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Affordability of Nutritious Diets in Rural India

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INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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ABSTRACT

Malnutrition is endemic in India. In 2015-16 some 38% of preschool children were stunted and 21% were wasted, while more than half of Indian mothers and children were anemic. There are many posited explanations for the high rates of malnutrition in India, but surprisingly few discuss the role of Indian diets, particularly the affordability of nutritious diets given low wages and the significant structural problems facing India's agricultural sector. This study was undertaken to address knowledge gaps around the affordability of nutritious diets in rural India. To do so we used nationally representative rural price and wage data to estimate the least cost means of satisfying India-specific dietary recommendations, referred to as the Cost of a Recommended Diet (CoRD), and assess the affordability of this diet relative to male and female wages for unskilled laborers. Although we find that dietary costs increased substantially over 2001-2011 for both men and women, rural wage rates increased more rapidly, implying that nutritious diets became substantially more affordable over time. However, in absolute terms nutritious diets in 2011 were still expensive relative to unskilled wages, constituting approximately 50-60% of male and about 70-80% of female daily wages, and were often even higher relative to minimum wages earned from the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). Since many poor households have significant numbers of dependents and substantial non-food expenditure requirements, it follows that nutritious diets are often highly unaffordable for the rural poor; we estimate that 45-64% of the rural poor cannot afford a nutritious diet that meets India's national food-based dietary guidelines. Our results point to the need to more closely monitor food prices through a nutritional lens, and to shift India's existing food policies away from their heavy bias towards cereals. Achieving nutritional security in India requires a much more holistic focus on improving the affordability of the full range of nutritious food groups and ensuring that economic growth results in sustained income growth for the poor.

Keywords: India, cost of diet, nutrition, rural, affordability

ACKNOWLEDGMENTS

ACRONYMS

CoNA	Cost of Nutrient Adequacy
CoRD	Cost of a recommended diet
CotD	Cost of the Diet
CPI	Consumer Price Index
FBDG	Food-based Dietary Guideline
INR	Indian Rupee
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
NIN	National Institute of Nutrition
NSS	National Sample Survey
PDS	Public Distribution System
USDA	United States Department of Agriculture

1. INTRODUCTION

India performs exceptionally poorly on a wide range of undernutrition indicators, exhibiting high rates of stunting (38%), wasting (21%) and anemia (58%) among preschoolers, and underweight (23%) and anemia (53%) among adult women (IIPS, 2015). High prevalence rates combined with a large population mean that India is the single largest contributor to maternal and child undernutrition world-wide. In recognition of these problems, the current Indian government has invested considerable resources in a national nutrition strategy, including the 2019 launch of the multi-ministry flagship initiative called the *Poshan Abhiyaan* (which roughly translates to 'nutrition mission'), the official stated goal of which is a malnutrition-free India by 2022. However, *Poshan Abhiyaan* and other nutrition initiatives face a particularly daunting challenge in rural areas where both poverty and undernutrition rates are especially high.

A complex set of factors affect nutritional status (UNICEF, 1990). These range from 'basic' causes (such as resource availability, political climate) to 'underlying' causes (inadequate access to food, care and health services, and an unhealthy environment), to 'immediate' causes (inadequate dietary intake and morbidity or disease). Despite the relative prominence of diets at a conceptual level, the role of affordability of diets in explaining poor nutritional outcomes has received far less attention than is warranted. Diet data are scarce, making it difficult to even characterize the problem, but existing data reveal that fewer than 10 percent of breastfed Indian children between the ages of 6 and 23 months receive a minimum adequate diet, with the number even lower in rural areas where households are still predominantly dependent on agriculture (IIPS, 2015). While some research has explored the importance of child feeding practices in reducing morbidity and improving nutrition outcomes (Dewey, 2016; Menon, Headey, Avula, & Nguyen, 2018; Paintal & Aguayo, 2016), few have focused on the broader importance of diet quality, especially for women's nutrition, and even fewer have discussed the cost of nutritious diets. Instead, explanations have tended to focus more on 'underlying' and 'basic' causes such as poor sanitation and hygiene, household income or socioeconomic status, household shocks or disaster events, and low levels of women's education

and empowerment, among others (Aguayo, Nair, Badgaiyan, & Krishna, 2016; Bhagowalia, Kadiyala, & Headey, 2012; Cavatorta, Shankar, & Flores-Martinez, 2015; Chambers & Medeazza, 2013; Coffey, Deaton, Drèze, Spears, & Tarozzi, 2013; Corsi, Mejía-Guevara, & Subramanian, 2016; Datar, Liu, Linnemayr, & Stecher, 2014; Fenske, Burns, Hothorn, & Rehfuess, 2013; Headey, Hoddinott, & Park, 2016; Joe, Rajaram, & Subramanian, 2016; Vir, 2016).

Multiple studies have documented the close link between agricultural production and household consumption and food security in South Asia, typically focusing on farm-level associations (Bhagowalia et al., 2012; Chandrasekhar, Aguayo, Krishna, & Nair, 2017; Haselow, Stormer, & Pries, 2016; Malapit, Kadiyala, Quisumbing, Cunningham, & Tyagi, 2015; Shively & Sununtnasuk, 2015; Sibhatu, Krishna, & Qaim, 2015). However, while some of these studies consider the role of market access, hardly any explicitly consider the affordability of nutritious foods or nutritious diets in the markets that poor rural people use. Indeed, studies of food expenditure patterns in rural areas of developing countries, such as Ethiopia, show that while the poor depend heavily on their own production for the consumption of staple foods, the bulk of their consumption of non-staple foods tends to be sourced in markets (Sibhatu & Qaim, 2017). Dependence on markets for food acquisition is likely to be even more important in India, where landlessness is very common, farm sizes are small and population density is high, such that many people likely live in close proximity to food markets. Using data from the 66th (2009-10) and 68th (2011-12) rounds of National Sample Surveys (NSS), Narayanan (2019) estimates that the district-wise average share of food sourced from the market ranges from 68 to 74 percent, suggesting heavy reliance on markets to supplement own production.

While physical access to markets may be relatively good in most of rural India, agricultural production systems and markets in India are thought to perform poorly from a nutritional perspective. A history of famine and basic caloric deficiencies prompted post-independence leaders to focus most of their resources on cereals, catalyzing a Green Revolution that transformed the country into a major producer of rice and

wheat. Progress in other sectors was uneven, however. Dairy production and marketing improved in the 1970s (the so-called White Revolution) and the poultry sector saw rapid growth in the 1990s through intensification and economies of scale. However, many other sectors have fared poorly. The production of pulses – an important source of protein in India, especially among vegetarian populations – declined dramatically because of the expansion of dry season irrigation for wheat and rice (Gowda, Srinivasan, Gaur, & Saxena, 2013; Srivastava, Sivaramane, & Mathur, 2010). And while fruit and vegetable production has increased in recent decades on the back of growing demand driven by higher incomes and urbanization, inadequate investment in horticulture, poor storage and transportation infrastructure, and the persistence of government-imposed regulations on food trade have resulted in very inefficient supply chains. A wide range of policies – including input subsidies, public food distribution and price controls – continue to bias agricultural activities towards rice and wheat, with significant implications for environmental sustainability as well as nutrition (Pingali, Mittra, & Rahman, 2017). While policy strategies from the 2000s onwards have increasingly tried to address food and nutrition insecurity through reforms to food and nutrition assistance programs and social protection schemes - such as the Midday Meals Scheme that provides free school meals to children in government and government-aided schools and the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) that guarantees 100 days of employment per year to every rural household (Raghunathan, Chakrabarti, Menon, & Alderman, 2017) - there remains widespread concern among nutrition experts that India's food system is not delivering adequate access to affordable and nutritious foods.

In light of these concerns, the objective of this paper is to assess affordability of nutritious diets for the rural poor in India. We define a nutritious diet as one meeting India's food-based dietary guidelines (FBDGs), as developed by India's National Institute of Nutrition. National food-based dietary guidelines are developed by countries to define culturally appropriate diet patterns that meet nutritional needs and protect health. Tracking the affordability of a nutritious diet over India's diverse regions requires long-term, high-frequency and spatially disaggregated and representative price and income data; data which few countries

collect. In India we were fortunate to obtain a panel of prices for 101 food items and wages for a variety of unskilled labor activities collected over almost all of India's districts on a monthly basis over 2001-2011.[1] This time period constituted a period of rapid economic growth, significant food inflation, and several major policy developments in the rural economy such as the roll out of MGNREGA from 2005 onwards. We use the price data to cost out the cheapest means of achieving the recommended diet, to examine which foods this diet frequently selects, and describe how the cost and components of this diet change over time, by gender, and by season. We then compare the cost of this diet to wages of male and female unskilled laborers, which can be viewed as reservation wages/income for the poor, especially in a country where millions of landless laborers and marginal farmers earn most of their income from selling their labor (Deaton & Drèze, 2002).[2] We also use state-level data on prescribed MGNREGA wages to assess the affordability of nutritious diets for MGNREGA participants. Finally, we examine how the affordability of the recommended diet has varied over time and explore heterogeneity in costs and affordability across India's diverse states.

To the best of our knowledge, no previous published research in India has assessed the cost of a nutritious diet relative to wages or incomes with such spatially and temporally rich data. The estimation of least cost nutrient adequate diets has a long history going back to Stigler (1945) and continues to be applied as one approach to assessing the cost of a nutritious diet (Chastre, Duffield, Kindness, LeJeune, & Taylor, 2009; Deptford et al., 2017),[3] although nutrient-based approaches have important conceptual and technical shortcomings (discussed below). Our approach uses the method applied in very recent studies costing recommended diets in South Asia (Dizon, Herforth, & Wang, 2019) and Myanmar (Mahrt, Mather,

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[1] Updated data have not been publicly released.

[2] We do not have information on the proportion of unskilled laborers who are also landless. However, the 18 activities/occupations included in the dataset are unskilled laborer, carpenter, mason, ploughing, blacksmith, sowing, weeding, harvesting, tractor driver, transplanting, cobbler, herdsman, threshing, winnowing, well digging, sweeper, picking (for various crops) and cane crushing. Given this list, it is perhaps not unreasonable to assume that an individual classified as an unskilled laborer did not work in agriculture in that given time period.

[3] The Cost of the Diet approach has been used by the World Food Programme to conduct 'Fill the Nutrient Gap' assessments in several countries, involving various government and non-government stakeholders, although this process has not occurred in India (WFP, 2017).

Herforth, & Headey, 2019), although these studies largely use single time points. In this paper the assessment of dietary costs relative to both private labor market wages and MGNREGA wages offers scope to assess secular changes in affordability as well as seasonal fluctuations or other shocks. Moreover, by examining food markets through a nutritional lens, this approach constitutes a powerful tool for developing more nutrition-sensitive food policies that reduce the market prices of comparatively expensive food groups or that use income transfers to improve affordability of nutritious diets as a whole. Given the extensive and multidimensional nature of undernutrition in India, more effective policies to improve access to sufficient, safe and nutritious diets are urgently needed.

