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HOUSEHOLD DIETARY PATTERNS AND THE COST OF A NUTRITIOUS DIET IN MYANMAR

By

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EXECUTIVE SUMMARY

Although Myanmar has made progress in reducing malnutrition, its prevalence among young children remains high, as 26.7 percent of children age 6-59 months are moderately or severely stunted (MoHS, 2019). Furthermore, nutrient inadequacy remains widespread. The National Nutrition Centre (NNC) in the Ministry of Health and Sports (MoHS) has identified and implemented interventions for five conditions resulting from under-nutrition: protein energy malnutrition, iron deficiency anemia, vitamin B1 deficiency (also known as beriberi), vitamin A deficiency, and iodine deficiency disorder (ibid, 2019). For example, recent evidence from the Myanmar Micronutrient and Food Consumption Survey (MMFCS) finds that anemia is prevalent among children and women. The survey found that 35.6 of children aged 6-59 months and 51 percent of children 5-9 years of age are anemic, as well as 30 percent of both adolescent girls (age 10-14) and women of reproductive age (age 15 to 49) (ibid, 2019).

While there are multiple factors that affect nutrition outcomes, one of the underlying causes of malnutrition is a lack of adequate food of sufficient nutritional quality (IFPRI, 2015). However, in every region of the world, the cost of protein- and micronutrient-dense foods, such as animal-source foods, fruits, and vegetables, are often considerably higher than the cost of energy-dense, staple foods such as cereals (Miller et al., 2016; Headey and Alderman, 2019). While factors other than the cost of different foods may affect dietary choices and thus nutrition outcomes, relative food costs likely play an important role in household dietary choices, especially for poorer households.

In recent years, the Government of Myanmar has made important commitments to reduce malnutrition in the country, including joining the Scaling Up Nutrition (SUN) Movement in 2013, joining the UN Zero Hunger Challenge in 2014, and bringing a number of ministries together in 2018 to create a Multi-sectoral National Plan of Action on Nutrition (MS-NPAN) (GoM, 2018). One goal of this paper is to inform the MS-NPAN by providing empirical analysis of household dietary patterns and the cost and affordability of a nutritious diet in Myanmar. This paper builds on previous empirical work on dietary patterns in Myanmar, as well as a recent approach from a reinvigorated international literature on estimating the cost of a nutritious diet (Masters et al., 2018; Dizon and Herforth, 2018).

In this study, we use the Cost of a Recommended Diet (CoRD) approach demonstrated by Dizon and Herforth (2018) and developed by Herforth et al. (2018). This approach estimates the cost of consuming a nutritious recommended diet as defined by a country's food-based dietary guidelines (FBDG). Because the CoRD method uses only a few lowest-cost food items from each recommended food group to estimate the cost of acquiring a recommended diet, it likely underestimates this cost compared to the cost if local tastes and preferences are taken into account. In order to estimate the cost of consuming a recommended diet using a set of foods that reflect these preferences, we propose a modification to the CoRD method called the Food Preferences CoRD (CoRD-FP). The CoRD-FP method estimates the cost of a recommended diet using prices from a wider range of foods that reflect current food consumption patterns and preferences, as observed in household survey data.

In this paper, we apply these methods to household food expenditure survey data from Myanmar (2010 and 2015) to demonstrate the utility of these methods for evaluating economic constraints on nutrition, and to characterize those constraints in the specific and complex setting of Myanmar. Our objectives are to:

a) Analyze household food consumption patterns in Myanmar relative to local and international definitions of a recommended diet;
b) Use the CoRD method to estimate regional minimum costs of a recommended diet in Myanmar;
c) Develop and demonstrate the CoRD-FP method to better reflect consumer preferences;
d) Assess the affordability of the CoRD and CoRD-FP relative to household food expenditure; and
e) Investigate the key drivers of the costs of the recommended diet using both the CoRD basket of minimum-cost foods and the CoRD-FP basket of preferred foods.

Our key findings are summarized below.

We find that, relative to recommended diet guidelines, a majority of households in Myanmar considerably under-consume all food groups except staples. In 2015, only 38 percent of the population lived in households that consumed the recommended quantity of protein-rich foods, 38 percent fats and oils, 16 percent vegetables, 9 percent fruits, and less than one percent consumed the recommended quantity of dairy products. These consumption patterns also vary considerably by region. For example, 47 percent of those in the Delta agro-zone consume the recommended quantity of protein, compared to 28 percent in the Hills and Mountains agro-zone.

With the exception of staples, consumption of each of the other five food groups increases considerably as total household expenditure increases. For example, only 8 percent of those in the poorest total household expenditure quintile consume the recommended quantity of protein-dense foods compared to 66 percent of those in the wealthiest quintile. Yet, even mean consumption per adult equivalent (AE) for households in the highest quintile falls below the recommended diet quantities for dairy, vegetables and fruit. This implies that income is not the only constraint to consuming a nutritious diet.

Consumption of the recommended number of servings of protein foods, vegetables, fruit, and fats increased from 2010 to 2015. This dietary shift is consistent with the 7.2 percent per year increase in Myanmar's GDP per capita between 2010 and 2015 (World Bank, 2019). However, even with increases in consumption of non-staple foods, many individuals lived in households that over-consumed staples relative to the recommended quantity, yet significantly under-consumed each of the other five recommended diet food groups.

The results above beg the question of why so many Myanmar households tend to over-consume staples and under-consume all non-staple food groups. While factors such as food preferences and nutritional knowledge affect household dietary choices, relative food costs also play an important role in these choices, especially for poorer households. Consistent with recent research from countries throughout South and Southeast Asia (Headey and Alderman, 2009), we find that **prices per calorie of the most micronutrient-dense foods in Myanmar are considerably higher than those of staple foods such as rice, which are calorie-dense yet relatively low in micronutrients**. These results suggest that a **key factor leading many Myanmar households to**

over-consume staples such as rice and under-consume more nutrient-dense foods is their inability to afford the latter. For example, the price per calorie of chicken and pork are 24 and 8 times higher, respectively, than the price per calorie of rice, while the average for a number of fish and seafood items is 18 times higher. Likewise, other perishable foods like eggs, fresh milk, and certain fruits and vegetables have high prices per calorie relative to rice.

Next, we estimate the CoRD for Myanmar, develop and estimate a modification to this method – the CoRD-FP – and also estimate the cost of meeting caloric needs based on the lowest cost staple food (CoCA). **We find that the CoRD and CoRD-FP are 2.5 and 3.7 times more expensive, respectively, than the CoCA, at the national level. We also find that the CoRD-FP is 47 percent more expensive than the CoRD.** This implies that meeting the recommended diet using foods that reflect observed food preferences (i.e. the CoRD-FP) costs more than doing so using a relatively small number of minimum-cost foods (CoRD). The CoRD-FP thus captures a "preference premium" – the additional cost of acquiring a recommended diet based on a set of foods that reflect preferences within each food group.

Differences in the cost of the protein and vegetable food groups explain nearly all of the gap between the total cost of the CoRD-FP and the CoRD, at the national level. For example, the recommended diet quantity of protein foods costs 3.5 times more for the CoRD-FP than the CoRD, and accounts for about three-quarters of the preference premium. The reason for this is the cost of the CoRD-FP protein food group is based on a combination of meat (chicken, pork, and/or beef), fish, eggs, and legumes. By contrast, the CoRD is based almost entirely on legumes, which are considerably less expensive per serving than animal-source foods. In addition, the recommended diet quantity of vegetables costs 46 percent more for the CoRD-FP than the CoRD and accounts for about a fifth of the preference premium.

Half of the population lives in a household that cannot afford the CoRD-FP relative to actual household food expenditure, and about one quarter cannot afford the CoRD. However, the affordability of CoRD and CoRD-FP improved compared to 2010, when 70 percent of the population lived in a household that could not afford the CoRD-FP and 32 percent could not afford the CoRD. This improvement is consistent with a 24 percent decline in the poverty headcount from 42 to 32 percent over the same time period (MoPF and World Bank 2017b). For households that cannot afford the estimated cost of the diet, the average deficiency in food expenditure relative to the CoRD or the CoRD-FP is 6 and 16 percent, respectively.

There are three main policy implications from these results. First, **our results suggest that Myanmar's food security and agricultural policies should focus on diversification of farm enterprises through improvements in farm-level productivity and reductions in the marketing costs of protein- and micronutrient-dense foods, such as animal-source foods, vegetables and fruits**. A focus on diversification will increase farm incomes and increase the availability and affordability of nutritious foods. For many decades, food security and agricultural policies in Myanmar have primarily focused on increasing national production levels of rice (Robertson et al., 2018). For example, in recent years up to an estimated 85 percent of the annual budget for the agricultural sector in Myanmar has focused on rice production (GoM, 2018). In addition, the Myanmar Agricultural Development Bank (MADB) provides larger loans for the production of rice relative to other crops (Robertson et al., 2018), although current rice-based

farming systems generate significantly less income for smallholders compared to most other production systems, such as those based on beans, pulses, oilseeds, aquaculture, and a wide range of other smallholder cash crops (GoM, 2018). Likewise, in some contexts, modifications to land use legislation could facilitate farm diversification. For example, there is a need to reduce administrative and legal barriers to enable smallholders to convert paddy land into permanent high value enterprises like aquaculture or floriculture.

Second, different regions have different levels of agro-ecological and market access potential for production of protein- and/or micronutrient-rich foods. This implies that **region-specific strategies are needed to overcome supply side (availability and cost) and demand side (household incomes, particularly for poorer households) constraints to increased household consumption of protein and micronutrients.** For example, the CoRD-FP is highest in the Hills and Mountains, followed by the Delta. However, strategies to reduce supply and demand-side constraints to improving the quality of diets in these two areas are likely to be quite different. For example, the types of high value agricultural enterprises that can generate additional income are quite different in hilly and mountainous states compared to the Delta.

Finally, **though the relatively high cost of many micronutrient-dense foods is a key constraint to consuming a nutritious diet, dietary preferences also play an important role**. This point is clearly illustrated by consumption choices of households in the highest expenditure quintile. **Though 88 percent of households in the highest expenditure quintile have household food expenditure levels sufficient to afford the CoRD-FP, only 19 and 36 percent of these households consume the recommended diet quantities of vegetables and fruits, respectively.** This highlights the need for nutrition education to encourage increased consumption of nutrient-dense foods.

We find that consumption of the CoRD-FP food basket in Myanmar meets the average macronutrient needs for adult men and women and the requirements for most micronutrients. Most notably, the CoRD-FP food basket meets average nutrient requirements for protein, iron, and vitamins A and B1, nutrients which the Government of Myanmar has identified as problem areas requiring targeted intervention (MoHS, 2019). This indicates that **efforts to encourage the population of Myanmar to consume a recommended diet could significantly reduce the prevalence of health conditions resulting from insufficient nutrient intake, such as anemia in women and children.** Thus, creation of national FBDG containing a recommended diet specific to Myanmar could be a powerful tool for increasing public awareness of ways to overcome known dietary shortfalls. Both greater use of the FBDG as well as development of a recommended diet specific to Myanmar (which includes recommended consumption quantities for various food groups) could help improve the effectiveness of nutrition policy. Efforts to promote consumption of a more nutritious diet would need to address both the economic constraints to eating more nutrient-dense yet relatively expensive protein foods, fruits and vegetables, as well as nutrition education and promotion of healthy diets.

CONTENTS

LIST OF TABLES

TABLE **PAGE**

LIST OF FIGURES

FIGURE **PAGE**

ACRONYMS

AE	Adult Equivalent
CoCA	Cost of Caloric Adequacy
CoNA	Cost of Nutrient Adequacy
CoRD	Cost of a Recommended Diet
CoRD-FP	Food Preferences Cost of a Recommended Diet
CotD	Cost of the Diet
CPI	Consumer Price Index
DGLV	Dark Green Leafy Vegetables
DHS	Demographic and Health Survey
EAR	Estimated Average Requirements
FAFH	Food Away from Home
FAO	Food and Agriculture Organization
FBDG	Food-Based Dietary Guidelines
FCS	Food Consumption Score
FSPES	Food Security and Poverty Estimation Surveys
GoM	Government of the Republic of the Union of Myanmar
IFPRI	International Food Policy Research Institute
IHLCA	Integrated Household Living Conditions Survey
LIFT	Livelihoods and Food Security Fund
MDD	Minimum Dietary Diversity
MoALI	Ministry of Agriculture and Livestock
MoH / MoHS	Ministry of Health (and Sports)
MoPF	Ministry of Planning and Finance
MLCS	Myanmar Living Conditions Survey
MMFCS	Myanmar Micronutrient and Food Consumption Survey
MNPED	Myanmar Ministry of Planning and Economic Development
MPLCS	Myanmar Poverty and Living Conditions Survey
MS-NPAN	Multi-sectoral National Plan of Action on Nutrition
MSU	Michigan State University
NNC	National Nutrition Centre
RDA	Recommended Daily Allowance
SUN	Scaling Up Nutrition
UNICEF	United Nations Children's Fund
UNDP	United Nations Development Programme
WDF	World Diabetic Foundation
WFP	World Food Programme
WHO	World Health Organization

1 INTRODUCTION

The state of food and nutrition security in Myanmar is paradoxical in a number of ways. On the one hand, Myanmar is a net exporter of grain (primarily rice) and pulses, and exports significant amounts of fish and crustaceans (Robertson et al., 2018). In addition, strong macroeconomic growth over the past decade has reduced poverty nationally by 17 percentage points from 42.4 in 2010 to 24.8 percent in 2017 (from 48.5 to 30.2 percent in rural areas) (MoPF, UNDP, World Bank, 2019). On the other hand, abundant agricultural production at the national level does not translate into adequate food and nutrition security. For example, the 2017 Myanmar Micronutrient and Food Consumption Survey (MMFCS) (MoHS, 2019) finds that 33 percent of households report food insecurity, while the 2015 Myanmar Poverty and Living Conditions Survey (MPLCS) found that 35 percent of households reported having inadequate quality of food in the past year (MoPF and World Bank, 2017a). Although Myanmar has made progress in reducing malnutrition, its prevalence among young children remains high, as 26.7 percent of children age 6-59 months are moderately or severely stunted (MoHS, 2019).[1] Furthermore, nutrient inadequacy remains widespread. The National Nutrition Centre (NNC) in the Ministry of Health and Sports (MoHS) has identified and implemented interventions for five conditions resulting from undernutrition: protein energy malnutrition, iron deficiency anemia, vitamin B1 deficiency (also known as beriberi), vitamin A deficiency, and iodine deficiency disorder (ibid, 2019). For example, the MMFCS finds that anemia is prevalent among children and women. The survey found that 35.6 of children aged 6-59 months and 51 percent of children 5-9 years of age are anemic, as well as 30 percent of both adolescent girls (age 10-14) and women of reproductive age (age 15 to 49) (ibid, 2019).[2]

While there are multiple factors that affect nutrition outcomes, one of the underlying causes of malnutrition is a lack of adequate food of sufficient nutritional quality (UNICEF, 1990). However, in every region of the world, the cost of protein- and micronutrient-dense foods, such as animal-source foods, fruits, and vegetables, is often considerably higher than the cost of energy-dense staple foods such as cereals (Miller et al., 2016; Headey and Alderman, 2019). It is also well established in the literature that healthier diets cost more than unhealthy diets (Alemu et al., 2019). Because the poor tend to be more sensitive to food prices (Green et al., 2013), they are more likely to be affected by the relatively higher costs of more nutritious foods and are thus more likely to consume cheaper, more energy-dense diets (Green et al., 2013; Darmon and Drewnowski, 2015; Miller et al., 2016). Recent research has also found a negative correlation between the consumption of various animal-source foods and stunting in children aged 6-23 months, and that high relative prices of animal-source foods are a key constraint limiting their consumption (Headey et al., 2018). While factors other than the cost of different foods may affect dietary choices and thus nutrition outcomes, relative food costs likely play an important role in household dietary choices, especially for poorer households.

