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# Evaluating nutrient claim accuracy of packaged food products in Indian E-commerce platforms

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## Abstract

**Background** As e-commerce expands, an increasing number of consumers are acquiring food products online, many of which make nutrient claims. Nevertheless, the veracity of these claims and their adherence with the Food Safety and Standards Authority of India (FSSAI) regulations remain underexplored. This study aims to evaluate the accuracy of nutrient claims on Indian e-commerce platforms concerning FSSAI regulations.

**Methods** A total of 105 food products from Indian e-commerce platforms were analysed for claim accuracy with FSSAI regulations. Data was collected and organized using Microsoft Excel, and basic statistical analyses were performed using R Software.

**Results** Among 105 products the price of products ranged from Rs. 10 to Rs. 698, with a mean price of Rs. 229.57. The analysis of nutritional claims on food products revealed that 71.4% of the claims were accurate, while 28.6% were inaccurate, highlighting a significant portion of misleading information. However, certain claims such as "Rich in fibre" and "Rich in calcium" were frequently misleading, with the former showing 88% inaccuracies and the latter exhibiting 100% inaccuracies.

**Conclusion** This study reveals significant inaccuracies in online nutrient claims, highlighting a critical gap in regulatory enforcement. Our findings underscore the urgent need for stricter guidelines, improved digital surveillance, and consumer education to safeguard consumer health and ensure transparency in India's rapidly expanding e-commerce food sector. This research contributes novel insights into claim accuracy dynamics across price points and categories in an under-researched market.

**Keywords** E-commerce, Food labels, FSSAI, Nutrient claims, Nutritional accuracy

## 1 Introduction

The accelerated growth of e-commerce and digital food retail is fundamentally transforming consumers' engagement with food markets, reshaping how food is accessed, evaluated, and purchased globally [36]. In India, this transformation is most pronounced given rapid internet penetration, burgeoning smartphone usage, and an expanding middle class, driving the e-grocery sector to an anticipated Compound Annual Growth Rate (CAGR) of over 37% from 2021 to 2026 [13, 42, 53, 55]. These trends mirror global trajectories, where digital food retail, including online groceries and delivery apps, not only caters to demands for convenience and variety but also alters the existing food environment—escalating both the accessibility of ultra-processed foods and the opportunity for digitally mediated nutrition interventions [24, 27]. This evolving landscape thus brings forth marked public health opportunities and risks, warranting urgent scholarly and regulatory attention [31, 78].

Of particular concern is the increasing prevalence and complexity of nutrient and health claims displayed on digital food retail platforms. Such claims—ranging from "low fat" to "high protein" and "sugar-free"—have a demonstrable impact on consumer perceptions, purchase behaviors, and ultimately dietary patterns [1, 28, 68]. Yet, international evidence consistently shows that many products touting nutrition or health claims are, paradoxically, high in critical nutrients of concern, potentially misleading consumers and undermining dietary health [21, 28, 68]. For instance, in diverse settings, a notable proportion of foods bearing "healthy" claims are not in compliance with recommended nutritional profiles, thereby increasing the consumer purchase and risking the propagation of non-communicable diseases (NCDs) such as obesity, diabetes, and cardiovascular disorders [21, 28, 48, 60, 68]. Recent systematic reviews also suggest that while nutrition and health claims can facilitate healthier food choices when scientifically substantiated and paired with clear labeling, they often increase perceptions of healthfulness irrespective of true nutritional quality, signalling a need for effective regulatory guardrails and interpretive labelling [45].

In India's fast-evolving digital food market, regulatory oversight is anchored by the Food Safety and Standards Authority of India (FSSAI), which has established guidelines for the veracity and substantiation of nutrient content claims, including recent efforts toward mandatory front-of-package labeling (FoPL) [9, 60]. FoPL formats—such as Health Star Ratings (HSR), Multiple Traffic Light labels (MTL), Daily Intake Guides (DIG), and warning labels are widely studied and increasingly adopted worldwide for their capacity to enable rapid, informed food choices, especially in digital retail contexts[9, 26, 27, 56]. Mandatory schemes, in particular, are associated with both consumer benefit (improved understanding and healthier choices) and industry reformulation of products toward better nutritional profiles [26, 27, 45]. However, compliance remains a challenge: studies indicate that a significant fraction of packaged foods marketed online in India and in comparable markets fail to adhere to regulatory standards or leverage claims in a way that may confound or mislead consumers [1, 9, 60]. Additionally, digital food retail opens new avenues for the amplification or distortion of claims, given the dynamic nature of online platforms and the opportunity for personalization and targeted marketing [1, 9]. With the rise of digitalization and convenience, many consumers now purchase food products online,however, vulnerable populations—particularly those with limited digital and nutritional literacy—are at greater risk of being misled and experiencing negative health outcomes [9, 15].