2. DATA AND METHODS

2.1 Data

Information on food prices and wages is taken from the Rural Price/Wage Data (Unit Level) – Schedule 3.01 dataset, collected by the National Sample Survey Organization (NSSO) of the Ministry of Statistics and Program Implementation of the Government of India. This dataset collates market-level data at the district level. Price data is collected at a monthly frequency for 24 states, 380 districts and 101 food items over the period October 2001 to June 2011.[4] In total these data encompass 1,772,228 item-month-district observations. However, the panel is not balanced: not all food items are reported in every district (presumably because not all markets in a district sell the full range of 101 products), not all districts appear in each time period, and there are India-wide gaps in data reporting for October 2007 to June 2009.[5] Hence in total, we have 32,373 distinct district-food item combinations, and 32,743 distinct district-month combinations. Most food items are reported in standard units of grams, kilograms, or liters.

The wage data covers the same time period and geography as the price data. It reports normal daily hours of work and cash and in-kind wages for men, women and children across 18 distinct occupations/activities of varying skill levels.[6] However, since we were interested in using wages as a proxy for the reservation wages of the poor, we use unskilled labor as our benchmark and retain adult (male and female) cash wage information only for this occupation. In total, we have 5,621 distinct district-occupation combinations, and 32,070 distinct district-month combinations.

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[4] India has a total of 28 states and 9 Union territories, however, the 24 states covered in our dataset account for over 99% of India's population according to the 2011 Census.

[5] Data are missing for the period October 2007-June 2009, a period of very steep food price increases because of the global food crisis. Our paper therefore cannot speak to the effect of the 2007-08 global food crisis on the cost of a nutritious diet, although prices also rose quickly during 2010-11 near the end of our sample.

[6] Please refer to footnote 2 for the full list of occupations included in this dataset.

2.2 Methods

2.2.1 Cost of recommended diet

The cost of a nutritious diet can be calculated in various ways depending on how the diet is defined. For decades, there have been attempts to find the lowest cost of meeting nutrient needs through linear programming (Chastre et al., 2009; Deptford et al., 2017; George & Shively, 2017; Håkansson, 2015; Masters et al., 2018; O'Brien-Place & Tomek, 1983; Stigler, 1945). While these methods are useful in highlighting the most nutrient-dense foods per unit of currency and which nutrients add to the cost of the diet, the focus on nutrients has several weaknesses. First, it can result in relatively unrealistic or unpalatable least-cost diets. Second, nutrient density alone does not satisfactorily describe the health properties of foods and diet patterns in protecting health, given the importance of non-nutrient bioactive components of food including fiber, antioxidant and other phytochemicals, and the food matrix. Third, consumers make dietary choices over food groups rather than nutrients (which are largely unobservable or unknown to a typical consumer).

The approach followed in this paper uses India's FBDG, taken from the National Institute of Nutrition's 2011 *Dietary Guidelines for Indians: A Manual*, to define a nutritionally adequate, recommended diet. FBDGs are a definition of diets that meet nutritional needs and satisfy cultural food preferences for a country, produced and adopted by national governments (Herforth et al., 2019). As such, they constitute national policy, and are often the basis for designing nutrition policy and programs. Therefore, the minimum cost of meeting a national FBDG is a highly policy-relevant metric that can lead to insights around which parts of a nutritious diet are most or least affordable over time.

We use a price-based index to measure the Cost of Recommended Diet, or CoRD. This index is a measure of how much it would cost to meet country-specific FBDG (Dizon et al., 2019). The India-specific FBDG provides information on the classification of foods into food groups, the recommended serving size and the

minimum and maximum number of servings per food group. Somewhat unusually, it also provides gender- and activity-specific serving size recommendations, allowing us to calculate the CoRD separately for men and women engaged in sedentary, moderate or strenuous activities. For the purpose of index construction, we assume that unskilled labor is a moderate activity.

India's FBDG lists six food groups in total: starchy staples, proteins (pulses, fish, meat, eggs), dairy, fruit, vegetables, and fats and oils (including nuts and seeds). It does, however, require that one of the vegetables consumed be a dark green leafy vegetable, so for ease of understanding we depict that as a separate food group in this paper. The recommended serving sizes and number of servings for each of these groups is provided in Table 1; we see from this table that men and women differ in recommended servings of staples, proteins and oils and fats.

The steps followed in the construction of CoRD are as follows:

1. Each of the foods in the price data is classified into one of the food group categories.

2. In the case of multiple types of the same food, only the lowest cost duplicate item is retained. For example, in the case of India, wheat (coarse) and wheat (med.) are both classified simply as wheat, and the more expensive of the two is dropped.

3. All item units are standardized to kilograms. For those items that were in non-standard units (e.g. "a dozen eggs"), estimates of the standard weight of these items were employed.[7]

4. All item prices are converted into price per edible serving, using a price conversion factor that was estimated as follows:

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[7] There are a few items that are recorded in non-standard units, e.g. a pair (of bananas), each (eggs, oranges), or one (bread). For items such as bananas, eggs and oranges, we make an educated guess as to their approximate weight. For example, each banana is assumed to weigh 120g, a hen egg 44g, a duck's egg 66g and an orange 131g. For bread, a comparison of the price with current prices in urban Delhi markets suggested that the unit was a 500g loaf. In the case of liquids, we used densities from United States Department of Agriculture (USDA). These densities are given in the Appendix Table A.1.

$$price\ conversion\ factor = \frac{serving\ size\ (in\ g)}{unit\ of\ food\ item\ (in\ g)}/edible\ portion$$

5. For all food groups except dark green leafy vegetables, the two cheapest items in the food group are selected; for dark green leafy vegetables, the cheapest item is chosen.

6. The recommended number of servings for each group and gender is multiplied by the average price per serving for each food group to generate the cost of that food group.

7. Finally, the cost of all food groups is summed to generate CoRD.

Table 1. Recommended serving sizes and number of servings per day in India's Food-based Dietary Guidelines

	Serving size	Number of servings (moderate activity level)	
		Men	Women
Starchy staples	30g	15	11
Proteins (pulses, meat, fish, eggs)	30g	3	2.5
Dairy	100g	3	3
Fruit	100g	1	1
Vegetables	100g	2	2
Dark green leafy vegetables	100g	1	1
Oils and fats	5g	6	5

Source: Dietary Guidelines for Indians: A Manual (2011).

Following these steps, we calculate the CoRD separately by gender for each district-month combination that appears in our data. Very high and very low prices are assumed to be anomalies, so we winsorize our data accordingly.

2.2.2 Affordability of diets

We are interested in the relative cost of the recommended diet and need to develop a measure of its affordability. To do this, we calculate a gender-district-time-specific CoRD relative to wages, by dividing the CoRD by the cash wages for men and women in that time period and geography. The CoRD relative to

wages is expressed as a percentage of the wages. Similar to the price data, we winsorize very high and very low wage data, likely to be erroneous entries.

Secondly, we estimate the share of the population that cannot afford CoRD (a poverty headcount measure) and the average gap between the incomes of the CoRD-poor and a CoRD-based poverty line (a poverty gap measure) at the national level. To do this, we use the World Bank's POVCAL tool which allows researchers to set alternative poverty lines[8]; fortunately for India this tool disaggregates poverty estimates for rural and urban in India in mid-2011 towards the end of our sample. The cost of a recommended diet will be lower for children due to their lower caloric needs; therefore, adult CoRD estimates over-estimate dietary costs for children. POVCAL does not account for differences in intrahousehold food or non-food expenditure requirements, so we make conservatively low assumptions about non-food expenditure requirements to balance the overestimate of children's CoRD. A lower benchmark uses the simple but unrealistic assumption that households spend all their income on food. A second benchmark uses the (somewhat arbitrary) assumption that avoiding $1.90/day poverty requires a household to spend at least one-third of its income on non-food expenditures.

2.2.3 Seasonality of cost and affordability of diets

We conduct tests for seasonal differences in food group prices, overall dietary costs, wages and CoRD/wage ratios. Specifically, we compute the log of the price/wage ratio for a given month and regress this against 11 monthly dummy variables (with January as the omitted base category), along with a flexible cubic time trend and district fixed effects. The coefficients on the monthly dummy variables approximately measure the percentage difference in price/wage ratios between January and all other months of the year.

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[8] See http://iresearch.worldbank.org/PovcalNet/povOnDemand.aspx.

3. COST AND AFFORDABILITY OF NUTRITIOUS DIETS IN RURAL INDIA

In this section we first report basic descriptive statistics on the nature of the food price data and dietary costs by food group, before examining the composition of the least cost diet, trends in the cost of the recommended diet, seasonality in food prices and the affordability of the recommended diet relative to unskilled wages and minimum MGNREGA wages.

3.1 Prices and dietary costs by food group

Table 2 reports summary statistics for the price data by the seven food groups that make up the recommended diet. The first column reports the number of specific food items in each group. Most are well populated although there are relatively few types of dairy products, fruits and dark green leafy vegetables. Importantly, there are a wide range of starchy staples, reflecting regional diversity in key staples in India, and a wide range of proteins, including a variety of pulses, which are a key component of the Indian diet. Although the least cost recommended diet metric only draws the cheapest two items from each food group, the prices per kilogram in Table 2 emphasize the extent to which prices vary both within and across food groups, and the scope for consumers to shift towards costlier foods as incomes and food budgets increase.

Figure 1 shows the average price per serving by food group (converted from price/kg) as well the maxima and minima, with the latter being important in terms of the least cost items. Dairy and fruit are the most expensive food groups per serving, both looking at average and least-cost prices, while oils and fats and starchy staples are the cheapest. It is clear from the figure that both the average and the dispersion of price per serving have increased substantially between 2001 and 2011.

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Table 2. Descriptive statistics for the National Sample Survey (NSS) Rural Consumer Price (RPC) 2001-2011 dataset by food group

	Number of food items	Number of price observations (district-month)	Mean price/KG (2011 rupees)	Median price/KG (2011 rupees)	Minimum price/KG (2011 rupees)	Maximum price/KG (2011 rupees)
Starchy staples	25	32,743	9.9	7.5	0.6	125.4
Proteins (pulses, fish, eggs)	30	32,741	33.8	22.0	5.5	251.7
Dairy	4	32,201	13.4	9.8	2.3	58.0
Fruit	6	32,330	11.8	8.4	1.9	90.9
Vegetables	19	32,733	8.3	6.4	1.2	35.8
Dark green leafy vegetables	5	29,359	6.3	4.7	1.4	22.3
Oils and fats	12	32,614	71.0	48.6	15.0	332.8

