*Original Research Article*

### THE PRICE OF NUTRITION: CAN HOUSEHOLD FOOD BUDGETS SUPPORT A HEALTHY DIET?

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ABSTRACT

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| **Background:** Access to nutritious food remains a major public health challenge in urban low- and middle-income settings, where economic barriers limit dietary adequacy. Despite growing awareness about nutrition, many households continue to consume energy-dense but nutrient-poor diets due to price constraints and limited affordability.  **Aims:** To assess whether household food budgets are sufficient to support a balanced diet in low- and middle-income households in Kolkata using the Cost of the Diet (CotD) analysis.  **Methodology:** A convergent mixed-method approach was employed, combining a cross-sectional household survey with embedded qualitative interviews. The study was conducted in Khidirpur, Kolkata over a two-month period from February to March 2025. Seventy households were purposively selected, and data were collected using a structured questionnaire that captured income, food expenditure, household size, and frequency of food group consumption. Qualitative questions assessed perceptions of diet quality, affordability, and openness to nutrition interventions. A market survey was conducted to record local food prices for 65 commonly consumed items. These prices were analyzed using the **Cost of the Diet (CotD)** software developed by Save the Children to model the minimum cost of four diet types based on nutritional adequacy. Food expenditure was then compared with modeled costs to determine affordability. The affordability ratio and affordability gap were derived for each household using descriptive analysis. Variables assessed included total income (independent), household size, and affordability gap (dependent). Descriptive analysis was conducted in Microsoft Excel. No formal inferential tests were performed.  **Results:** The average household spent ₹5,535 (USD 66.61)/month on food. CotD analysis revealed the minimum cost of a nutritious diet for a 5-member household was ₹6,866 (USD 82.64)—representing 33.28% of monthly income, which exceeds average food budgets. Most households consumed cereals daily but had inadequate intake of fruits, vegetables, and proteins. Major barriers included high cost of nutritious foods (64.3%) and limited availability. A majority (82.9%) expressed interest in low-cost nutritious meal plans.  **Conclusion:**The cost of a balanced diet often exceeds household food budgets, leading families to rely on cheaper, nutrient-poor diets. These findings emphasize the need for targeted food subsidies, nutrition education, and policy-level interventions to improve affordability and ensure dietary adequacy. |

*Keywords: Food affordability Cost of the Diet (CotD), nutritional adequacy, food security, malnutrition, public health, economic constraints.*

INTRODUCTION

Access to a nutritionally adequate diet is essential for physical development, disease prevention, cognitive performance, and economic productivity. However, the affordability of healthy diets remains a major global concern, especially for low- and middle-income populations (Barosh et al., 2014; Darmon & Drewnowski, 2015). In India, where food expenditure accounts for over 40% of total household budgets among lower-income groups (Gupta et al., 2020), dietary diversity is frequently compromised by rising food prices, income volatility, and limited access to affordable nutrient-dense foods (Kachwaha et al., 2020).

Recent national estimates reflect the severity of the problem. The NFHS-5 reported that 35.5% of Indian children under the age of five are stunted, 32.1% are underweight, and 57.2% of women aged 15–49 are anaemic. These figures highlight a persistent nutrition crisis despite improvements in food production and policy interventions. Evidence shows that households with lower socioeconomic status consume significantly fewer animal-source proteins, fruits, and dairy products, instead depending on low-cost cereals and starch-based foods to meet daily energy requirements (Raghunathan et al., 2021a; Gupta et al., 2021). A study by Jahan, Mahbub, and Ahmed (2019) in Bangladesh similarly reported that 78.5% of pregnant women from low-income urban households experienced moderate to severe food insecurity, strongly associated with insufficient dietary intake of protein and micronutrients.

The Cost of the Diet (CotD) tool, developed by Save the Children, provides a standardized approach to estimate the minimum cost of a culturally acceptable and nutritionally adequate diet using locally available foods (Deptford et al., 2017a). In India, a notable study using CotD in Uttar Pradesh found that the cost of a fully nutritious diet for a household of five was approximately ₹8,260 per month. This cost exceeded actual food expenditure in 84% of surveyed households, with the affordability gap being more than 50% of income for the poorest groups (Kachwaha et al., 2020). Importantly, affordability is not merely a question of economic cost, but also of physical access and market availability. The Tasmanian Healthy Food Access Basket (HFAB) Survey (2014) highlighted that households in economically vulnerable regions often encounter compounded challenges of both high prices and limited availability of healthy food. Under nutrition and diet-related deficiencies continue to have long-term consequences. Poor diets contribute to stunting, weakened immunity, lower educational outcomes, increased susceptibility to chronic diseases, and reduced productivity (Mahapatra, 2021; Ruel & Alderman, 2013a). These nutritional deficits ultimately impair national development by straining healthcare systems and reducing human capital (Ford et al., 2017; James et al., 1997; Webb, 2010).