This context underscores the criticality and urgency of evaluating the authenticity and public health implications of nutrient claims on Indian e-commerce platforms. Given mounting evidence around low compliance, consumer misunderstanding, and the potential for industry manipulation of labeling regulations, rigorous research examining the reliability of online nutrient claims against FSSAI standards is essential [35, 37, 46]. Such research not only informs targeted policy refinements, enforcement strategies, and educational interventions but is vital to safeguarding public health amidst India's ongoing nutrition transition and the dual burdens of undernutrition and NCDs [60], Ramachandran, n.d.; [79].

## 2 Methodology

### 2.1 Study design

We conducted a comprehensive cross-sectional content analysis of the e- commerce food products between June and November 2024, examining a total of 39,606 food products available on major e-commerce platforms in India. The primary aim of this research is to evaluate the accuracy and compliance of nutrient claims made by food products listed on Indian e-commerce platforms with respect to the guidelines and regulations set forth by the Food Safety and Standards Authority of India (FSSAI). This study also seeks to explore the influence of product pricing on the accuracy of these nutrient claims and identify emerging trends in nutrient claims across various food product categories, thereby uncovering patterns related to the types of claims made and their alignment with regulatory standards. The food products were selected from various categories, including Cereals, Ready to eat mixes, Biscuits and cookies, Nuts and seeds and dairy products. Our analysis involved evaluating product descriptions, labelling practices, pricing trends, customer reviews, and promotional content to gain insights into how these products are positioned to consumers. We assessed the presence of nutritional claims, such as High in Fibre, High Protein, Trans fat free etc. and examined the alignment of these claims with actual product ingredients and nutritional content.

### 2.2 Sampling strategy and justification

To ensure a robust and representative sample of packaged food products available to Indian consumers, we conducted a comprehensive multi-step sampling process across three major e-commerce grocery platforms: Amazon Fresh, Flipkart Grocery, and BigBasket. These platforms were deliberately chosen due to their wide market reach, popularity, and consumer trust, making them among the most influential digital food retailers in India [2, 61, 73]. Their extensive product offerings, geographic reach, and consistent consumer engagement made them ideal for capturing the breadth of online food purchases and for ensuring diversity and accessibility in the selected product pool.

The sampling process began with the identification of 39,606 food products through targeted category searches across the three platforms. The search terms included popular food categories such as breakfast cereals, biscuits, cookies, dairy products, ready-to-eat mixes, nuts, seeds, and oils—categories purposefully selected due to their high frequency of consumption and prevalence of nutrient claims [32, 33],Iyer, n.d.; [51]. To refine this initial pool, we applied a price filter of ₹10 to ₹700, a range that reflects typical consumer spending patterns and focuses on commonly purchased, affordable products [20, 43, 72]. This step reduced the product pool to 17,956 items. Next, to ensure product credibility and quality, we filtered for items with a minimum customer rating of 3.5 out of 5 [2], which yielded 10,245 products. A further criterion required each product to have at least 10 customer reviews [2], signalling active consumer engagement, narrowing the pool to 2791 products.

These 2791 products were then merged, and duplicates (products listed on multiple platforms) were removed, resulting in 999 unique items. From this, we conducted an information completeness screening to ensure all products had clear, accessible nutritional labels and a verifiable ingredient list, leading to 408 products being retained. Finally, the sample was further filtered to include only those products that carried explicit nutrient content claims as specified by FSSAI, such as "high protein," "low fat," or "rich in fiber," resulting in a final analytical sample of 105 unique products (Fig. 1). This multi-layered filtration process ensured that the final sample was not only representative of the online Indian grocery market but also comprised products with sufficient data for meaningful evaluation of claim accuracy and FSSAI compliance.