Source: Authors' estimates from the NSS Rural Consumer Price (RPC) 2001-2011 dataset. See text for details.
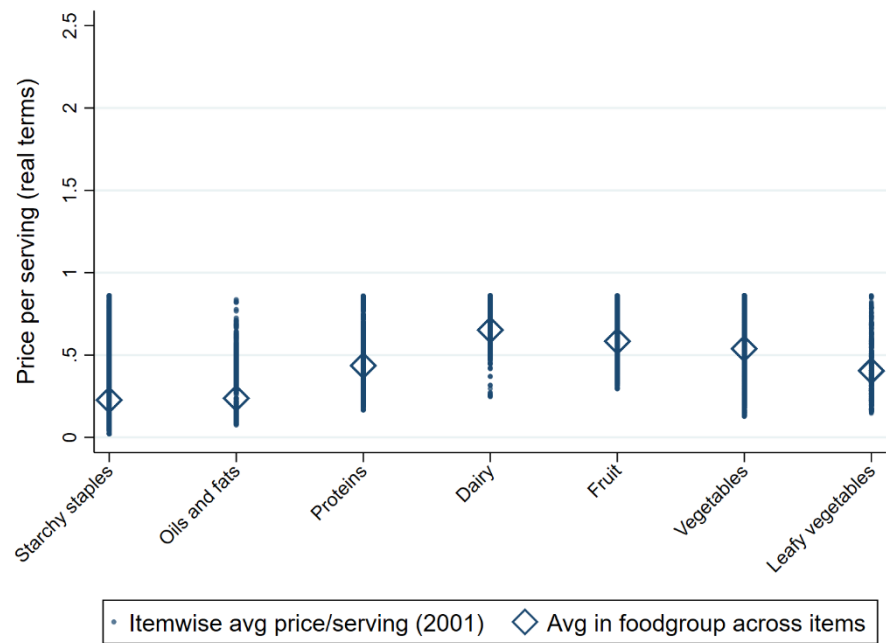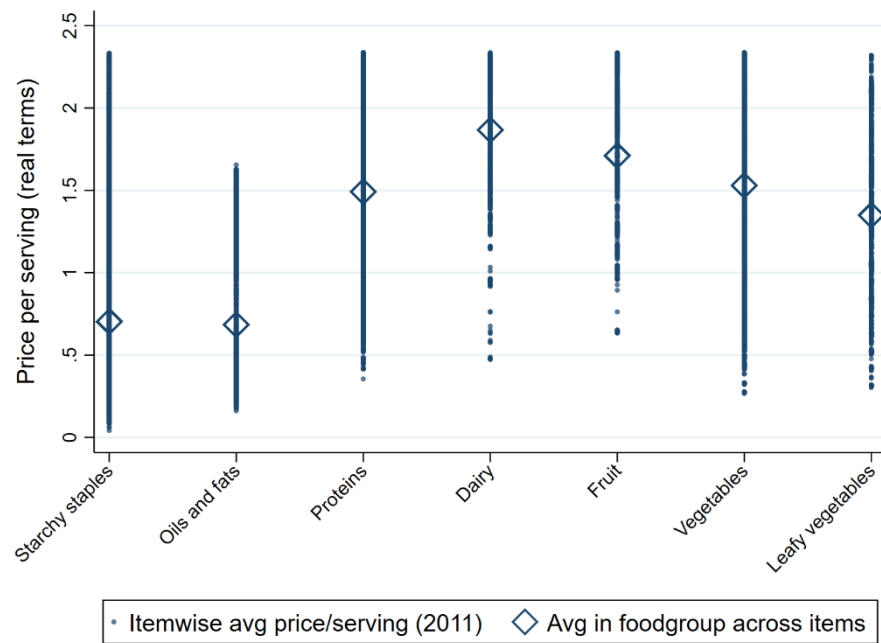
Panel A: 2001
Panel B: 2011

Figure 1. Real food prices per edible serving by food group for rural India in 2001 and 2011 (in 2011 rupees)

Source: Authors' estimates from the NSS Rural Consumer Price (RPC) 2001-2011 dataset. See text for details.

In Table 3 we report the five most common cheapest food items selected in each food group for CoRD over the full range of observations. Among staples, rice and wheat are often selected, but so too are coarse grains common in some parts of India, such as *bajra* (pearl millet). Because of their lower cost, pulses are much more commonly selected key sources of protein than meat, fish or eggs, which offer high-quality protein and various micronutrients, but which are generally much more expensive in kilogram or per calorie terms. In fact, flesh foods and eggs are only selected in 0.02 percent of the cases.[9] Cow and buffalo milk are the two most common dairy items, while tropical fruits dominate the fruit category. Radish and onion are the two most common non-leafy vegetables and *palak* (spinach) is the most commonly selected dark green leafy vegetable. The oils and fats category is populated by a range of oils, including the increasingly popular (and cheap) palm oil. Since availability can vary considerably across geography, Table A.2 presents the most common items in each food group in each state.

Table 3. The five most common food items in CoRD (nationally) based on total district-year observations

Food group	Most common items appearing in CoRD
Starchy staples	Maize, Bajra, Rice (coarse), Wheat (coarse), Bread
Proteins (pulses, fish, eggs)	Peas, Gram, Pea dal, Khesari dal, Gram dal
Dairy	Milk (cow), Milk (buffalo), Curd, Ghol (lassi)
Fruit	Banana, Guava, Papaya, Pineapple, Orange
Vegetables	Radish, Onion, Gourd, Pumpkin, Tomato
Dark green leafy vegetables	Palak, Bhaji sag leaves, Amaranth (chaulai), Mustard leaves, Gogukura
Oils and fats	Mustard oil, Refined oil, Groundnut oil, Palm oil, Gingelly oil

Source: Authors' estimates from the NSS Rural Consumer Price (RPC) 2001-2011 dataset. See text for details.

3.2 Trends and variation in prices, dietary costs, wages and dietary affordability

Table 4 reports trends in cost per serving for each food group, total dietary costs and male and female unskilled wages over 2001-2011 (all in real terms), as well as the average costs over this period and the coefficient of variation to capture volatility in dietary costs and affordability. Strikingly, real food costs increased dramatically over 2001-2011, albeit with variation across groups. Figure 2 shows the food group-wise contribution to average CoRD over time.[10] Dairy is the largest contributor to average CoRD, followed

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[9] We should note here that the units for poultry were not provided, and we were unable to make an informed guess at to the approximate weight based on the average prices reported. As a result, poultry had to be dropped from our analysis. We do not believe that this substantially affects the composition of the least cost recommended diet, given that eggs are cheaper than poultry and still only appear in the least cost diet in 0.01 percent of the cases.

[10] Average CoRD is the CoRD calculated using the expected number of servings, i.e. a simple average of the male and female

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by starchy staples and fruit. Dark green leafy vegetables, other non-leafy vegetables and oils and fats contribute the least. There was a sharp increase in CoRD after 2007, coinciding with a period of global food price inflation.

Consistent with rising real food costs, the overall least cost recommended diet increased by 32.1 rupees for men and 28.7 rupees for women over 2001. Over the same period of time India experienced significant economic growth, and wages outpaced real changes in dietary costs, although the change in wages for men was around twice as much as the change for women. Hence, CoRD/wage ratios for men and women both improved somewhat over time (Table 4).

recommended servings per food group.

Table 4: Trends in cost per serving, wages, CoRD, and CoRD/wage ratios for rural India

	2001	2011	Average, 2001-2011	Change, 2001-2011	Coefficient of variation, 2001-2011
Price per recommended consumption per day, in 2011 rupees (cheapest foods)					
Starchy staples	2.8	10.8	5.4	8.0	56.5
Oils and fats	1.7	5.0	2.8	3.3	40.3
Fruit	1.4	5.7	2.7	4.3	57.5
Vegetables	1.4	4.2	2.4	2.8	53.7
Dark green leafy vegetables	0.3	1.2	0.6	0.9	56.9
Dairy	4.3	14.2	7.3	9.9	51.2
Proteins (pulses, fish, eggs)	1.8	5.2	2.9	3.4	47.5
Daily cost of recommended diet (CoRD) in 2011 rupees					
Male CoRD (INR/day)	13.1	45.1	22.0	32.1	52.6
Female CoRD (INR/day)	11.7	40.5	19.7	28.7	52.9
Daily unskilled wages in 2011 rupees					
Male unskilled wages (INR/day)	27.1	107.4	47.8	80.3	75.1
Female unskilled wages (INR/day)	14.4	55.6	25.7	41.2	101.2
Affordability of CoRD relative to wages					
CoRD as % of male wages	53.3%	48.2%	53.4%	-5.1 points	34.8
CoRD as % of female wages	68.2%	61.7%	67.9%	-6.5 points	42.6

Source: Authors' estimates from the NSS Rural Consumer Price (RPC) 2001-2011 dataset. See text for details.
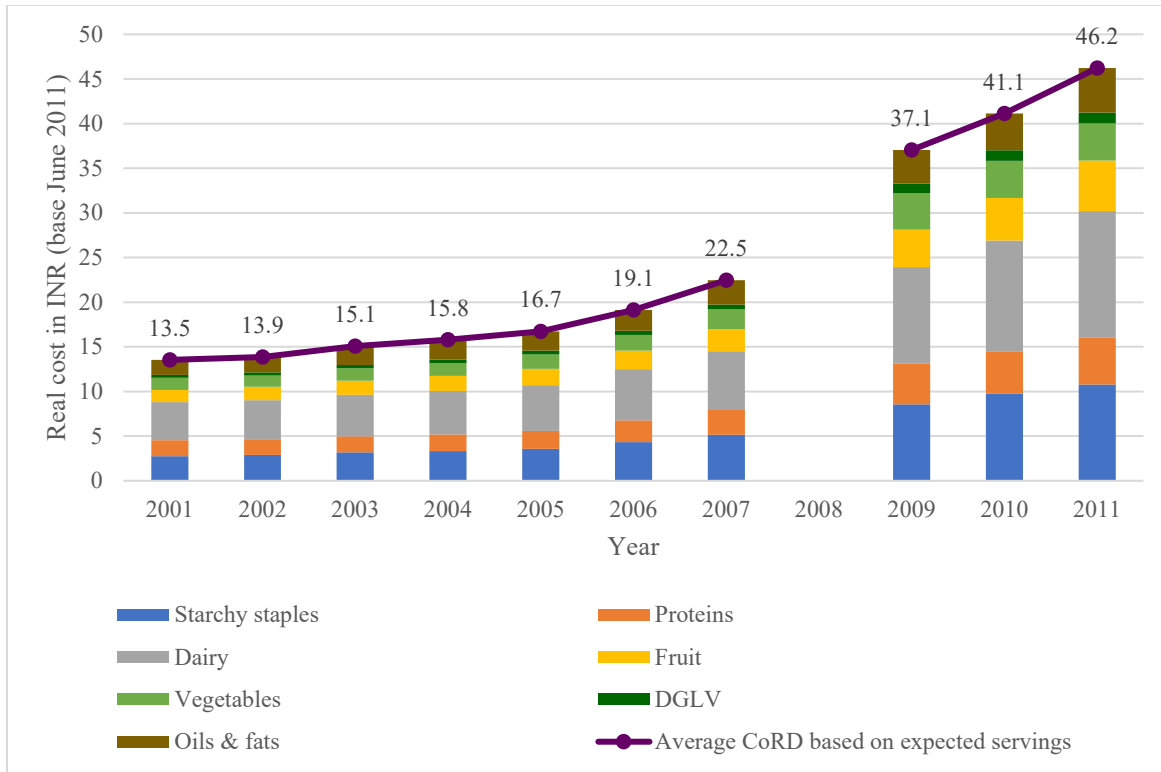
Figure 2: Food group-wise contribution to CoRD based on expected servings, 2001-2011

Figure A.1 tracks the trends in real wages over time, for both men and women. Real wages have increased steeply over the time period of our data, but the rate of increase has been greater for men, especially after 2008. Since national-level numbers hide a lot of variation in a country as large and diverse as India, we also investigate trends in the rate of growth of state-level averages of CoRD/unskilled wage ratios for men and women over 2001-2011, the first and last years in our data (Figures 3 and A.2, Table A.3).