In recent years, the Government of Myanmar has made important commitments to reduce malnutrition in the country, including joining the Scaling Up Nutrition (SUN) Movement in 2013, joining the UN Zero Hunger Challenge in 2014, and bringing a number of ministries together in 2018 to create a Multi-sectoral National Plan of Action on Nutrition (MS-NPAN) (GoM, 2018). One goal of this paper is to inform the MS-NPAN by providing empirical analysis of household dietary patterns and the cost and affordability of a nutritious diet in Myanmar. This paper builds on

[1] Robertson et al. (2018) provide a review of the various recent measures of malnutrition in Myanmar and empirical research on its determinants.

[2] Results from MMFCS tests of the levels of a number of different micronutrients in sampled individuals have not yet been released (MoHS, 2019).

previous empirical work on dietary patterns in Myanmar, as well as a recent approach from a reinvigorated international literature on estimating the cost of a nutritious diet (Masters et al. 2018; Dizon and Herforth 2018).

There are a number of different methods for estimating the cost of a "nutritious" or "healthy" diet. The oldest such method was developed by Stigler (1945) and uses linear programming to choose a diet from a list of foods that minimizes the cost of meeting a set of nutritional requirements. Recent applications of this general approach that also use linear programming include the Cost of Nutrient Adequacy (CoNA) metric by Masters et al. (2018) and the Cost of the Diet (CotD), a method and software developed by Save the Children (Deptford et al., 2017). However, least-cost nutrient adequacy approaches have limitations. One longstanding concern is that linear programming approaches produce diets that are unrealistic, leading to approaches that aim to incorporate food preferences (Deptford et al., 2017).[3] Another concern is that healthy diets do not simply reflect nutrient intake alone, since there are non-nutrient properties of food that influence their impacts on nutrition and health, such as levels of anti-nutrients, anti-oxidants, fiber and effects on the microbiome. For this reason, many countries around the world have developed recommended diets in the form of national food-based dietary guidelines (FBDG) that typically are tailored to country-specific food preferences and nutritional conditions, identify diet patterns that protect health, and which thereby factor in some of the non-nutrient characteristics of food.

In this study, we use the Cost of a Recommended Diet (CoRD) approach demonstrated by Dizon and Herforth (2018) and developed by Herforth et al. (2018). This approach estimates the cost of consuming a nutritious recommended diet defined by country's FBDG. It uses price data to select the cheapest items in each food group within the recommended diet to estimate the cost of consuming the recommended quantity of each food group. The CoRD is then the sum of the costs of each food group. Because the CoRD method uses only a few lowest-cost food items from each recommended food group to estimate the cost of acquiring a recommended diet, it likely underestimates this cost compared to the cost if local food tastes and preferences are taken into account. In order to estimate the cost of consuming a recommended diet using foods that reflect these preferences, we propose a modification to the CoRD method called the Food Preferences CoRD (CoRD-FP). The CoRD-FP method estimates the cost of a recommended diet using prices from a wider range of foods that reflect current food consumption patterns and preferences, as observed in household survey data.

In this paper, we apply these methods to household food expenditure survey data from Myanmar (2010 and 2015) to demonstrate the utility of these methods for evaluating economic constraints on nutrition, and to characterize those constraints in the specific and complex setting of Myanmar. Our objectives are to:

a) Analyze household food consumption patterns in Myanmar relative to local and international definitions of a recommended diet;
b) Use the CoRD method to estimate the regional minimum costs of a recommended diet in Myanmar;
c) Develop and demonstrate the CoRD-FP method to better reflect consumer preferences;

[3] Deptford et al. (2017) developed the Cost of the Diet (CotD) approach for Save the Children-UK, which uses information on the price, nutrient content, availability of and preferences for local foods to estimate the minimum cost of a four diets that differ by the number of nutrients for which the diet meets estimated average requirements for a given individual and by the extent to which they reflect local food preferences (ibid et al., 2017).

d) Assess the affordability of the CoRD and CoRD-FP relative to household food expenditure; and
e) Investigate the key drivers of the costs of the recommended diet using both the CoRD basket of minimum-cost foods and the CoRD-FP basket of preferred foods.

The paper is organized as follows. Section two provides a summary of recent empirical research on household food consumption patterns in Myanmar as well as estimations of the cost of a recommended diet. Section three presents the data and methods we use for our analysis. Section four presents our results and section five our main conclusions and policy recommendations.

2 BACKGROUND ON FOOD CONSUMPTION PATTERNS AND THE COST OF A NUTRITIOUS DIET IN MYANMAR

2.1 Evidence on food consumption patterns in Myanmar

There are several sources of recent evidence on household food consumption patterns in Myanmar. The first is household food expenditure data observed in the nationally-representative 2015 MPLCS. This data show that diets of poorer households were less diverse than those of wealthier ones. Calories consumed (per adult equivalent, AE)[4] via rice, pulses, and nuts (primarily rice) varied little by total household expenditure quintile (MoPF and World Bank, 2017a).[5] However, households in the top quintile spent an average of only 15 percent of their food expenditure per AE on rice, pulses, and nuts compared to 35 percent by households in the lowest quintile. Furthermore, households in the top quintile also spent four times as much on animal source foods as well as vegetables and fruits, relative to those in the lowest quintile (ibid, 2017a).

Another recent source of evidence on food consumption patterns comes from Food Security and Poverty Estimation Surveys (FSPES), which were implemented by the World Food Programme (WFP) in collaboration with the Department of Rural Development of the Government of Myanmar. The FSPES surveyed over 13,000 rural households between June 2013 and August 2015 across 278 of Myanmar's 287 rural townships (Robertson et al., 2018). Robertson et al. (2018) use this data to calculate a household Food Consumption Score (FCS). The FCS is a method developed by WFP (2006) which produces a composite score for each household based on dietary diversity, the frequency of consumption of different types of food and their nutrient content (see Appendix A for a description and assessment of the FCS method).

Using the FCS method and cutoffs, 22 percent of Myanmar's rural households were estimated to consume a nutritionally inadequate diet during this time period (2013 to 2015), though this varied considerably by state/region (ibid, 2018). The lowest rates of household dietary inadequacy were found in regions in the Delta such as Bago (19 percent) and Ayeyerwaddy (16 percent) and on the coast in Tanintharyi (15 percent) and Mon (18 percent). Most parts of the Dry Zone had moderate rates of household dietary inadequacy, with rates ranging from 15 to 28 percent for south Sagaing, Mandalay and Magway. Yangon also had a moderate rate of 23 percent of households. The highest rates of household dietary inadequacy were found in the hilly and mountainous states, where rates ranged from 40 percent in much of Shan, to 52 percent in north Kachin to as high as 85 percent in Chin. Consistent with results from the 2015 MPLCS, the FSPES data also indicate that wealthier rural households consumed meat/fish more frequently relative to poorer households, while the frequency of cereal consumption was relatively constant across wealth quintiles.

A third recent source of evidence of food consumption patterns comes from the 2014 National Survey of Diabetes Mellitus and Risk Factors for Non-communicable Diseases in Myanmar. This survey found that the mean number of servings of fruits and/or vegetables per day was 2.8 among adults age 25-64 in Myanmar; 64 percent of adults consumed less than three servings of fruits and/or vegetables per day; and, 87 percent consumed less than the recommended five servings of fruits and/or vegetables (MoH, WHO and WDF, 2015).

[4] Adult equivalency (AE) is a measure of household composition that reflects caloric needs by age and gender.
[5] The MPLCS poverty report considers seven food categories: 1) rice, pulses, nuts; 2) meat, eggs, and dairy; 3) fish and seafood; 4) vegetables, fruits, and roots; 5) fats and oils; 6) FAFH; and 7) other foods (MoPF and World Bank, 2017a).

Survey data measuring complementary foods consumed by children age 6 to 23 months provide two additional sources for evaluating food consumption patterns. The first is from a 2013 survey of 3,200 households from states/regions in three key zones, Uplands (Chin, Kachin, and North and South Shan), the Dry Zone and the Delta, which was funded by Livelihoods and Food Security Fund (LIFT). The survey collected 24-hour recall information on the diets of 1,197 children age 6 to 23 months. This information was used to create a Minimum Dietary Diversity score (MDD) for each child, based on guidelines from WHO (2008). Minimum dietary diversity is met if a child consumed foods from 4 or more of 7 food groups during the 24-hours preceding the survey,[6] and is a proxy measure of the nutritional quality of an infant or young child's diet (Arimond and Ruel, 2004).[7]

The LIFT survey finds that only 21 percent of children age 6 to 23 months in LIFT program areas had minimum acceptable dietary diversity (Win and Cashin, 2016). Regression analysis also found that children age 6 to 23 months in a household with "higher monthly income" (>75,000 kyat) had 602 percent higher odds of achieving minimum acceptable dietary diversity relative to children from households with lower income (ibid, 2016).

The second source of data on the complementary foods consumed by children age 6 to 23 months is from the nationally-representative Myanmar Demographic Health Survey (DHS) of 2015 (MoHS and ICF, 2017). The DHS collected 24-hour recall information on the diets of children in this age range that enabled the creation of an MDD for each of 1,621 children. Only 25 percent of children had a minimally adequately diverse diet (ibid, 2017). In addition, only 18.5 percent of children in the lowest household wealth quintile had consumed four or more food groups, as compared with 38.7 percent of children in the highest quintile.

Results from these household and individual-level surveys highlight the value of investigating the cost of a nutritious diet in Myanmar. In each case, household wealth appears to be a key factor that leads poorer households (or children) in Myanmar to consume more energy-dense diets that are relatively low in nutrient-rich foods.

2.2 Evidence of the cost of a nutritious diet in Myanmar

In 2017, Save the Children implemented their CotD method in several townships in the Dry Zone of Myanmar. They collected data from markets and villages measuring food availability, prices and preferences by township to estimate the costs of three separate diets: (1) the lowest cost diet that meets only the average energy requirements of household members (called an "energy only diet"); (2) the lowest cost diet that meets the average energy and recommended nutrient requirements of the household ("micronutrient nutritious diet"); and (3) the lowest cost diet that meets the average energy and recommended nutrient requirements of the household, while also reflecting typical food consumption patterns in the areas in which food availability and data were collected ("food habits nutritious diet") (Save the Children, 2017).

[6] The MDD food groups include: 1) grains, roots and tubers; 2) legumes and nuts; 3) dairy products (milk, yogurt, cheese); 4) flesh foods (meat, fish, poultry and liver/organ meats); 5) eggs; 6) vitamin-A rich fruits and vegetables; and 7) other fruits and vegetables.
[7] Regression analysis by Arimond and Ruel (2004) found that higher dietary diversity of children age 6 to 23 months was significantly associated with lower rates of stunting in a number of developing countries.

The study found that the cost of the micronutrient nutritious diet is 1.7 times more expensive than that of an energy only diet (ibid, 2017). This implies that the cost of adding a few least-cost micronutrient-dense foods to an energy-only diet increases the overall diet cost by 70 percent. Likewise, the food habits nutritious diet is 1.5 times more expensive than the micronutrient nutritious diet and more than twice (2.6 times) as expensive as the energy only diet (ibid, 2017). This implies that meeting macro-and micro-nutrient requirements using a number of different foods that are commonly consumed rather than limiting the diet to a relatively small number of minimum-cost nutrient-rich foods results in this diet costing 50 percent more than the micronutrient diet.

The Save the Children analysis offers important insights into nutritional affordability, but also has two important limitations. First, it is confined to the Dry Zone; diets and socioeconomic status vary markedly across Myanmar. Second, the analysis is not linked to large-scale representative survey data. The methods and analysis described below fill these knowledge gaps.

3 DATA AND METHODOLOGY

This section outlines the household food consumption and food price data that we use in this analysis, and the methods for estimating the CoRD and CoRD-FP.

3.1 Household consumption data

3.1.1 IHLCA and MPLCS household surveys

Analysis in this report is derived primarily from the Government of Myanmar's two most recent nation-wide household expenditure and living standards surveys that are publicly available: (1) the Integrated Household Living Conditions Assessment Survey (IHLCA) from 2009/10 (hereafter referred to as IHLCA) and (2) the 2015 MPLCS. The main purpose of both surveys was to monitor and assess changes in living conditions in Myanmar. In addition to other aspects of household living conditions, the IHLCA and MPLCS survey instruments included questions about household food and non-food consumption, which provide the key data used in this analysis. There is little empirical work to date assessing the evolution of household dietary patterns and the costs and affordability of a nutritious diet in Myanmar, particularly using data that is representative at the national and agro-zone levels. We take advantage of the availability of two recent national surveys to gain insights into variations in these patterns both across time and space.

The IHLCA visited a total of 18,660 households twice; first in December 2009/January 2010 and again in May 2010. The first period falls in the cool season, a few months after the monsoon harvest. The second period is during the dry season and the end of the pre-monsoon season. It is representative at the national, urban/rural, agro-zone, and state/region levels.[8] The IHLCA 2010 sample design was based upon (but modified from) that used by the earlier IHLCA 2004/05.[9] The sampling frame for IHLCA 2004/05 drew upon the 1983 census, which provided the most reliable population estimates available at the time.[10] Due to concerns about security and transportation, 45 townships were excluded from the sample frame used for both the IHLCA 2004/05 and the IHLCA 2010. The population in these excluded townships represented approximately 5 percent of the total population of Myanmar at the time (MNPED, UNDP, UNICEF, and SIDA. 2011a).

The MPLCS visited a total of 3,648 households once between the end of January and the beginning of April 2015, which corresponds to the end of the cool season, and extends through the dry pre-monsoon season. The survey is designed to be representative at the national, urban/rural, and agro-zone levels, but not the agro-zone, urban/rural or the state/region level.[11] [12] The MPLCS sampling frame was based on preliminary results from the 2014 Census (implemented in April 2014). Changes in the security and conflict situation by 2015 allowed all townships in Myanmar to be included in the master sample frame.[13]

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[8] The IHLCA was implemented by the Myanmar Ministry of Planning and Economic Development (MNPED) in collaboration with the United Nations Children's' Fund (UNICEF) and the Swedish International Development Cooperation Agency (Sida). Additional technical support was provided by the World Bank, UNICEF and the United Nations Development Program (UNDP).