### 2.3 Inclusion criteria

The study focused on products from categories such as breakfast cereals, biscuits, cookies, ready-to-eat mixes, dairy products, nuts, seeds, and oils, which were purposively

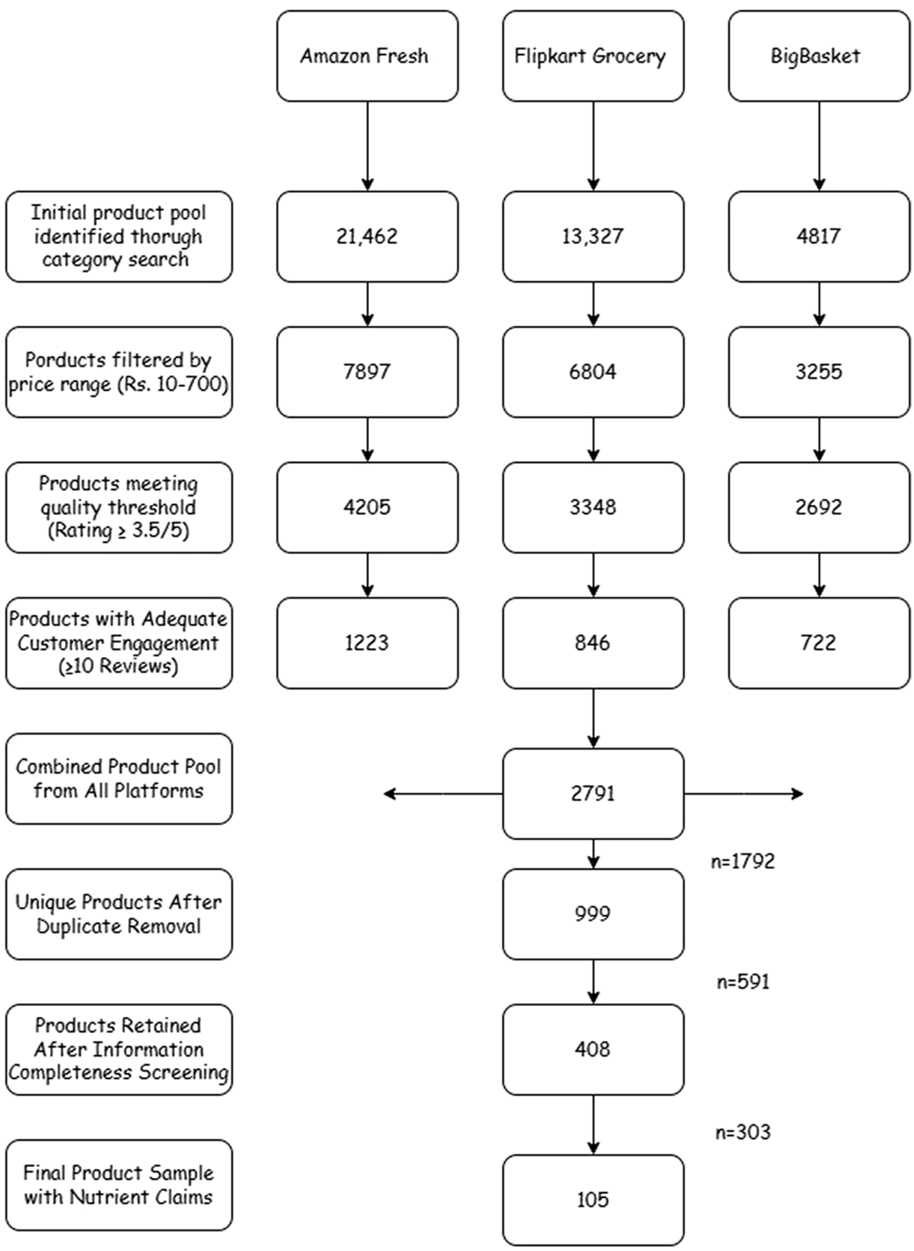


**Fig. 1** Flowchart depicting the systematic selection process of products from three e-commerce platforms

selected due to their widespread consumption in India. Products priced between Rs. 10 and Rs. 700 were included to ensure the sample represented affordable, commonly purchased food items, reflecting typical consumer spending patterns. Only products with customer ratings of $\geq$ 3.5/5 and at least 10 reviews were chosen, as these were considered popular and trusted by consumers. Additionally, products with clear and complete nutrient labels were selected to facilitate the evaluation of nutrient claims (e.g., "high protein," "low fat," and "high fiber") in compliance with FSSAI standards.

### 2.4 Exclusion criteria:

The exclusion criteria for the study included products that are infrequently consumed, those lacking a complete nutrient label, which would hinder the evaluation of nutrient claims, and products without specific nutrient claims (e.g., "high fiber" or "low fat"), as the focus of the study was on assessing the accuracy of such claims. Additionally, multiple variations of the same product (e.g., different flavors or packaging sizes) were excluded, as well as products with fewer than 10 customer reviews or those with ratings below 3.5/5. Products priced below Rs. 10 or above Rs. 700 were also excluded to ensure the sample remained within the targeted range of typical consumer spending.