Khidirpur, located in southwestern Kolkata, was selected as the study site due to its high population density, socio-economic heterogeneity, and vulnerability to food insecurity. The locality includes large clusters of low- and middle-income households residing in rental tenements, slums, and subsidized housing. A significant proportion of residents rely on informal sector employment, including small-scale retail, daily wage labor, and port-related services, which makes their monthly income volatile and insufficient for stable food access. Despite the presence of markets and ration shops, food choices are heavily influenced by affordability rather than nutritional value. Dietary patterns observed in the area are cereal-dominated with poor protein and micronutrient intake, a trend also reflected in informal interviews and local community health data. These factors make Khidirpur an appropriate microcosm to study the affordability of balanced diets in rapidly urbanizing Indian contexts, where food security is increasingly shaped by structural economic limitations rather than availability alone.

Given these concerns, the present study applies the CotD analysis to low- and middle-income households in the Khidirpore locality of Kolkata. The research aims to evaluate food affordability in relation to household income, identify nutritional gaps, and explore the barriers households face in accessing a healthy diet. Findings are expected to inform food policy by highlighting the importance of targeted subsidies, nutrition-sensitive agricultural interventions, and cost-effective public nutrition strategies.

MATERIAL AND METHODS

**Study Design and Duration**

This study used a **convergent parallel mixed-methods design**, where quantitative and qualitative data were collected concurrently and analyzed separately before being integrated during interpretation. This approach enabled both numerical estimation and contextual understanding of the affordability of nutritious diets. The research was conducted in **Khidirpur, Kolkata**, over a two-month period from **February to March 2025**.

**Sampling and Participants**

A total of **70 households** were selected through purposive sampling based on the following inclusion criteria: permanent residency in Khidirpur, a monthly household income of INR ₹10,000–₹25,000, and informed verbal consent. This sample range was chosen to reflect the demographic and economic profile typical of low- and middle-income urban households (NSSO, 2023–24).

**Quantitative Data Collection**

Structured questionnaires, adapted from the National Sample Survey Office's Household Consumption Expenditure Schedule (2023–24), were used to collect data on:

* Household income and food expenditure
* Family size and demographic composition
* Frequency of food group consumption
* Primary purchasing sources and food access behavior

Responses were numerically coded and analyzed using Microsoft Excelto produce descriptive statistics such as means, ranges, and frequency distributions.

**Qualitative Data Collection**

Open-ended questions embedded in the household survey explored:

* Perceptions of dietary quality
* Awareness of nutrition requirements
* Barriers to accessing balanced diets
* Preferences and openness to low-cost nutritious meals

Responses were transcribed and manually categorized into thematic codes in Excel. Categories included “cost constraints,” “market access,” “health knowledge,” and “food preference.” Frequencies of recurring themes were calculated to describe dominant perceptions. No software-based textual analysis tools were used.

**Market Survey and Diet Cost Modeling**

A concurrent **market survey** was conducted to record the prices of **98 locally available food items** in wet markets and neighborhood grocery stores. These prices were entered into the **Cost of the Diet (CotD) software**, developed by Save the Children, which calculates the least-cost diet that meets household-level energy and nutrient requirements using local foods (Deptford et al., 2017a).

CotD modeled the following diet types:

1. Energy-only diet
2. Macronutrient-sufficient diet
3. Fully nutritious diet (including micronutrients)
4. Culturally acceptable nutritious diet

Modeling was based on a reference five-member household using **FAO/WHO Recommended Nutrient Intake values** and consumption patterns relevant to the urban Indian setting.

**Affordability Assessment and Data Analysis**

Diet affordability was assessed using:

* **Affordability Ratio (%)** = (Cost of Nutritious Diet ÷ Monthly Income) × 100
* **Affordability Gap (INR)** = Cost of Nutritious Diet − Actual Food Expenditure

A household was considered “unable to afford a nutritious diet” if its affordability ratio exceeded 30% of monthly income, in line with international standards on dietary affordability (Herforth et al., 2020). Studies in India have confirmed that this threshold is applicable in rural and urban low-income contexts, where food often competes with other essential expenditures (Raghunathan et al., 2021a).