In most states male CoRD/wage ratios declined over time, suggesting that nutritious recommended diets became substantially more affordable for men, such that by 2011 CoRD/wage ratios were typically less than 60 percent.[11] For women, the patterns are often very different; indeed there is no significant correlation between male and female CoRD/wage ratio across states in either 2011 or 2001, or between changes in

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[11] The largest improvements were in Uttaranchal, Andhra Pradesh and Odisha, where these ratios declined by over 20 percent.

these ratios over time for men and women. In most states, CoRD/wage ratios declined over time for unskilled female workers, but there were some notable exceptions where CoRD became much less affordable: Punjab (22.1% increase), Gujarat (18.1% increase) and Kerala (13.0% increase). These states saw minimal growth in real wages for women. Gujarat has surprisingly high CoRD/wage ratios, even by 2011, in spite of relatively rapid economic growth.[12]

Strikingly, there are large variations in both initial CoRD/wage ratios and in changes over time (Table A.3). For example, in Kerala – a wealthy state but also one with strong labor unions and high rates of overseas emigration and remittances – CoRD accounts for just 22.0 percent of male wages in 2011. CoRD was also relatively low compared to male wages in Haryana, Tamil Nadu, Jammu & Kashmir, and Punjab, where agricultural productivity is relatively high and structural transformation relatively advanced. At the other extreme, CoRD accounted for close to 100% of female wages in several states, even in 2011. For men, CoRD was least affordable in Chhattisgarh, costing 80.1% of male wages in 2001 and 75.6% in 2011. Table A.4 summarizes CoRD and unskilled labor wages in 2011 for both men and women. Figure A.2 presents the overall trend in CoRD as a percentage of wages for men and women over this time period; from this it is clear that affordability of the recommended diet has increased, especially after 2008.

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[12] It is fairly well known that Gujarat's economic performance has not translated into high rural or urban skilled or unskilled wages, see for example the India Wage Report 2018 published by the International Labor Organization (https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---sro-new_delhi/documents/publication/wcms_638305.pdf).
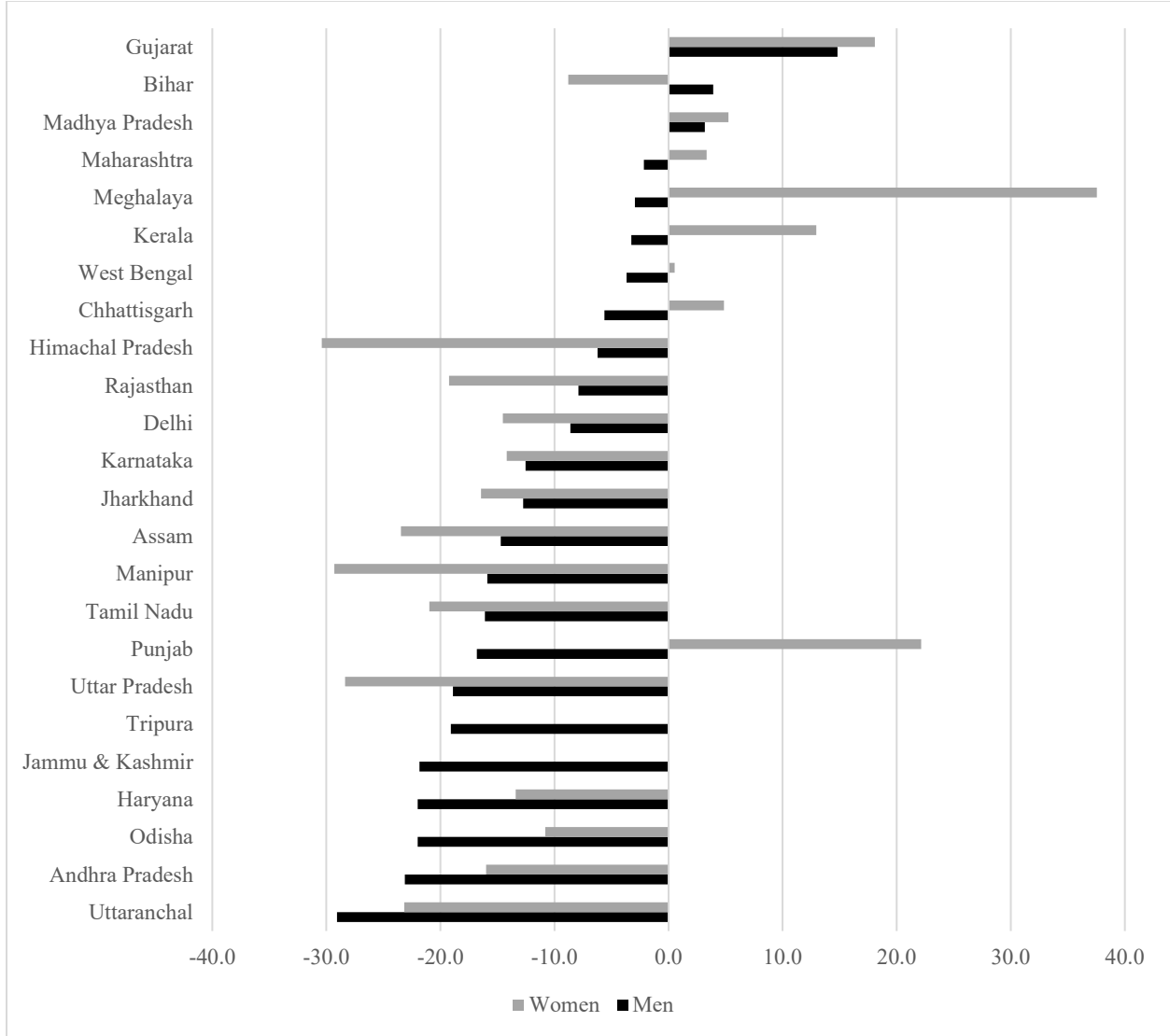
Figure 3: Percent change in CoRD as a fraction of wages from 2001 to 2011, across states

We then provide a comparison of the cost of recommended diet to the wages paid under the large national workfare scheme, the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). Under this Act, notified in 2005 and implemented in early 2006, every rural household is entitled to 100 days of unskilled labor to be compensated at the state minimum wage (subject to a national minimum). The Act guidelines mandate that 33% of jobs be reserved for women, who are to be paid the same wage as men. At the time of its introduction, MGNREGA wages were set at a level higher than prevailing market-determined

agricultural and other rural unskilled labor wages, thereby exerting upward pressure on the daily wages of casual laborers (Azam, 2011; Imbert & Papp, 2016; Khera, 2011; Zimmermann, 2018, Imbert & Papp, 2015). However, since the entitlement is limited to only a 100 days per household per year, this upward pressure did not necessarily result in an alignment of labor wages with the minimum wages paid under the Act. At the time of the notification of the Act, prevailing unskilled labor wages in 2005 were lower than the MGNREGA wage for both men and women in all states, with the sole exception of male wages in Jammu and Kashmir. Six years later, in 2011, only eight states reported prevailing unskilled labor wages for men greater than the minimum wage. No state reported unskilled labor wages for women greater than the minimum wage in 2005 or 2011. The difference between the unskilled labor wages and the state-specific minimum wage was often considerable: for men, unskilled labor wages were 28.6-121.2% of MGNREGA minimum wages in 2005 and 51.4-169.9% in 2011; for women the gap was even larger, at 7.1-41.1% in 2005 and 13.6-89.0% in 2011 (Table A.5).

Table A.6 reports CoRD as a percent of state-wise minimum wages, which are also the wages paid to workers in the MGNREGA. Unlike the market wages for unskilled workers used above, MGNREGA minimum wages increased more uniformly across states, and the uniform minimum wage for men and women means that patterns of CoRD/wage ratios for men and women look similar (since CoRD is similar for men and women). In 2005, CoRD/NREGA wage ratios were relatively low, generally less than 30%, and with a national average of 24.9% for men and 22.4% for women (Table 7). However, the minimum wages for MGNREGA workers did not increase at the same rate as CoRD, meaning that CoRD/NREGA wage ratios increased by around 50% by 2011, producing a national average of 34.8% for men and 39.7% for women. The largest increases were observed in Andhra Pradesh, Kerala, Tamil Nadu and the Punjab. Insofar as the rural poor are likely to use MGNREGA more in the lean season (Clément Imbert & Papp, 2016; Johnson, 2009), it is possible that MGNREGA has become less effective over time at dampening seasonal shocks.
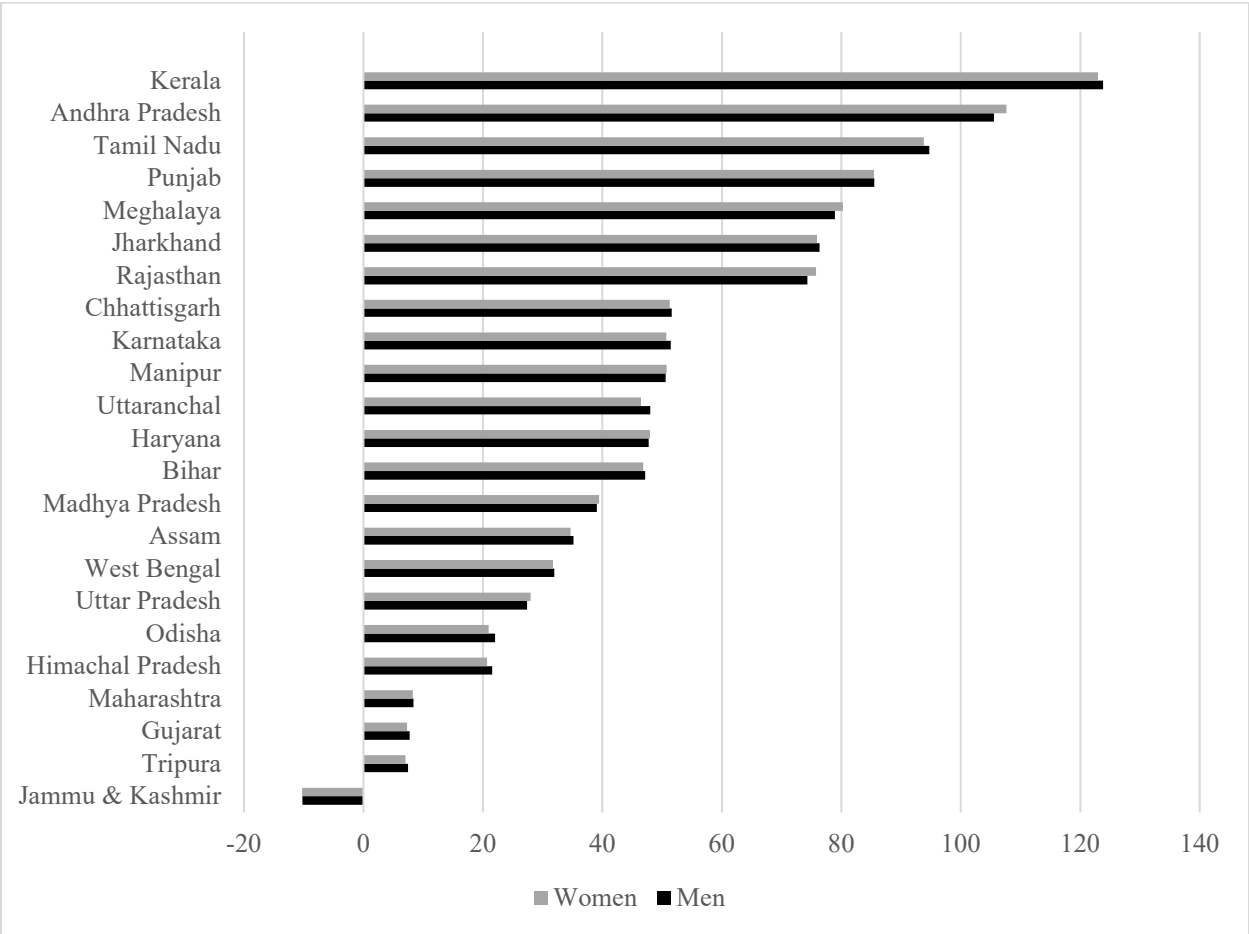
Figure 4: Percent change in CoRD as a fraction of minimum wages from 2005 to 2011, across states

3.3 Estimating the share of the rural population that cannot afford the recommended diet

Table 8 shows the poverty headcounts and poverty gaps for the rural Indian population if CoRD were used as an alternative poverty line. CoRD for an adult woman amounted to 35.91 rupees per day in June 2011 (in nominal terms). Using the 2011 purchasing power parity conversion factor this amounts to $2.40 per day in international dollars, which is 50 cents above the World Bank's $1.90/day poverty line. Adding a 63 cent/day non-food spending requirement would raise this nutritionally based alternative poverty line from $2.40 to $3.03/day.