### 2.5 Data extraction and analysis

Data for the study was collected under several key headings, including price, e-commerce source, star rating, product category, claim type and description, nutritional content, relevance to the claim, and compliance status. While evaluating fiber-related claims, we considered 'high' and 'rich' as largely interchangeable, as per FSSAI's labeling regulations. However, due to noticeable differences in usage patterns observed on product labels, we analyzed 'High in fibre' and 'Rich in fibre' separately to capture any variation in claim accuracy (Table 1).

The nutrient claims, ingredient list, and labeling of each product were verified for accuracy according to the official FSSAI guidelines, as presented in Table 1. The compliance assessment was conducted by two independent evaluators (SS and SC) to ensure consistency and mitigate bias. The determination of a third reviewer (BP) was considered conclusive in the event of any disputes. This consensus method was employed to ensure interrater reliability in the evaluation process [14].

This information was organized using Microsoft Excel and analyzed using R Studio statistical software. Basic statistical analyses were performed, including descriptive statistics (mean, median, standard deviation, and range) for product price and consumer ratings. Furthermore, the analysis determined the percentage of accurate and inaccurate nutrient claims across the entire sample and for specific claim types. Fisher's exact test was utilized to assess the statistical significance of the correlation between claim accuracy and product price. Additionally, a category-wise analysis of inaccurate claims was performed. The collected data allowed for a detailed evaluation of product pricing, consumer ratings, nutritional claims, and compliance with FSSAI standards.

**Table 1** FSSAI criteria for nutrient claims

| S. No | Nutrient/component | Claim | Conditions |
|---|---|---|---|
| 1 | Energy/ calorie | Low | Not more than **40 kcal** per 100 g for solids or **20 kcal** per 100 ml for liquids |
| | | Free | Not more than **4 kcal** per 100 ml for liquids |
| 2 | Fat | Low | Not more than **3 g** of fat per 100 g for solids or **1.5** g of fat per 100 ml for liquids |
| | | Free | Not more than **0.5 g** of fat per 100 g for solids or 100 ml for liquids |
| 3 | Cholesterol | Low | Not more than **20 mg** cholesterol per 100 g for solids and **1.5** g saturated fat per 100 g for solids or **10 mg** per 100 ml for liquids and **0.75** g of saturated fat per 100 ml for liquids and in either case must provide not more than **10%** of energy from saturated fat |
| | | Free | Not more than **5 mg** cholesterol per 100 g for solids or 100 ml for liquids. Additionally, the food shall contain no more than **1.5 g** saturated fat per 100 g for solids or **0.75** g of saturated fat per 100 ml for liquids and in either case must provide not more than **10%** of energy from saturated fat |
| 4 | Trans-fat | Free | The food contains **less than 0.2 g** trans-fat per 100 g or 100 ml of food |
| 5 | Omega 3 fatty acids | Source | The product contains: **at least 0.3 g alpha-linolenic acid** per 100 g and per 100 kcal, or **at least 40 mg of the sum of eicosapentaenoic acid and docosahexaenoic acid** per 100 g and per 100 kcal |
| | | High | The product contains: **at least 0.6 g alpha-linolenic acid** per 100 g and per 100 kcal, or **at least 80 mg of the sum of eicosapentaenoic acid and docosahexaenoic acid** per 100 g and per 100 kcal |
| 6 | Sugars | Low | The product contains not more than 0.5 g of sugars per 100 g for solids or 2.5 g of sugars per 100 ml for liquids |
| | | Free | The product contains not more than 0.5 g of sugars per 100 g for solids or 100 ml for liquids |
| 7 | Protein | Source | 10% of RDA per 100 g for solids or 5% of RDA per 100 ml for liquids or 5% of RDA per 100 kcal |
| | | Rich/high | 20% of RDA per 100 g for solids or 10% of RDA per 100 ml for liquids or 10% of RDA per 100 kcal |
| 8 | Vitamin (s) and/or minerals (s) | Source | The food provides at least **15%** of RDA of the vitamin/mineral per 100 g for solids or **7.5%** of RDA of the vitamin/mineral per 100 ml for liquids |
| | | High | The food provides at least **30%** of RDA per 100 g for solids or **15%** of RDA per 100 ml for liquids |
| 9 | Dietary fiber | Source | Product contains at least **3 g** of fibre per 100 g or 1.5 g per 100 kcal |
| | | High or rich | The product contains at least **6 g** per 100 g or 3 **g** per 100 kcal |

