Beyond the Consumer Food Price Index

Measuring the Cost of a Healthy Diet in India

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In this paper, we make a case for routinely computing the CoHD alongside the CPI-F. We show that, though correlated with the consumer price index for food, they do not always move in the same direction and that the CPI-F is a poor predictor of CoHD. Thus, attempts to draw inferences on the health and nutritional implications of food inflation using the CPI-F can lead to erroneous conclusions. We propose that the CoHD be used as a barometer for barriers faced in attaining healthy diverse diets across time as well as space and as an input into policy decisions, such as costing social protection programmes.

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It is widely acknowledged that the nutritional challenges many countries in the world face go beyond addressing hunger and food security to tackling the triple burden of malnutrition—calorie inadequacy, micronutrient deficiencies, and obesity (Masters et al 2022). Target 2.2 of Goal 2 of the Sustainable Development Goals (SDGs) duly emphasises the need to eradicate all forms of malnutrition by 2030. While many factors influence the prevalence of malnutrition, the quality and quantity of food intake are the key underlying and immediate determinants of nutrition outcomes (UNICEF 2021).

Both globally and in India, the cost and affordability of a healthy diet have been identified as a critical constraint to achieving diet quality. Countries, where nutritious diets are least affordable (as a share of household expenditure), have a greater prevalence of stunting and micronutrient deficiencies, as well as a smaller prevalence of obesity (Masters et al 2022; Bai et al 2021). It is estimated that 42% of the global population were unable to afford a healthy diet in 2021, close to one-third of whom live in India (FAO et al 2023).

Indian diets deviate quite significantly from the EAT-Lancet recommendations in ways that tend to reduce diet quality, with households spending significantly more than recommended on cereals, and significantly less on pulses, fruits, vegetables, meat, fish, and eggs (Sharma et al 2020). Rao et al (2018) conclude that more than two-thirds of Indians consume diets that are deficient in essential micronutrients. An analysis of prices suggests, in 2011, healthy diets that met national food-based dietary guidelines (FBDGs) were unaffordable to two-thirds to three-fourths of the rural Indian population (Raghunathan et al 2021). Primary data too confirm this. Data collected in Uttar Pradesh suggests that the minimum-cost nutritious diet was unaffordable for 75% of households, with the poorest households needing to rely heavily on social safety nets to supplement their consumption (Kachwaha et al 2020). Gupta et al (2021) find that in four rural Indian districts, households would have to more than triple their expenditure on food, on average, to meet the least-cost version of the EAT-Lancet diet. At the same time, information about what constitutes a healthy diet is crucial, especially as healthy diets can be achieved by a reallocation of expenditures towards healthier alternatives. Households could diversify diets within existing food budgets to improve nutrient intake and simultaneously reduce greenhouse gas emissions (Rao et al 2018).

The premise of this paper is straightforward: if one is to direct public policy to promote healthy diets, one must first be

able to track their costs and affordability. Thus far, the Indian government, both the union and states, has focused primarily on the consumer price index for food (CPI-F). The government has further justifiably focused on tracking individual food groups that are deemed sensitive either from the perspective of international or domestic trade, but that do not sufficiently reflect nutritional or health concerns. For example, tomatoes, onions, and potatoes, often referred to as "TOP," are widely consumed as part of routine diets and the prices consumers face for these commodities have often been a politically sensitive issue (Desai 2012). More recently, efforts to estimate the cost of preparing a *thali*, a composite meal, have found a place in occasional reports (GoI 2020), representing an important step towards discussing diets rather than an abstract food basket. Yet, while the price of a thali bears a closer resemblance to the family of cost of a healthy diet (CoHD) indicators, the construction and cost of the thali do not fully address nutritional concerns, nor has this metric been reported systematically by government agencies since it was first proposed.

In this paper, we make a case for routinely computing the CoHD alongside the CPI-F. The CoHD calculates the "minimum" per person per day expenditure needed to purchase the daily recommended quantities of various foods prescribed by national FBDGs (Herforth et al 2020; Herforth 2015). While nutrient requirements are generally not listed explicitly in FBDGs, CoHDs typically meet most macro- and micro-nutrient thresholds while generating realistic-looking diets (Herforth et al 2022).

Our case rests on four arguments. First, we show that while the CPI-F and CoHD are correlated, they often diverge substantially and can move in opposite directions, rendering the CPI-F an unreliable indicator of inputs into nutritional outcomes. This provides a key rationale for routine monitoring of the CoHD. Second, the CoHD can be computed without too much additional effort since it relies on data that are already available and collected routinely by the Government of India. Third, the CoHD can be extended to offer insights into the affordability of healthy diets, especially when analysed in tandem with wages and incomes. Just as CPI-F can often be used to gain insights into the cost of living, the CoHD can shed light on the affordability of healthy diets. This can help identify key barriers to health and nutrition; for example, by assessing the extent to which the deviation of actual diets from healthy diets is due to affordability constraints, as opposed to consumer preferences and behaviour. Fourth, CoHD can be used as an analytical tool to shape nutrition policy, to help cost programmes that focus on in-kind distribution of food, to assess the scope and limitations of cash transfer programmes, and to inform the setting of wages.

After describing the CoHD, we contrast it briefly with the CPI-F and compare it with alternative measures such as the cost of a thali. Then, we present our findings and demonstrate how the CoHD can be used to investigate affordability and as inputs into programme design followed by the conclusion.