The share of the rural Indian population in 2011 unable to afford CoRD even with 100% of income spent on food would be 44.9%, or 387.5 million people. On average, the incomes of that population would be

11.2% below CoRD. Under the arguably more realistic $3.03 poverty line, 63.8% of the rural population in 2011 could not afford CoRD plus $0.60/day non-food expenditures (551 million), and that population's average income would fall 20.3% below this alternative poverty line. Importantly, these estimates of the share of the rural Indian population that cannot afford the nutritionally recommended diet are much higher than the World Bank $1.90/day estimates of poverty (24.8% of the population identified as poor). These numbers are somewhat speculative, but they do reveal the scale of the dietary affordability problem in rural India: nutritious diets are too expensive, and incomes far too low.

Table 5: Estimating poverty headcounts and poverty gaps for the rural Indian population in 2011 when CoRD is used in alternative poverty lines

Indicator	Estimates
Food and non-food costs	
Cost of Recommended Diet - women, June 2011 (2011 rupees)	35.91
Purchasing power parity conversion factor, 2011 (2011 PPP$)	$14.98
CoRD - women, June 2011 (2011 PPP$)	$2.40
Assumed requirements for non-food expenditure (2011 PPP$)	$0.63
Estimate 1 (lower benchmark)	
Rural population unable to afford $2.40 CoRD (poverty headcount)	44.9%
Gap between expenditure of CoRD-poor and CoRD (poverty gap)	11.2%
Estimate 2 (upper benchmark)	
Rural population unable to afford $2.40 CoRD + $0.63 non-food expenditures (poverty headcount)	63.8%
Gap between average expenditure of CoRD-poor and CoRD + non-food spending requirements (poverty gap)	20.3%
World Bank $1.90/day estimates	
Rural population unable to afford $1.90/day expenditures (poverty headcount)	24.8%
Gap between average expenditure of $1.90/day poor and $1.90/day poverty line (poverty headcount)	5.0%

Source: The CoRD estimate in 2011 rupees is drawn from the authors' estimates from the NSS Rural Consumer Price (RPC) 2001-2011 dataset. All other estimates are based on data from the World Bank's PovcalNet interactive database: http://iresearch.worldbank.org/PovcalNet/povOnDemand.aspx.

3.4 Seasonal variation in prices, dietary costs, wages and dietary affordability

Figure 4 shows the proportional changes in monthly fruit and vegetable prices (Panel A-C), male CoRD, male wages and male CoRD/wage ratios (Panels D-F) relative to January. These results are presented for the sake of brevity because other food groups showed no statistically or economically significant seasonal variation in prices, and because results for women's CoRD, wages and CoRD/wage ratios were almost identical to the results for men in Panels D-F.

Fruit and vegetable prices show very strong seasonality in India. Relative to January, fruit prices fall by 10% in March and April, but then increase rapidly, with June and July prices around 20% higher than January prices. Prices then fall again in the late monsoon (August) and stabilize in the last third of the calendar year. Green leafy and other vegetable prices follow a pattern distinct to that of fruit prices, rising steadily from January until July, at which point they are 25% high than January. Prices remain high from July to October, and then fall sharply down again from November to February. By contrast, the prices of staples, dairy and oils and fats exhibit far less seasonal variation (Figure A.3).

These increases in fruit and vegetable prices inflate the CoRD. Relative to January, CoRD is 3-5% from May through November, with the peak cost coming right in the middle of the monsoon (Panel D). Men's wages show no statistically significant seasonality (Panel E). The net result for CoRD/wage ratios is a 3 to 5 percent increase from May to November relative to January.
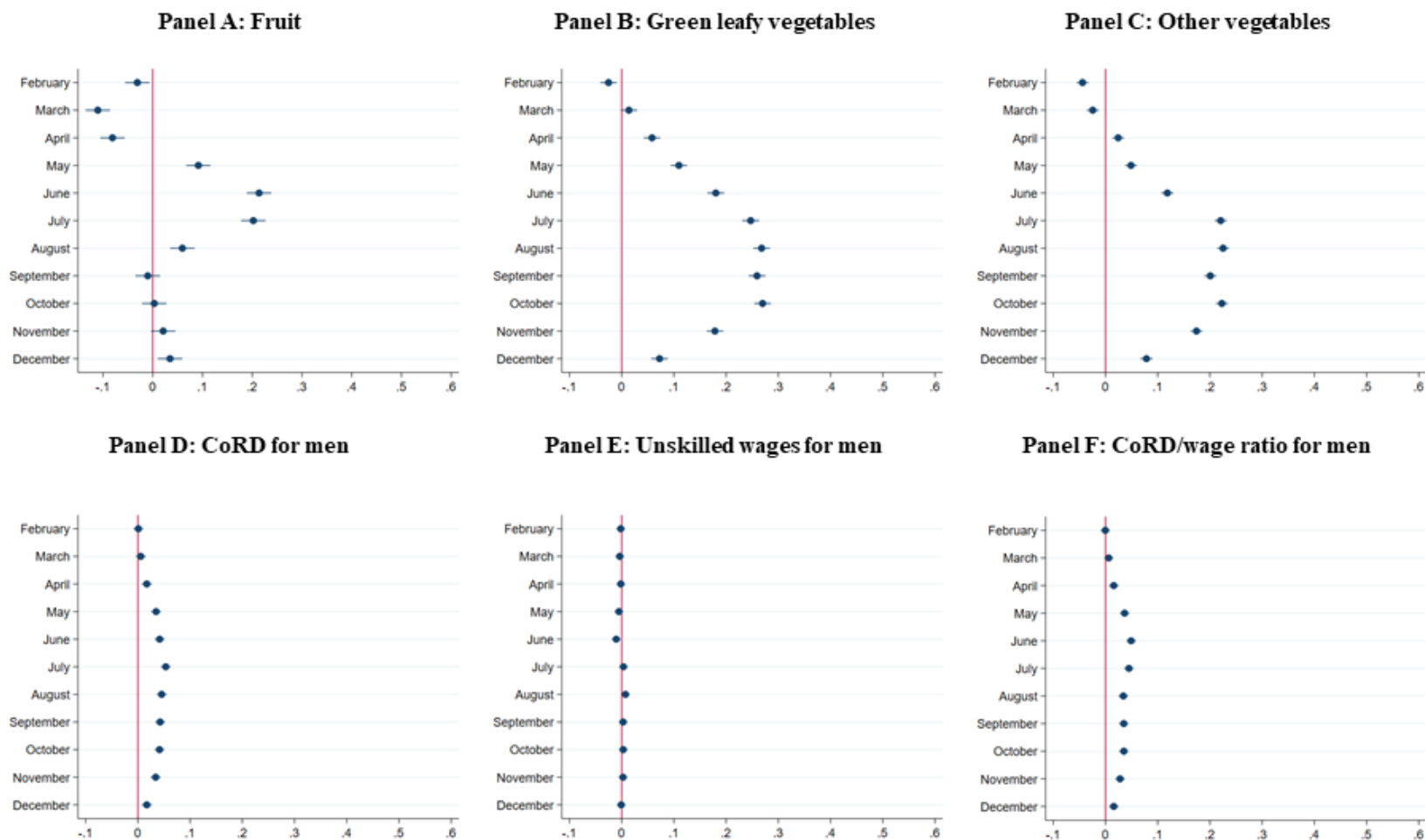
Figure 5: Proportional seasonal changes in fruit prices, vegetable prices, male CoRD, male wages and male CoRD/wage ratios relative to January

Notes: Authors' estimates from the NSS Rural Consumer Price (RPC) 2001-2011 dataset. See text for details. The figure reports results from multivariate regressions of the log of the differences between the dependent variable's value for a given month relative to the corresponding value for January. Dependent variables are in nominal terms, and refer to fruit/vegetable prices, CoRD, wages and CoRD/wage ratios against monthly dummy variables, controlling for linear time trends. Results for CoRD for women, wages for women and CoRD/wage ratios for women are qualitatively and quantitatively very similar. Results for other food groups show no strong indications of seasonal variation in prices and were therefore omitted for the sake of brevity.

4. DISCUSSION

For most of India's post-independence history policymakers have been deeply concerned with achieving basic food security through focusing agricultural investments, price controls and social safety nets on staple foods. Access to nutritious food has not been a focus of food security policy. Nutrition has variously been marginalized, regarded as a health problem rather than a fundamental economic problem, or viewed as a narrow calorie deficiency problem to be addressed by improving the affordability of rice and wheat. Only recently have high level policy initiatives started to envisage strong multisectoral efforts to improve intake of a broader range of nutritious foods to address multiple dimensions of undernutrition and prevent obesity and diet-related non-communicable diseases. However, this invigorated focus on nutrition has entailed remarkably little research on the basic question of how affordable nutritious diets are for India's poor. In this study we estimated the cheapest means of achieving nationally recommended diets in rural areas and assessed affordability relative to wages for unskilled workers over time and across states.

What did we find, and what do our results imply for policy reforms and future research?

Costing nutritious diets and their affordability

A first finding of considerable practical importance is that the approach of calculating least-cost diets based on quantitative food-based dietary guidelines, following the application by Dizon, Herforth and Wang (2019), results in a realistic selection of food groups that align closely to consumption patterns of Indian consumers in a qualitative sense (although an average Indian would under-consume a wide range of nutritious foods). In contrast, nutrient-adequate least-cost diets – following Stigler (1945)– can sometimes result in diets that represent a significant departure from existing food preferences. India's national FBDG constitute a policy document, and the minimum cost to access officially recommended diets is therefore an important piece of information for designing policy-coherent actions to improve the ability of the rural poor to consume the recommended diet.