All data analysis was conducted using Excel, and only **descriptive statistics** were employed. The study did **not use any inferential statistical tests** such as t-tests, correlation, or regression due to its small sample size and purposive sampling method. Observed differences across income groups and affordability outcomes were described narrative based on identified trends

The study was approved by the Institutional Ethics Committee. All participants provided **informed verbal consent** after being briefed on the study's purpose and confidentiality. No identifying data were recorded. Data management adhered to established academic research ethics protocols.

RESULTS

Table 1 presents summary statistics of monthly income and food expenditure for the 70 households surveyed in Khidirpur, kolkata. The average monthly income was ₹20,614.29 (≈ ****$247.82 usd****, using ₹1 = $0.012 USD), while the mean monthly food expenditure was ₹5,535 (≈ ****$66.42 USD****), accounting for approximately 26.8% of income. However, ****43% of households spent less than ₹4,000 (~$48 USD)**** on food, indicating significant constraints in achieving dietary adequacy within current income levels.

****Table 1**:** Household income and food spending summary (n = 70)

|  |  |  |
| --- | --- | --- |
| Metric | Value (INR) | Value (USD) |
| Mean Monthly Income | ₹20,614.29 | $247.82 |
| Median Monthly Income | ₹19,000.00 | $228.00 |
| Mean Food Expenditure | ₹5,535.00 | $66.42 |
| % Of Income Spent On Food | 26.8% | \_ |
| House Holds With Spending < ₹4,000 | 43.0% | \_ |

**Table 2: Frequency of consumption of different food groups among sample population (n=70)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| How often does your family consume the following food groups? | | | | |
| **Food Groups** | **Daily** | **3-5 Times A Week** | **1-2 Times A Week** | **Rarely** |
| **Cereals And Grains** | 56 | 4 | 15 | - |
| **Pulses And Legumes** | 12 | 19 | 38 | 1 |
| **Vegetables** | 13 | 32 | 27 | - |
| **Fruits** | 6 | 7 | 23 | 34 |
| **Milk And Dairy Product** | 7 | 15 | 45 | 1 |
| **Meat ,Fish And Egg** | 9 | 5 | 53 | 2 |
| **Oil And Fats** | 47 | 20 | 1 | - |
| **Processed Food** | 8 | 33 | 26 | 6 |
| **Sugary Food** | 16 | 35 | 17 | 6 |

Daily consumption of cereals and grains was nearly universal (80%), reflecting a carbohydrate-heavy dietary structure. However, protein and micronutrient-rich food groups were consumed far less frequently. Only 17% of households consumed pulses daily, while more than 48% consumed fruits rarely or not at all. Daily intake of milk and dairy products was reported by just 10% of families, and only 12.9% consumed animal-source foods such as meat, fish, or eggs daily. In contrast, processed foods and sugary snacks were consumed 3–5 times a week by nearly half of the households, suggesting a drift toward energy-dense, nutrient-poor dietary patterns.

**Table 3: nutritional adequacy of their family's diet of the sample population (n=70)**

|  |  |  |
| --- | --- | --- |
| Do you think your family's current diet is nutritious? | | |
| Yes | Somewhat | No |
| 6 | 42 | 18 |

Household perceptions mirrored these findings: only 8.6% of respondents believed their diet were nutritious, while 57.1% considered it only “somewhat” nutritious, and 31.4% admitted it was not nutritious at all. These self-assessments highlight a growing awareness of dietary insufficiency, even in the absence of formal nutrition education

**Table 4: Barriers to Maintaining A Nutritious Diet (n=70)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| What are the main barriers to eating a more nutritious diet? | | | | |
| High cost of healthy food | Limited availability of fresh food | Lack of knowledge about nutrition | Preference for fast/processed foods | Other reasons |
| 38 | 8 | 8 | 1 | 4 |

