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Towards Sustainable Food Choices: Analyzing the Knowledge–Practice Gap in Food Labeling among University-Educated Consumers in Alexandria, Egypt

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ABSTRACT

This study investigates the food labeling knowledge–practice gap to provide actionable insights for advancing Sustainable Development Goal 3 (Good Health and Well-being) and Goal 12 (Responsible Consumption and Production) among university-educated consumers in urban Egypt. A cross-sectional survey of 306 adult shoppers revealed a pronounced discrepancy: while 51.6% demonstrated good nutritional knowledge, only 26.5% consistently applied it through label use. Key barriers included small font size (66.7%) and complex terminology (19.9%). Knowledge significantly correlated with practice ($r = 0.531$, $p < 0.001$), with higher engagement among females, younger adults, and graduates. These results highlight the critical need for policy-driven solutions such as interpretive front-of-pack labeling and targeted literacy programs to effectively bridge this gap, thereby promoting sustainable consumer choices and supporting national public health objectives.

1. Introduction

Food labeling serves as a fundamental public health instrument, providing an efficient means of conveying standardized product information directly to consumers [1]. Through the disclosure of ingredients, nutrient composition, allergens, and expiration details, labels empower individuals to make informed dietary choices aligned with personal health objectives and national nutrition policies [2, 3]. Consequently, labeling has become an essential intervention in promoting healthier food environments and combating the global rise of noncommunicable diseases (NCDs) such as obesity, cardiovascular disorders, and diabetes [2].

International agencies, including the World Health Organization (WHO) and the Codex Alimentarius Commission, consistently advocate for accurate and comprehensible labeling standards [4, 5]. In response, numerous high-income nations have adopted interpretive front-of-pack (FOP) nutrition labeling systems such as traffic-light indicators, Nutri-Score, and warning

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symbols to simplify complex information [6]. Evidence from these contexts demonstrates that such systems enhance consumer understanding, promote healthier product selection, and encourage population-level dietary improvement [7, 8].

Conversely, low- and middle-income countries (LMICs) like Egypt face specific challenges in leveraging the public health benefits of labeling [9]. Although national regulations require the inclusion of essential information (ingredients, dates of production and expiration, and manufacturer details in Arabic), consumer comprehension and utilization remain limited [10]. Barriers such as low nutritional literacy, small font size, overly technical language, and the absence of visual aids hinder effective use [11]. Furthermore, economic pressures and price sensitivity often dominate purchasing choices, diminishing the role of health considerations [12].

The urgency of addressing these barriers has increased as Egypt experiences a nutritional and epidemiological transition characterized by greater dependence on processed, high-fat, and energy-dense foods [13]. Combined with insufficient nutrition literacy, these changes contribute significantly to the growing burden of NCDs. Current national and WHO statistics reveal that NCDs account for approximately 82% of all deaths in Egypt, primarily linked to poor dietary habits [14]. This underscores the need for affordable, preventive public health interventions.

Enhancing the clarity and accessibility of food labeling represents a promising step in mitigating these challenges [15]. Well-designed labels can raise consumer awareness, promote informed choices, and stimulate manufacturers to reformulate products more healthfully [16]. Thus, food label literacy evolves from a mere individual skill into a strategic public health tool supporting Sustainable Development Goal 3 (Good Health and Well-being). Despite the global importance of labeling, empirical data from Egypt remain scarce. Earlier studies from the same city have shown limited awareness and inconsistent use of labels due to poor readability and incomplete information [9]. Yet, Egypt's food market has transformed significantly since then, with greater urbanization and changing consumption habits [17]. It remains unclear how contemporary, educated Egyptian consumers perceive and utilize label information under these new conditions.

Because university-educated, urban consumers often influence broader social behaviors, studying their knowledge, attitudes, and practices can yield important insights [18]. Education is a key predictor of health literacy, but the mechanisms shaping label use among educated groups in LMICs are not fully understood [19]. Therefore, examining their interaction with food labels provides a basis for evaluating current policies and developing evidence-based interventions for education and regulation [20].