The Cost of Healthy Diets: Concept and Measurement

The CoHD is the least-cost way of meeting national FBDGs which are a country's definition of a healthy and culturally appropriate dietary pattern.[1] Quantitative FBDGs specify daily energy targets and quantities of various food groups; the CoHD simply converts those quantities into costs using food composition tables and available data on prices. In India, the FBDGs are developed by the Indian Council of Medical Research (ICMR) and the National Institute of Nutrition (NIN). We use these guidelines and a range of publicly available price data collected by government agencies to compute a weekly location-specific CoHD that can be aggregated to a national-level estimate.

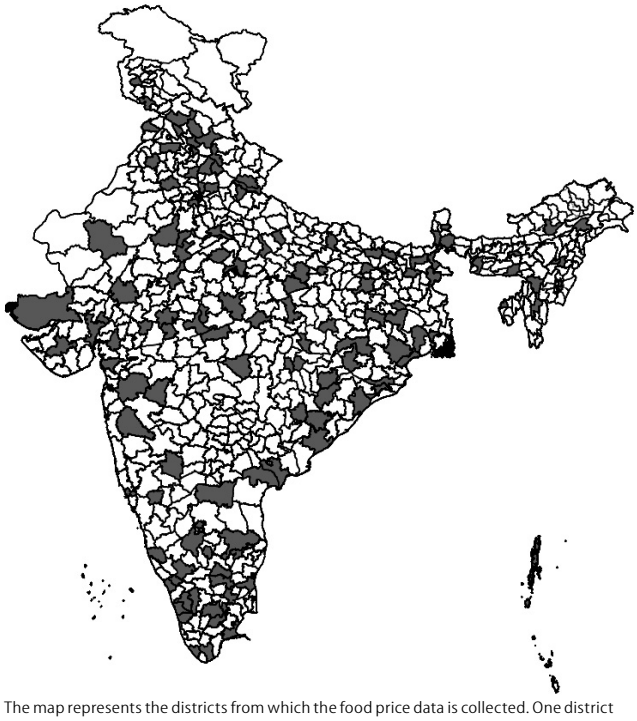
Data: We draw on available data sources to generate the CoHD. First, we use daily retail and wholesale price data from the Department of Consumer Affairs (DCA) with information from 318 urban market centres for 21 commodities. Second, we use daily retail prices from the National Horticulture Board (NHB), for 26 fruits and vegetables from 31 urban markets. Third, we use the Department of Economics and Statistics-Ministry of Agriculture (DES-MoA) weekly retail prices for 45 commodities from 77 urban market centres.[2] Some commodities appear in more than one source; in these cases, we first use as source the DES-MoA, then the NHB, and then the DCA in order of preference.

Since none of these sources includes prices for dark green leafy vegetables (DGLV) or nuts and seeds, we supplement these with farmgate prices from our fourth source, that of *mandi* (local wet market) prices from agmarknet.gov.in. These daily mandi prices are available at the commodity-district level for a total of 311 items and 485 districts. Mandi prices are closer to producer and wholesale prices than retail consumer prices, that is, they more closely represent the price paid to those producers with sufficient volume to sell at these markets. We retain mandi prices for nine commodities: amaranthus, Indian colza (sarson), knool khol (kohlrabi) leaves, leafy vegetables, fenugreek leaves, and spinach (dark green leafy vegetables), and almonds, cashews, groundnuts, walnuts (nuts and seeds).

Daily prices from the DCA, NHB, and mandi price data sets are aggregated to the weekly level using simple averages across daily data. These three sets of urban retail price data are then merged with each other and into the DES-MoA data set at the centre-week level to generate a commodity-centre unbalanced panel with 330 centres and 68 commodities from January 2018 to March 2023.[3] Two additional points bear mentioning. First, we do not have prices for all commodities at each centre at each point in time; nor does the set of commodities represented at a given centre remain the same over the weeks of the year or across years. Under the assumption that a missing price at a given centre-week combination indicates that the item in question was not sold in that centre in that week, we refrain from imputing missing prices and use the data set as it is. Second, we have price information on miscellaneous items, including spices, beverages, green chillies, and ginger, but these commodities are not included in the CoHD calculation since they are typically used in small quantities as condiments and do not contribute significantly to the nutritive value of the diet.

While centre-level prices are unlikely to be representative of the district, the districts with centres for which we compute

Figure 1: Food Price Centres in India



The map represents the districts from which the food price data is collected. One district may contain multiple centres. The international boundaries represented in this map are those recognised by the Government of India and should not be construed as reflecting the views of the institution the authors belong to.
Source: Authors' compilation.

the CoHD are well-distributed across the country (Figure 1). Our national CoHD estimate is calculated as the weighted average of the CoHD across urban centres using centre-wise 2011 population as weights. We focus on national-level estimates in this paper, but relegate, for a more granular presentation of our results, to a companion paper (Raghunathan et al 2024). Since the CoHD is only available when information on all constituting food groups in a week is non-missing, there are significant data gaps. Much of this is driven by the addition of the mandi data, due to both unmatched centres as well as time-specific missing price information on DGLV and nuts and seeds for centres that are represented.[4]

Methods: The CoHD method is a simple linear programming approach that converts nationally appropriate food group-wise energy recommendations into a least-cost estimate (Dizon et al 2019; Raghunathan et al 2021). In addition to being computationally less demanding than the cost of the diet (CotD) (Chastre et al 2007) or the cost of nutrient adequacy or CoNA, the lowest cost of a diet that meets the recommended intake of each required nutrient (Bai et al 2021), this approach has the advantage of yielding realistic looking diets that typically also meet nutrient requirements (Dizon et al 2019).[5]