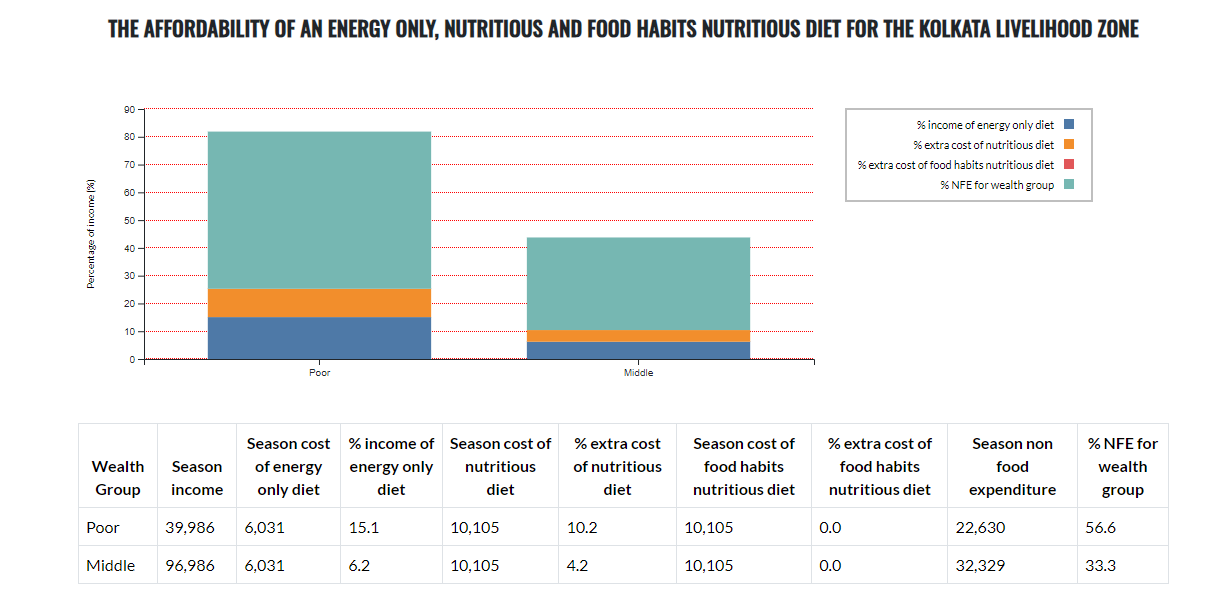
**Table 5: Demand for affordable, nutritious meal plans (n=70)**

|  |  |  |
| --- | --- | --- |
| Would you be interested in receiving a low-cost, nutritious meal plan based on your budget? | | |
| Yes | Maybe | No |
| 56 | 12 | - |

**Table 6: Dietary preferences if they were more affordable (n=70)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Which foods would you be willing to include more in your diet if they were affordable? | | | | | |
| Seasonal vegetables | Whole grains | Pulses & legumes | Dairy products | Eggs & lean meat | Fruits |
| 9 | 1 | 16 | - | 22 | 23 |

When asked about barriers to healthier eating, **64.3% of respondents** identified **high food costs** as the primary constraint. **Limited availability (11.4%)** and **lack of nutrition knowledge (11.4%)** were also cited as significant but less frequent challenges (**Table 4**). Despite these constraints, the majority of households demonstrated a strong openness to dietary improvement: **82.9% expressed willingness** to adopt low-cost, nutritious meal plans if made accessible (**Table 5**). When asked about food preferences that they would include if affordability improved, households favored **protein- and vitamin-rich options**, such as **eggs and lean meats (40%)**, **pulses and legumes (22.9%)**, and **fruits (24.3%)** (**Table 6**). These preferences reflect both awareness of dietary value and unmet nutritional demand among low- and middle-income families in Khidirpur.



X

Y

The X- axis – Economic groups

The Y- axis –Percentage of income

**Figure 1: Proportion of monthly household income required to afford CotD-modeled diets (n = 70), based on food prices recorded during the survey period (February–March 2025). Horizontal dashed line indicates the 30% affordability threshold. USD equivalents are provided using ₹1 = $0.012.**

**Figure 1** illustrates the proportion of monthly household income required to afford each of the four diet models generated using CotD software. The models are based on local food prices collected during the **study season (February to March 2025)** in Khidirpur, which corresponds to late winter and early spring. This seasonal context is relevant as it influences the availability and pricing of perishable items like vegetables, fruits, and dairy.

The **energy-only diet** cost ₹3,088 (≈ **$37.05 USD**) and required **15% of monthly income** on average. The **macronutrient-sufficient diet** cost ₹4,915 (≈ **$58.95 USD**), while the **fully nutritious diet**—which meets all essential macro- and micronutrient requirements cost ₹6,866 (≈ **$82.39 USD**). This cost equated to **33.28% of average monthly income**, thereby **exceeding the 30% affordability threshold** (Herforth et al., 2020; Raghunathan et al., 2021a).

Affordability ratios were notably higher for households earning below ₹15,000/month, where the nutritious diet consumed more than **45% of income**. The figure also demonstrates that even the culturally acceptable diet, though lower in cost than the fully nutritious model, still exceeded the affordability range for a significant portion of the study population.