[9] The IHLCA 2010 sampling procedure takes into account changes in the sample frame since 2004 and retains a panel of 50 percent from the IHLCA 2004/05 sample of households. See MNPED, UNDP, UNICEF, and Sida (2011a) for details.

[10] Population estimates are from 2002 as reported by the Population Department of the Ministry of Population (IDEA, MNPED, UNDP, 2010).

[11] Five agro-zones are defined as follows. Hills and Mountains (Chin, Kachin, Kayah, Kayin, Shan); Dry Zone (Magway, Mandalay, Nay Pyi Taw (MPLCS only), Sagaing); Coastal (Rahkine, Tanintharyi); Delta (Ayeyarwaddy, Bago, Mon); Yangon.

[12] The MPLCS was implemented by the Myanmar Ministry of Planning and Finance in collaboration with the World Bank.

[13] Some selected areas were resampled due to conflict.

3.1.2 Comparability of food consumption data from the IHLCA and MPLCS

Differences in the food consumption modules from the two surveys are relevant for our analysis as part of our analysis considers food consumption patterns over time. The main food consumption module of both the IHLCA and MPLCS asked households to report quantities of foods consumed during a specified recall period, along with quantities and values of purchased food items. The recall period for most foods in the IHLCA is 7 days. However, information about grains, oils, non-perishable milk products, and a few "other food items" is collected using a 30-day recall. By contrast, all food consumption in the MPLCS is recorded based on a 7-day recall period. Because longer recall periods often have larger recall errors (Beegle et al., 2012) – which tend to be biased downward -- the longer 30-day recall period used for some items in the IHLCA could result in lower reported quantities consumed per day for those food items relative to quantities reported using the shorter (7-day) recall period in the MPLCS. The recall modules also differ in terms of food recall lists and options for reporting units (see MoPF and World Bank (2017b) for more details).[14]

Furthermore, consumption patterns may be influenced by seasonal differences in the periods in which the surveys were implemented. Therefore, direct comparisons of food consumption should be made with these caveats in mind. Nonetheless, for our analysis, we do not find evidence that these differences are prohibitive to using the two surveys to investigate whether there have been changes from 2010 to 2015 in household dietary patterns and the composition and affordability of a nutritious diet.

3.1.3 Construction of household consumption variables

A technical report published by MoPF and World Bank (2017c) details the methodology applied to construct the MPLCS and IHLCA household food quantities consumed, unit values, and food and total household expenditure. Survey values reported in this study are in nominal terms. One notable exception is that the calculation of household expenditure quintiles is based on spatially adjusted real household expenditure values (as well as seasonal adjustments for the IHLCA). We assign caloric values and wastage factors for most food items based on food composition data shown in Table A2.2 of the MPLCS poverty estimation technical report (ibid, 2017c). These values were derived from three sources: MoHS (n.d.b), FAO (1972), and MNPED et al. (2011b). For fish and seafood items, we use caloric values and wastage factors reported for in a recent database assembled by World Fish (Scott, 2019). Wastage factors allow "as purchased" food quantities to be converted to edible portions.[15] Household unit values are also converted to unit values per edible portion.

To avoid misinterpretation, we emphasize that throughout this analysis the term "consumption" is intended to be interpreted simply as quantities of a given food item that households report consuming. We acknowledge that household surveys do not provide nuanced individual- or household-level food consumption information as precisely as more specialized dietary surveys with 24-hour recall periods. Furthermore, we are not able to and do not attempt to measure intra-household distribution of food consumption. Nonetheless, our analysis of reported household food consumption provides important information regarding broad dietary patterns at national and regional levels in Myanmar that have not yet been published, to our knowledge.

[14] More details regarding survey comparability issues are provided in Annex A2 of MoPF and World Bank (2017b).
[15] "As purchased" food quantities include portions of food items which are not typically eaten, such as bones and fruit peels. Edible portion quantities are the relevant measure for estimating the quantity of food a household consumed and is used to compare household consumption to a recommended diet.

3.2 Adult Equivalency

Adult equivalency scales permit comparison of total household consumption quantities, expenditure, and nutrient intake across households that differ in size and demographic composition. Equivalency scales assign household members an equivalence factor in accordance to their estimated age and sex-specific energy requirements relative to that of a reference adult, which in this study is a 30 year old adult male. Dividing household consumption by the number of adult equivalents (AE) in the household thus adjusts household consumption by estimates of household energy requirements. Assigning a reference adult also assists in assessing and providing context for the dietary recommendations outlined in the FBDG. While our analysis is conducted in per AE terms, we do not assume that per AE values represent intra-household distribution of food which may differ from that implied by the AE scale.

Following dietary energy recommendations detailed by the FAO (2004) and a methodology described by Waid et al. (2017), we determine caloric needs by sex, age, and the stature of the Myanmar population. This method is described in Appendix B. The resulting calorie standard for the reference adult male is 2,790 kcal per day.[16] Notably, our AE scale, which is designed for food consumption analysis, differs from that used by the World Bank for use with both food and non-food consumption in poverty analysis (MoPF and World Bank, 2017c). Specific details of the MoPF/World Bank AE scales are also presented in Appendix B.

3.3 Cost of a Recommended Diet (CoRD)

The CoRD method, demonstrated by Dizon and Herforth (2018) and developed by Herforth et al. (2018), estimates the daily cost of acquiring the recommended number of servings of each food group in a recommended diet. The method is straightforward and requires only two pieces of information: (a) the daily total recommended quantity (in edible grams) of each food group in the recommended diet, and (b) the price per edible gram of two to three least-cost foods within each food group. We begin by describing the recommended diet used in this analysis and then outline the steps to estimate food group prices. We conclude this section by describing our approach to assessing the affordability and nutrient adequacy of the CoRD.

3.3.1 Food-based dietary guidelines and the recommended diet

The purpose of an FBDG is for governments to provide healthy diet recommendations based on scientific evidence while incorporating country-specific factors such as policy priorities, local production and consumption patterns, and cultural norms (FAO/WHO, 1998). The Government of Myanmar has produced an FBDG document that outlines principles of a healthy diet for the people of Myanmar (MoHS, n.d.a).[17] Though this Myanmar FBDG provides descriptions of a recommended diet, it does not include specific quantity recommendations by food group, information necessary to estimate the CoRD. The document does identify seven food groups and advises individuals to eat at least one item from each group every day: (1) starchy staples, (2) vegetables, (3) fruits, (4) dairy, (5) meat/fish/seafood/eggs/legumes, (6) nuts/oils, and (7) sweets. The guidelines further recommend eating five different kinds of fruits and vegetables each day, one of which should be a dark green leafy vegetable (DGLV).[18]

[16] Our daily calorie requirements by age and sex are similar to those published by the MoHS (n.d.a).
[17] While the Myanmar FBDG document is available on the website of the Ministry of Health and Sports, it does not have a publication date.
[18] This recommendation is specific to those with iron deficiency. However, given the high prevalence of anemia among women (47 percent) and young children (58 percent) in Myanmar (MoHS and ICF, 2017), we retain the DGLV recommendation as relevant for the general population.

Given that Myanmar's current FBDG lacks specific quantity recommendations by food group, we reviewed a number of FBDG in Southeast Asia. Most also lacked key pieces of information or had aspects of the guidelines that were difficult to interpret (Florentino et al., 2016; Tee et al., 2016). We therefore follow a set of regional South Asia dietary guidelines developed by Dizon and Herforth (2018) for cross-country comparisons (Table 1). Dizon and Herforth developed these quantity guidelines based on recommendations from the FBDG of Bangladesh, India, and Sri Lanka. Their "South Asia recommended diet" contains the same food categories as those listed in the Myanmar FBDG.[19] Moreover, Myanmar borders South Asia (India and Bangladesh) and shares similarities to South Asian diets, including common staples (notably rice), proteins (notably fish, chicken and pulses), and various fruits and vegetables.[20]

The South Asia recommended diet specifies both a range of recommended number of servings per day for each food group and a recommended quantity per serving in edible grams (Table 1).[21] We follow Dizon and Herforth (2018) and estimate the CoRD based on the average of the minimum and maximum recommended number of servings for each food group. Thus, the recommended diet quantity of each food group is simply the average number of recommended servings per day multiplied by the recommended quantity per serving.

The recommended diet is designed to provide adequate nutrition, which includes meeting caloric needs. Because foods within a food group can have significantly different caloric or nutrient compositions, it is sometimes necessary to assign different serving sizes within the same food group. For this reason, four of the six food groups in the recommended diet have sub-group specific guidelines for quantities per serving.[22] For example, to obtain the calories provided by 30 grams of rice, one must consume 120 grams of the average root or tuber included in the household surveys.[23]

[19] The Myanmar FGDB also includes the category "sweets". The guidelines note that it should be consumed in limited quantities and is therefore consistent with the South Asia RD, which provides no recommendation for "sweets".
[20] Myanmar also has a common colonial heritage to India, Bangladesh and Pakistan, being part of the British Empire until independence, although also shares similarities to South-East Asian countries, and has considerable variation within regions.
[21] Edible portion factors are used to convert "as purchased" survey quantities to edible grams and unit values to kyat per edible gram.
[22] The subgroup serving sizes for legumes is specified in the South Asia diet (Dizon and Herforth, 2018). The dried meat/fish relative to fresh meat/fish serving size is noted by Herforth et al. (2018). Tuber, nut/seeds, and powdered milk serving sizes are based on calorie ratios, while, due to high sugar content, the condensed milk serving size is based on calcium and protein ratios (USDA, 2016; Shaheen et al., 2013).
[23] Our analysis includes the comparison of costs and quantities consumed across food groups, as well as comparison of food prices and quantities consumed within food groups. However, such analysis is only meaningful if quantities per gram of each food item within a food group are indeed comparable in terms of the recommended diet. For example, if a household consumes 25 grams per AE of dried fish, this is the equivalent of one 50 gram protein group serving. To facilitate comparison with other foods in the protein group, we convert this 25 grams of dried fish to 50 grams of protein food group consumption. Likewise, throughout this paper, we also convert all sub-group quantities and prices to food group equivalent values. These conversions are made using the sub-group conversion factors listed in Table 1, which are simply the ratios of sub-group serving sizes to the food group serving size.

Table 1. South Asia recommended diet, per person, based on Dizon and Herforth (2018)

Food Group	Food sub-group	Recommended number of servings			Weight per serving (grams)	Sub-group conversion factor	Average recommended quantity (grams)
		Min.	Max.	Average			
Staples		9	20	14.5	30		435
	Grains				*30*	*1*	
	Roots/Tubers				*120*	*4*	
Protein Foods		3	4	3.5	50		175
	Fish/meat/eggs				*50*	*1*	
	Dried meat/fish				*25*	*0.5*	
	Pulses				*30*	*0.6*	
Dairy		2	3	2.5	100		250
	Fresh milk				*100*	*1*	
	Sweetened condensed milk				*40*	*0.4*	
	Powdered milk				*16*	*0.16*	
Vegetables	*At least one dark green leafy vegetable*	3	6	4.5	100		450
Fruits		1	2	1.5	100		150
Fats		2	4	3	15		45
	Oils				*15*	*1*	
	Nuts/seeds				*24*	*1.6*	

Source: Dizon and Herforth (2018), Herforth et al. (2018), and authors' calculations.

Dizon and Herforth (2018) note that the average number of servings in the South Asia recommended diet approximates a thirty year old male's energy needs and meets the estimated average requirements for a key set of macro- and micro-nutrients. Because Dizon and Herforth's South Asia recommended diet was not developed in the context of the dietary habits of Myanmar, we also assess the nutrient content of the recommended diet applied to Myanmar (for the CoRD and CoRD-FP food baskets). We find that the average number of recommended servings applied to typical Myanmar food consumption patterns meets the majority of the nutritional needs of our reference adult, a 30-year old male (see Section 3.3.5) for a description of the method and Section 4.5 for specific results). Thus, we confirm Dizon and Herforth's finding that the average number of servings is the appropriate choice for an adult male, and consequently an appropriate choice for making comparisons to per AE quantity and expenditure values derived from the household surveys. Henceforth, we refer to "average recommended number of servings" as "recommended servings" or "recommended quantities".

The Myanmar FBDG recommends that dairy products be consumed daily and the South Asia recommended diet advocates consuming 250 grams per day, which is approximately equivalent to a 250 mL glass of milk. This quantity is consistent with the dairy portion of the EAT Lancet reference diet, a diet designed to be internationally relevant (Willett et al., 2019). Nonetheless, a number of factors could call into question the legitimacy of including dairy in a recommended diet in the Myanmar context. Average household dairy consumption in Myanmar is very low and generally limited to use in tea and coffee (van der Lee et al., 2014; CEPA, 2016). Furthermore, Myanmar's

dairy production is also quite limited (van der Lee et al., 2014), and there is not a tradition among Myanmar's farmers to raise cattle or other ruminants for dairy production. It is estimated that rates of lactose intolerance are quite high in much of Southeast Asia (Sahi, 1994; Swagerty et al., 2002; Nissim et al., 2015), and this may well include Myanmar.

However, these conditions do not necessarily preclude the dairy food group from having a legitimate place in dietary recommendations for Myanmar. In a survey of 90 national FBDG, Herforth et al. (2019) find that 10 countries in the Asia-Pacific region (of 17 total) include dairy as distinct food group in their FBDG. A key reason why dairy products are so often included in recommended diets is that dairy is rich in calcium. Indeed, other countries in the region without a tradition of dairy consumption and with high rates of lactose intolerance including Vietnam, Thailand, and China have successfully promoted increased dairy production and consumption (FAO, 2008; Sharma and Rou, 2016).[24]

It is important to note that some commonly consumed items (e.g. sweets, seasonings, betel leaf, and alcoholic beverages) do not fall into any South Asia recommended diet food group due to negligible or adverse nutritional value. These "other" foods comprise 9 and 12 percent of food expenditure in 2010 and 2015, and 3 percent of calorie consumption in each survey. Many "other" foods are essential components in preparing palatable food. Therefore, a household's cost of acquiring and preparing a nutritious diet would likely exceed the CoRD and CORD-FP.

Unlike "other" foods, which do not belong in the recommended diet, we exclude food consumed away from home (FAFH) from the recommended diet due to a lack of information required to place FAFH consumption within food groups and to measure unit values and quantities consumed. FAFH comprises 7 percent of food expenditure in 2010 and 10 percent in 2015, and therefore exclusion of FAFH may lead to a nontrivial underestimation of recommended diet food group consumption, particularly in urban areas where expenditure on FAFH is more common.