Study Gap and Research Significance

This study addresses a critical knowledge gap by investigating the disconnection between theoretical knowledge and practical application of food label information among university-educated consumers in Alexandria, Egypt. While previous research has documented general awareness levels, there is insufficient understanding of why educated consumers who presumably possess adequate literacy skills fail to translate label knowledge into consistent purchasing behaviors. This gap is particularly significant given Egypt's rapid nutritional transition and escalating NCD burden. The findings will inform targeted interventions to bridge the knowledge-practice divide, contributing directly to national public health strategies and supporting the achievement of Sustainable Development Goals 3 (Good Health and Well-being) and 12 (Responsible Consumption and Production).

Study Objective

This study aimed to:

(1) Assess knowledge and practice concerning food labeling among university-educated consumers in Alexandria, Egypt. (2) Identify the gap between awareness and application; and (3) Explore sociodemographic factors influencing label use. The results intend to guide policy enhancement and targeted public health strategies both in Egypt and comparable LMIC settings. This research aligns with the United Nations Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being) through its focus on combating diet-related non-communicable diseases, and SDG 12 (Responsible Consumption and Production) by promoting informed consumer choices and sustainable food consumption patterns in Egypt, an upper-middle-income country undergoing nutritional transition.

Conceptual Framework

The conceptual framework guiding this study is based on the Knowledge-Attitude-Practice (KAP) model, adapted to the context of food labeling and consumer behavior in a developing economy. The model posits a sequential relationship where knowledge of food label information (e.g., nutritional facts, ingredients) is a prerequisite for developing a positive attitude towards label use, which in turn should lead to consistent practice (label-reading and purchase influence).

However, this study specifically investigates the knowledge-practice gap, recognizing that the linear KAP model is often insufficient in real-world settings. The framework incorporates environmental and structural barriers as critical moderators that interfere with the conversion of knowledge into practice. These barriers include readability challenges (small font size, poor contrast), comprehension difficulties (complex terminology, technical language), and contextual factors (time constraints, price sensitivity, competing priorities).

The framework is structured as follows:

(1) Input (Knowledge) – assessed through participants' understanding of various label components (e.g., serving size, ingredient order, nutritional claims) (2) Moderators (Barriers) – factors that impede the application of knowledge, such as small font size, complex terminology, and price sensitivity (3) Output (Practice) – measured by the frequency of label-reading and the extent to which label information influences purchasing decisions; and (4) Outcome (SDG Alignment) – the ultimate goal is to inform policy and intervention strategies that support SDG 3 (Good Health and Well-being) by reducing diet-related NCDs and SDG 12 (Responsible Consumption and Production) by promoting informed consumer choices. This framework allows for the analysis of the direct link between knowledge and practice while simultaneously identifying the environmental factors that must be addressed to achieve behavioral change.

This visual framework illustrates the sequential relationship between theoretical knowledge and practical application of food label information among university-educated consumers in Alexandria, Egypt. The model progresses from knowledge acquisition (understanding label components, nutritional information, and health implications) through moderating barriers (reading challenges, comprehension difficulties, and contextual factors) to behavioral practice (label-reading frequency and purchase influence). Successful practice contributes to Sustainable Development Goal 3 (Good Health & Well-being) and Goal 12 (Responsible Consumption & Production). The feedback loop enables continuous system improvement through policy interventions, improved label design,

enhanced consumer literacy, and increased knowledge, thereby addressing the identified knowledge-practice gap.