Hence an important policy recommendation is that Indian governments could use this least-cost recommended diet metric to monitor dietary costs and affordability on a timelier and more regular basis, and to consider CoRD as an alternative nutrition-sensitive poverty line, similar to the nutrient adequacy poverty line approach proposed by Allen (2017). Currently, governments only measure food costs through consumer price indices (CPIs) that weight foods by expenditure shares; however, these expenditure shares in no way reflect the nutritional importance of different foods, and indeed, in poor countries such as India CPIs are heavily weighted towards nutrient-sparse starchy staples, meaning that trends in the food CPI can be misleading from a nutritional standpoint. Furthermore, a practical advantage of CoRD – certainly in comparison to costing nutrient-adequate diets – is its technical simplicity, involving only the identification of the cheapest serving(s) in each food group.[13]

This type of analysis could also be undertaken by non-government organizations and private researchers, although the accessibility of food price data in India is poor, and different price data are collected by different government bodies and released haphazardly or not at all. The National Sample Survey (NSS) dataset accessed for this study was collected by the Ministry of Statistics and Programme Implementation but has not been updated beyond 2011, pertains only to prices from rural centers and was quite challenging to access and use. Urban price data are collected separately by the Labour Bureau, Ministry of Labour and Employment, and do not appear to be easily accessible. Quite extensive wholesale price data are collected by the Office of the Economic Adviser in the Department for Promotion of Industry and Internal Trade, but only reported at the national level. There is therefore considerable scope to improve the accessibility of government food price statistics in India, and to use these data sources to analyze food systems more rigorously.

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[13] In principle, CoRD can even be calculated in an excel spreadsheet.

Addressing the rising cost of nutritious diets

We find that nutritious diets are highly unaffordable. We estimated that between 45-64% of the rural population of India in 2011 could not afford the recommended diet. Although male and female wages have improved, particularly from about 2007 onwards, recommended diets account 50-60% of male and 70-80% of female daily wages. It is important to keep in mind that this cost does not allow for individual tastes and preferences, and merely chooses the cheapest items in each food group. It also does not take into consideration family size, which, to the extent that the rural poor tend to have larger family sizes, exacerbates the high cost of recommended diets. However, there are also two caveats that deserve mention, as they could both lead to an overestimation of the cost of the recommended diet. First, the CoRD measure we employ captures the retail cost of purchasing food from the market, and hence, by design, does not account for food received through government schemes such as India's Public Distribution System (PDS), a highly subsidized government-provided monthly food ration consisting mainly of rice and wheat. Second, with the data we have we are unable to account for consumption out of own production. We do not anticipate this to be a large concern since we have restricted our comparison of CoRD to the wages of unskilled laborers, a class of workers not engaged in agricultural activities. These laborers are likely to rely heavily on the market for their food; if anything, they might supplement this with small quantities of fruits and vegetables grown in kitchen gardens on their homestead.

As acknowledged previously, one major limitation of our analysis is the lack of recent information on prices and wages. Even the last round of the NSSO's Employment-Unemployment survey with information on wages dates to 2011-12, and in absence of more recent data, we can only provide conjectures on what might have happened in the decade since. Data released by the Center for Monitoring the Indian Economy reveals sharply rising unemployment in recent years, with unemployment rates in October 2019 at a three-year high of 8.48 percent. At the same time, nominal prices have continued to rise across almost all food groups. Figure A.4 plots the trend in wholesale market (*mandi*) prices for all food groups (except dairy, for which

prices are not available).[14] The red dashed line indicates the end of the rural price and wage data used for the main analysis in this paper; it is evident that the rising trend observed pre-2012 continues after as well. While wholesale prices are not to be conflated with retail prices, this provides some indication of the increasing cost of market-based foods. These two facts combined suggest that the problem of unaffordability of nutritious diets is likely to have persisted even after 2011.

Diversifying agriculture toward nutrient-dense foods

We show that the most expensive food groups in this recommended diet are fruit and dairy, and that dietary costs for these two groups rose fastest, although other foods saw real price increases also. The rising cost of these nutrient-dense food groups is perhaps not surprising. Both dairy and fruits have high income elasticities in India (Kumar, Kumar, Parappurathu, & Raju, 2011), such that India's relatively rapid income growth over 2001-2011 will have significantly raised demand for these products. However, if rising demand is not met by improvements in domestic production and trade then prices may increase commensurately since these highly perishable products cannot cost-effectively be imported from overseas, especially to rural India.

A key goal for nutrition-sensitive agriculture in India must be to raise production, productivity and marketing of more nutritious foods. Previous research has emphasized the need to diversify Indian agriculture largely for the sake of addressing rural poverty, since India's millions of smallholders need to increase revenue per hectare by switching to higher value agricultural products (Birthal, Joshi, & Roy, 2013; Joshi, Gulati, Birthal, & Tewari, 2004; Rao, Birthal, & Joshi, 2006). There are many barriers to diversification of Indian agriculture, including limited public investment in research, development and extension, poor infrastructure (roads/transport, cold storage), and institutional failures that limit smallholders' access to aggregators and traders, which can be especially problematic for highly perishable

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[14] This data was downloaded for every Thursday from January 2004 to December 2018 from agmarknet.gov.in, which reports daily wholesale prices for a range of food and non-food items from 510 districts across 26 states.

products (Pingali, 2015). While these constraints limit the scope for diversification to improve rural incomes, our analysis suggests there is a strong nutritional rationale for using agricultural diversification to curb price inflation for nutrient-dense foods. Furthermore, diversification can increase access to nutrient-dense foods for the rural poor not well connected to markets, where home production or wild gathering of foods may be essential.

Improving rural incomes, especially women's incomes

Despite the rising cost of nutritious diets over 2001-2011, wage growth for unskilled rural workers typically outpaced rising dietary costs for both men and women. Several states bucked this positive trend, however, and more generally there was substantial spatial variation in food affordability trends in rural India over this decade. This result emphasizes the scope for pro-poor economic growth to improve diets, concomitantly with food policy reform to reduce real prices of nutritious foods. It also emphasizes gender inequities in income and in nutritional poverty and highlights the importance of increases in women's income. We likely underestimate the problem of unaffordability at the household level, because women are often the nutritional gatekeepers for the entire household, including men, and therefore female access to (men's and women's) income is likely to affect whether nutritious diets are obtained for the whole household (Doss, 2006; Duflo & Udry, 2004; Hoddinott & Haddad, 1995; Quisumbing, Brown, Feldstein, Haddad, & Peña, 1996).

Since poverty reduction through economic growth is a gradual process, however, it is also essential to provide income support for the poor. The fact that nutritious diets cost more than international and national poverty lines for India suggests that existing safety net schemes may be inadequate from a nutritional perspective.[15] Our research, for example, finds that minimum MGNREGA wages cover only one-third of the individual cost of a nutritious diet for a man or woman. This is grossly insufficient given high

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[15] This result was also found for the United States, which assessed the Supplemental Nutrition Assistance Program (SNAP) benefit against the cost of the federal Dietary Guidelines for Americans (Mulik & Haynes-Maslow, 2017).

dependency ratios in rural India as well as significant non-food expenditure requirements. Future research should therefore attempt to understand how India's various safety net schemes influence diets, but should also assess, ex ante, what level or modality of transfer would suffice to meaningfully improve diets.

Marketing and promotion strategies for healthy dietary diversification

Finally, although improving affordability is a necessary step for improving diets, it is hardly sufficient. Income elasticities for some nutritious foods are high, suggesting that the poor will increase consumption of these foods as incomes rise (Kumar et al., 2011). For other nutritious foods, such as vegetables and pulses, income elasticities are substantially lower, which raises the prospect that income/wage growth will not increase consumption of these foods to desired levels. Moreover, income elasticities for unhealthy processed foods are also high, implying economic growth will dramatically raise consumption of these foods. The historical experience of other developing countries suggests that the unhealthy "Westernization" of diets can, if unchecked, proceed rapidly and irreversibly.

A major challenge for nutrition strategies in India is therefore to limit the advertising of and access to unhealthy processed foods, while simultaneously promoting healthy traditional foods and diets. Currently, many nutrition programs target mothers of young children to improve infant and young child feeding practices (understandably), but more effort and innovation is needed to improve consumer knowledge and awareness more generally, such as through media campaigns, school-based interventions and public-private partnerships to improve marketing and advertising for nutritious foods. Furthermore, chemical contamination of vegetables and fruits with pesticide residues or artificial cosmetic enhancement is a growing consumer concern in India (Bailey et al., 2018). For consumer demand to increase for these foods, public trust in food safety is essential, necessitating enforcement of basic food quality standards (Umali-Deininger & Sur, 2007).

Given the persistence of undernutrition in India as well as its rapidly rising rates of obesity and related non-communicable diseases, there is an urgent need to reduce prices of nutrient-dense foods on the supply side, and encourage their consumption on the demand side, such that future income growth achieves nutritional dividends. In the meantime, there is also an urgent need to address the widespread unaffordability of the nutritious diets recommended in India's food-based dietary guidelines through social safety net programs, so that the rural poor are able to consume sufficient, safe, nutritious foods to meet dietary needs.

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APPENDIX

Table A.1: Densities for liquid food items

Food item	Density (kg/liter)
Coconut oil	0.921
Ghol (lassi/buttermilk)	1.036
Gingelly oil	0.921
Groundnut oul	0.913
Linseed oil	0.926
Milk (buffalo)	1.031
Milk (cow)	1.031
Mustard oil	0.921
Palm oil	0.913
Rapeseed oil	0.921
Refined oil (vegetable)	0.921
Toria oil	0.921

Source: United States Department of Agriculture (USDA) guidelines.

Table A.2: Most common items appearing in CoRD, by state

State name	Starchy staples	Proteins	Dairy	Fruit	Vegetables	Leafy vegetables	Oils and fats
Andhra Pradesh	Bajra, Ragi, Maize	Peas, Gram, Gram dal	Milk (buffalo), Milk (cow), Curd	Banana, Guava, Papaya (ripe)	Gourd, Onion, Tomato	Gogukura, Amranth (chaulai), Palak	Palm oil, Groundnut oil (loose), Refined oil
Assam	Rice (coarse), Paddy, Bread	Peas, Khesari dal, Gram	Milk (cow), Curd, Milk (buffalo)	Banana, Papaya (ripe), Pineapple	Gourd, Pumpkin, Radish	Bhaji sageaves, Mustard leaves, Gogukura	Mustard oil (loose), Refined oil, Rapeseed oil
Bihar	Maize, Paddy, Wheat (coarse)	Peas, Khesari dal, Pea dal	Milk (cow), Milk (buffalo), Ghol (lassi)	Banana, Guava, Papaya (ripe)	Radish, Gourd, Pumpkin	Bhaji sageaves, Palak, Amranth (chaulai)	Mustard oil (loose), Refined oil, Ghee (buffalo)
Chhattisgarh	Bread, Rice (coarse), Wheat (coarse)	Peas, Khesari dal, Gram	Milk (cow), Milk (buffalo), Curd	Banana, Guava, Papaya (ripe)	Radish, Onion, Gourd	Bhaji sageaves, Palak, Amranth (chaulai)	Refined oil, Mustard oil (loose), Rapeseed oil
Delhi	Bajra, Wheat (coarse), Jowar	Gram, Peas, Pea dal	Ghol (lassi), Milk (buffalo), Milk (cow)	Banana, Guava, Pineapple	Radish, Onion, Carrot	Amranth (chaulai), Bhaji sageaves, Mustard leaves	Mustard oil (loose), Refined oil, Groundnut oil (loose)
Gujarat	Bajra, Maize, Jowar	Peas, Gram, Urd (whole)	Milk (buffalo), Milk (cow), Curd	Banana, Papaya (ripe), Guava	Onion, Radish, Tomato	Palak, Bhaji sageaves, Amranth (chaulai)	Groundnut oil (loose), Mustard oil (loose), Refined oil
Haryana	Bajra, Wheat (coarse), Barley	Gram, Peas, Gram dal	Milk (buffalo), Milk (cow), Curd	Banana, Guava, Papaya (ripe)	Radish, Onion, Carrot	Palak, Mustard leaves, Bhaji sageaves	Mustard oil (loose), Refined oil, Toria oil
Himachal Pradesh	Wheat atta, Maize atta, Rice (coarse)	Gram dal, Besan (ground gram dal), Urd (whole)	Milk (cow), Curd, Ghol (lassi)	Banana, Guava, Mango	Onion, Pumpkin, Carrot	Palak, Bhaji sageaves, Amranth (chaulai)	Mustard oil (loose), Ghee mixed (cow & buffalo), Refined oil
Jammu and Kashmir	Maize, Bread, Wheat atta	Gram dal, Peas, Gram	Milk (cow), Curd, Milk (buffalo)	Banana, Orange (med), Guava	Radish, Onion, Turnip	Palak, Mustard leaves, Bhaji sageaves	Mustard oil (loose), Ghee mixed (cow & buffalo), Ghee (cow)