3.3.2 Estimating the CoRD and the Food Preferences CoRD (CoRD-FP)

The first step in estimating the CoRD is to identify the most appropriate set of retail food prices given the goals of the analysis and data availability. Dizon and Herforth (2018) demonstrate that this method can be implemented using either the underlying retail food price data collected to construct the food component of a country's Consumer Price Index (CPI) or food prices derived from household food expenditure survey data.[25]

There are several advantages and limitations of each approach. Using CPI prices is considerably less time-intensive and complicated than generating prices from household survey data. Furthermore, CPI price data are collected monthly or weekly, which enables seasonal as well as annual tracking of the CoRD. By contrast, household expenditure surveys are administered much less frequently, often only every 5-6 years. In addition, household survey prices are limited to survey implementation periods, which may not exhibit much seasonality, depending upon the months during which the survey was implemented. Though both approaches can assess spatial differences in the CoRD, CPI

[24] Lactose intolerance is not a major constraint for dairy consumption among young children, and even some lactose intolerant populations of older children and adults can tolerate dairy consumption in moderation. This depends on an individual's level of lactose intolerance, the quantity of the dairy product consumed, and particularly the type of dairy product. For example, milk has high levels of lactose relative to yoghurt and cheese.

[25] A third option is to use retail food price data collected from agricultural market information systems, where available (Dizon and Herforth, 2018).

prices are collected for a limited number of areas, often urban centers, while household surveys typically provide food prices from both urban and rural areas throughout the country. Household survey prices also enable an assessment of the affordability of the recommended diet by comparing the CoRD to observed household food expenditure. In this analysis, we opt to use household food expenditure data in order to both assess the affordability of the CoRD in Myanmar and to develop and demonstrate a modification of the CoRD method that better reflects household food preferences.

To calculate food group prices using household data, we closely follow the method outlined in Dizon and Herforth (2018) where the food group price per edible gram is based on the price of the cheapest food group items in a given area and time period. We refer to this minimum cost estimate of the recommended diet as the CoRD. However, the cheapest items in each food group are not necessarily items that are consumed in significant quantities due to local food tastes and preferences. Therefore, while the CoRD provides a valuable estimate of the potential minimum cost of purchasing a recommended diet, it likely underestimates how much even poor households would spend to eat a nutritionally balanced diet as preferences play a nontrivial role in consumption choices.

In order to gain insight into the cost of acquiring the recommended diet while following actual dietary patterns, in this paper we introduce a modification to the CoRD method that we call the Food Preferences CoRD (CoRD-FP). The main difference between the CoRD and CoRD-FP is that in estimating the latter, we compute the price per edible gram for each food group based not on the lowest-cost food items in that group, but rather on the weighted price of a potentially larger basket of commonly-consumed foods in each food group. Because any additional foods in the CoRD-FP basket are more expensive (per edible gram) than the lowest-cost food items in the CoRD basket (by definition), the CoRD-FP is therefore at least as expensive and most likely more expensive than the CoRD. Thus, the difference in cost between the CoRD and CoRD-FP captures a "preference premium" – the additional cost of acquiring a recommended diet based on a basket of foods that reflect food preferences within each food group.

Our computation of the CoRD follows four basic steps. Since one of our main objectives is to assess the affordability of a nutritious diet, we aim to reduce the potential influence of higher quality, more expensive foods that may be purchased by wealthier households. Our first step is thus to restrict price calculations to data from households in the bottom four expenditure quintiles.[26] Second, in each food group, we consider food items that together account for the top 80 percent of quantities consumed.[27] By eliminating less frequently consumed items, we avoid items that are either not typically consumed or have very few observations. Within this restricted sample, we identify the median household price (unit value) per food group equivalent edible gram of each food item.

[26] Sensitivity analysis was conducted to test how restricting the sample even further (i.e. to include primarily poorer households) would impact calculations of a national CoRD and CoRD-FP. Restricting the sample to households in the bottom two expenditure quintiles reduces the CoRD by only 1 percent and the CoRD-FP by 4 percent. It also causes the difference between the CoRD and CoRD-FP to fall by only 11 percent. As the impact on the CoRD and CoRD-FP are not large and the MPLCS sample is relatively small, we opt to keep a larger share of households (i.e. the bottom 80 percent in terms of total household expenditure) to enable a finer degree of spatial analysis.

[27] A large and diverse set of protein items are consumed in Myanmar. For many individual fish and legumes, quantity shares are quite small resulting in these items being dropped. However, the overall consumption shares of fish and legumes are not small. In order to reflect the original distribution of consumption between the meat, egg, fish, and legumes sub-groups, items are reweighted to restore original sub-group quantity shares.

Third, following Herforth et al. (2018) and the Cost of Nutritious Diets Consortium (2018), for each food group we identify the two food items with the lowest median prices per edible gram. The choice of two items reflects the emphasis by FBDG on consumption diversity among and within food groups (Dizon and Herforth, 2018). Because the Myanmar FBDG and the South Asia recommended diet recommend eating at least one DGLV every day, the three lowest vegetable prices are identified, one of which must be the price of a DGLV. The price per gram for each food group is simply the average unit value of the lowest-cost foods. Finally, once food group prices are estimated, the CoRD is computed as the sum of the cost of the recommended number of servings of each of the recommended diet food groups.

We also compute the CoRD-FP using four steps. The difference between the CoRD and the CoRD-FP lies entirely in the calculation of food group prices in step three. CoRD-FP food group prices are based on actual consumption patterns within each food group. Specifically, we compute the price per gram of each food group as the weighted average unit value of the entire basket of foods (for each food group) selected in step two. Weights are based on each food item's quantity share of the total food group basket's quantity.[28] [29]

To capture spatial and seasonal variation in both prices and food preferences, the four-step procedure for both the CoRD and CoRD-FP is applied separately to six urban and seven rural spatial domains, and in the case of the IHLCA, by the two survey seasons.[30] Though the CoRD and CoRD-FP are estimated by domain, throughout the results section, we present population weighted averages by wealth quintile and at several geographical levels of aggregation (national, urban/rural, agro-zone) for which the MPLCS is representative.

While the CoRD likely underestimates the cost of purchasing the recommended diet, the CoRD-FP likely overestimates this cost. The CoRD-FP assumes that a household chooses to consume the recommended diet quantity of each food group while maintaining current consumption patterns within each food group. However, in reality, if households decided to eat the recommended diet yet remained constrained by their current expenditure levels, it is likely that substitution would occur within food groups based on relative prices. For example, households would likely replace at least some portion of relatively inexpensive energy-dense staple foods with increased quantities of more protein- or other nutrient-dense foods. However, many protein- and nutrient-dense foods are considerably more expensive (per calorie and per gram) than staples. Thus, if households decide to increase their consumption of, say, more protein-dense foods, their budget constraints may lead them to consume a larger share of less expensive proteins (such as fish and legumes) relative to more expensive proteins (such as poultry, pork, beef and eggs). In essence, the CoRD could be

[28] Typically, when weighting a variety of food items, expenditure shares or calorie shares are preferred as monetary and caloric values are comparable units across foods. In our analysis we chose quantity weights for several reasons. First, the recommended diet is described in grams per serving for all foods falling in the same food group. Second, we convert foods to comparable quantities within each food group. Third, we are interested in the nutrient contribution of each food item. Within food groups micronutrient contributions are more closely related to quantities consumed than caloric or expenditure levels. Quantity weighting has the advantage, in this context, of avoiding giving greater influence to more expensive and calorie dense items that are not necessarily more nutrient dense.

[29] In order the ensure the vegetable food group price reflects the requirement of eating at least one DGLV every day, vegetable weights are adjusted so that the sum of quantity weights of the DGLV food items included equals one third of the vegetable weight.

[30] Urban spatial domains are defined as the urban areas of the following state groupings: Chin, Kachin, Kayah, Kayin, Shan; Magway, Mandalay, Nay Pyi Taw (MPLCS only), Sagaing; Rahkine; Mon, Tanintharyi; Ayeyarwaddy, Bago; Yangon. Rural spatial domains are defined as the rural areas of the following state groupings: Chin, Kachin, and Shan; Kayah and Kayin; Magway, Mandalay, Nay Pyi Taw (MPLCS only), and Sagaing; Mon and Tanintharyi; Ayeyarwaddy and Bago; Yangon.

thought of as providing a lower-bound estimate of the cost of a nutritious diet, while the CoRD-FP provides an upper-bound.

3.3.3 Affordability of the recommended diet

After estimating the CoRD and CoRD-FP, we estimate the affordability of the recommended diet by counting the number households with food expenditure falling below the CoRD and CoRD-FP in each spatial-temporal domain. The population weighted average of these counts provides an estimate of the share of the population living in households that cannot afford each diet, based on how much they actually spend on food. An implicit assumption in assessing affordability in terms of food expenditure is that the non-food component of household expenditure is fixed. In principle, nutrition policy might persuade consumers to spend a greater share of household expenditure on food.

To understand the extent of affordability short falls, we also estimate a recommended diet affordability gap which measures the average percentage shortfall of household daily food expenditure per AE relative to the CoRD and CoRD-FP, for households with food expenditure below the CoRD or CoRD-FP. The recommended diet affordability gap is analogous to the poverty gap index typically included in poverty analysis as it captures the depth of household food expenditure deficiency relative to the expenditure required to purchase the recommended diet. The gap could also be thought of as the amount of income transfer needed to render the CoRD or CoRD-FP affordable.

3.3.4 Cost of Calorie Adequacy (CoCA)

The cost of calorie adequacy (CoCA) estimates the minimum cost of attaining a calorie target assuming that the diet consists of only the cheapest starchy staple food. CoCA could be thought of as a survival/subsistence diet, since sufficient calories are essential for basic biological function, but it also serves as a useful lower benchmark for comparing the additional costs required to satisfy requirements for a much fuller range of nutrients. The CoCA is simply the price per calorie multiplied by the calorie requirement of our reference adult, 2,790 calories, for the lowest price per calorie staple in each spatial-temporal domain. In every spatial-temporal domain, the cheapest staple is a variety of rice.

3.3.5 Assessing the nutrient adequacy of the recommended diet in Myanmar

Though recommended diets are designed to hit key nutrient targets for the population on average, there is no guarantee that these targets will be attained. It is possible that the foods in the CoRD or CoRD-FP baskets might not satisfy nutrient requirements because the nutrient content of different foods within the same food group can vary quite substantially. Therefore, the final piece of analysis in this paper examines whether the foods selected for a national level CoRD and the CoRD-FP are indeed nutritionally adequate based on the estimated average requirements (EAR) for 19 to 30 year old men and woman, an age range that generally has the highest requirements. EARs estimate the intake level of a given nutrient necessary to meet the nutrient requirements of half the healthy individuals in a gender-age group whereas recommended daily allowances (RDA) estimate the levels necessary to meet the needs of nearly all healthy individuals in the group. Because we base our CoRD and CoRD-FP estimates on the average food group quantities provided by the recommended diet, EARs are appropriate as a nutrient standard for comparison.

To calculate the nutrient composition of the South Asia recommended diet, we apply an approach similar to that used to derive weighted food group prices, described in the Section 3.3.2. Using foods

in the MPLCS selected for national CoRD and CoRD-FP baskets, we calculate the sum of the weighted average of nutrients obtained across the six recommended diet food groups. Nutrient values are obtained from the USDA and Bangladesh food composition databases (Shaheen et al., 2013; USDA, 2016) and supplemented with work by World Fish (Scott, 2019). EARs and RDAs of key nutrients, by age and sex, are reported by the Institute of Medicine (2006). We derive energy requirements, by age and sex, for the Myanmar population (see Appendix B).

4 RESULTS

4.1 Consumption of recommended diet food groups

4.1.1 Consumption relative to recommended diet quantities

We begin by exploring household consumption of recommended diet food groups relative to the recommended consumption quantities of each food group in the recommended diet. We first consider the percentage of the population living in households that consume at least one serving of each food group (Table 2) and then the percentage of the population living in households that consume the recommended number of servings (or more) of each food group (Table 3).

While 90 to 100 percent of the population lived in a household that reported consumption of *at least one serving* each of staples and protein foods during the recall period in 2010 and 2015, the percentage of the population with household consumption meeting or exceeding the average *recommended* number of servings of these two food groups was 62 and 38 percent, respectively, in 2015 (Table 3). Similarly, most of the population consumed at least one serving each of fats and vegetables in 2015, but only 38 and 9 percent, respectively, consumed the recommended number of servings. Only 27 percent of the population consumed at least one serving of fruit in 2015, while 16 percent consumed the recommended quantity. Dairy consumption is negligible, as only 3 percent of the population lived in households that consumed at least one serving in 2015, and less than one percent consumed the recommended number of servings (see Section 3.3.1 for background on Myanmar's low dairy consumption).

Table 2. Percentage of the population living in households that consume at least one serving of each food group per AE per day

										HH total expenditure quintile				
Year	Food group	National	Urban	Rural	Hills	Dry	Delta	Coastal	Yangon	1	2	3	4	5
2010	Staples	100	100	100	100	100	100	100	100	100	100	100	100	100
	Protein foods	96	96	96	92	97	99	91	96	85	97	99	99	99
	Dairy	1	3	0	1	1	1	1	4	0	0	0	1	4
	Vegetables	79	74	81	86	93	69	69	66	60	77	84	88	88
	Fruit	29	29	29	26	35	28	21	23	7	18	27	40	53
	Fats	85	88	84	76	97	88	42	93	63	84	90	94	94
2015	Staples	99	99	98	98	99	98	98	99	97	98	100	99	100
	Protein foods	91	96	89	82	90	94	88	98	70	90	98	97	99
	Dairy	3	6	1	2	2	2	3	5	1	1	1	2	8
	Vegetables	86	85	87	82	94	85	84	79	70	84	90	94	94
	Fruit	27	34	24	21	29	28	22	30	7	14	23	38	52
	Fats	91	93	91	83	97	95	74	95	77	90	96	96	97

Source: Authors' calculations based on the 2010 IHLCA and the 2015 MPLCS. Note: 1) Expenditure quintiles are estimated using spatially deflated total household expenditure per AE; IHLCA expenditure is also seasonally deflated. 2) All quantities are converted to edible portions and food group equivalents (see Table 1).

Table 3. Percentage of the population living in households that consume at least the average recommended servings of each food group per AE per day

										HH total expenditure quintile				
Year	Food group	National	Urban	Rural	Hills	Dry	Delta	Coastal	Yangon	1	2	3	4	5
2010	Staples	67	40	77	65	69	76	72	41	60	70	73	72	62
	Protein foods	33	31	34	24	33	41	23	32	4	16	33	52	61
	Dairy	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vegetables	3	2	4	3	6	2	1	0	0	1	2	4	9
	Fruit	12	12	13	11	15	13	9	10	2	5	9	17	29
	Fats	24	19	26	9	47	17	2	17	5	15	25	35	41
2015	Staples	62	32	74	63	61	73	74	37	62	66	67	65	51
	Protein foods	38	39	38	28	36	47	30	43	8	22	41	54	66
	Dairy	0	1	0	0	0	0	0	1	0	0	0	0	1
	Vegetables	9	9	9	6	13	8	11	5	1	3	10	12	19
	Fruit	16	20	14	12	17	16	14	17	2	6	12	23	36
	Fats	38	30	41	22	59	38	19	26	16	28	43	48	53

Source: Authors' calculations based on the 2010 IHLCA and the 2015 MPLCS. Notes: See Notes for Table 2.