We use ICMR-NIN's 2018 "My Plate for the Day" recommendations for India (Table 1), which provide the number of kcal per person per day from each recommended food group, along with the approximate gram conversions using a representative item from that food group. We combine these with the energy per 100-gram information from India's food composition tables (Longvah et al 2017) to calculate the quantity in grams of each commodity in our data set that would need to be consumed to meet the energy recommendations for the corresponding food group. Then, using estimates of the edible fraction for each commodity, that is, the fraction of the purchased weight of that commodity that can be consumed, and the deflated food prices, we estimate the cost in Indian rupees (₹) of achieving these recommendations for each commodity in our data set. In other words, we calculate

$$\text{Commodity daily cost} = \left[\frac{\text{price(per kg)}}{\text{ediblefraction}\left(\frac{\text{edible kg}}{\text{total kg}}\right)}\right] * \frac{\text{servingsize}\left(\frac{\text{edible g}}{\text{serving}}\right)}{1000\left(\frac{\text{g}}{\text{kg}}\right)}$$

For each centre-week combination in our data set, we then sort commodities within a given food group in increasing order of this daily cost. In addition to daily quantities, ICMR-NIN's "My Plate for the Day" recommendations advocate for variety in cereals, pulses, and vegetables; we implement this by retaining the two lowest-cost foods in these food groups. For dairy, DGLV, nuts and seeds, and oils and fats, we retain the cheapest item only. The process of identifying the lowest-cost food by week implies that the basket of goods could be different across weeks. This approach mimics the shopping behaviour of a price- and health-conscious consumer who seeks to minimise food expenditures while also trying to acquire a healthy diet.

The food group-wise cost of achieving the healthy diet recommendations is calculated as the average daily cost across the lowest cost items in each food group. Adding up these costs across food groups gives us the CoHD for each centre-week combination, that is, the minimum an individual in that location and at that time would need to spend to meet the ICMR–NIN daily recommendations. The set of foods that frequently appear in the least-cost diet are indeed commonly consumed foods (Table 2).

Table 1: Dietary Recommendations from ICMR–NIN's 'My Plate for the Day'

	Amount to be Consumed (g/day)	Total Energy (kCal)/day
Cereals	250	843
Pulses	85	274
Milk/curd	300	216
Vegetables + dark green leafy vegetables (DGLV)	400	174
Fruits	100	56
Nuts and seeds	35	181
Fats and oils	27	243
Total	1,200	2,000

Source: ICMR–NIN's "My Plate for the Day" recommendations (viewed on 5 November 2023, from https://www.nin.res.in/downloads/My_Plate_for_the_day_J24.pdf).
The recommendations for the vegetables category are split across leafy and non-leafy vegetables in the ratio of 1:2. The recommendations also state: (1) Eggs, fish and meat can substitute pulses. (2) Use different varieties of cooking oils, vegetables, fruits, nuts, etc, to obtain a variety of phytonutrients, vitamins, minerals, and bioactive compounds.

Table 2: Food Group-wise Items Appearing in the Least-cost Healthy Diet

Food Group	Most Commonly Appearing Lowest-cost Items, 2018–23
Cereals	Wheat, rice, bajra, bread, maida
Pulses	Gram dal (split or whole), masoor, tur, besan, moong
Dairy	Milk
Fruits	Banana, apple, sapota (chikoo), orange, pineapple
Non-leafy vegetables	Potato, onion, tomato, peas, brinjal
Leafy vegetables, etc	Spinach, leafy vegetable, amaranthus, methi leaves, knool khol leaves
Oils and fats	Palm oil, soya oil, mustard oil, groundnut oil, gingelly oil
Nuts and seeds	Groundnut, cashew nut, almond, walnut

Source: Authors' calculations. Milk is the only commodity in the dairy food group for which we have price information.

Figure 2: Food Group-wise Contributions to the National Average Cost of a Healthy Diet

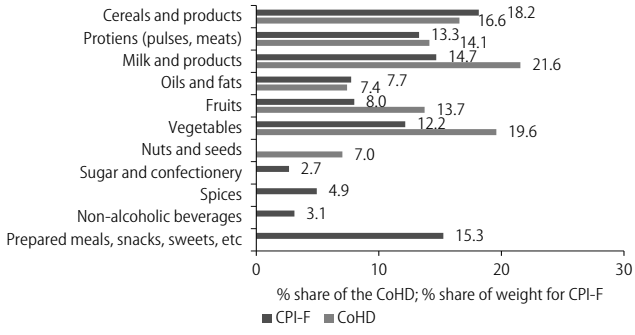
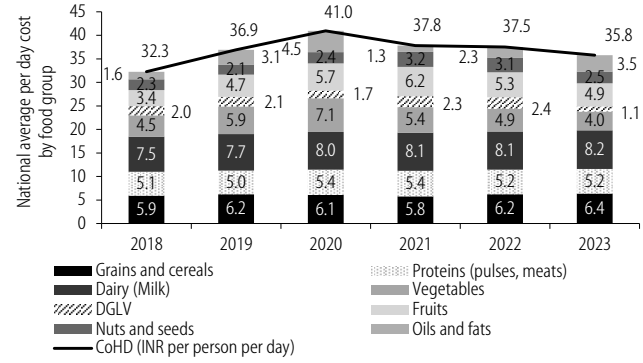


Figure based on similar calculations in Kishore (2020); CPI-F is the share of weights for urban areas, obtained from https://cpi.mospi.gov.in/Weights_2012.aspx. CPI-F weights for proteins are the sum of weights for meat and fish, eggs, and pulses and products; CoHD is the national average cost of a healthy diet for 2018–23.
Source: Authors' estimation and compilation.