Jharkhand	Paddy, Maize, Wheat (coarse)	Peas, Khesari dal, Gram	Milk (cow), Milk (buffalo), Curd	Banana, Guava, Papaya (ripe)	Radish, Gourd, Pumpkin	Palak, Bhaji sageaves, Amranth (chaulai)	Mustard oil (loose), Refined oil, Rapeseed oil
Karnataka	Ragi, Rice (coarse), Jowar	Gram, Peas, Besan (ground gram dal)	Milk (cow), Milk (buffalo), Curd	Banana, Guava, Pineapple	Radish, Tomato, Onion	Palak, Bhaji sageaves, Mustard leaves	Groundnut oil (loose), Refined oil, Palm oil
Kerala	Tapioca, Rice (coarse), Ragi	Peas, Gram, Pea dal	Milk (cow), Curd, Milk (buffalo)	Banana, Guava, Pineapple	Onion fresh, Gourd, Pumpkin	Palak, Amranth (chaulai), Bhaji sageaves	Palm oil, Coconut oil, Gingelly oil (loose)
Madhya Pradesh	Wheat (coarse), Maize, Jowar	Gram, Peas, Soyabean	Milk (buffalo), Milk (cow), Curd	Banana, Papaya (ripe), Guava	Onion, Radish, Tomato	Palak, Bhaji sageaves, Amranth (chaulai)	Mustard oil (loose), Refined oil, Groundnut oil (loose)
Maharashtra	Jowar, Bajra, Bread	Peas, Gram, Khesari dal	Milk (buffalo), Milk (cow), Curd	Banana, Guava, Papaya (ripe)	Onion, Radish, Tomato	Palak, Bhaji sageaves, Amranth (chaulai)	Refined oil, Groundnut oil (loose), Palm oil
Manipur	Maize, Rice (coarse), Bread	Peas, Pea dal, Gram	Milk (cow), Curd, Milk (buffalo)	Pineapple, Banana, Guava	Pumpkin, Cabbage, Gourd	Mustard leaves, Palak, Bhaji sageaves	Palm oil, Refined oil, Mustard oil (loose)
Meghalaya	Rice (coarse), Bread, Wheat atta	Peas, Gram, Khesari dal	Milk (cow), Curd, Milk (buffalo)	Banana, Pineapple, Papaya (ripe)	Radish, Arum, Cabbage	Bhaji sageaves, Mustard leaves, Palak	Mustard oil (loose), Refined oil, Ghee (cow)
Odisha	Bread, Paddy, Rice (coarse)	Peas, Urd (whole), Pea dal	Milk (cow), Milk (buffalo), Ghol (lassi)	Banana, Guava, Papaya (ripe)	Gourd, Radish, Pumpkin	Bhaji sageaves, Palak, Amranth (chaulai)	Palm oil, Refined oil, Mustard oil (loose)
Punjab	Wheat (med.), Wheat atta, Wheat (coarse)	Peas, Gram, Gram dal	Milk (buffalo), Milk (cow), Ghol (lassi)	Banana, Guava, Pineapple	Radish, Onion, Turnip	Palak, Mustard leaves, Bhaji sageaves	Mustard oil (loose), Toria oil, Refined oil
Rajasthan	Bajra, Barley, Maize	Gram, Gram dal, Soyabean	Milk (buffalo), Milk (cow), Curd	Banana, Papaya (ripe), Guava	Onion, Radish, Tomato	Palak, Amranth (chaulai), Bhaji sageaves	Mustard oil (loose), Refined oil, Groundnut oil (loose)
Tamil Nadu	Bajra, Ragi, Jowar	Peas, Pea dal, Gram	Milk (cow), Milk (buffalo), Curd	Banana, Guava, Papaya (ripe)	Gourd, Pumpkin, Radish	Palak, Bhaji sageaves, Amranth (chaulai)	Groundnut oil (loose), Gingelly oil (loose), Palm oil
Tripura	Rice (coarse), Rice (med.), Wheat atta	Peas, Gram, Pea dal	Milk (cow), Curd, Ghol (lassi)	Banana, Orange (med), Pineapple	Pumpkin, Radish, Cabbage	Bhaji sageaves, Mustard leaves, Palak	Mustard oil (loose), Refined oil, Rapeseed oil

Uttar Pradesh	Wheat (coarse), Bajra, Maize	Peas, Pea dal, Gram	Milk (buffalo), Milk (cow), Curd	Banana, Guava, Papaya (ripe)	Radish, Gourd, Pumpkin	Palak, Amranth (chaulai), Mustard leaves	Mustard oil (loose), Refined oil, Ghee (buffalo)
Uttarakhand	Rice (coarse), Wheat atta, Bajra	Peas, Soyabean, Pea dal	Milk (buffalo), Curd, Milk (cow)	Banana, Guava, Orange (med)	Radish, Cabbage, Pumpkin	Palak, Mustard leaves, Bhaji sageaves	Refined oil, Mustard oil (loose), Palm oil
West Bengal	Paddy, Bread, Rice (coarse)	Peas, Khesari dal, Pea dal	Milk (cow), Milk (buffalo), Curd	Banana, Guava, Papaya (ripe)	Gourd, Radish, Pumpkin	Bhaji sageaves, Palak, Mustard leaves	Mustard oil (loose), Palm oil, Refined oil

Table A.3: CoRD as a % of unskilled wages by state, 2001 and 2011

	% of Men's unskilled wages			% of Women's unskilled wages		
State name	2001	2011	% change	2001	2011	% change
Andhra Pradesh	55.1	42.3	-23.1	71.4	59.9	-16.0
Assam	62.3	53.1	-14.7	108.6	83.1	-23.5
Bihar	63.9	66.4	3.9	73.0	66.6	-8.8
Chhattisgarh	80.1	75.6	-5.6	79.6	83.4	4.9
Delhi	33.8	30.9	-8.6	98.5	84.2	-14.5
Gujarat	62.2	71.4	14.8	66.5	78.5	18.1
Haryana	32.5	25.3	-22.0	38.5	33.4	-13.4
Himachal Pradesh	46.8	43.9	-6.2	79.2	55.1	-30.4
Jammu & Kashmir	38.4	30.0	-21.8			
Jharkhand	54.5	47.5	-12.7	59.0	49.3	-16.4
Karnataka	58.9	51.5	-12.5	88.2	75.7	-14.2
Kerala	22.8	22.0	-3.3	31.3	35.3	13.0
Madhya Pradesh	62.8	64.8	3.2	66.5	70.0	5.2
Maharashtra	54.2	53.0	-2.2	79.7	82.4	3.3
Manipur	66.6	56.0	-15.9	80.0	56.6	-29.3
Meghalaya	59.5	57.7	-3.0	66.0	90.8	37.5
Odisha	54.5	42.5	-22.0	57.9	51.6	-10.8
Punjab	36.7	30.6	-16.8	36.3	44.4	22.1
Rajasthan	40.4	37.2	-7.9	45.9	37.1	-19.2
Tamil Nadu	36.1	30.3	-16.1	57.9	45.7	-21.0
Tripura	77.5	62.7	-19.1	167.3		
Uttar Pradesh	49.9	40.5	-18.9	64.6	46.3	-28.4
Uttaranchal	48.8	34.6	-29.1	68.5	52.6	-23.2
West Bengal	63.4	61.1	-3.7	72.3	72.7	0.5

Source: Authors' estimates from the NSS Rural Consumer Price (RPC) 2001-2011 dataset. See text for details.

Table A.4: CoRD and unskilled labor wages for men and women, 2011

	Men		Women	
State name	**CoRD (in June 2011 prices)**	**Unskilled labor wages (in June 2011 prices)**	**CoRD (in June 2011 prices)**	**Unskilled labor wages (in June 2011 prices)**
Andhra Pradesh	45.70	111.34	40.95	73.61
Assam	53.75	101.99	48.10	19.08
Bihar	42.01	63.25	37.68	38.95
Chhattisgarh	46.41	62.80	41.57	50.95
Gujarat	47.26	70.46	42.40	42.42
Haryana	45.46	182.39	41.20	143.49
Himachal Pradesh	61.79	143.02	55.13	50.59
Jammu & Kashmir	51.61	174.86	46.39	0.00
Jharkhand	44.10	95.14	39.76	84.15
Karnataka	41.68	84.91	36.67	34.53
Kerala	48.28	254.80	42.60	60.85
Madhya Pradesh	43.53	71.55	39.40	59.63
Maharashtra	42.88	84.68	38.57	45.43
Manipur	49.51	85.60	44.36	77.52
Meghalaya	55.71	99.89	49.74	42.27
Odisha	39.42	95.28	35.05	78.37
Punjab	47.09	158.79	42.23	20.88
Rajasthan	45.49	128.56	41.44	105.96
Tamil Nadu	43.54	157.52	38.52	76.70
Tripura	63.17	100.92	57.09	0.00
Uttar Pradesh	40.89	102.19	36.86	50.46
Uttaranchal	51.24	147.34	45.86	28.07
West Bengal	43.29	73.11	39.21	48.03

Table A.5: Unskilled labor wages for men and women as a percentage of state-wise MGNREGA minimum wages, 2005 and 2011