To further assess observed household food consumption relative to the recommended diet, we next compare consumption quantities of each food group in 2015 to the recommended diet quantities. We find that many households appear to over-consume staples relative to the recommended diet by a significant amount. For example, mean and median household staple consumption (509 and 501 grams per AE per day) exceeds the recommended diet quantity of 435 grams (per AE per day) in all areas except urban and the Yangon zone (Tables 4 and 5). While high rates of staple consumption could partly reflect high energy requirements, it more likely reflects substitution of cheap calorie-dense staples for more nutrient-rich non-staple foods. Most households significantly under-consume dairy, vegetables, and fruit, as no expenditure quintile has mean or median consumption of these food groups that meets or exceeds their recommended diet quantities. Only households in the top two quintiles of total household expenditure consume protein foods and fats in quantities that exceed the recommended diet quantity.

Table 4. Mean household daily consumption (grams/AE) by food group, 2015

		Mean household consumption (grams/AE)												
										HH total expenditure quintile				
Food group	Rec. Diet	National	Urban	Rural	Hills	Dry	Delta	Coastal	Yangon	1	2	3	4	5
Staples	435	509	386	556	511	482	566	585	404	483	522	519	529	492
Protein foods	175	167	171	166	131	162	196	146	177	86	128	164	206	252
Dairy	250	10	18	7	8	8	9	12	16	3	4	7	12	24
Vegetables	450	242	232	246	215	277	241	248	201	154	199	250	288	320
Fruit	150	76	91	70	63	77	80	65	87	30	47	67	99	138
Fats	45	43	39	44	32	56	43	30	37	28	38	44	50	55

Source: Authors' calculations from the 2015 MPLCS. Notes: See Notes for Table 2. Cells in yellow (green) represent values lower (higher) than those in the recommended diet.

Table 5. Median household daily consumption (grams/AE) by food group, 2015

Food group	Rec. Diet	Median household consumption (grams/AE)												
		National	Urban	Rural	Hills	Dry	Delta	Coastal	Yangon	HH total expenditure quintile 1	2	3	4	5
Staples	435	501	363	550	515	477	564	615	380	496	520	511	521	448
Protein foods	175	142	148	139	112	138	168	123	158	78	118	153	192	216
Dairy	250	0	0	0	0	0	0	0	0	0	0	0	0	0
Vegetables	450	207	198	212	184	234	208	209	175	146	174	215	259	283
Fruit	150	45	63	37	32	45	45	31	62	9	24	43	72	105
Fats	45	37	34	38	28	51	37	26	33	24	33	41	44	48

Source: Authors' calculations from the 2015 MPLCS. Notes: See Notes for Table 2. Cells in yellow (green) represent values lower (higher) than those in the recommended diet.

4.1.2 Food group consumption by urban and rural areas

In 2015, for most recommended diet food groups, the share of the population living in households that consumed the recommended number of servings is relatively similar in rural and urban areas, with the exception of staples (Table 3). For example, 74 percent of the rural population consumes the recommended servings of staples relative to only 32 percent of the urban population. Likewise, the mean daily consumption of staples among the rural population is 556 grams per AE relative to 386 for the urban population (Table 4).

There are at least three potential explanations for this difference. First, poverty rates in Myanmar are considerably higher in rural areas (38.8 percent in 2015) relative to urban areas (14.5 percent) (MoPF and World Bank, 2017a), and poorer households are more likely to consume cheaper, more energy-dense diets (Green et al., 2013; Miller et al., 2016). Second, agriculture is still the predominant economic activity of most adults in rural areas, thus these adults may be more likely to engage in physically intense manual labor than those in urban areas and have higher caloric needs. Third, household consumption of FAFH, which we do not include in our estimates, is predominantly staple-based and more common in urban relative to rural areas.[31] However, if we add an estimate of the quantity of staples contained in FAFH dishes to staple quantities, we find that only about 15 percent of the difference between the mean staple consumption quantities of urban and rural populations is due to higher FAFH consumption in urban areas.[32] Thus, even after adjusting for excluded FAFH, the difference in urban and rural staple consumption levels remains quite large.[33]

[31] In 2015, 66 percent of the urban population lived in households that reported consumption of FAFH compared to 46 percent of the rural population.

[32] The FAFH module in the IHLCA survey enables us to test the sensitivity of estimated staple consumption to the exclusion of FAFH. IHLCA households report specific dishes consumed outside the home, and an IHLCA technical document reports conversion factors to grams for each dish (IDEA, MNPED, UNDP, 2010). Among the list of 17 FAFH dishes, 11 feature rice, noodles, or bread components. We arbitrarily assume that staples comprise 75 percent of these dishes, and re-estimate 2010 staple consumption including the 11 staple-based FAFH items. Adding this estimated quantity of staple-based FAFH items to household staple consumption results in the percentage of the population consuming at least the recommend servings of staples increasing from 40 percent without FAFH to 55 percent with FAFH in urban areas and from 77 to 81 percent in rural areas. Likewise, mean consumption of staples increases to 474 and 614 grams per AE in urban and rural areas. If we instead assume that staples comprise 100 percent of staple-based FAFH dishes, the percentage of the urban and rural populations consuming at least the recommended servings of staples increases to 57 and 82 percent, respectively. Likewise, mean consumption of staples would increase to 491 and 623 grams per AE in urban and rural areas.

[33] Because FAFH is consumed away from home by potentially more than one individual in a household, who may or may not be the one interviewed by our surveys, FAFH may well be underreported. If this is the case, given that FAFH is more prevalent in urban areas, a larger proportion of the gap between mean urban and rural staple consumption might be attributed to differences in urban and rural FAFH consumption.

4.1.3 Food group consumption by agro-zone, expenditure quintiles, and year

The percentage of the population living in households that consume the recommended quantity of various food groups varies considerably by agro-zone. For example, 47 percent of those in Delta consumed the recommended quantity of protein foods in 2015, compared to 28 percent in Hills and Mountains[34] and 30 percent in Coastal (Table 3). Because many protein foods are among the most expensive in Myanmar (see Table 13) and because meat and fish consumption tends to increase as household income increases, this spatial variation in protein food consumption may be related to the fact that the Delta zone has the lowest poverty rate (26.2 percent in 2015) while the Hills and Coastal zones has the highest (40 and 44 percent, respectively).

Among the six food groups of the recommended diet, starchy staples was the only food group in 2015 for which consumption of the recommended number of servings did not vary much by expenditure quintile. For all other food groups, consumption increases considerably as household expenditure rises. For example, only 8 percent of those in the poorest quintile consume the recommended quantity of protein-dense foods compared to 66 percent of those in the wealthiest quintile (Table 3).

The percentage of the population with household consumption meeting the recommended number of servings of protein foods, vegetables, fruit and fats increased from 2010 to 2015, while those for staples declined somewhat. This dietary shift is consistent with the 7.2 percent per year increase in Myanmar's GDP per capita between 2010 and 2015 (World Bank, 2019) and with Bennett's Law, which predicts that as wealth increases, consumers will decrease the proportion of their food expenditure on starchy staples and increase it for food such as meat, vegetables, fruits, and dairy products.

4.2 Cost of a Recommended Diet

4.2.1 Relative costs of CoCA, CoRD and CoRD-FP diets

We now turn to the cost of acquiring the recommended diet in Myanmar, focusing on 2015. We begin by presenting the cost of meeting the recommended diet requirements using either prices of a few lowest-cost foods (CoRD) or prices of a larger basket of foods that reflect food consumption patterns (CoRD-FP). We also present the minimum cost of meeting caloric needs (CoCA), which provides a benchmark of the absolute minimum cost of a survival diet. Table A1 in Appendix C and Table 13 provide insight into the food items that form the basis of the CoRD and the CoRD-FP.

At the national level, the CoRD is 2.5 times more expensive than the staple-only CoCA (Table 6). For example, the CoRD is 808 kyat per day while the CoCA is 317 kyat per day. Likewise, at the national level, the CoRD-FP costs 1,189 kyat per day, which is 3.7 times more expensive than the CoCA, and 47 percent more expensive than the CoRD. This implies that meeting the recommended diet using foods that reflect observed consumer preferences (i.e. the CoRD-FP) costs 47 percent more than doing so using minimum-cost foods (CoRD). In other words, the preference premium is very high.

4.2.2 Cost of food groups within CoRD and CoRD-FP

In 2015, the cost of the protein food group in the CoRD-FP was 3.5 times higher than in the CoRD (Figure 1). Higher CoRD-FP protein food costs are the primary source of the difference in total

[34] Referred to hereafter as simply "Hills".

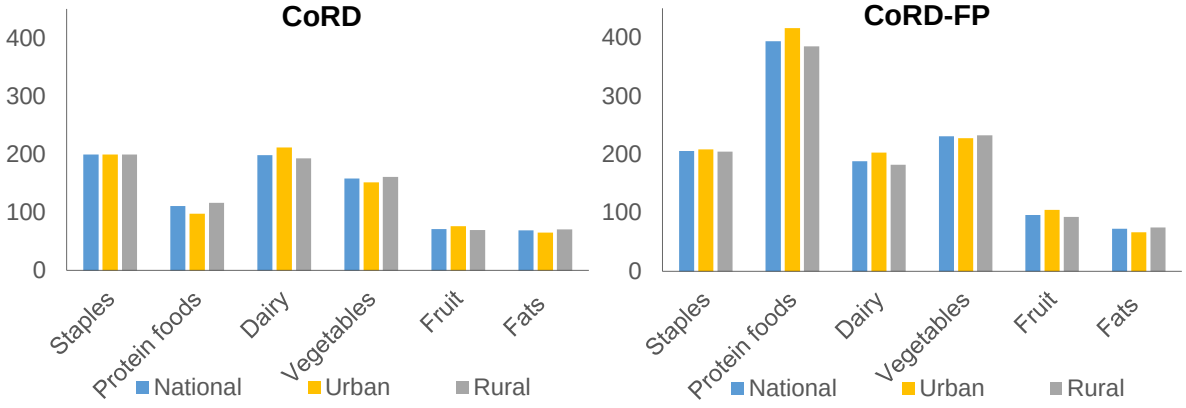
costs of the CoRD-FP and the CoRD, and accounts for most (72 percent) of this difference. The cost of the CoRD-FP protein food group is based on observed food preferences, which for Myanmar includes a combination of meat (chicken, pork, and/or beef), fish, eggs and legumes. By contrast, the protein food group for the CoRD includes only the two lowest-cost protein foods in each spatial domain. In all but two spatial domains (Table A1), these two foods are legumes, which are considerably cheaper than meat, fish or eggs.

Table 6. Relative costs of CoCA, CoRD and CoRD-FP diets, 2015

	Diet cost (kyat/day)		Ratios of diet cost	
	CoRD	CoRD-FP	CoRD to National CoRD	CoRD-FP to National CoRD-FP
National	808	1,189		
Urban	802	1,227	0.99	1.03
Rural	810	1,173	1.00	0.99
Hills	902	1,336	1.12	1.12
Dry Zone	727	1,087	0.90	0.91
Delta	841	1,241	1.04	1.04
Coastal	830	1,072	1.03	0.90
Yangon	773	1,200	0.96	1.01

Source: Authors' calculations based on the 2015 MPLCS.

Figure 1. Cost of the recommended diet by food group and by urban/rural (kyat per day), 2015



Source: Authors' calculations based on the 2015 MPLCS.

In Table 7, we summarize the protein food group from the 2015 national basket that is presented in Table 13. Twelve types of fish and fish products account for the largest quantity share of protein foods, followed by seven types of legumes, and then meats, and eggs. The cost per serving of fish is 3.1 times higher than that of legumes, while those for chicken, pork, and chicken eggs are 9.6, 6.3 and 3.4 times higher than that of legumes. Thus, the cheapest foods in the CoRD-FP protein food basket are legumes, yet they only account for about 8 percent of the cost of the CoRD-FP protein group, while the other 92 percent of this cost comes from more expensive foods (Table 7). By

contrast, in most CoRD spatial domains, the cost of the protein food group is based on the prices of the two least-cost protein foods, which are both legumes.

Table 7. Cost per serving and share of total food group cost for food items and sub-groups within the CoRD-FP protein food group, national level, 2015

Protein group food item or sub-group	Quantity share (%)	Cost per serving (kyat/day)	Protein group cost share (%)
Fish	43.0	94	37.4
Legumes	26.7	30	7.5
Chicken	8.4	290	22.5
Pork	8.2	191	14.4
Chicken eggs	7.7	104	7.4
Duck eggs	3.2	118	3.5
Beef	2.8	288	7.4

Source: Authors' calculations based on the 2015 MPLCS.

The next largest source of the difference in the total cost of the CoRD-FP and the CoRD is the cost of the recommended diet quantity of vegetables. Vegetables are 46 percent more expensive in the CoRD-FP and account for approximately 19 percent of the total difference. By contrast, the costs of staples and fats are quite similar between the CoRD-FP and CoRD, as both of these food groups primarily consist of only a few food items that are the same in both baskets (such as rice for staples and palm or groundnut oil for fats).

The most expensive food group within the CoRD-FP is protein-rich foods (394 kyat per day), which accounts for one-third of the total cost of this diet at the national level (Figure 1). The cost of protein foods for the CoRD-FP is also almost double that for staples at the national level, a pattern which is consistent across all zones. Vegetables are the second most expensive food group in the CoRD-FP diet (231 kyat per day), accounting for about 19 percent of the total diet cost. Although the recommended diet dairy requirement is not high (250 grams of fluid milk equivalent per day at the national level) its cost is nearly as high as the cost of the much larger recommended quantity of staples (435 grams) (189 and 206 kyat, respectively).

4.2.3 Spatial variation in the CoRD and CoRD-FP

Spatial and temporal variation in the CoRD and CoRD-FP could result from two factors: (1) variation in the price of the same food items, and/or (2) variation in the combination of food items included in the food group prices. The CoRD is virtually the same for urban and rural areas, while the CoRD-FP is slightly more expensive in urban relative to rural areas. (Table 8). There is considerably more spatial variation in the CoRDs across agro-zones. For example, the CoRD and CoRD-FP in the Hills are the highest in the country and cost 12 percent more than the national average. This agro-zone has the highest cost of every food group, except fruit, in either the CoRD, the CoRD-FP, or both (Figure 2). This is perhaps not surprising given the Hills' relatively poor road infrastructure combined with rugged terrain, resulting in more limited access to markets (Robertson et al., 2018).