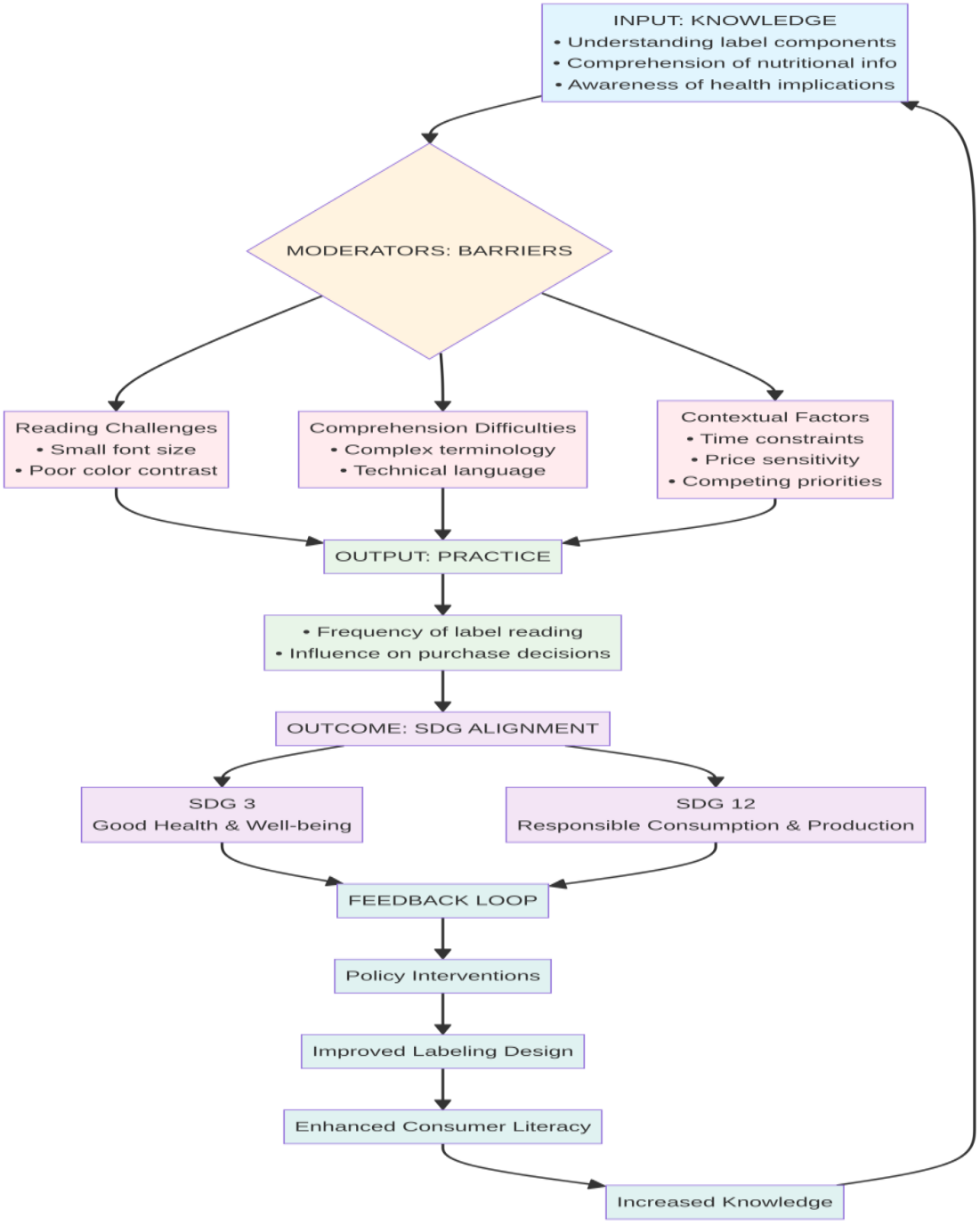

Fig. 1. Conceptual Framework of the Knowledge-Practice Gap in Food Label Use.

2.Materials and Methods

2.1 Study Design and Setting

A cross-sectional study was conducted in three major hypermarkets in Alexandria, Egypt. These sites were chosen as they attract a diverse and representative range of urban consumers who regularly purchase prepackaged foods. The study was implemented between March and May 2023.

2.2 Study Population

The study targeted adult consumers (aged ≥18 years) who were able to read and write Arabic and who were directly involved in household food purchasing. Individuals with visual impairments or those unable to read food labels were excluded.

2.3 Sample Size and Sampling Procedure

The sample size was calculated using Epi Info based on a prior prevalence estimate of 27.4% of consumers being aware of food labels. Assuming a 95% confidence level and 5% margin of error, a minimum sample of 306 participants was required. Consumers were approached systematically during shopping hours using a consecutive sampling method until the required sample was achieved. The consecutive sampling approach ensured proportional representation across different days and times, capturing diverse shopping patterns throughout the week.