Figure 3: Food Group Contribution to CoHD



For the list of commodities in each food group, see Table 2.
Source: Authors' estimation.

The CPI-F and CoHD Compared

CPI for food: Broadly, the CPI is designed to measure "changes over time in the level of prices of goods and services that a reference population acquires, uses, or pays for consumption" (GoI 2010). In practice, the CPI measures the cost of purchasing a fixed basket of goods and services. CPI-F represents an index that measures a typical and fixed food basket. In India, the CPI is compiled by using the Laspeyres' base weighted formula, which keeps quantities fixed and allows only for prices to vary:

$$\frac{\sum_i q_{0i} p_{ti}}{\sum_i q_{0i} p_{0i}} \times 100 \quad \ldots (1)$$

where q_{oi} is the quantity of commodity i during a base year, p_{oi} is the base price of commodity i, and p_t is the price of commodity i in the year t. This index represents the ratio of outlay on a fixed basket of commodities in year t to the outlay on that same basket in the base year, expressed as a percentage. Operationally the numerator can be rewritten as follows:

$$\frac{\sum_i q_{0i} p_{0i} \times \frac{p_{ti}}{p_{0i}}}{\sum_i q_{0i} p_{0i}} \times 100 \quad \ldots (2)$$

where the expression $\frac{p_{ti}}{p_{0i}}$ is the ratio of the price of an item in period t to its price in the base period, called the "price relative" (GoI 2010). Expression (2) is therefore a base-weighted average of price relatives, the weights being the expenditures incurred on various goods and services in the fixed base-period consumption basket of a reference population. This reduces to computing base-period expenditures—the weights—just once, based on a household survey and using price data collected to obtain the price relative for commodities in the consumption basket and hence update the CPI (see GoI 2010 for details). The CPI-F follows an identical procedure but focuses only on food items in the consumption basket; these quantities are derived from nationally representative household consumption expenditure surveys.

The coverage and applicability of CPIs are generally limited to specified socio-economic groups. The CPI is a proxy for the cost of living and is primarily used for national accounting and for indexing wages and salaries. The CPI-F, like the CPI itself, is accessible and easily understood and has therefore become the barometer for the cost of living in a very basic sense, although the two are distinct concepts. In this paper, we use the all-India-level monthly CPI-F for 2018–23. To enable comparisons with the CoHD, we rescale the CoHD by setting 2018 January to 100.

The conceptual differences between the CoHD and CPI-F are apparent, further distinguished by the choice of the food basket and aggregation method. Figure 2 illustrates the relative importance of various food groups in both metrics. The CPI-F overweighs cereals and cereal products and oils and fats relative to the CoHD, while also providing positive weights to unhealthy foods such as sugar, prepared meals, snacks and sweets, non-alcoholic beverages, and spices. Further, the CPI-F does not account for nuts and seeds at all and does not distinguish between non-leafy and leafy vegetables. Simply put, the CPI-F is an indicator of the price of food while the CoHD is a measure of the cost of a healthy diet.

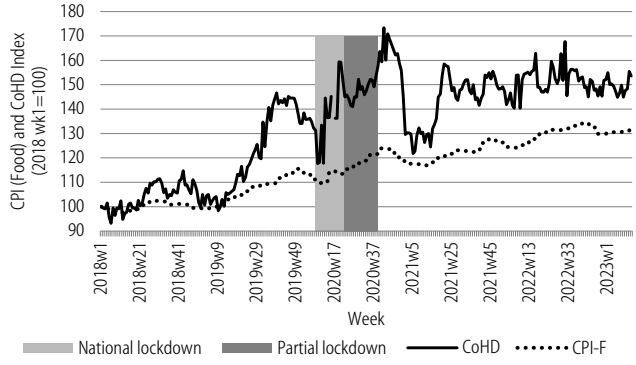
The CoHD also has some operational advantages over the CPI-F. Since the commodity basket is determined by nutritional requirements and prices, the CoHD does not require consumption expenditure or family budget surveys. With the CPI-F, there is a risk that without up-to-date representative surveys, the indices might not accurately capture current consumer food bundles.

Estimates of CoHD and the CPI-F for India, 2018–23

The overall weekly national average CoHD over the period we consider (2018–23) ranges from ₹29.5 per day in 2018 week 6 to ₹46.9 per day in 2020 week 42. The weekly centre-wise average CoHD ranges from ₹27.1 per day in Jaipur, Rajasthan (2018 week 8) to ₹70.7 per day in Mumbai, Maharashtra (2020 week 20). Dairy consistently contributes the most to the daily cost, followed by cereals and fruits (Figure 3). Nuts and seeds, dark green leafy vegetables, and oils and fats contribute the least to overall costs, partly due to their small daily recommended serving sizes and partly because we use mandi prices for these items, which are, on average, considerably lower than rural or urban retail prices.

