table A.6 Percentage of adults consuming different food groups in the past 24 hours in the first three quarters of 2022

	Q1 (Dec-Feb 22)	Q2 (Apr-Jun 22)	Q3 (Jul-Aug 22)	Difference: Q3 – Q1
		Means (%)		*% points*
Cereals, grains, roots & tubers	99.3	98.9	99.6	0.3**
Beans	53.7	52.7	52.7	-1.0
Nuts or seeds	43.9	37.9	36.1	-7.8***
Milk and dairy products	16.4	16.6	13.7	-2.7***
Egg	52.7	47.1	48.3	-4.3***
Meat and Fish	88.9	80.7	81.8	-7.0***
Other fruits	40.7	52.0	50.2	9.5***
Vitamin A rich fruits	49.3	25.9	27.0	-22.3***
Dark green vegetables	84.3	84.1	80.8	-3.4***
Other vegetables	82.0	72.6	77.3	-4.7***

Note: Asterisks refer to the level of statistical significance in the difference in means across Quarter 3 and Quarter 1: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: Authors' estimates based on the MHWS.

Table A.7 Percentage of adults with inadequate diet diversity by state/region (fewer than 5 out of 10 food groups) in the past 24 hours in the first three quarters of 2022

	Q1 (Dec-Feb 22)	Q2 (Apr-Jun 22)	Q3 (Jul-Aug 22)	Difference: Q3 – Q1
		Means (%)		*% points*
Kachin	15.5	27.1	20.8	5.2***
Kayah	24.6	42.6	21.5	-3.1*
Kayin	28.0	35.0	36.9	8.9
Chin	26.2	51.5	33.2	7.0*
Sagaing	10.2	21.4	19.6	9.4***
Tanintharyi	26.0	27.9	32.8	6.9
Bago	21.9	25.8	35.3	13.4***
Magway	19.7	25.5	27.2	7.5***
Mandalay	15.2	19.2	18.0	2.8*
Mon	26.2	35.6	32.5	6.3**
Rakhine	34.4	34.0	37.0	2.6
Yangon	22.2	26.8	29.5	7.3***
Shan	13.1	21.7	19.2	6.0***
Ayeyawady	29.5	36.8	35.6	6.1***
Nay Pyi Taw	10.8	24.6	23.5	12.7***
No. of observations	*12,100*	*12,142*	*12,128*	

Note: Asterisks refer to the level of statistical significance in the difference in means across Quarter 3 and Quarter 1: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: Authors' estimates based on the MHWS.

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