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ORIGINAL RESEARCH ARTICLE

Knowledge, Attitudes, and Practices Regarding Food-Label Reading and Healthy Food Choices among University Students in Sialkot, Pakistan: A Cross-Sectional Study

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ABSTRACT

Food labels can support healthier food choices, but access to nutrition information does not guarantee that consumers understand or use it. University students are increasingly responsible for their own dietary decisions and are heavily exposed to packaged foods. To assess knowledge, attitudes and practices (KAP) regarding food label reading and healthy food choices among university students, to examine associations between selected variables and KAP, and to identify barriers to label use. A quantitative, cross-sectional descriptive study was conducted among 200 university students aged 18 years or older, recruited by convenience sampling. Data were collected with a structured, self-administered questionnaire covering sociodemographic characteristics, food-label knowledge, attitudes and label-reading practices, and were analysed in SPSS with descriptive statistics and chi-square tests (significance, $p < 0.05$). Percentages are based on 199 analysable responses. Overall knowledge was good in 50.8%, moderate in 43.7% and poor in 5.5% of students, and attitudes were positive in 54.8% and moderate in 45.2%; none was negative. Students knew the meaning of expiry dates (89.9%), the Nutrition Facts Panel (88.4%) and the link between sodium and hypertension (86.9%), but only 47.7% understood serving size and 45.7% could compare two products. Most agreed that label reading is important for health (92.5%), yet 67.3% found it too time-consuming and 82.4% wanted labels to be easier to understand. Only 10.1% always and 44.7% often read labels before purchase, and 24.1% never compared products. Attitude level was associated with practice ($\chi^2 = 12.445$, $p = 0.014$), whereas knowledge level was not ($\chi^2 = 3.127$, $p = 0.537$). Knowledge level differed by gender ($p < 0.001$). Students had moderate-to-good knowledge and favourable attitudes, but label-reading practice was inconsistent, indicating a knowledge–practice gap. Education should emphasise practical skills, particularly serving size and product comparison, and should be supported by clearer labels and healthier campus food environments.

KEYWORDS

University students; Nutrition literacy; Food labels; Nutrition labelling; Knowledge, Attitudes and practices; Healthy food choices

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1. Introduction

Noncommunicable diseases (NCDs), including cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes, represent a major global public health challenge. According to the World Health Organization (WHO), NCDs caused at least 43 million deaths worldwide in 2021, accounting for approximately 75% of non-pandemic-related deaths. Unhealthy dietary patterns, physical inactivity, tobacco use, and harmful alcohol consumption are among the major modifiable risk factors contributing to the global burden of these diseases [1]. Dietary behaviours characterised by excessive consumption of energy-dense, nutrient-poor foods and in adequate intake of fruits, vegetables, and dietary fibre contribute to the development of several diet-related chronic conditions. Consequently, promoting nutrition literacy and enabling informed dietary choices are important components of preventive public health strategies. An umbrella review associated greater ultra-processed-food exposure with several adverse health outcomes [2], while a small controlled feeding trial observed greater energy intake during an ultra-processed diet than during an unprocessed diet [3].

University students represent an important population for nutritional health promotion because university life often marks a transition from family-directed dietary practices to independent food purchasing, meal planning, and consumption decisions. Academic responsibilities, limited financial resources, irregular meal schedules, social influences, and the widespread availability of convenient packaged foods may shape students' dietary behaviours. Sogari et al. [4]

demonstrated that eating habits among college students are influenced by interconnected individual, social, and environmental factors. The dietary practices established during this transition al period may persist into adulthood, highlighting the importance of promoting informed food choices and practical nutritional skills among university students.

Food labelling provides consumers with information about the nutritional composition, ingredients, serving sizes, energy content, and other characteristics of packaged food products. Nutrition labels can assist individuals in evaluating the nutritional quality of foods, comparing alternative products, identifying potentially excessive amounts of sodium, sugar, and saturated fat, and making purchasing decisions consistent with their dietary needs. Evidence from previous research indicates that nutrition-label use is associated with aspects of healthier dietary behaviour. Graham and Laska [5] reported that nutrition-label use partially mediated the relationship between attitudes toward healthy eating and overall dietary quality among college students. Similarly, Campos et al. [6], in a systematic review, demonstrated that nutrition labels can influence consumer awareness and food selection, although their effectiveness varies according to consumer characteristics and the presentation of information. A meta-analysis by Shangguan et al. [7] further reported that food labelling can influence consumer dietary behaviours and certain food-industry practices, supporting its potential contribution to public health nutrition strategies. A separate meta-analysis of randomized studies reported benefits for healthier product selection [8], whereas a Cochrane review judged the evidence for some real-world purchasing and consumption outcomes to be of low certainty [9].

Despite these potential benefits, the availability of nutritional information does not necessarily ensure that consumers understand or consistently use it. Effective interpretation of nutrition labels requires a combination of nutritional knowledge, functional health literacy, numeracy, and the ability to apply quantitative information during food selection. Miller and Cassady [10] identified nutrition knowledge as an important factor influencing food-label use, while also recognising the complexity of the relationship between knowledge and consumer behaviour. Similarly, Malloy-Weir and Cooper [11] highlighted the influence of literacy, health literacy, and numeracy on the understanding and interpretation of nutrition labels. Consumers may recognise familiar nutritional terms but experience difficulties interpreting serving sizes, recommended daily values, nutrient quantities, and product-comparison information. These challenges suggest that general nutrition awareness and practical nutrition-label literacy represent related but distinct competencies.