**Table 2** Descriptive statistics of the price ranges and ratings of selected food products

| Variables | Mean | Median | Standard Deviation | Range |
|---|---|---|---|---|
| Price | 229.573 | 199 | 163.6 | 10 to 698 |
| Ratings | 4.16 | 3.23 | 0.67 | 3.5 to 5 |

## 3 Results

### 3.1 Overview of product evaluation

The price of products ranged from Rs. 10 to Rs. 698, with a mean price of Rs. 229.57(SD = 163.60). The consumer star ratings varied between 3.5 and 5, with an average rating of 4.16 (SD = 0.67) (Table 2).

### 3.2 Nutritional claims compliance report

Claims related to "Source of protein" and "Low calories" showed perfect accuracy, with all claims being correct. Similarly, claims like "High in fibre", "Rich in protein", and "Source of calcium" demonstrated relatively high accuracy rates, typically above 80%. Some claims show mixed accuracy, such as "High in fibre" (89% accurate) and "High protein" (82% accurate). However, certain claims such as "Rich in fibre" and "Rich in calcium" were frequently misleading, with the former showing 88% inaccuracies and the latter exhibiting 100% inaccuracies. (Table 3).

### 3.3 Impact of price points on claim accuracy

The product prices were classified into three distinct price categories based on the accuracy of nutrient claims, with percentiles (25th, 50th, and 75th) calculated. Products priced below the first percentile were classified as "Low," while those priced between the first and third percentiles were classified as "Medium." Products priced above the third percentile were classified as "High." This analysis found patterns of accuracy that were consistent across price ranges, enabling a comparative assessment of the compliance rates of low, medium, and high-priced products.

The finding indicated that the high-priced category exhibited a higher claim accuracy rate of 48% than the other two categories. Fisher's exact test demonstrated a statistically significant correlation between claim accuracy and product price ($p = 0.0138$). This implies that products priced higher are more likely to comply with compliance standards and make accurate claims, while those priced lower are more likely to make inaccurate claims. This relationship underscores the potential impact of price on the accuracy of claims and adherence to regulatory requirements, with lower-priced products potentially being at a higher risk of regulatory violations and inaccuracies. (Fig. 2).

**Table 3** Nutritional claims on foods products

| Claim | Accurate claims n (%) | Inaccurate claims n (%) | Total |
|---|---|---|---|
| High in Fibre | 16 (89) | 2 (11) | 18 (100) |
| Rich in Fibre | 2(12) | 15(88) | 17 (100) |
| High Protein | 14(82) | 3(18) | 17 (100) |
| Rich in Protein | 9(90) | 1(10) | 10(100) |
| Source of Protein | 6(100) | 0(0) | 6 (100) |
| Trans fat free | 5(71) | 2(29) | 7(100) |
| Source of Fibre | 4(80) | 1(20) | 5(100) |
| Low fat | 3(75) | 1(25) | 4(100) |
| Rich in calcium | 0(0) | 3(100) | 3(100) |
| Cholesterol free | 2(67) | 1(33) | 3(100) |
| Source of calcium | 2(100) | 0(0) | 2(100) |
| Low calories | 2(100) | 0(0) | 2(100) |
| High/ rich in omega 3 | 2(100) | 0(0) | 2(100) |
| Source of Iron | 2(100) | 0(0) | 2(100) |
| Sugar free | 1(100) | 0(0) | 1(100) |
| Fat free | 1(100) | 0(0) | 1(100) |
| High in calcium | 1(100) | 0(0) | 1(100) |
| Source of Vitamin C | 1(100) | 0(0) | 1(100) |
| Rich in Vitamin E | 0(0) | 1(100) | 1(100) |
| High in iron | 1(100) | 0(0) | 1(100) |
| High in Vitamin C | 1(100) | 0(0) | 1(100) |
| **Total** | **75(71.4)** | **30(28.6)** | **105(100)** |