The CoRD is least expensive in the Dry Zone, where it costs about 10 percent less than the national average. Likewise, the CoRD-FP is least expensive in the Dry Zone and Coastal, where it costs about 9 to 10 percent less than the national average. The Dry Zone has the lowest cost of four of

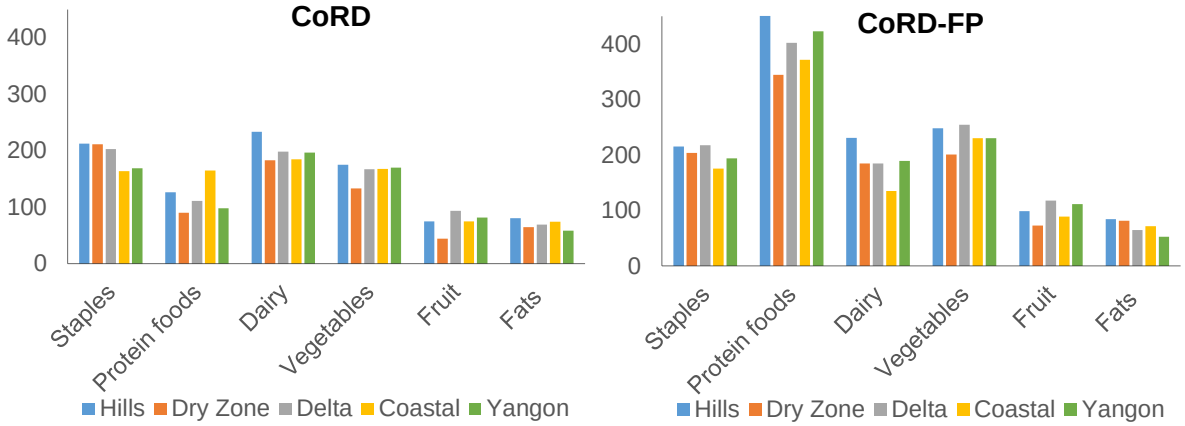
the six food groups (protein foods, dairy, vegetables, and fruit) in the CoRD and/or the CoRD-FP (Figure 2). If we instead compare the CoRD-FP in each agro-zone to the lowest zonal CoRD-FPs – which are from Coastal and the Dry Zone – we find that the CoRD-FP from Hills costs 25 percent more than in Coastal or the Dry Zone, 16 percent more in Delta, and 12 percent more in Yangon.

Table 8. Relative costs of CoRD and CoRD-FP by spatial area, 2015

	Diet cost (kyat/day)		Ratios of diet cost	
	CoRD	CoRD-FP	CoRD to National CoRD	CoRD-FP to National CoRD-FP
National	808	1,189		
Urban	802	1,227	0.99	1.03
Rural	810	1,173	1.00	0.99
Hills	902	1,336	1.12	1.12
Dry Zone	727	1,087	0.90	0.91
Delta	841	1,241	1.04	1.04
Coastal	830	1,072	1.03	0.90
Yangon	773	1,200	0.96	1.01

Source: Authors' calculations from 2015 MPLCS.

Figure 2. Cost of the recommended diet by food group and by agro-zone (kyat per day), 2015



Source: Authors' calculations based on the 2015 MPLCS.

4.2.4 Seasonal variation in the CoRD and CoRD-FP

Understanding seasonal variation in the CoRD and its food group components is an important aspect of estimating and monitoring the CoRD. Using household food expenditure survey data, we are only able to assess the seasonality of the CoRD using the IHLCA survey from 2009/10, and only at two points in the year (December/January and May).

At the national level, we find that the CoRD is only six percent more expensive in May than in December/January, and we find essentially no temporal variation in the CoRD-FP. There is also rather limited temporal variation in the cost of the two food groups with the highest quantity share, starchy staples and protein foods, which are both about 10 percent more expensive in May relative

to December/January, for both the CoRD and CoRD-FP. The results for staples are not surprising as December/January is only a few months after the monsoon harvest, the season during which most of Myanmar's rice is produced. Dairy and fats are also slightly more expensive in May relative to December/January. By contrast, vegetables and fruit are 35 percent more expensive in December/January relative to May for the CoRD-FP and 13 percent more expensive for the CoRD. Therefore, while overall CoRD and CoRD-FP vary little, the share of costs from different food groups varies (starchy staples and protein foods higher in May, and fruits and vegetables lower in May), pointing to the importance of examining temporal price variation by food group. The relative price differences could have important effects on consumption, as evidence shows larger price elasticity of demand for fruits and vegetables than cereals and protein foods (Cornelsen et al., 2015).

Assessing the cost of the recommended diet using monthly market-based retail food price data could find more temporal variation in the CoRD, as demonstrated by Dizon and Herforth (2018) using CPI food price data. If the data permits, a useful extension the CoRD using household survey data would thus be to compute its cost using monthly retail price data already collected by the Government of Myanmar's Central Statistical Office (CSO) for generating a monthly CPI. Two advantages of this approach would be first the ability to better assess the potential seasonality of the total CoRD and specific recommended diet food groups during different periods of the year, and second the ability to assess potential variation in the CoRD in each state/region from year to year.

4.3 Affordability of the CoRD and CoRD-FP

4.3.1 Diet costs relative to median daily household food expenditure

To assess the affordability of the CoCA, CoRD, and CoRD-FP, we first compare them with mean and median household daily food expenditure per AE in 2015 (Table 9). At the national level, the CoCA and the CoRD fall considerably below food expenditure levels (28 and 71 percent of median household food expenditure) compared to the CoRD-FP which just exceeds food expenditure (104 percent).

While both the CoRD-FP and CoRD are about the same in urban and rural areas, median household food expenditure per AE in urban areas is 20 percent higher than in rural areas (Table 9). Subsequently, the CoRD-FP is 94 percent of median food expenditure in urban areas while it is 108 percent in rural areas, indicating that households' ability to afford the recommended diet while maintaining current food preferences is relatively lower in rural areas. The same pattern is seen for the CoRD.

The CoRD is only higher than median household food expenditure for households in the lowest expenditure quintile (Table 9). By contrast, the CoRD-FP is higher than median household food expenditure for households in the bottom two quintiles, and nearly the same for households in the middle quintile.

Table 9. Cost of CoCA, CoRD and CoRD-FP compared to mean and median daily household food expenditure per AE (kyat per day), 2015

	Cost (kyat/day)			Household daily food expenditure (kyat/AE)		Cost as a percentage of median food expenditure (%)		
	CoCA	CoRD	CoRD-FP	Mean	Median	CoCA	CoRD	CoRD-FP
National	317	808	1,189	1,305	1,140	28	71	104
Urban	318	802	1,227	1,516	1,310	24	61	94
Rural	317	810	1,173	1,225	1,090	29	74	108
Hills	378	902	1,336	1,180	1,039	36	87	129
Dry Zone	361	727	1,087	1,234	1,081	33	67	101
Delta	289	841	1,241	1,355	1,197	24	70	104
Coastal	260	830	1,072	1,207	1,093	24	76	98
Yangon	248	773	1,200	1,567	1,366	18	57	88
Q1-low	317	823	1,189	642	649	49	127	183
Q2	317	802	1,167	943	941	34	85	124
Q3	319	803	1,181	1,211	1,215	26	66	97
Q4	319	804	1,191	1,564	1,567	20	51	76
Q5-high	316	806	1,215	2,168	1,998	16	40	61

Source: Authors' calculations based on the 2015 MPLCS. Notes: Q1 to Q5 refer to spatially adjusted total household per AE expenditure quintiles.

4.3.2 Affordability of the CoRD and CoRD-FP

To further assess the affordability of the recommended diet, we consider the percentage of the population living in households whose daily food expenditure per AE is lower than the CoRD or CoRD-FP. In 2010, about one-third of the population lived in households that could not afford the CoRD, compared to about 70 percent for the CoRD-FP (Table 10). However, between 2010 and 2015, the percentage of the population living in households that could not afford the CoRD and CoRD-FP fell by 8 and 18 percentage points, respectively, which is equivalent to a 23 and 26 percent decline. These relatively large reductions over time in the affordability of the CoRD and CoRD-FP are quite similar to the estimated 24 percent decline in the poverty headcount from 42 percent in 2010 to 32 percent in 2015 (MoPF and World Bank 2017b).

Across zones, the percentage of individuals in households that could not afford the CoRD in 2015 was highest in Hills and Coastal (38 and 32 percent) and the lowest in Yangon (17 percent) (Table 10). Similarly, the highest percentage of individuals in households that could not afford the CoRD-FP was found in Hills (69 percent) and the lowest in Yangon (47 percent). The relative lack of affordability of the CoRD and CoRD-FP in Hills occurs both because the cost of these diets are highest in that agro-zone (Table 8) and because mean and median household food expenditure in Hills is also the lowest (Table 9). These zonal patterns are consistent with 2015 poverty headcount rates which were highest in the Hills and Coastal zones (40 and 44 percent, respectively) (ibid, 2017b).

At the national level, the affordability of the CoRD and CoRD-FP varies considerably by total household expenditure quintiles. For example, 79 percent of the population within the lowest expenditure quintile live in households that could not afford the CoRD, in 2015, compared to only three percent within the highest expenditure quintile (Table 10). Similarly, 100 percent of the

population within the lowest expenditure quintile live in households that could not afford the CoRD-FP, compared to only 12 percent within the highest expenditure quintile.

Table 10. Percentage of households with daily food expenditure per AE below the CoRD and CoRD-FP

	Households with daily food expenditure per AE below the CoRD (%)					
	CoRD			CoRD-FP		
	2010	2015	% change	2010	2015	% change
National	32	24	(23)	70	52	(26)
Urban	32	20	(36)	69	49	(30)
Rural	32	26	(18)	70	53	(24)
Hills	36	38	5	80	69	(14)
Dry Zone	25	21	(16)	64	50	(21)
Delta	27	21	(22)	67	47	(30)
Coastal	52	32	(38)	82	50	(40)
Yangon	40	17	(57)	72	47	(34)
Q1-low	99	79	(20)	100	100	0
Q2	58	26	(55)	100	81	(18)
Q3	23	9	(60)	80	44	(44)
Q4	10	5	(50)	45	22	(51)
Q5-high	6	3	(48)	25	12	(51)

Source: Authors' calculations based on the 2010 IHLCA and the 2015 MPLCS. Notes: Q1 to Q5 refer to spatially adjusted total household per AE expenditure quintiles; additionally, IHLCA expenditure is seasonally deflated.

4.3.3 CoRD and CoRD-FP affordability gap

To further evaluate the affordability of the recommended diet in Myanmar, we consider the CoRD and CoRD-FP affordability gap, which measures the depth of household food expenditure deficiency relative to the expenditure required to acquire the recommended diet (for households with expenditure below CoRD or CoRD-FP). The CoRD-FP affordability gap declined from 22 percent in 2010 to 16 percent in 2015, while that for the CoRD declined only slightly (Table 11). The Hills zone not only has the highest percentage of the population that cannot afford either the CoRD or CoRD-FP, but also the highest affordability gaps for both the CoRD and CoRD-FP (25 and 11 percent, respectively). The 2015 CoRD affordability gap is lowest in the Dry, Delta and Yangon zones (about 4 to 5 percent).

Table 11. CoRD and CoRD-FP affordability gap

	Average food expenditure shortfall (%)					
	CoRD			CoRD-FP		
	2010	2015	% change	2010	2015	% change
National	7	6	(13)	22	16	(25)
Urban	7	5	(36)	22	15	(33)
Rural	7	7	(3)	21	17	(22)
Hills	8	11	30	28	25	(11)
Dry Zone	5	4	(4)	17	15	(11)
Delta	5	5	(3)	19	13	(30)
Coastal	15	9	(39)	32	16	(51)
Yangon	9	4	(59)	24	14	(40)
Q1-low	26	23	(12)	49	45	(10)
Q2	5	5	(9)	29	20	(30)
Q3	2	1	(37)	16	9	(45)
Q4	1	1	(22)	8	5	(43)
Q5-high	1	0	(11)	5	3	(40)

Source: Authors' calculations based on the 2010 IHLCA and the 2015 MPLCS. Notes: see notes for Table 10.

4.3.4 CoRD and CoRD-FP relative to the food poverty line

We next compare the MPLCS food poverty line to the CoRD and CoRD-FP for 2015. The food poverty line measures the cost of meeting caloric needs based on food consumption patterns of poor households. The CoRD-FP and the poverty line are similar in that both are derived from a basket of foods determined by household consumption patterns. The key difference is that the food poverty line is the cost of the entire basket of foods, which is scaled to meet the caloric needs of a reference adult. By contrast, the CoRD-FP is the sum of food group costs, where quantities in each food group basket are adjusted to the recommended diet levels.[35] For consistency with the analysis throughout this paper, we rescale the 2015 World Bank food poverty line to reflect the calorie-focused adult male equivalency scale used in this study.[36]

As would be expected, we find that the CoRD-FP (1,189 kyat per day) is 17 percent higher than the rescaled MPLCS food poverty line (1,017 kyat per AE per day). Thus, the cost of acquiring caloric adequacy is less expensive than the cost of acquiring a diet based on a similar set of foods but that is approximately calorically adequate and nutritionally balanced. By contrast, the CoRD (808 kyat per day), which like the CoRD-FP is also approximately calorically adequate and nutritionally balanced, is 26 percent lower than the food poverty line. This result is consistent with expectation because relative to the CoRD, the food poverty line is based on a considerably larger number of food items, many of which cost more per edible gram than the lowest-cost foods used to estimate the CoRD. Said another way, it is possible to acquire the recommended diet for less than the food poverty line, but the cost of a recommended diet taking into account food preferences is higher than the food poverty line.

[35] There are two additional important distinctions between the World Bank food poverty line and the CoRD-FP: (1) the food poverty line is based on consumption patterns of households near the poverty line whereas the CoRD-FP is based on households in the bottom four total expenditure quintiles; (2) the food poverty basket is comprised of all foods consumed whereas the CoRD-FP uses foods in the top 80 percent by quantity shares in each food group (MoPF and World Bank 2017b).

[36] The 2015 World Bank food poverty line (850 kyat per World Bank AE per day) is based on an AE scale designed for total poverty analysis rather than specifically for food related analysis (see Appendix B) (MoPF and World Bank 2017b).

4.3.5 CoRD and CoRD-FP food group expenditure shares compared to those from observed household food expenditure

We next evaluate observed household expenditure shares by food group and compare these shares to each food group's cost shares in the CoRD and CoRD-FP, in 2015.[37] The results presented in Table 12 must be interpreted within the context that (a) about half of all households have food expenditure levels below the CoRD-FP; and (b) while a majority of households over-consume starchy staples (in quantity terms) relative to the recommended diet, most households under-consume each of the non-staple food groups (Tables 4 and 5). Therefore, it is possible for a household to allocate a higher share of food expenditure to a given food group than the CoRD-FP cost share yet consume less than the recommended diet quantity for that food group.

For example, food expenditure data show that, in every agro-zone, households prioritize protein foods by allocating to protein foods a greater share of their food expenditure than the CoRD-FP cost share (Table 12). Yet, despite these relatively higher expenditure shares, most households do not consume the recommended quantity of protein foods (Tables 4 and 5). In other words, observing that household protein food expenditure shares exceed the CoRD-FP cost shares does not imply that households consume more protein foods than is recommended. Rather, household expenditure shares simply demonstrate how households are allocating their food expenditure across the six food groups in the recommended diet within the context of relatively low average food expenditure levels.