The public distribution system (PDS) and nutrition programs like ICDS and MDM while essential for calorie provision were found grossly inadequate for ensuring diet quality. These schemes focused heavily on cereal staples and lacked protein, dairy, or fruit components. School meal programs suffered from infrastructural weaknesses and inconsistent food safety standards.

**Table 7: Inexpensive sources of essential nutrients, for a low cost nutritious diet with percentage of nutrient requirements met.(Based on CotD analysis)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Food list** | **% Energy** | **% Protein** | **% Fat** | **%**  **Vit A** | **%**  **Vit C** | **%**  **Vit B1** | **%**  **Vit B2** | **% Niacin** | **%**  **Vit B6** | **%**  **Folic Acid** | **%**  **Vit B12** | **% Calcium** | **% Iron** | **% Zinc** |
| **Jaggery ,Sugarcane Solid** | 8.3 | 0.3 | 0.1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 4.1 | 2.2 | 0.4 |
| **Mustard Oil** | 13.1 | 0 | 61.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0.1 | 0 | 0 | 0 |
| **Raw Drumstick Leaf** | 0 | 0.1 | 0 | 3.3 | 2.5 | 0.1 | 0.2 | 0.1 | 0.5 | 0.2 | 0 | 0.2 | 0 | 0 |
| **Spinach Leafs** | 4.5 | 18.4 | 2.4 | 83.8 | 82.7 | 26.7 | 55 | 21.2 | 76.1 | 82.6 | 0 | 55.4 | 45.4 | 29.5 |
| **Whole Fat Buffalo Milk** | 5.9 | 7 | 18.1 | 2.8 | 4.1 | 3.7 | 14.9 | 0.5 | 2.2 | 1 | 49.1 | 25 | 1.4 | 2.4 |
| **Raw Chicken Liver** | 0.3 | 1.6 | 0.6 | 10.3 | 0 | 1.2 | 6.2 | 2.4 | 4.1 | 5.1 | 46.2 | 0.1 | 8.6 | 1.4 |
| **Dried Pea** | 17.9 | 37.8 | 4.7 | 0.2 | 0 | 34.8 | 8.3 | 27.8 | 6.6 | 5.2 | 0 | 8.5 | 16.8 | 35.7 |
| **Potato** | 0.4 | 0.3 | 0 | 0 | 2.3 | 0.6 | 0.1 | 0.7 | 2 | 0.1 | 0 | 0 | 0.1 | 0.2 |
| **Rice, Flaked** | 9.2 | 5.3 | 1.2 | 0 | 0 | 7.3 | 1.5 | 9.5 | 0 | 0 | 0 | 1.3 | 11.2 | 6.5 |
| **Rice, Puffed, Salted** | 20 | 11.6 | 0.2 | 0 | 0 | 7.3 | 1.8 | 18 | 0 | 1.8 | 0 | 1.1 | 2.4 | 8.7 |
| **Wheat Flour** | 16.8 | 16 | 3.3 | 0 | 0 | 8.4 | 3 | 17.7 | 7.7 | 2.8 | 0 | 1.3 | 11.8 | 14 |

**Table 7** presents the list of inexpensive foods identified through **Cost of the Diet (CotD) analysis** as key contributors to meeting essential nutrient requirements at minimal cost. These foods were selected from among the 98 locally available items surveyed in Khidirpur markets and represent the most cost-effective options for meeting dietary adequacy.

The table illustrates that **certain green leafy vegetables** such as **spinach and amaranth leaves** are highly affordable sources of **vitamin A and vitamin C**, contributing over **80% of the daily requirement per 100g**. Similarly, **chicken liver** was identified as a low-cost yet nutrient-dense food, supplying **over 50% of the daily vitamin B12 requirement**, along with significant contributions to **iron and protein**. These findings align with earlier Indian CotD applications in Uttar Pradesh, where nutrient-dense items such as organ meats and seasonal greens were prioritized in cost-efficient diets (Kachwaha et al., 2020).

**Mustard oil**, widely used in West Bengal, emerged as an inexpensive source of **essential fats**, covering over **65% of fat requirements** in typical meal plans. **Groundnuts and roasted chickpeas** were also highlighted for their affordability and contribution to **protein, iron, and energy** requirements, making them viable plant-based alternatives in vegetarian households.