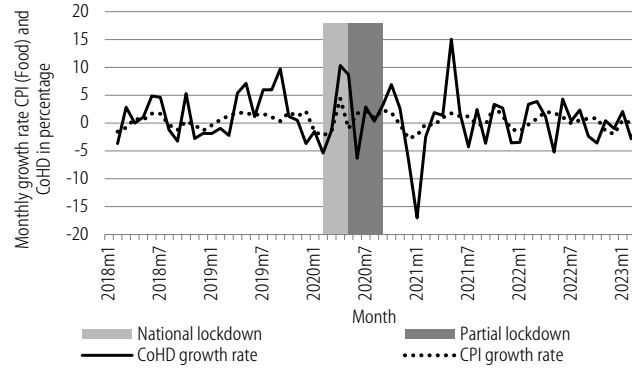
We begin by comparing the CoHD with the CPI-F (Figure 4, p 52). For this comparison, prices are deflated to the first period in

Figure 4: The Cost of a Healthy Diet versus CPI-F, 2018–23



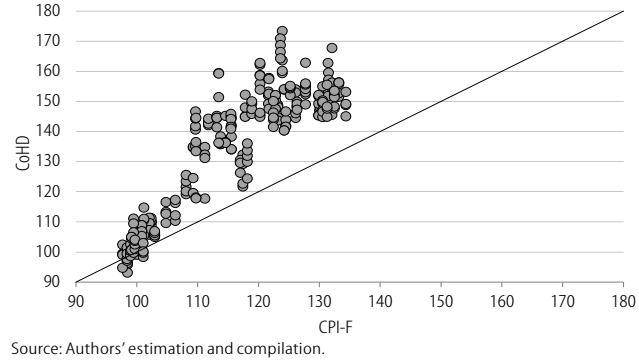
Both CoHD and CPI-F are normalised to 2018 week 1 and 2018 month 1 prices, respectively. CoHD is the national weekly cost of healthy diets across centres with all eight food group prices. CPI-F is the urban consumer food price index.
Source: Authors' estimation and compilation.

Figure 5: Monthly Rate of Change in CoHD and CPI-F, 2018–23



Monthly growth rate for CoHD is calculated as the percentage difference between CoHD for current month and previous month, divided by the CoHD of the previous month. Similarly, for CPI-F growth rate. Here, CoHD is the national monthly cost of healthy diets across centres with eight food group prices and CPI-F is the urban consumer food price index.
Source: Authors' estimation and compilation.

Figure 6: A Scatter Plot of CoHD versus CPI-F with Base Period=100, 2018–23



Source: Authors' estimation and compilation.

our time series, week 1 of January 2018, using the state-month-level general urban CPI to account for overall price trends. This comparison is illustrative rather than precise since the CPI-F is from published sources and its construction differs somewhat from our approach to aggregating over centre, tackling missing values, and so on. Further, whereas the CPI-F is available at a monthly frequency, we compute a weekly CoHD. We overlay the period of complete and partial national COVID-19 lockdowns as these were a particularly volatile period for food prices; soon after, the national lockdown was announced on 24 March 2020, disruptions in supply chains led to an increase in the prices of many commodities (Lowe et al 2021; Narayanan and Saha 2021).

We highlight three specific findings. First, the CoHD index that we compute tends to be higher than the CPI-F (Figure 4). Given that both series are tied to the same base period, this implies that the CoHD has risen more sharply, on average, than CPI-F. This is confirmed by the rate of change, which is significantly higher for the CoHD (Figure 5). This suggests that using the CPI-F exclusively to gauge trends or change (that is, food inflation) in food prices would be misleading from a nutritional perspective. The period of the national lockdown in response to COVID-19 provides a useful illustration: here, the CoHD increased substantially more than the CPI-F. Using the CPI-F would have underestimated the implications of COVID-19-induced disruptions on the cost of meeting nutrition requirements.

Second, the CoHD and CPI-F do not always co-move (Figure 4). If the two metrics were different only in levels but always moved in tandem, any one of the two could serve as a proxy measure for the direction of change in the cost of a healthy diet. Instead, the two measures co-move month-to-month in 44 of the 62 months for which we have data on both, but for 18 periods they move in opposite directions. Even the direction of this divergence is not constant—for eight of the 18 periods CoHD increases while CPI-F declines and for the remaining 10 it is the opposite. Thus, tracking the movement in CPI-F can be misleading if one wants to infer the costs of healthy diets, providing the rationale for computing an additional metric, such as the CoHD.

Third, although the CoHD and CPI-F are highly linearly correlated, the latter is a poor predictor of the former (Figure 6). We expect the CoHD and the CPI-F to be positively correlated since the CoHD draws on a similar set of commodities with a different weighting pattern. The linear correlation between the two is over 0.9 across versions, whether one uses weekly or monthly CoHD and whether one uses the abbreviated or the full CoHD. At the same time, a unit change in CPI-F is associated on average with a change of 1.65 in the CoHD (base period=100) or 0.38 paise in the CoHD over the period considered (Table 3). Thus, the two indicators cannot serve as proxies for one another.