Table 12. Food group cost shares for the CoRD and CoRD-FP and observed household expenditure shares, 2015

	CoRD	CoRD-FP	Mean household food group expenditure shares (%)							
Food groups	(%)	(%)	National	Urban	Rural	Hills	Dry	Delta	Coastal	Yangon
Staples	25	17	31	26	33	37	32	29	33	26
Protein foods	14	33	39	44	37	34	34	43	38	47
Dairy	25	16	1	1	1	1	1	1	1	1
Vegetables	20	20	15	13	16	15	15	15	17	12
Fruit	9	8	6	8	5	6	6	6	5	8
Fats	9	6	8	7	9	7	12	7	6	6

Source: Authors' calculations based on the 2015 MPLCS. Note: Household food group expenditure shares are computed using only foods in the recommended diet.

In contrast, the average household expenditure share for staples is approximately twice as large as the staples cost share in the CoRD-FP and on average households do exceed the recommended quantity of staples (Tables 4 and 5). Finally, both consumption levels and expenditure shares for dairy, vegetables, and fruits fall short of the recommended diet quantities and the CoRD-FP cost shares. While the CoRD-FP cost share for dairy is 16 percent, households only spend an average of one percent of their food expenditure on dairy products.

[37] Average household food group expenditure shares do not include expenditure on food items excluded from the recommended diet, such as seasonings, sweets, and FAFH.

4.4 Cost of nutrient-rich non-staple foods relative to the cost of starchy staples

Why do so many Myanmar households under-consume non-staple foods? While factors such as food preferences and nutritional knowledge may affect dietary choices, relative food costs likely play an important role in household dietary choices, especially for poorer households.

Using internationally comparable prices across 176 countries from the International Comparison Program (ICP), Headey and Alderman (2019) use relative caloric prices to compare the price per calorie of non-staple foods to that of the cheapest country-specific staple cereal (i.e. rice, wheat, or maize products).[38] They find that caloric prices of protein-rich animal-source foods and micronutrient-rich vegetables and fruits are considerably higher than the caloric price of the cheapest country-specific staple cereal, for a number of lower-income countries in various regions. For example, among 10 countries from Southeast Asia (Myanmar included) used in their analysis, they find that it costs 5.8 times more to consume a calorie from white meat than it does a calorie from a staple cereal, while caloric price ratios indicate that DGLVs, other vegetables, processed milk, eggs and fish are 15.8, 6.0, 6.7, 8.2 and 4.9 times more expensive than the staple cereal. These relative caloric prices are consistent with research from many countries that finds that the high cost of nutrient-dense flesh foods, dairy, and fruits and vegetables relative to calorie-dense starchy staples and fats play a key role in explaining why poorer households tend to consume cheaper, more calorie-dense diets (Green et al., 2013; Darmon and Drewnowski, 2015; Miller et al., 2016; Headey et al., 2018).

To investigate why many Myanmar households under-consume non-staple foods, we evaluate the food basket associated with a national level CoRD-FP for 2015 (Table 13).[39] We then follow the approach of Headey and Alderman (2019) and compute the caloric price of each food item relative to the caloric price of rice, the least expensive, commonly-consumed starchy staple food in Myanmar.[40]

Our findings are similar to those of Headey and Alderman (2019). For example, animal-source foods are very expensive relative to rice, with relative caloric prices for meat ranging from 8 for pork to 19 for beef and 24 for chicken (Table 13). Ratios for fish and seafood range from 10 to 33, with an average of 18. Likewise, highly perishable foods like eggs, fresh milk, DGLVs, and certain fruits and vegetables have high prices per calorie relative to rice. By contrast, the average relative caloric price for legumes is only 2.5.

[38] To compute a calorie-price ratio, Headey and Alderman (2019) first compute the price per calorie of different types of foods. Their calorie-price ratios are computed as the price per calorie of a given non-staple food divided by the price per calorie of the cheapest (though commonly-consumed) country-specific staple cereal.

[39] Though for our analyses we compute the CoRD and CoRD-FP separately for each spatial-temporal domain, for illustrative purposes, Table 13 presents the basket of food items and prices that the CoRD-FP method selects if we were to implement it at the national level. Expenditure and calorie shares reported in this table are the shares among items reported in the table only and sum to 100. While the protein food group is a single group in the RD, we list plant and animal sources of protein separately, for illustrative purposes only. All prices are reported in price per edible gram.

[40] We compute a quantity-weighted average price using the three types of rice listed in Table 13, where the most common variety is "other/local variety."

Table 13. Shares and prices of foods within a national-level Food Preferences CoRD food basket, 2015

	Food item	Quantity share (%)	Calorie share (%)	Food exp. share (%)	Price / serving (kyat/day)	Price / gram (kyat/g)	Price / calorie (kyat/c)	Ratio of p/calorie to rice
Staples	Other rice (local variety)	59	60	63	14	0.46	0.13	1.1
	Rice (Emata)	23	21	22	13	0.42	0.12	1.0
	Rice (Ngasein)	18	19	15	12	0.38	0.10	0.8
Plant sourced protein foods	Chickpea	7	9	2	28	0.92	0.25	2.1
	Butter bean	4	5	1	26	0.87	0.26	2.1
	Pegyi (Lablab beans)	4	5	1	33	1.09	0.31	2.5
	Sadawpe (green peas)	4	3	1	37	1.22	0.50	4.1
	Pegya (Lima beans)	3	3	1	26	0.85	0.24	1.9
	Penilay (Peyaza, lentils)	3	3	1	37	1.22	0.36	3.0
	Green gram (Pedesane)	2	3	1	30	1.01	0.29	2.4
Animal sourced protein foods	Chicken	8	10	20	290	5.80	2.90	23.8
	Pork	8	18	13	191	3.82	0.97	7.9
	Chicken eggs	8	7	7	104	2.07	1.33	10.9
	Ngapiyae (fish sauce)	7	2	4	61	1.23	2.22	18.2
	Shrimp paste	4	3	3	61	1.22	1.22	10.0
	Ngagyin (freshwater fish)	4	3	8	177	3.54	4.08	33.5
	Other small freshwater fish	4	3	5	106	2.12	2.14	17.6
	Other dried small seawater fish	4	2	3	77	3.07	1.79	14.7
	Ngayant (freshwater fish)	4	2	6	148	2.95	3.98	32.7
	Other small seawater fish	3	2	3	90	1.80	2.29	18.8
	Duck eggs	3	3	3	118	2.37	1.26	10.3
	Fish/ shrimp sauce	3	2	1	31	0.61	0.49	4.0
	Beef	3	5	7	288	5.76	2.25	18.5
	Ngamyitchin (freshwater fish)	2	2	3	113	2.26	2.24	18.4
	Other dried small freshwater fish	2	2	2	78	3.13	1.46	12.0
	Other dried med. freshwater fish	2	2	2	92	3.67	1.63	13.4
	Ngapyayma (freshwater fish)	2	3	3	106	2.12	1.20	9.9
Dairy	Condensed milk	59	74	53	69	1.72	0.51	4.2
	Fresh milk	41	26	47	94	0.94	1.49	12.2
Vegetables	Tomato	15	13	23	65	0.65	3.26	26.8
	Water leaf	13	8	7	62	0.62	1.47	12.1
	Roselle leaf	12	8	5	43	0.43	1.04	8.5
	Onions	12	18	11	40	0.40	1.05	8.7
	Brinjal/ eggplant	10	12	13	42	0.42	1.60	13.1
	Vegetable gourd	10	7	7	28	0.28	1.73	14.2
	Cabbage	9	9	8	34	0.34	1.56	12.8
	Gourd leaf	8	3	4	59	0.59	2.18	17.9
	Cauliflower	3	4	7	83	0.83	2.85	23.4
	Garlic	3	14	10	147	1.47	1.39	11.4
	Bean/ long bean	3	4	6	64	0.64	2.30	18.9
Fruit	Watermelon	48	28	38	42	0.42	1.30	10.7
	Bananas	31	56	42	71	0.71	0.66	5.4
	Papaya	12	9	12	52	0.52	1.15	9.5
	Plums	9	7	8	50	0.50	1.10	9.1
Fats	Palm oil	45	44	32	18	1.22	0.14	1.1
	Groundnut oil	42	43	54	32	2.14	0.24	2.0
	Sesame oil	13	13	14	28	1.84	0.21	1.7

Source: Authors' calculations based on the 2015 MPLCS. Notes: See footnote 39.

Our findings are similar to those of Headey and Alderman (2019). For example, animal-source foods are very expensive relative to rice, with relative caloric prices for meat ranging from 8 for pork to 19 for beef and 24 for chicken (Table 13). Ratios for fish and seafood range from 10 to 33, with a (quantity-weighted) average of 18. Likewise, highly perishable foods like eggs, fresh milk, DGLVs, and certain fruits and vegetables have high prices per calorie relative to rice. By contrast, the (quantity-weighted) average relative caloric price for legumes is only 2.5.

As noted in Section 4.2.2 above, legumes are a considerably cheaper source of protein relative to meat, fish and eggs. However, legumes make up only 7.4 percent of the average household expenditure on all proteins in 2015. This indicates that while legumes are the cheapest source of protein in Myanmar, many households nevertheless choose to pay higher prices and consume more expensive meat, fish, and eggs, in addition to legumes.

Why do non-staple foods tend to be so much more expensive relative to staples, especially in lower-income countries? One explanation is that staples are likely to be tradable commodities whose prices largely depend on access to world markets, while micronutrient-dense vegetables and animal-source foods are less easily traded (especially those that are highly perishable), thus their prices are more sensitive to the efficiency of local supply chains and retail services (Headey and Alderman, 2019; Alemu et al., 2019; Pingali, 2015).

4.5 Nutrient adequacy of the CoRD and CoRD-FP

Recommended diets are designed to hit key nutrient targets for the population on average. However, there is no guarantee that these targets will be attained given specific dietary choices. In this section, we consider calorie and nutrient levels provided by the basket of foods selected in our application of the CoRD and CoRD-FP methods.

We find that the calories provided by the spatial-temporal food baskets associated with the 2010 and 2015 CoRD and CoRD-FP satisfy or nearly satisfy the caloric needs of our reference adult (2,790 calories) (Table 14). The average calories provided for the nation and urban/rural areas differ from the caloric needs of the reference adult by no more than plus or minus 2 percent. This calorie consistency extends to agro-zones and expenditure quintiles.

Table 14. Average calories provided by CoRD and CoRD-FP food baskets

	2010		2015	
	CoRD	CoRD-FP	CoRD	CoRD-FP
Union	2,841	2,815	2,766	2,749
Urban	2,851	2,808	2,795	2,754
Rural	2,837	2,818	2,754	2,746

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

Finally, we assess whether the foods selected for a 2015 national-level CoRD and CoRD-FP provide adequate levels of other nutrients based on EARs for men and women between the ages of 19 and 30. This analysis is only intended to estimate the nutrient content of the raw foods in the CoRD and CoRD-FP food baskets. That is, we are not attempting to estimate individual levels of nutrient intake from the food baskets, nor do we take into account differences based on cultivar, bioavailability, or type of food preparation.

We find that the CoRD-FP food basket surpasses or closely approaches the thresholds given by the EAR of all nutrients except vitamin E (Tables A2 and A3 in Appendix D). The CoRD food basket falls short of the EAR for vitamin B12, vitamin A, and vitamin E for men. For women, the CoRD has the same EAR shortfalls, though vitamin A is 92 percent of the EAR.

Differences in the nutrient content of the CoRD and the CoRD-FP food baskets are driven by differences in the micronutrients provided by legumes compared to animal-sourced foods. A diet with protein obtained entirely from legumes more adequately provides folate, thiamin, and iron, whereas a combination of legumes, meat, fish (including small fish with bones), and eggs more adequately provides calcium and vitamins A and B12.

Two important caveats about this assessment should be noted. First, vitamin B12 is generally only available from animal-sourced foods (which includes dairy), and therefore the inability of the CoRD to meet the EARs for vitamin B12 is not surprising given that its protein food basket only contains legumes, in most spatial domains. Second, dairy is not typically consumed in significant quantities in Myanmar and thus it is unlikely that a typical household could easily adhere to the dairy recommendation. However, when we evaluate the nutritional content of the recommended diet using the CoRD-FP basket without the dairy food group, this modified basket nearly meets the calcium EAR. Specifically, non-dairy foods in the CoRD-FP basket (e.g. DGLVs and fish with small bones) provide 94 percent of the calcium EAR for adult men and women.

The recommended diet's quantities applied to Myanmar's food group preferences (the CoRD-FP food basket) meets the average macronutrient needs and most micronutrient needs for adult men and women. This finding highlights the important role of national FBDG in promoting nutritionally adequate diets and specifically the value of Myanmar developing and promoting their own recommended diet. Promoting a recommended diet involves shifting dietary patterns that are based not only on preferences but also on nutritional knowledge and food prices. Therefore, additional production or price incentives as well as nutrition education might be required to steer individuals toward not only consuming recommended quantities of various food groups but also to choosing more micronutrient-dense foods within food groups. For example, the nutrient content of the CoRD food basket demonstrates that it is possible to consume a recommended diet without achieving nutrient adequacy. The CoRD food basket's lack of animal-source protein foods results in a shortfall of key nutrients such as vitamin A and B12, which illustrates a need to not only promote the consumption of protein foods but a variety of protein foods including some that are animal-sourced. Furthermore, in Myanmar where dairy consumption is extremely low, it would be useful to advocate for increased consumption of small fish with bones and DGLVs, which are also good sources of calcium. Likewise, relatively low levels of vitamin E in both CoRDs might require promotion of certain oils or nuts.

5 CONCLUSIONS

In this paper, we use survey data on household food expenditure from 2010 and 2015 to explore various aspects of access to nutritious diets in Myanmar. Our objectives are to:

a) Analyze household food consumption patterns in Myanmar relative to local and international definitions of a nutritious diet (which we refer to as a "recommended diet");
b) Use the CoRD method to estimate regional minimum costs of a recommended diet in Myanmar;
c) Develop and demonstrate a modification to the CoRD method, the Food Preferences CoRD (CoRD-FP), which estimates the cost of a recommended diet based on a larger basket of foods (relative to those used for the CoRD) that reflect food consumption patterns in Myanmar;
d) Assess the affordability of both the CoRD and CoRD-FP relative to household food expenditure; and
e) Investigate the key drivers of the costs of the recommended diet using both the CoRD basket of minimum-cost foods and the CoRD-FP basket of preferred foods.

Our key findings are summarized below.