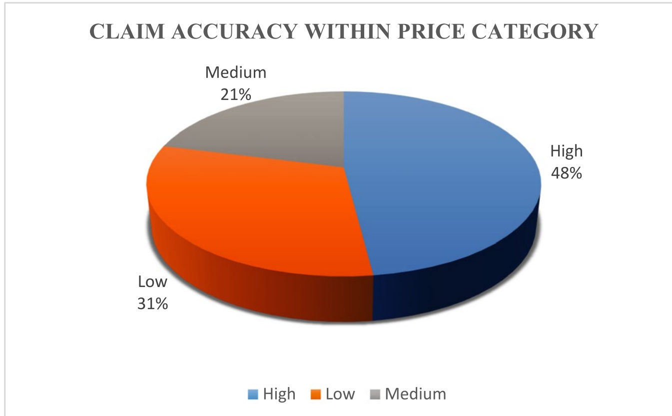


**Fig. 2** Claim accuracy within price Category

**Table 4** Inaccurate claims: Category-wise

| Category | Products selected | Inaccurate claims n (%) |
|---|---|---|
| Cereal | 57 | 16 (28) |
| Ready to eat mixes | 14 | 4 (28.5) |
| Biscuits and cookies | 14 | 5 (35.7) |
| Nuts and seeds | 10 | 3 (30) |
| Dairy products | 10 | 2 (20) |

### 3.4 Inaccurate claims: category-wise

Among the 57 cereal products selected, 28% (16) were found to have inaccurate claims. Ready-to-eat mixes showed a similar proportion, with 28.5% (4) of the 14 products evaluated containing misleading claims. Biscuits and cookies had the highest percentage of inaccurate claims at 35.7% (5) among the 14 products examined. Nuts and seeds products had 30% (3) inaccurate claims out of 10 products, while dairy products had the lowest proportion, with 20% (2) of the 10 selected products being misleading. These findings indicate that while inaccuracies were present across all categories, biscuits and cookies exhibited the highest rate of misleading claims, highlighting the need for greater scrutiny in this category. (Table 4).

## 4 Discussion

This study highlights substantial inaccuracies in nutrient content claims on food products marketed via Indian e-commerce platforms, raising critical concerns for public health, consumer rights, and regulatory efficacy. With an overall accuracy rate of 71.4%, nearly one-third of reviewed products contained misleading or unverifiable nutritional information. These findings are aligned with Bragolusi et al, 2023 [10], who reported that 35.8% of online food products listed at least one nutrient value outside regulatory tolerance limits, underscoring the challenges of digital food retail environments in ensuring label compliance [10]. In the context of India's growing e-commerce grocery sector—expected to expand at a CAGR exceeding 30%—such misrepresentations are likely to exacerbate nutritional misinformation if not addressed promptly [13, 42, 43, 53, 55].

Globally, similar patterns have been observed. Kikuta et al. [47], in a cross-sectional analysis of packaged foods in Brazil, found that 36.28% of products carried nutrition claims, and 5.4% made health claims, many of which lacked regulatory substantiation

[47]. Further, the rise of "greenwashing", where manufacturers exaggerate or falsely communicate health-related or environmental benefits, has raised global concern [17, 57]. These deceptive strategies thrive particularly in online retail, where physical label inspection is not possible, and consumers must rely on marketing claims and product descriptions. In Low and middle income countries, factors such as low nutritional literacy and limited regulatory oversight further heighten consumer vulnerability [75].

Within the Indian context, this study reveals claim-type discrepancies in compliance. While claims such as "Source of protein" and "Low calories" demonstrated 100% accuracy, others like "Rich in fibre" (88% inaccurate) and "Rich in calcium" (100% inaccurate) showed egregious misrepresentation. This echoes the findings of Verbeke et al. [80], who noted that fibre and calcium claims often exploit consumer preferences while failing to align with actual nutrient content [80]. Similar observations have been made in recent evaluations of fibre-fortified food products, where by-product fortification failed to deliver clinically meaningful benefits [12, 22]. Such discrepancies are especially dangerous for individuals with dietary requirements based on medical conditions such as osteoporosis, cardiovascular disease, or diabetes [70]. Inaccurate calcium and fibre labeling can derail public health strategies aimed at improving micronutrient adequacy and digestive health [70].

Despite regulatory equivalence, our findings showed a marked difference in compliance: "High in fibre" claims were 89% accurate, whereas "Rich in fibre" had an 88% inaccuracy rate. This disparity may stem from semantic preferences in marketing or misunderstanding of regulatory terms by manufacturers. As noted by in previous studies inconsistencies in nutrient labeling practices are common in emerging markets, partly due to gaps in regulatory enforcement and manufacturer awareness [23]. Our results suggest a need for greater clarity in communication and oversight to ensure uniform industry adherence [23, 44, 70, 74].