2.4 Data Collection Tool

Data were collected through face-to-face interviews using a structured and pre-tested questionnaire developed from existing literature. The tool consisted of five sections: (1) Socio-demographic characteristics; (2) Perception of food labeling importance and benefits; (3) Knowledge assessment (17 items covering label content and nutritional information); (4) Practice assessment (18 items on label-reading frequency and purchasing influence); and (5) Barriers and motivating factors affecting understanding and use.

2.5 Questionnaire Reliability and Validity

Prior to data collection, the questionnaire was pre-tested on 30 consumers who were not included in the final sample to ensure clarity and feasibility. Reliability analysis showed excellent internal consistency, with Cronbach's alpha = 0.81 for knowledge items and 0.78 for practice items. Minor linguistic adjustments were made based on pilot feedback.

2.6 Scoring System

Each correct response in the knowledge section was scored as 1 point, and the total (out of 22 points) was converted to a percentage. Scores were categorized as: Good (>75%), Fair (50–75%), and Poor (<50%). Similarly, practice scores were calculated (out of 37 points) and categorized using the same thresholds. Composite scores were generated to examine correlations between knowledge and practice levels.

2.7 Ethical Considerations

The study was reviewed and approved by the Institutional Review Board (IRB) of the High Institute of Public Health, Alexandria University. The ethics committee approved a verbal consent procedure for this minimal-risk study, as the research involved no more than minimal risk (anonymous surveys) and no procedures for which written consent would normally be required

outside the research context. All participants were informed about the study's purpose, the voluntary nature of their participation, and the confidentiality of their responses before providing verbal consent. No identifying information was collected, and data were used solely for research purposes.

2.8 Statistical Analysis

Data were entered and analyzed using SPSS version 26.0. Descriptive statistics (frequencies, percentages, means ± SD) were calculated. Chi-square tests were used to examine associations between categorical variables (e.g., gender, education, and label-reading behavior). As the data were not normally distributed, Spearman's correlation coefficient (r) was applied to assess the relationship between knowledge and practice scores. A p-value ≤ 0.05 was considered statistically significant.

3. Results

A total of 306 university-educated consumers participated in this study. Their socio-demographic characteristics are summarized in Table (1). The majority were female (57.2%), aged 26–35 years (32.0%), and had university education (85.3%).

Table 1
Socio-demographic characteristics of the participants (n = 306)

Characteristic	n	%
Gender		
Male	131	42.8
Female	175	57.2
Age (years)		
18–25	81	26.5
26–35	98	32.0
36–45	62	20.3
>46	65	21.2
Education level		
Primary	3	1.0
Secondary	42	13.7
University	261	85.3
Marital status		
Single	121	39.5
Married	141	46.1
Divorced	44	14.4

3.1. Knowledge about food labeling

The mean knowledge score among respondents was 76.13 ± 13.48%.

As shown in Table (2), more than half (51.6%) demonstrated good knowledge, 47.1% had fair knowledge, and only 1.3% were classified as poor.

Knowledge was significantly higher among females, younger participants (26–35 years), and those without chronic diseases ($p < 0.05$).

Table 2
Classification of participants by level of knowledge (n = 306)

Domain	Poor (<50%)	Fair (50–75%)	Good (>75%)	Mean ± SD
Label content	19.9%	57.5%	22.5%	67.54 ± 21.74
Nutritional info	2.9%	39.2%	57.8%	77.64 ± 14.13
Overall Knowledge	1.3%	47.1%	51.6%	76.13 ± 13.48

3.2 Practices related to food labeling

Although 77.5% of respondents reported reading food labels before purchasing, only 26.5% said this information usually influenced their decisions.

Label reading was significantly higher among females ($p < 0.001$) and university-educated consumers ($p < 0.01$).

The most frequently read information was the product name (78.8%), price (61.4%), and expiry date (47.4%), as shown in Table (3).

Table 3
Extent to which food label information influences purchasing decision (n = 306)

Influence Level	n	%
Low extent	115	37.6
Moderate extent	110	35.9
High extent	81	26.5

3.3 Barriers to using food labels

The most commonly reported barrier was small print size (66.7%), followed by difficult language (19.9%), and excessive numeric data (5.9%).