Table 3: Regressions of CoHD on CPI-F

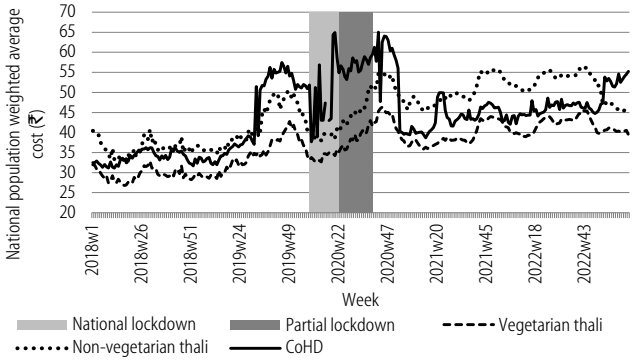
	With Month FE	Without Month FE
Panel A: Regression CoHD on CPI-F		
CPI-F	0.383***	0.376***
	(0.00378)	(0.00998)
Constant	-20.53***	-16.89***
	(0.681)	(1.544)
N	272	272
R^2	0.969	0.808
adj R^2	0.960	0.807
Panel B: Regression CoHD on CPI-F, both scaled to 2018 Jan week 1=100		
CPI-F	1.651***	1.621***
	(0.0163)	(0.0430)
Constant	-65.11***	-53.56***
	(2.159)	(4.896)
N	272	272
R^2	0.968	0.797
adj R^2	0.958	0.796

Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Source: Authors' calculations.

These three findings provide a rationale for CoHD as an independent measure of interest. Our analysis of CoHD also shows substantial weekly variations, suggesting that more frequent surveillance of food prices would be a useful policy tool.

CoHD and Thalinomics: Although the focus of this paper is to make a case for moving away from CPI-F to CoHD, it is noteworthy

Figure 7: The CoHD and Price of Thali, 2018–23



Source: Authors' estimation and compilation.

that a similar metric of the cost of a diet, namely—"the cost of a *thali*"—or composite meal, has generated popular interest recently. In the *Economic Survey 2019–20*, a chapter is devoted to what was referred to as Thalinomics, where they constructed representations of commonly consumed or "typical" thalis and costed these using the quantities (in grams) specified in the FBDGs (GoI 2020). The "typical" thali used included rice and wheat (cereals), arhar, gram, masur and urad (pulses), potato, onion, tomato, brinjal, cabbage, cauliflower, and lady's finger/okra (vegetables). The non-vegetarian thali replaced pulses with an animal-source protein, one from among eggs, fish, or goat meat.[6] Mustard oil, groundnut oil, and coconut oil were chosen based on the state since different states have different commonly consumed oils (GoI 2020). The cost of a thali also included the costs of small quantities of spices and condiments and firewood and fuel charges, reflecting, partially, the costs of preparation.[7]

The prices of the components of each thali were averaged at the food group-level using quantity weights derived from the actual consumption of these different components from the National Sample Survey 2011–12 Consumption Expenditure Survey (NSS-CES 2011–12) and added across food groups to estimate the cost of preparing a thali. This approach is similar in spirit to measures that assess the cost of diets, with two main points of divergence. First, several nutrient-rich food groups from India's FBDGs were not included (notably dairy and fruits; dark green leafy vegetables were also not emphasised within the vegetable group). The main components of the thali account for approximately 61% of the recommended daily requirement of various foods in grams and 65% of the NIN's caloric recommendation and it would likely fall short of the recommended nutrient quantities due to the exclusion of several nutrient-rich food groups. Second, Thalinomics accounts for some other costs of meal preparation, such as condiments and fuel, which do not factor into the CoHD. There are some limitations of the Thalinomics approach. The thali uses quantities from the NSS–CES to construct weights, which increases its data requirements. In contrast, estimating the CoHD does not require household-level consumption surveys, and provides the cost of a more holistic basket of foods. While Thalinomics might appear to have the advantage of representing "typical" meals, that distinction is artificial if not arbitrary; as discussed above, the CoHD uses FBDGs that already account for these cultural and context-specific preferences, and typically generates a set of commonly consumed foods (Table 2).

Finally, the explicit costing of meat items in the price of a thali is worth explaining. Since plant-based sources are invariably a less expensive way of attaining the FBDGs' requirements for that food group (of pulses/flesh foods), least-cost diets produced by the CoHD tend not to contain eggs or flesh foods. Since the goal of the CoHD is to obtain a lower-bound estimate, this is not a limitation of the approach. The CoHD is basket agnostic; by design, the set of lowest cost foods varies by time and place. Any adjustments to accommodate specific items—for example, to account for non-vegetarian items, or to accommodate tastes and preferences—must, by definition, be more expensive than the CoHD.

We estimate the price of a thali, replicating the method as outlined above and in the *Economic Survey 2019–20* (GoI 2020), with some deviations. We exclude the partial costs of preparing the meal, such as fuel costs, to enable comparisons with the CoHD. For each food group, we compute the average price for the commodities in the food group by applying state-level NSS–CES quantity weights as in GoI (2020) for all centres within the state.[8] Telangana was assigned the same weights as Andhra Pradesh. We also compute the cost of a thali by centre-week, using the data set on prices constructed to compute CoHD, described under the subheading "Data," and aggregate across centres to obtain a national-level estimate by using centre-wise population weights. This differs from the GoI (2020), where estimates are constructed at the state level before aggregation, using state-level population weights to obtain the national level. We use the updated NIN dietary guidelines (Table 1) recommendations to identify foods to be consumed (g/day) instead of the quantities mentioned in GoI (2020) which were based on an earlier version of the FBDGs. Finally, we also scale up the quantities of oil and seasonings for each food group, following the methods in GoI (2020).

$$\text{Cost of a thali} = \sum_{f}\left(\frac{\sum_i w_i p_i}{\sum_i w_i}\right) \times q_f^{NIN} + \text{cost of addons}_{\text{(oil,spices,condiments)}}$$

where f is the food group, p_i are prices of the individual commodities selected for each food group, f, w_i are state-level quantity weights from the NSS–CES 2011–12, applied to obtain a weighted average of the price of items in the food group f, q_f^{NIN} is the quantity per person of each food group recommended by ICMR-NIN FBDGs. We follow the assumption in GoI (2020), that the thali provides an individual two full meals so that the recommended daily quantities of select food groups are obtained from a single thali, allowing a direct comparison with the CoHD.