The perfect accuracy of "Source of protein" claims can be attributed to the lower FSSAI qualifying threshold of 10% of the Recommended Daily Allowance (RDA) per 100 g, making it easier for manufacturers to meet. In contrast, "Rich in protein" requires 20% of the RDA, a stricter benchmark. This threshold-based difference likely accounts for the inaccuracies observed in "Rich in protein" claims, reflecting either overestimation or strategic marketing use of stronger nutrient language despite non-compliance. As highlighted by Grunert & Wills [34], stronger nutrient claims tend to attract greater consumer attention, increasing purchase among the consumers [34].

Discrepancies on nutrient claims are especially dangerous for individuals with dietary requirements based on medical conditions such as osteoporosis, cardiovascular disease or diabetes [70]. Inaccurate calcium and fibre labeling can derail public health strategies aimed at improving micronutrient adequacy and digestive health [47, 70]. These claims can have serious public health implications, particularly when consumers rely on front-of-pack information to guide food choices. Studies show that nutrient labels heavily influence consumer perception of healthfulness, especially in online food retail where direct product inspection is not possible [11, 38, 39, 52]. Misleading claims may lead to overconsumption of unhealthy foods, create a false sense of nutritional adequacy, or compromise efforts in managing chronic conditions like diabetes and obesity [29, 38, 68].

Furthermore, improper labeling and unverified food claims can lead to serious safety risks, particularly for individuals with food allergies or strict dietary restrictions [58]. The elderly and individuals with chronic health conditions are also highly vulnerable to misleading labels, underscoring the critical need for robust regulation and public education [58]. The use of complex or ambiguous terminology on food labels, as highlighted by Omar et al. [59], can lead to significant consumer confusion, resulting in misinformed purchasing decisions that may negatively impact health outcomes [59]. Sebastián-Ponce et al. [69] further assert that inadequate or unclear food labeling is significantly associated with suboptimal consumer choices, which may contribute to the rising prevalence of obesity [69].According to Miller and Cassady [54], frequent exposure to misleading labels undermines consumer trust and may contribute to dietary imbalances [54]. Given India's dual burden of malnutrition and the rise of nutrition-related non-communicable diseases, ensuring the accuracy of online food labeling is crucial for safeguarding public health [8, 9].

Labeling regulations in high-income countries such as the European Union or Australia are more stringent, often requiring scientific substantiation of nutrient content and functional claims [25, 49, 62]. While India's FSSAI mandates claim accuracy, enforcement across e-commerce platforms remains inconsistent. Our findings suggest that India's digital marketplace may currently lack the regulatory infrastructure and surveillance systems necessary to uphold these standards uniformly [8, 9].

One of the study's most statistically significant findings was the association between product price and nutrient claim accuracy ($p = 0.0138$). Products in the high-price category showed better compliance (48% accuracy) than medium- and low-priced counterparts. This trend is consistent with the results of Darmon et al. (2008), who demonstrated that higher-priced food products tend to offer superior nutritional profiles, partly due to better quality control and ingredient sourcing [16]. Sugimoto et al. [76] similarly found that premium products had lower sodium and added sugar levels and were more likely to meet nutrient profile thresholds [76]. These observations suggest that higher-end manufacturers may be more invested in regulatory compliance, likely to preserve brand reputation and consumer trust [6]. Conversely, lower-priced products may resort to cost-cutting measures that compromise labeling accuracy, disproportionately affecting lower-income consumers [6]. This socioeconomic dimension of claim inaccuracy is concerning. Evidence from Sub-Saharan Africa and Southeast Asia shows that although 60–70% of consumers report reading food labels, less than half can accurately interpret them [3],*Implementing Nutrition Labelling Policies*, 2021; [50]. In India, with large swathes of the population having limited health or nutritional literacy, inaccurate claims on affordable products can mislead those most in need of trustworthy dietary guidance [65].

When analyzed by product category notable inaccuracies were seen among biscuits and cookies followed by nuts and seeds. These findings are consistent with Allemandi et al. [4], who found that nearly 40% of processed snacks and biscuits in Argentina carried misleading front-of-pack claims despite poor nutritional profiles [4]. Bashir et al. [7] and Rodrigues et al. [67] also documented widespread label non-compliance in baked goods and packaged foods [7, 67]. In India, biscuits are often positioned as healthy snack options for children and working adults, amplifying the risk of misinformation [5].