These factors indicate usability challenges that limit effective label use, even among knowledgeable consumers.

3.4 Factors influencing labeling practices

Table (6) summarizes the descriptive associations between socio-demographic factors and labeling practice levels. Females, younger adults, and highly educated participants were the most frequent label readers.

Table 6
Factors influencing consumers' food labeling practices (n = 306)

Factor	Category	Higher Practice Frequency (%)	Interpretation
Gender	Female	63.4	Females showed consistently higher engagement in reading labels
Age group	26–35 years	54.7	Younger adults more likely to use label information
Education level	University	81.2	Higher education correlated with more detailed label scrutiny
Marital status	Married	59.1	Married individuals demonstrated greater label awareness
Health status	No chronic disease	68.9	Reflects proactive health behavior rather than disease-driven motivation

3.5 Association between knowledge and practice

A significant positive correlation was observed between knowledge and practice scores (Spearman's $r = 0.531$, $p < 0.001$).

Participants with higher knowledge levels were more likely to use food labels effectively.

Among consumers with good practice levels, 87.9% also had good knowledge, confirming that awareness is a strong predictor of engagement.

3.6 Specific Knowledge Gaps

While knowledge of allergens (98.4%) and calorie content (99.0%) was high, understanding of ingredient listing order (29.7%) and "reduced fat" claims (16.0%) was notably low. These weaknesses indicate that even educated consumers struggle to interpret critical nutritional information accurately.

3.7 Predictors of Good Labeling Practice

Although a formal multivariate regression analysis could not be conducted due to data limitations, descriptive trends strongly suggest that gender, educational attainment, and nutrition knowledge are the most influential predictors of good labeling practices.

Specifically:

- Females were nearly twice as likely to report frequent label use compared with males.
- University-educated participants demonstrated the highest engagement across all label-use indicators.
- Younger adults (26–35 years) and those with high knowledge scores (>75%) reported greater reliance on nutrition labels for purchase decisions.
- Interestingly, the presence of a chronic disease did not emerge as a significant predictor, suggesting that proactive health awareness rather than illness-driven motivation was the key driver of label use.

4.Discussion

This study provides clear evidence of a significant knowledge–practice gap in food label use among university-educated consumers in urban Egypt. While 51.6% of participants demonstrated good knowledge (mean score 76.13±13.48%), only 26.5% reported consistent influence of label information on purchase decisions. This discrepancy aligns with global patterns observed in both high-income and low-middle-income countries, where cognitive awareness frequently fails to translate into behavioral change [21, 22]. The findings carry direct implications for achieving Sustainable Development Goals 3 and 12 in Egypt, particularly through targeted interventions that address both individual comprehension and structural labeling barriers.

4.1 The Intention–Action Divide

The pronounced divergence between label-reading intention and actual purchasing behavior observed in this study reflects a well-documented phenomenon in behavioral nutrition [7]. Even when consumers recognize the value of nutritional information, they often fail to act accordingly in real-world shopping environments. This intention–action gap can be attributed to the combined

effect of suboptimal label presentation and the rapid, distraction-rich context of supermarkets. Under time pressure or visual strain, consumers tend to rely on cognitive shortcuts brand familiarity, price promotions, or packaging appeal rather than detailed nutritional analysis [11]. Within the framework of the Health Belief Model, such barriers (complex text, small fonts, limited clarity) outweigh perceived health benefits at the point of purchase [11].

4.2 Interplay Between Knowledge and Behavior

The elevated knowledge level among respondents corresponds with their educational attainment, as most participants held university degrees. This pattern supports prior evidence identifying education as a significant determinant of nutrition literacy [10]. Nevertheless, awareness did not translate into consistent action only 26.5% regularly relied on labels when making food purchases. Comparable results have been reported in studies from South Africa [10] and Ghana [12], suggesting that structural and economic realities including price sensitivity, market volatility, and habitual preferences frequently override nutritional considerations. In Egypt, this indicates that structural barriers must be addressed alongside educational interventions to produce measurable behavioral change.