We find that, relative to recommended diet guidelines, a majority of households in Myanmar under-consume all food groups with the exception of staples. In 2015, only 38 percent of the population lived in households that consumed the recommended diet quantity of protein-rich foods, 38 percent fats and oils, 16 percent vegetables, 9 percent fruits, and less than one percent consumed the recommended quantity of dairy products. These consumption patterns vary considerably by agro-zone. For example, 47 percent of those in the Delta consume the recommended quantity of protein foods, compared to 28 percent in the Hills and Mountains.

With the exception of staples, consumption of each of the other five food groups increases considerably as total household expenditure increases. For example, only 8 percent of those in the poorest total household expenditure quintile consume the recommended quantity of protein-dense foods compared to 66 percent of those in the wealthiest quintile. Yet, even mean consumption per AE for households in the highest quintile falls below the recommended diet quantities for dairy, vegetables, and fruit. This implies that income is not the only constraint to consuming a nutritious diet.

Consumption of the recommended number of servings of protein foods, vegetables, fruit, and fats increased from 2010 to 2015. This dietary shift is consistent with the 7.2 percent per year increase in Myanmar's GDP per capita between 2010 and 2015 (World Bank, 2019). However, even with increases in consumption of non-staple foods, many individuals live in households that over-consume staples relative to the recommended quantity, yet significantly under-consume each of the other five recommended diet food groups.

The results above beg the question of why so many Myanmar households tend to over-consume staples and under-consume all non-staple food groups. While factors such as food preferences and nutritional knowledge affect household dietary choices, relative food costs also play an important role in these choices, especially for poorer households. Consistent with recent research from countries throughout South and Southeast Asia (Headey and Alderman, 2019), we find that prices per calorie of the most micronutrient-dense foods in Myanmar are considerably higher than those of staple foods such as rice, which are calorie-dense yet relatively low in micronutrients. These results suggest that a key factor leading many Myanmar households to over-consume staples such as rice

and under-consume more nutrient-dense foods is their inability to afford the latter. For example, the price per calorie of chicken and pork are 24 and 8 times higher, respectively, than the price per calorie of rice, while the average for a number of fish and seafood items is 18 times higher. Likewise, other perishable foods like eggs, fresh milk, and certain fruits and vegetables have high prices per calorie relative to rice.

Next, we estimate the CoRD for Myanmar, develop and estimate a modification to this method – the CoRD-FP – and also estimate the cost of meeting caloric needs based on the lowest cost staple food (CoCA). We find that the CoRD and CoRD-FP are 2.5 and 3.7 times more expensive, respectively, than the CoCA, at the national level. We also find that the CoRD-FP is 47 percent more expensive than the CoRD. This implies that meeting the recommended diet using foods that reflect observed food preferences (i.e. the CoRD-FP) costs more than doing so using a relatively small number of minimum-cost foods (CoRD). The CoRD-FP thus captures a "preference premium" – the additional cost of acquiring a recommended diet based on a set of foods that reflect preferences within each food group.

Differences in the cost of the protein and vegetable food groups explain nearly all of the gap between the total cost of the CoRD-FP and the CoRD, at the national level. For example, the recommended diet quantity of protein foods costs 3.5 times more for the CoRD-FP than the CoRD, and accounts for about three-quarters of the preference premium. The reason for this is that the cost of the CoRD-FP protein food group is based on a combination of meat (chicken, pork, and/or beef), fish, eggs, and legumes. By contrast, in most spatial domains, the CoRD is based only on legumes, which are considerably less expensive per serving than animal-source foods. In addition, the recommended diet quantity of vegetables costs 46 percent more for the CoRD-FP than the CoRD and accounts for about a fifth of the preference premium.

In 2015, half of the population lived in a household that could not afford the CoRD-FP relative to actual household food expenditure, and about one quarter could not afford the CoRD. That is, the cost of the diet is higher than their actual food expenditure. However, the affordability of CoRD and CoRD-FP improved compared to 2010, when 70 percent of the population lived in a household that could not afford the CoRD-FP and 32 percent could not afford the CoRD. This improvement is consistent with a 24 percent decline in the poverty headcount from 42 to 32 percent over the same time period (MoPF and World Bank 2017b). For households that cannot not afford the estimated cost of these diets, the average deficiency in household food expenditure relative to the CoRD or the CoRD-FP is 6 and 16 percent, respectively.

There are three main policy implications from these results. First, our results suggest that Myanmar's food security and agricultural policies should focus on diversification of farm enterprises through improvements in farm-level productivity and reductions in the marketing costs of protein- and micronutrient-dense foods, such as animal-source foods, vegetables and fruits. A focus on diversification will increase farm incomes and increase the availability and affordability of nutritious foods. For many decades, food security and agricultural policies in Myanmar have primarily focused on increasing national production levels of rice (Robertson et al., 2018). For example, in recent years up to an estimated 85 percent of the annual budget for the agricultural sector in Myanmar has focused on rice production (GoM, 2018). In addition, the Myanmar Agricultural Development Bank (MADB) provides larger loans for the production of rice relative to other crops (Robertson et al., 2018), although current rice-based farming systems generate significantly less income for smallholders compared to most other production systems, such as those based on beans, pulses,

oilseeds, aquaculture, and a wide range of other smallholder cash crops (GoM, 2018). Likewise, in some contexts, modifications to land use legislation could facilitate farm diversification. For example, there is a need to reduce administrative and legal barriers to enable smallholders to convert paddy land into permanent high value enterprises like aquaculture or floriculture.

Second, different regions have different levels of agro-ecological and market access potential for production of protein- and/or micronutrient-rich foods. This implies that region-specific strategies are needed to overcome supply side (availability and cost) and demand side (household incomes, especially for poorer households) constraints to increased household consumption of protein and micronutrients. For example, the CoRD-FP is highest in the Hills zone, followed by the Delta zone. However, strategies to reduce supply and demand-side constraints to improving the quality of diets in these two areas are likely to be quite different. For example, the types of high value agricultural enterprises that can generate additional income are quite different in the Hills compared to the Delta zone.

Finally, though the relatively high cost of many micronutrient-dense foods is a key constraint to consuming a nutritious diet, dietary preferences and nutrition knowledge also play an important role in food consumption decisions. This point is clearly illustrated by consumption choices of households in the highest expenditure quintiles. Though 88 percent of households in this expenditure quintile have household food expenditure levels that are sufficient to afford the CoRD-FP, only 19 and 36 percent of these households consume the recommended diet quantities of vegetables and fruits, respectively. This highlights the need for nutrition education to encourage increased consumption of nutrient-dense foods.

We find that consumption of the CoRD-FP food basket in Myanmar meets the average macronutrient needs for adult men and women and the requirements for most micronutrients. Most notably, the CoRD-FP food basket meets average nutrient requirements for protein, iron, and vitamins A and B1, nutrients which the Government of Myanmar has identified as problem areas requiring targeted intervention (MoHS, 2019). This indicates that efforts to encourage the population of Myanmar to consume a recommended diet could significantly reduce the prevalence of health conditions resulting from insufficient nutrient intake, such as anemia in women and children. Thus, creation of national FBDG containing a recommended diet specific to Myanmar could be a powerful tool for increasing public awareness of ways to overcome known dietary shortfalls. Both greater use of the FBDG as well as development of a recommended diet specific to Myanmar (which includes recommended consumption quantities for various food groups) could help improve the effectiveness of nutrition policy. Efforts to promote consumption of a more nutritious diet would need to address both the economic constraints to eating more nutrient-dense yet relatively expensive protein foods, fruits and vegetables, as well as nutrition education and promotion around healthy diets.

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APPENDIX A. FOOD CONSUMPTION SCORE METHODOLOGY

In order to calculate a FCS, surveyed households are asked to recall the number of days within the last seven days in which they consumed food items from various food groups (Robertson et al., 2018). A standardized set of weighted values are assigned to each food group according to its nutritional importance. Households are then placed in three different diet categories depending on their FCS: poor, borderline and acceptable. There is no pre-determined international level at which a given household's FCS represents a "nutritionally adequate/acceptable" diet. Rather, the level at which a FCS is considered to be "nutritionally acceptable" is typically determined on a country-by-country basis according its specific dietary composition and consumption behaviors (ibid, 2018). Based on knowledge of the Myanmar diet, the Government of Myanmar and WFP determined that a FCS of 38.5 represents the lowest value for which a household can be considered to have a nutritionally acceptable diet. Everything below this figure is considered borderline or poor (ibid, 2018).

An advantage of the FCS approach is that the required data is relatively easy and quick to collect from surveyed households and it provides information on various aspects of household food consumption that are relevant for food and nutrition security assessment. However, a limitation of the FCS method is that the cut-off points for the three categories are relatively arbitrary and could be improved with recalibration as well as other modifications to the method (Wiesmann et al., 2009). Another limitation is that while a household needs to consume a variety of vegetables and fruits in order to obtain an adequate combination of micronutrients, FCS data does not provide information on the diversity of food items consumed within a given food group (Robertson et al., 2018). A further limitation of the FCS method is that it does not collect data on the actual quantity of different types of food that is consumed, which is needed to assess actual nutrient intake (ibid, 2018).

APPENDIX B. NOTES ON CONSTRUCTION OF OUR ADULT EQUIVALENCY SCALE

Following dietary energy recommendations detailed by the FAO (2004) and a methodology described by Waid et al. (2017), we determine caloric needs by sex, age, and the stature of the Myanmar population. The resulting calorie standard for the reference adult male is 2,790 kcal per day.[41] For adolescents and adults, we base caloric needs on weight for attained height, which is a method of applying a healthy BMI to typical population heights to estimate a healthy weight target. The 2014 Myanmar STEPS survey conducted by the WHO in conjunction with the Ministry of Health (MoH, WHO and WDF, 2015) provides mean heights for men and women aged 25-64, to which we apply a BMI of 22 and assume a moderate activity level. Actual height data is not available for healthy adolescents in Myanmar. Comparing mean heights for (a) adults aged 25-24 from the Myanmar 2014 STEP survey and (b) women's heights from the Myanmar 2015 Demographic and Health Survey (MoHS and ICF, 2017) to (c) WHO's international child growth standards for 18 and 19 year olds (WHO, 2006), we select an appropriate child growth percentile (tenth) to assign heights to children aged 10 to 17. Weights for attained height are determined using the WHO's international child growth standards 50th percentile BMI. For children nine and under, we determine caloric needs based on median weight for age according to the WHO's international child growth standards.

This AE scale – which is designed for food consumption analysis – differs from that used by the World Bank for poverty analysis (MoPF and World Bank, 2017c). The World Bank AE scale is based on caloric needs that vary by age but not by sex, and the assumption that nonfood needs are constant across age and sex. The calorie-based component of the World Bank AE scale is calculated by age relative to the average caloric needs of adult men and women (2,400 kcal). This combined AE scale is the weighted average of the food and nonfood components with weights of 0.7 and 0.3, respectively (ibid, 2017c). As a result, the World Bank AE scale leads to a greater average number of AEs per household compared to our AE scale. For example, the average number of household members in 2015 is 4.6 compared to 4.5 with the World Bank AE scale and 3.7 with our AE scale. Consequently, expenditure values reported in the World Bank's MPLCS poverty analysis (MoPF and World Bank, 2017a, 2017b, 2017c) are not directly comparable to expenditure values reported in this analysis

[41] Our daily calorie requirements by age and sex are similar to those published by the MoHS (n.d.a).

APPENDIX C. FOODS ITEMS IN CORD SPATIAL DOMAIN BASKETS

Table A1. Food items that appear in two or more CoRD spatial domain baskets (2015)

Food group	Food item	Number of areas
Staples	Other rice (local variety)	8
	Rice (Ngasein)	6
Protein foods	Gram (Chick pea)	11
	Sadawpe (Green peas)	4
	Butter Bean	4
	Pegyi (Lablab beans)	3
	Pegya	2
	Other dried medium river fish (5"-10")	2
	Penilay (Peyaza)	2
Dairy	Branded condensed milk	13
	Fresh milk	12
Vegetables	Vegetable gourd	12
	Roselle leaf	7
	Cabbage	6
	Onions	5
	Pumpkin	3
	Mustard leaf	3
	Gourd leaf	2
Fruit	Watermelon	13
	Bananas	6
	Papaya	4
	Plums	3
Fats	Palm oil	12
	Groundnut oil	9
	Sesamum oil	3

Source: Authors' calculations based on the 2015 MPLCS.

APPENDIX D. NUTRIENT ADEQUACY OF THE CORD AND CORD-FP FOR MYANMAR

Table A2. Nutrient adequacy of national-level CoRD and CoRD-FP food baskets for adult males age 19-30 (2015)

		Food basket values		Percentage of EAR	
Nutrient	EAR	CoRD	CoRD-FP	CoRD	CoRD-FP
Protein (g)	56	68	74	122	132
Carbohydrates (g)	-	480	442	-	-
Calcium (mg)	800	876	1032	110	129
Iron (mg)	6	19	16	316	271
Magnesium (mg)	330	525	390	159	118
Phosphorus (mg)	580	1297	1237	224	213
Zinc (mg)	9	12	11	124	113
Copper (mg)	1	2	2	278	269
Selenium (mcg)	45	53	102	119	227
Vitamin C (mg)	75	134	137	179	182
Thiamin (mg)	1	1	1	138	106
Riboflavin (mg)	1	2	1	150	131
Niacin (mg)	12	12	14	99	117
Vitamin B6 (mg)	1	2	2	185	171
Folate (mcg)	320	718	373	225	117
Vitamin B12 (mcg)	2	1	3	39	157
Vitamin A (mcg)	625	459	608	73	97
Vitamin E (mg)	12	8	10	70	79

Source: Authors' calculations based on the 2015 MPLCS, USDA (2016), Shaheen et al. (2013), and Scott (2019). Notes: Cells shaded yellow indicate a percentage of EAR below 95 percent.

Table A3. Nutrient adequacy of national-level CoRD and CoRD-FP food baskets for adult females age 19-30 (2015)

		Food basket values		Percentage of EAR	
Nutrient	EAR	CoRD	CoRD-FP	CoRD	CoRD-FP
Protein (g)	46	68	74	149	161
Carbohydrates (g)	-	480	442	-	-
Calcium (mg)	800	876	1032	110	129
Iron (mg)	8	19	16	234	201
Magnesium (mg)	255	525	390	206	153
Phosphorus (mg)	580	1297	1237	224	213
Zinc (mg)	7	12	11	171	157
Copper (mg)	1	2	2	278	269
Selenium (mcg)	45	53	102	119	227
Vitamin C (mg)	60	134	137	223	228
Thiamin (mg)	1	1	1	153	118
Riboflavin (mg)	1	2	1	183	160
Niacin (mg)	11	12	14	108	127
Vitamin B6 (mg)	1	2	2	185	171
Folate (mcg)	320	718	373	225	117
Vitamin B12 (mcg)	2	1	3	39	157
Vitamin A (mcg)	500	459	608	92	122
Vitamin E (mg)	12	8	10	70	79

Source: Authors' calculations based on the 2015 MPLCS, USDA (2016), Shaheen et al. (2013), and Scott (2019). Notes: Cells shaded yellow indicate a percentage of EAR below 95 percent.