The percentages shown reflect **how much of the Recommended Nutrient Intake (RNI)** could be achieved per 100g serving of each food, considering nutrient density and local price per unit. These foods formed the core of the modeled low-cost nutritious diet in CotD and demonstrate that while **some affordable nutrient sources exist**, they must be properly combined and consumed in sufficient quantities to meet full dietary adequacy.

### ****DISCUSSION****

This study provides important insights into how urban low- and middle-income households navigate the challenges of food affordability and dietary decision-making in resource-constrained environments. The study population, primarily engaged in informal labor sectors such as domestic work, street vending, and port-related daily wage employment, represents a group particularly vulnerable to income instability. These households face multiple systemic constraints including fluctuating earnings, persistent food price inflation, and limited access to formal safety nets that significantly influence their food acquisition strategies. Prior studies have similarly demonstrated that reliance on informal employment reduces dietary resilience and exacerbates vulnerability to nutrient deficiencies (Ford et al., 2017; Eng et al., 2022; Aziz et al., 2021).

The average household size ranged from four to six members, with nearly one-third comprising a single income-earner supporting multiple dependents. This demographic composition results in lower per capita food expenditure and reinforces dietary trade-offs in favor of energy-dense but nutrient-poor staples. Such patterns are well-documented in the literature, particularly in low-income contexts where larger households prioritize caloric sufficiency over dietary diversity due to budgetary constraints (Gupta et al., 2020; Jahan et al., 2019). These characteristics support the present study’s findings that while households demonstrated an understanding of healthy dietary practices, actual food purchasing behavior remained largely constrained by economic and structural realities.

Qualitative responses in this study reveal that perceptions of healthy eating are rooted in real-life affordability challenges rather than lack of awareness. Although a majority of respondents identified high food prices as the main barrier to improving diet quality, many articulated a desire to include nutrient-dense foods such as eggs, pulses, lean meats, and fruits indicating that nutrition knowledge is present but economically inaccessible. This reflects the broader regional experience in South Asia, where undernourishment persists despite awareness, due to macroeconomic instability and food system inequities (Aziz et al., 2021; Marty et al., 2015). Respondents’ openness to adopting low-cost, nutritious diets aligns with the findings of Kachwaha et al. (2020) and Kuri et al. (2024), who demonstrated that affordability rather than availability or acceptability is often the principal determinant of dietary adequacy among low-income populations.

The food environment in Khidirpur introduces further complexity. Respondents primarily rely on wet markets, subsidized ration shops, and informal vendors channels that often offer low diversity and limited access to fresh perishables. Irregular income patterns discourage bulk buying and promote daily low-volume purchases, which limits the feasibility of nutritionally balanced meal planning. Similar patterns have been observed in low-income settings across Asia and Africa, where the fragmentation of food systems, poor storage infrastructure, and high perishability restrict meaningful dietary improvements (Rahmawati et al., 2025; Ruel & Alderman, 2013a; Belayneh et al., 2020).

Crucially, the present findings challenge commonly held assumptions that cultural norms or lack of education drive poor dietary behavior among low-income groups. Instead, they confirm that affordability is the dominant constraint exacerbated by demographic pressures and the structural limitations of informal food economies. The evidence presented here underscores that knowledge of healthy eating exists, but financial agency to act on that knowledge does not. These findings reinforce calls for integrated policy frameworks that address both affordability and food system inefficiencies, as emphasized by Kuri et al. (2024), Darmon and Drewnowski (2015), and Herforth et al. (2020).

Conclusion

This study provides compelling evidence that economic affordability is the dominant barrier to achieving a nutritionally adequate diet among low- and middle-income households in urban India. Despite sufficient food availability and basic nutrition awareness, financial limitations prevent households from accessing protein- and micronutrient-rich foods essential for health and development. The observed affordability gap underscores that dietary inadequacy in such contexts is not a matter of choice or ignorance, but of constrained agency shaped by systemic inequities in income and food pricing.

The application of the Cost of the Diet (CotD) methodology, combined with household-level data, demonstrates that even basic nutritious diets remain financially inaccessible for a significant portion of the population. These findings reinforce the urgent need for nutrition-sensitive policy frameworks that move beyond education campaigns to address the structural drivers of food insecurity. This includes scaling up targeted subsidies for nutrient-dense foods, improving the reach of public food programs, and ensuring price stability in informal food markets.

Addressing food affordability at the intersection of income inequality and nutrition policy is not only a matter of social justice but a public health imperative. Interventions that fail to consider the economic realities of vulnerable households risk exacerbating dietary inequities and undermining national nutrition goals. As urbanization and inflation continue to reshape food environments, affordability must be central to future nutrition strategies.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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