Daily vegetarian thali prices (that is, the cost equivalent of two meals) in the sample period ranged from ₹18.2 in Sagar, Madhya Pradesh (2018 week 13) to ₹72.0 in Port Blair, Andaman and Nicobar Islands (2021 week 52); while those of the non-vegetarian thali ranged from ₹17.6 in Tumkur, Karnataka (2018 week 37) to ₹107.4 in Malda, West Bengal (2022 week 39).

Since both the CoHD and the price of a thali are costs of composite meals, we can compare them directly without resorting to setting a base at 100, as was necessary for the CoHD-CPI-F comparison. The prices of the vegetarian and non-vegetarian thalis move reasonably closely, but Figure 7 shows that the two

are only modestly correlated with the CoHD over the period considered. The linear correlation of the CoHD with the vegetarian thali is 0.60 and with the non-vegetarian thali is 0.53. Much like the comparison of the CoHD and the CPI-F, the CoHD and the cost of a thali do not always move together, indicating that they are not good proxies for one another.

Applications, Extensions and Limitations

From cost to affordability: The CoHD is a useful metric but assumes greater significance when compared to measures of income or wages. Indeed, the comparison to the wages of poor unskilled workers is perhaps the most informative about the nutrition vulnerability of a given population (Raghunathan et al 2021; Headey et al 2024). However, using wages is a poor proxy for monthly household incomes since the former overlooks labour force participation and unemployment. If wages are used, it might be better to present the changes in the two, CoHD and wages, side by side. For example, Radhakrishnan and Loganathan (2023) note that the cost of a home-cooked vegetarian thali in Mumbai has increased by 65% in the last five years while the average wage earned by casual labourers and salaried workers in urban Maharashtra increased by only 37% and 28%, respectively. Saini and Khatri (2022) used wage rates of agricultural (general) and non-agricultural (including porters and loaders) workers and, assuming one person earned each day of the month, find that the cost of two thalis per person accounted for 48% of monthly household income in June 2017 for a family of five, rising to 60% by June 2022.

An alternative approach is to compare existing outlays on food consumption to uncover whether healthy diets can be accomplished within existing food budgets by merely reallocating away from "unhealthy" to healthier foods or whether a shift to healthy diets warrants additional outlays on food, relative to the existing expenditures. Our other ongoing analyses suggest that over the period considered, healthy diets cost more than the food expenditures for the bottom two quintiles of rural households covered in the 2011–12 NSS–CES, adjusted for inflation. For the top three rural quintiles, and all but the poorest urban quintiles, however, per adult equivalent food expenditures exceeded the cost of the healthy diet, suggesting that a reallocation of expenditures towards healthier foods could improve diet quality without requiring additional outlay.

Social protection programmes: Another potential use is to be able to cost social protection and food-based programmes. A key concern in many programmes is that wages in workfare programmes or allocations within programmes geared to address nutritional concerns are inadequate. Several existing nutrition-specific programmes such as the Integrated Child Development Services (ICDS) scheme already use nutritional norms for the supplementary nutrition component and cost these accordingly. Several states also run canteens that provide affordable meals for guests, for example, Amma Canteens (Tamil Nadu), Indira Canteens (Karnataka), Indira rasois (now Annapurna rasois) (Rajasthan), or the Annapurna Canteens (Telangana). Estimates of CoHD can be used as an input into costing schemes that have in-kind food distribution as one component. The CoHD can also inform the setting of appropriate wages or cash transfers so that they are adequate to support healthy diets as well as non-food essential expenditures. In the context of India, with substantial diversity across regions and states in prices, incomes/wages and nutritional outcomes, local estimates of CoHD can help tailor programmes to better address nutritional security. It is also possible to estimate the cost of provisioning a healthy diet from the market for those households that receive in-kind transfers from the public distribution system (PDS). The PDS provides for 25 kilogram (kg) of wheat at ₹2 per kg and 10 kg of rice at ₹3 per kg, for an average per kg cereal cost of ₹2.3. Assuming a household of four persons, the daily requirement of cereals according to the ICMR-NIN FBDGs is roughly 1 kg per day (250 grams per person), which would be completely covered by the PDS allocation. The contribution of the cereal food group to the CoHD is approximately ₹6 (Figure 3). This would fall to approximately ₹0.5 (₹2.3 per day, for a total of four persons).

Limitations: While the CoHD does not rely on expensive and time-consuming household surveys, it does require a rich price series for several food groups. In India, we have the advantage of price data on a relatively large number of commodities; where this is not the case, other more parsimonious approaches such as the cost of dietary diversity (CoDD) that estimates the cost of meeting minimum dietary diversity recommendations, might prove easier to implement (Masters et al 2018).