Evidence suggests that well-designed front-of-pack (FoP) labeling systems can mitigate such risks. A meta-analysis by Shangguan et al. [70], synthesizing data from 60 global studies, concluded that FoP labeling reduces consumer energy intake by 6.6%, fat intake by 10.6%, and consumption of unhealthy products by 13% [70]. Additionally, such policies often incentivize product reformulation by the food industry. Therefore, adoption of interpretive FoP systemssuch as Health Star Ratings or nutrient-specific warning labelscould help Indian consumers make more informed decisions while driving better compliance among manufacturers [8, 9].

Given these findings, the enforcement of FSSAI's existing labeling regulations must be strengthened, especially within the online food ecosystem [8, 9, 71]. A systemic issue that underpins this discussion is the asymmetry of information—consumers lack the tools to verify claims, while manufacturers retain discretion over disclosure [30]. Economic theory supports that this imbalance can be corrected through mandatory transparency policies and disincentives for misinformation [19]. While mandatory back-of-pack nutrition labelling exists, voluntary nutrient content claims- especially in online listings- remain weakly regulated and poorly enforced [18, 63].

### 4.1 Limitations

While the study provides valuable insights as one among the first to document nutrient claim accuracies on Indian E-commerce platforms, it is subject to several limitations that may affect the generalizability of its findings. The sampling approach was limited to three major Indian e-commerce platforms, potentially excluding products from other regional or niche online retailers, and the exclusion of offline markets further limits the broader applicability to the full Indian retail ecosystem. Furthermore, the price range filter (₹10–₹700) may have excluded premium or bulk products with differing labeling characteristics, while the reliance on customer ratings and review counts could have introduced a popularity bias. Methodologically, only products with complete online nutritional and ingredient data were considered, possibly favouring more digitally transparent brands, and the manual identification of nutrient claims may have led to subjective interpretation or missed claims phrased differently.

This study primarily employed descriptive analysis to assess the accuracy of nutrient claims due to the categorical nature and structure of the data. While an inferential analysis using Fisher's exact test was conducted to explore the association between product price and claim accuracy, additional statistical tests were not feasible given the limited variability and sample size distribution across other variables. Future studies with larger and more diverse datasets may allow for more comprehensive inferential analyses to further validate and expand upon these findings.

### 4.2 Recommendations

Policy experiences from countries such as Chile, Mexico, and Israel demonstrate that comprehensive labeling reforms, including nutrient warning symbols and restrictions on marketing to children can substantially reduce misleading claims and improve population-level nutrition outcomes [64, 77]. India has the opportunity to adapt these global best practices while taking into account its unique digital ecosystem, consumer diversity, and regional dietary habits [8].

In light of the observed association between lower-priced food products and reduced compliance with FSSAI labeling regulations, it is recommended that the Food Safety and Standards Authority of India (FSSAI) strengthen surveillance and enforcement mechanisms, particularly targeting low-cost food categories. This will help ensure that affordability does not undermine regulatory standards or compromise consumer health and safety.

Future research is essential to uncover the underlying drivers of non-compliance, including industry practices, consumer understanding, and the effectiveness of current regulatory frameworks. Longitudinal studies are also needed to evaluate the long-term impact of improved labeling practices on consumer trust, purchasing behavior, and health outcomes, thereby contributing to a more robust and evidence-based policy environment.

## 5 Conclusion

This study provides one among the first comprehensive analysis revealing significant inaccuracies in nutrient claims on Indian e-commerce food products, demonstrating critical discrepancies across claim types, price categories, and product segments. These findings carry profound public health implications for consumer trust and informed dietary choices, underscoring an urgent need for strengthened FSSAI enforcement and proactive policy refinements within India's rapidly expanding digital food market. While cross-sectional and limited to publicly accessible product data, this research serves as a vital call to action for continuous regulatory surveillance of online labeling practices and necessitates further investigation into the dynamic interplay between digital food retail and public nutrition.

**Declaration of generative AI and AI-assisted technologies in the writing process**
The authors utilized ChatGPT to ensure the spelling and grammar errors during the composition of this work. The authors reviewed and edited the content as necessary after using this tool and assume full responsibility for the publication's content.

**Author contributions**
Sruthi Sree: Conceptualization, Formal analysis, Investigation, Data curation, Methodology, Resources, Software, Validation, Visualization, Writing—review & editing Saravanan Chinnaiyan: Formal analysis, Investigation, Methodology, Project administration, Resources, Writing—original draft, Writing—review & editing, Data curation. Bharathi Palanisamy: Software, Supervision, Writing—original draft, Writing—review & editing, Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Sai Prashanthini Sivakumar: Data curation, Project administration, Writing—review and editing.

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**Data availability**
The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

## Declarations

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## Publisher's Note