State Name	Unskilled labor wages as % of MGNREGA wage in 2005		Unskilled labor wages as % of MGNREGA wage in 2011	
	Men	**Women**	**Men**	**Women**
Andhra Pradesh	34.65	23.12	92.02	60.84
Assam	57.51	7.14	78.46	14.68
Bihar	43.28	21.59	52.71	32.46
Chhattisgarh	28.59	22.85	51.47	41.76
Gujarat	54.32	41.20	56.82	34.21
Haryana	51.00	37.71	101.89	80.16
Himachal Pradesh	84.74	17.59	105.94	37.48
Jammu & Kashmir	121.19		144.52	
Jharkhand	43.29	36.78	79.29	70.13
Karnataka	40.78	22.61	67.93	27.63
Kerala	67.69	27.58	169.87	40.56
Madhya Pradesh	41.22	31.80	58.64	48.87
Maharashtra	55.58	32.05	66.67	35.77
Manipur	45.56	33.03	67.93	61.52
Meghalaya	62.24	21.04	85.38	36.13
Odisha	49.00	40.63	76.23	62.70
Punjab	43.76	13.39	103.78	13.65
Rajasthan	48.74	38.20	108.03	89.04
Tamil Nadu	52.84	32.26	132.37	64.45
Tripura	70.55	1.70	85.52	
Uttar Pradesh	55.47	29.08	85.16	42.05
Uttaranchal	62.28	19.55	122.79	23.39
West Bengal	41.78	27.73	56.24	36.95

Table A.6: CoRD as a percentage of the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) minimum wages for men and women, by state, 2005 & 2011

State name	Men's CoRD/NREGA wage ratios			Women's CoRD/NREGA wage ratios		
	2005	2011	% change	2005	2011	% change
All rural India	24.9	34.8	39.5	22.4	31.3	39.7
Andhra Pradesh	18.4	37.8	105.6	16.3	33.8	107.7
Assam	30.6	41.3	35.1	27.5	37.0	34.7
Bihar	23.8	35.0	47.2	21.4	31.4	46.8
Chhattisgarh	25.1	38.0	51.6	22.5	34.1	51.3
Gujarat	35.4	38.1	7.7	31.9	34.2	7.3
Haryana	17.2	25.4	47.8	15.6	23.0	48.0
Himachal Pradesh	37.7	45.8	21.6	33.8	40.8	20.7
Jammu & Kashmir	47.5	42.7	-10.2	42.7	38.3	-10.3
Jharkhand	20.8	36.8	76.4	18.8	33.1	76.0
Karnataka	22.0	33.3	51.4	19.5	29.3	50.7
Kerala	14.4	32.2	123.8	12.7	28.4	123.0
Madhya Pradesh	25.7	35.7	39.1	23.2	32.3	39.4
Maharashtra	31.2	33.8	8.4	28.0	30.4	8.3
Manipur	26.1	39.3	50.6	23.3	35.2	50.8
Meghalaya	26.6	47.6	79.0	23.6	42.5	80.3
Odisha	25.8	31.5	22.0	23.2	28.0	21.0
Punjab	16.6	30.8	85.5	14.9	27.6	85.5
Rajasthan	21.9	38.2	74.3	19.8	34.8	75.8
Tamil Nadu	18.8	36.6	94.7	16.7	32.4	93.8
Tripura	49.8	53.5	7.5	45.2	48.4	7.0
Uttar Pradesh	26.7	34.1	27.4	24.0	30.7	28.0
Uttaranchal	28.8	42.7	48.0	26.1	38.2	46.5
West Bengal	25.2	33.3	32.0	22.9	30.2	31.8

Source: Authors' estimates from the NSS Rural Consumer Price (RPC) 2001-2011 dataset. MGNREGA wages in 2005-06 and 2011 were obtained from Ministry of Rural Development, Government of India (https://nrega.nic.in/nerega_statewise.pdf). See text for details.
Notes: The MGNREGA was notified in 2005, so the two years presented here are state-wise minimum wages at the time of notification of the Act and in the last year in our data. Missing blocks come from states where wages for female unskilled laborers were not reported.
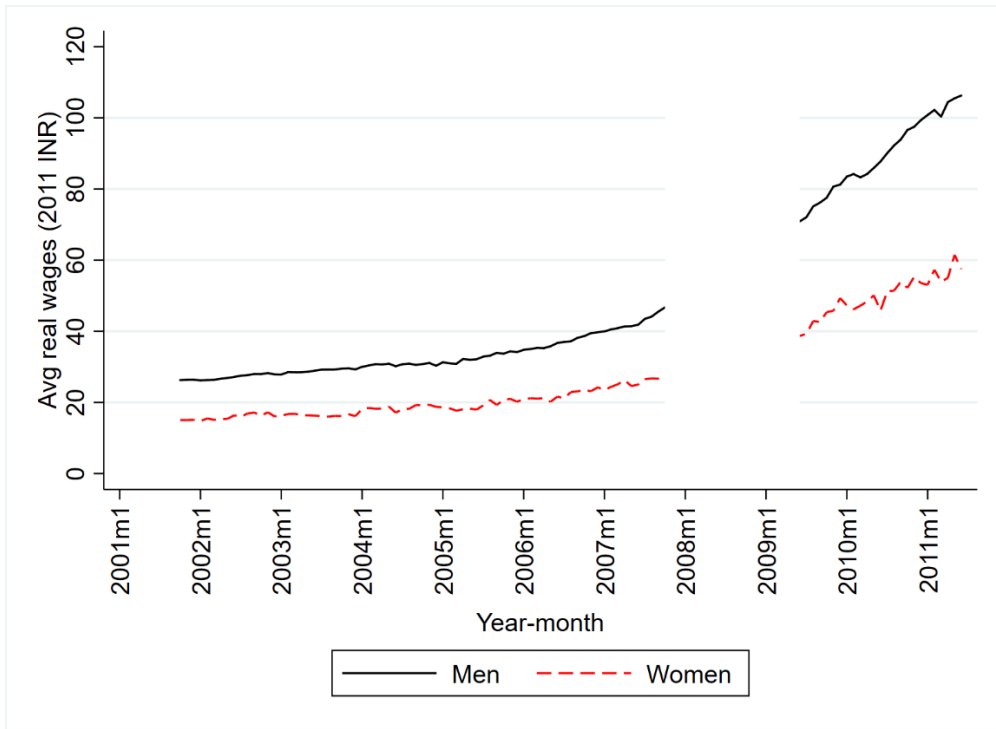
Figure A.1: Trends in real wages for men and women engaged in unskilled labour (2011 INR)

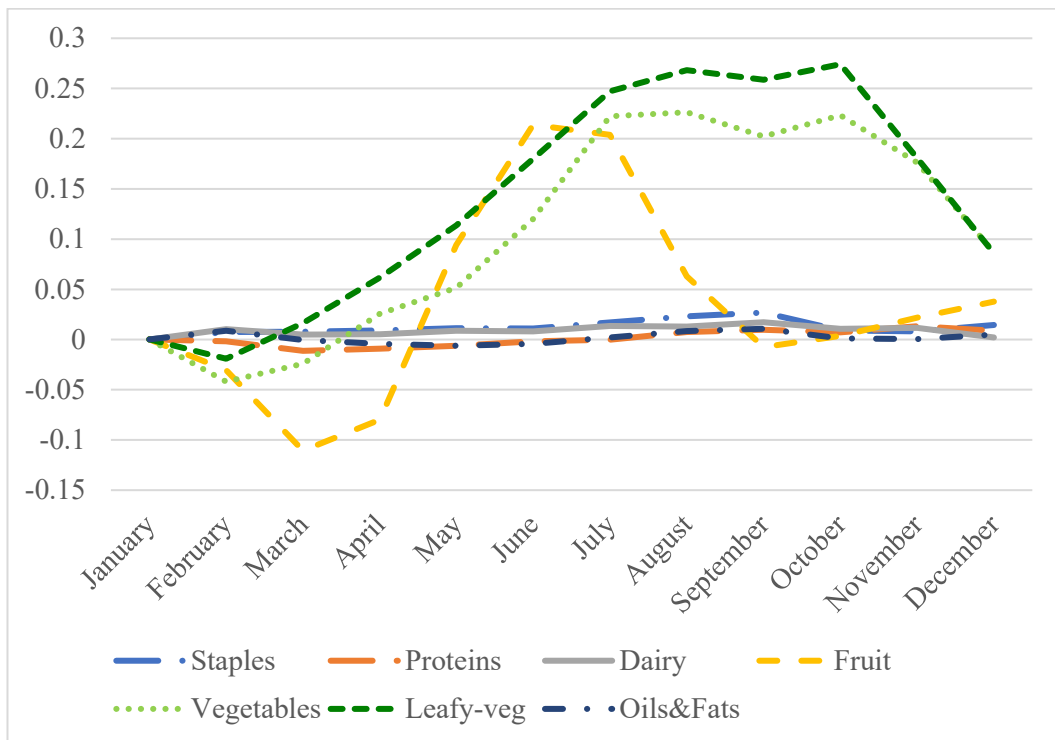*Figure A.2: Trends over time in CoRD relative to unskilled labor wages, men and women*

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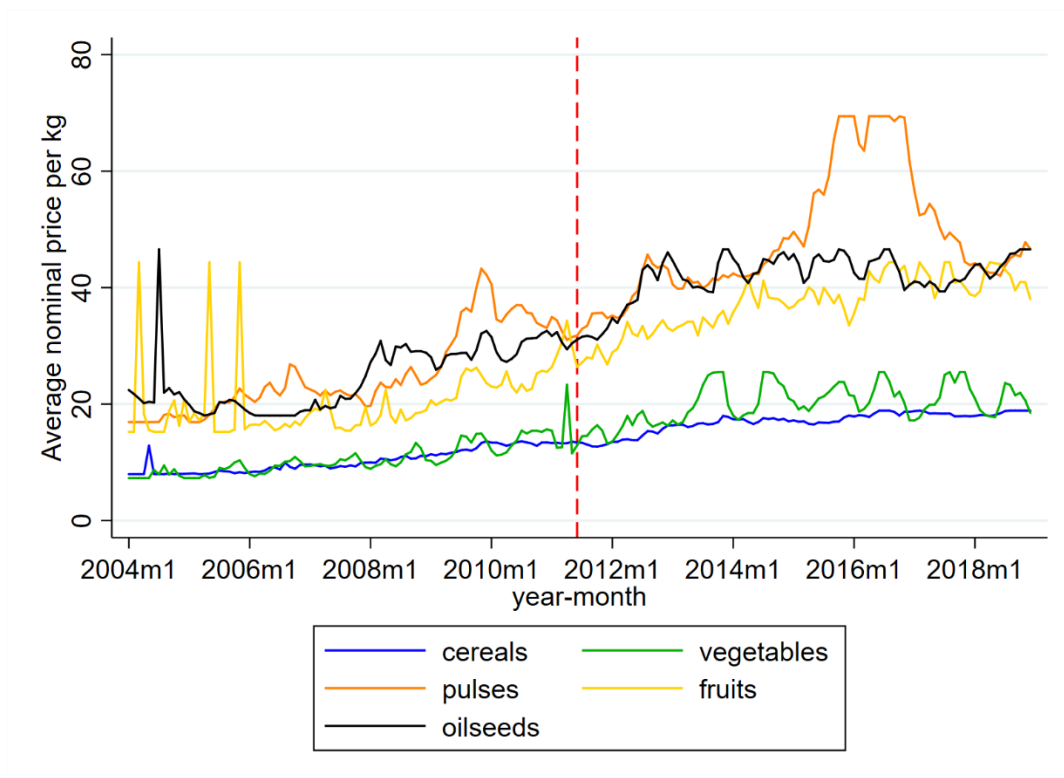*Figure A.3: Seasonality in log of food prices by food group, over months of the year*

Figure A.4: Nominal wholesale prices per kilogram for 2004-2018

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