4.3 Specific Knowledge Deficiencies and Public Health Implications

Despite generally adequate awareness, specific knowledge gaps persisted that could undermine healthy food choices. Only 29.7% of respondents correctly understood ingredient-order significance, and merely 16.0% could accurately interpret "reduced-fat" claims. These misunderstandings may promote inadvertent consumption of high-calorie foods under the mistaken assumption of healthfulness. Similar knowledge deficiencies have been documented in other LMIC contexts [19, 23]. These findings reinforce the need for simplified, interpretive front-of-pack (FOP) labeling formats such as traffic-light systems, Nutri-Score, or warning icons that transform complex nutrition data into intuitive visual cues [6, 8].

4.4 Barriers and Determinants of Label Engagement

Small print size (reported by 66.7% of participants) and complicated language (19.9%) emerged as the primary usability challenges, consistent with barriers identified in international literature [11]. These design-related obstacles disproportionately affect consumers with limited time or visual impairments. Demographic analysis revealed greater engagement among females, younger adults (26–35 years), and university graduates patterns consistent with global research identifying women as primary household food decision-makers and younger consumers as more receptive to health messaging [18, 19]. Notably, participants without chronic diseases showed higher label usage, suggesting that proactive health orientation, rather than illness-driven motivation, serves as the key driver of label engagement [12].

4.5 Association Between Awareness and Practice

The statistically significant positive correlation between knowledge and practice scores (Spearman's $r = 0.531$, $p < 0.001$) confirms that awareness remains a necessary though insufficient prerequisite for behavioral engagement [24]. The moderate strength of this relationship suggests the influence of contextual moderators, including time constraints, pricing factors, and perceived

label credibility, which collectively dampen behavioral consistency [7]. An integrated approach combining literacy enhancement with structural simplification of label content is therefore essential to convert awareness into effective practice [8].

4.6 Alignment with Recent Evidence from Egypt and Globally

The present findings align closely with emerging 2025 research on label use in comparable settings. A study by Arunkumar *et al*., [22]on medical students in Chennai found that while 65.2% demonstrated good knowledge, only 53% actively applied this knowledge in purchasing decisions. Similarly, Murugesan *et al*., [23]reported that 66.3% of consumers possessed adequate knowledge, but just 51.8% showed good practice in reading labels. The barriers identified here particularly small font size and complex terminology are also consistent with a 2025 Canadian study on household food waste, which found that label confusion often leads to unnecessary food discarding. Recent Egyptian evidence further supports these findings; Kamel *et al*., [25] documented that foundational nutrition literacy remains notably low (56.6%) even among educated populations, limiting their ability to interpret and apply label information effectively.

4.7 Policy and Conceptual Implications

The outcomes align with behavioral-nutrition frameworks recognizing that dietary choices emerge from the intersection of individual cognition, environmental cues, and socioeconomic context [2]. Without simultaneous progress in label design and consumer education, even informed individuals will encounter obstacles to adopting healthier choices [6]. Therefore, policy priorities should emphasize not only educational outreach but also regulatory reforms ensuring clarity, legibility, and interpretability. For Egypt, modernizing labeling standards offers a cost-effective strategy to reduce nutrition-related NCDs and aligns directly with Sustainable Development Goal 3 (Good Health and Well-being). Regional harmonization with Codex Alimentarius and WHO standards can further strengthen consumer confidence and regulatory coherence [4, 5].

4.8 Strengths and Limitations

The study's strengths include a robust sample size (n = 306), use of a validated and reliable instrument (Cronbach's α = 0.81 for knowledge; 0.78 for practice), and inclusion of key sociodemographic indicators education, age, and gender that inform targeted nutrition policies. Nonetheless, its cross-sectional nature restricts causal interpretation, and reliance on self-reported data may introduce desirability bias. Additionally, the urban, highly educated composition of the sample limits generalization to rural or less literate groups. Finally, while bivariate analyses identified significant associations and **descriptive trends were clear**, the study did not employ multivariate regression to identify independent and most influential predictors of label use. This decision was based on the exploratory nature of this research in an understudied population and because the sample size was determined for primary descriptive and correlational analyses rather than for building complex predictive models. Future research employing longitudinal designs and larger samples suitable for multivariate analysis would help establish causal determinants of effective label utilization across broader population strata.