The CoHD focuses on ingredients and does not incorporate additional costs of preparing the meal, including fuel and labour time for acquisition and preparation. The Thalinomics estimates of the cost of a thali included some of these components but had other limitations. Extending the CoHD to include these costs is straightforward but does add an additional step to the calculation, while also requiring this data to be available at the same frequency and for the same geographies.

Like any other price-based index, the CoHD uses representative prices as if they were unique and universal. Yet, there is rich literature that suggests that prices can vary widely based on the type of market, quantities purchased, quality of the commodity, or the time of purchase (Rao and Komala 1997; Anania and Nisticò 2014, for example). The underlying assumption is also that purchases are perfectly divisible so that an adult can purchase the recommended quantities and no more. There are naturally no adjustments for the quality of the produce, pesticide residues, and other toxins that can affect both price and nutritional values significantly.

Finally, the CoHD we present is for the urban centres available in the public domain. These centres are widespread but not representative of the districts they are situated in, nor do they

capture rural prices. It is possible to set up high frequency price data collection in specific sentinel rural sites to be able to generate the CoHD for a wider set of locations weekly. It is worth noting also that some of the data used in this paper are no longer available publicly, making future work in this area difficult to implement.

In Conclusion

The goal of this paper was to make a case for going beyond the CPI-F and for routinely generating the CoHD to be able to better track the cost of a healthy diet. Our comparative analysis shows that the CoHD and CPI-F are correlated but measure different things and that the rate of change in the CoHD often outstrips that of the CPI-F. Further, CoHD and CPI-F often move in opposite directions. Collectively, these results suggest that the CPI-F is not a good proxy for the CoHD. The CoHD can be calculated with little additional effort or cost using data that were available in the public domain until recently and can be presented alongside CPI-F to enable meaningful comparisons. We briefly discuss other approaches, such as the price of a thali, but note that although both the CoHD and the price of a thali attempt to cost diets rather than just food (as with the CPI-F), the significant conceptual differences between the two warrant a prioritisation of the CoHD.

The CoHD can be used in a variety of ways. A comparison of household food expenditure and the composition of the food expenditure basket with the CoHD helps assess whether households need to spend more to be able to consume healthy diets or whether expenditures can be reallocated to commodities that can contribute to healthy diets. The CoHD is also a useful metric to incorporate in programme design and costing, including for social protection programmes.

Although our illustration uses publicly available Indian data, our findings and proposal can be translated to other countries as well as subnational regions within countries. Several multilateral agencies have begun to systematically report the cost and affordability of healthy diets across countries.[9] Governments in developing countries, including Ethiopia, Nigeria, and Pakistan, have recently embarked on systematic efforts to publish CoHD routinely, offering useful examples of proactive surveillance of the cost of healthy diets.[10] India already has the capacity to undertake a similar effort. Further, such an effort is not only possible but also necessary in a context where these data on prices are no longer available publicly. It is imperative that the government takes the lead in publishing periodic reports on the costs of healthy diets, thereby offering a credible basis for understanding its key drivers and considering solutions to make it more affordable. This would be a simple but a significant step towards attaining healthy diets.

NOTES

1 For a detailed review of these measures, see Herforth et al (2022) among others.

2 The DCA commodities are rice, wheat (cereals); gram dal, arhar (tur), urad, moong, masoor (pulses); potato, onion, tomato (vegetables); milk (dairy); groundnut oil, mustard oil, vanaspati, soya oil, sunflower oil, palm oil (oils and fats); iodised salt, sugar, jaggery, and tea (miscellaneous); the NHB commodities are amla, apple, banana, *ber* (Indian jujube), grapes, guava, litchi, lime, orange, mango, papaya, pineapple, pomegranate, sapota (fruits); bitter gourd, brinjal, cabbage, cauliflower, okra, onion, peas, potato, tomato (vegetables); garlic, ginger, green chilly (miscellaneous) and the (DES-MoA commodities include atta (wheat flour), bajra, bread, jowar, maida, maize, ragi, rice, suji, wheat (cereals); arhar (tur), besan (gram flour), gram, masur, moong, urad, eggs, fish, chicken, meat (plant and animal-sourced proteins); butter, ghee, milk (dairy); apple, banana, coconut (fruits); brinjal, onion, potato, tomato (vegetables); coconut oil, gingelly oil, groundnut oil, mustard oil, vanaspati (oils and fats); biscuits, coffee, tea, black pepper, coriander, cumin seed, gur, red chillies, salt, sugar, turmeric (miscellaneous).

3 DES-MOA stops publicly reporting prices after March 2023.

4 Fruits too tend to have missing values, likely because many fruits are seasonal.

5 A common exception to this is calcium and vitamin B12. These generally come from non-dairy animal-sourced foods which are rarely represented in the least-cost baskets, given the lower relative costs of pulses.

6 Egg prices for a dozen are converted to grams, assuming one egg weighs 44 grams.

7 Thalinomics does not account for the full costs of meal preparation, which would also include, for example, costs of acquisition and the cost of time to prepare the meal.

8 We also use NSS–CES quantity weights at the district level to compute average prices of constituent commodities within a food group; these results are available on request.

9 The FAO's State of Food Insecurity and Nutrition in the World (SOFI), for example, report provides estimates of the number of people, across geographies, who cannot afford a healthy diet.

10 See, for example, the Nigerian government's report on the Cost of Healthy Diets, https://nigerianstat.gov.ng/elibrary/read/1241450 and Fatima et al (2024) for CoHD for Pakistan.

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