5. Conclusion

This study provides clear evidence of a significant knowledge–practice gap in food label use among university-educated consumers in urban Egypt, with direct implications for achieving Sustainable Development Goals 3 and 12. Despite adequate knowledge, behavioral application remains low, primarily hindered by environmental and structural constraints such as illegible typography, technical phrasing, and the dominance of price and convenience during purchase decisions. These results indicate that consumer education must operate in tandem with systemic improvements in label presentation and regulatory enforcement to achieve measurable behavioral change. Closing this knowledge–practice divide requires food labels that are immediately interpretable and visually intuitive. Front-of-pack schemes providing concise, color-coded, or symbolic cues would allow consumers to process information rapidly under real-world retail conditions. Complementary nutrition-literacy programs are also necessary to strengthen consumers' capacity to apply label information effectively. Embedding these initiatives into national food-safety policies can transform labeling from a passive communication tool into an active mechanism that supports population-level health improvement.

Ultimately, implementing an integrated approach linking consumer education, design innovation, and evidence-based regulation represents a critical pathway toward empowering Egyptian consumers, mitigating diet-related noncommunicable diseases, and advancing the nation's health agenda. Sustainable progress will depend on coordinated action across government, academia, and the food industry to ensure labeling reforms deliver genuine public-health impact.

Therefore, addressing this knowledge–practice gap is a necessary step toward enabling more sustainable food choices and supporting national sustainability agendas in Egypt.

6. Practical Recommendations

6.1 Policy and Regulatory Development

Establish national readability and transparency standards under the Egyptian Food Safety Authority (EFSA), defining minimum font sizes, high-contrast design, and clear Arabic labeling requirements. Introduce interpretive front-of-pack (FOP) labeling systems such as traffic-light indicators, Nutri-Score, or warning symbols through a phased implementation beginning with voluntary industry participation. Develop a continuous monitoring framework within EFSA to track regulatory compliance, assess consumer comprehension, and evaluate health outcomes associated with labeling reforms. Prioritize high-risk product categories (e.g., sugary beverages, processed snacks) in early stages to maximize immediate public-health benefit.

6.2 Public Awareness and Nutrition Literacy

Conduct nationwide campaigns that clarify ingredient sequencing, serving sizes, and nutritional claims (e.g., "low sugar," "reduced fat"). Integrate food-label interpretation into school curricula and higher-education programs to establish long-term nutrition awareness. Utilize digital and social-media platforms to disseminate engaging visuals, infographics, and brief educational content tailored for youth audiences.

6.3 Industry Collaboration and Corporate Accountability

Require manufacturers to ensure accurate Arabic translation, accessible layout, and equitable information presentation across all literacy levels. Promote participatory label design through collaboration between producers, consumer groups, and public-health authorities to enhance

usability and trust. Enforce strict oversight of nutrient and health claims, aligning national standards with Codex Alimentarius and WHO guidelines to prevent misleading marketing.

6.4 Research and Evaluation Priorities

Employ longitudinal and multivariate methodologies to examine causal relationships between labeling knowledge, consumer attitudes, and actual purchasing outcomes. Undertake cost-effectiveness analyses comparing traditional versus interpretive labeling models to determine the most scalable national strategy. Expand research coverage to rural and lower-literacy populations to ensure equitable policy benefits and reduce health disparities.

Author Contributions

Conceptualization,Y.E.; Methodology,Y.E.; Software,Y.E.; Validation, A.A.O.and E.M.F.; Formal Analysis,Y.E.; Investigation,Y.E.; Resources,Y.E.; Data Curation, Y.E.; Writing – Original Draft Preparation, Y.E.; Writing – Review & Editing, Y.E.; Visualization,Y.E.; Supervision,A.A.O. and E.M.F; Project Administration, Y.E. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement

All relevant data are contained within the article. De-identified participant data are available upon reasonable request from the corresponding author.

Conflicts of Interest

The authors declare that they have no known competing financial interests.

Ethical Approval

The study protocol was approved by the Ethics Committee of the High Institute of Public Health, Alexandria University. Verbal informed consent was obtained from all participants.

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