The design, read ability, and presentation of food labels may also influence consumer understanding and use. Traditional nutrition information panels frequently contain numerical values and technical terminology that may be difficult for consumers with limited nutritional knowledge or numeracy skills to interpret. Simplified and interpretive front-of-package nutrition-labelling approaches have therefore been investigated as potential strategies for improving the accessibility of nutritional information. Hawley et al. [12] reviewed evidence concerning front-of-package food labels and highlighted the importance of label design and consumer comprehension. However, the effectiveness of simplified labelling depends on multiple factors, including the characteristics of the label, consumer knowledge, purchasing context, and the nature of the nutritional information presented. A network meta-analysis examined how colour-coded and warning formats influence consumer choices [13]. In a randomized simulation, spectrum labels promoted healthier selections than some alternatives [14], whereas another randomized experiment found that FDA-style Nutrition Info labels improved product comparisons, with effects differing by nutrition-literacy level [15].

In addition to comprehension difficulties, food-label reading is influenced by practical, behaviour al, and socioeconomic factors. Consumers may consider nutritional information important while remaining reluctant to examine labels because of time constraints, small print, unfamiliar terminology, established purchasing habits, or competing preferences for taste, convenience, and affordability. Cowburn and Stockley [16] identified substantial variation in consumer understanding and use of nutrition labels, while Grunert et al. [17] demonstrated differences in nutrition-label awareness, understanding, and use across European consumer populations. These findings indicate that the presence of nutritional information alone may be insufficient to support informed food choices without addressing barriers related to accessibility, motivation, and purchasing circumstances. In Chile, a combined package of front-of-pack warnings and marketing restrictions was associated with reduced purchases of sugar-sweetened beverages [18] and lower purchased amounts of several nutrients of concern [19]. Research on restaurant menu labelling has likewise linked calorie information with modest differences in calories purchased, although menu labels are not equivalent to packaged-food labels [20].

Among university students and young adults, food-label reading practices have been associated with nutritional knowledge, attitudes toward healthy eating, demographic characteristics, and individual behaviour al factors. Christoph et al. [21], in a review of research involving college students and young adults, identified several correlates of nutrition-label use, including nutrition knowledge, healthy-eating attitudes, and perceived ability to interpret food labels. Misra [22] also examined nutritional knowledge, attitudes, and label use among college students, contributing evidence regarding the relationship between nutritional understanding and purchasing behaviour. These observations highlight the importance of examining food-label knowledge, attitudes, and practices together rather than considering nutritional awareness as the sole determin ant of consumer behaviour.

The theory of planned behaviour offers a useful conceptual perspective for understanding the relationship between attitudes and food-related practices. According to Ajzen [23], behaviour al intentions are influenced by attitudes, subjective norms, and perceived behaviour al control. Within the context of nutrition labelling, students may possess adequate nutritional knowledge and recognise the value of food labels but fail to translate these perceptions into regular purchasing practices because of limited motivation, perceived difficulty, or environmental constraints. However, knowledge and attitudes should not be assumed to cause particular purchasing behaviours without appropriate longitudinal or experimental evidence. Education al interventions that focus on practical nutritional interpretation may help address some of these barriers. Miller et al. [24] evaluated an electronic health education tool designed to improve food-label reading skills among college students, providing evidence that targeted education al approaches can strengthen nutritional interpretation skills and perceived empowerment in food selection.

In Pakistan, food-label reading has also received attention in the local literature, including discussion of consumers' engagement with information displayed on packaged foods [25]. However, the interpretation and use of nutrition labels may vary according to education al background, purchasing patterns, food affordability, nutritional awareness, and the surrounding food environment. International findings may therefore not fully represent the experiences of Pakistani university students. Research from other university populations, including the study by Md Zaini et al. [26], has demonstrated the value of examining food-label knowledge, attitudes, and practices collectively to identify nutritional understanding and behaviour al gaps. Context-specific evidence from Pakistani universities is important for informing locally relevant education al programmes and identifying practical barriers to the effective use of food-label information.

Although previous investigations have examined different dimensions of nutritional knowledge and food-label reading, there remains a need to understand how these factors coexist within specific university settings and how students' reported knowledge and attitudes relate to their everyday food-label reading practices. Particular attention is needed to distinguish basic recognition of nutritional information from practical competencies, such as interpreting serving sizes and comparing packaged food products. Further more, understanding students' perceptions of time constraints, label complexity, and food affordability may help identify barriers that cannot be addressed through nutritional awareness alone.

Therefore, the present cross-sectional study aimed to assess the knowledge, attitudes, and practices regarding food-label reading and healthy food choices among university students enrolled at selected universities in Sialkot, Pakistan. Specifically, the study sought to evaluate students' knowledge of commonly encountered food-label information, examine their attitudes toward nutritional labelling and healthier food choices, describe their self-reported label-reading and product-comparison practices, investigate associations between selected sociodemographic characteristics and KAP measures, and identify perceived barriers to the effective use of food labels. The findings are intended to provide context-specific evidence that may inform practical nutrition-literacy education, university-based health-promotion activities, and future research investigating the relationship between food-label understanding and dietary decision-making.

2. Materials and Methods

2.1 Study Design and Setting

A quantitative, descriptive cross-sectional study was conducted to assess knowledge, attitudes, and practices (KAP) regarding food-label reading and healthy food choices among university students in Sialkot, Pakistan. The study was carried out between 10 January 2026 and 25 June 2026 at three higher education institutions: Grand Asian University Sialkot, the University of Sialkot, and the University of Management and Technology, Sialkot.

The cross-sectional design enabled the assessment of participants' knowledge, attitudes, and self-reported food-label reading practices during the study period. This design was considered appropriate for describing the distribution of KAP characteristics and examining associations between selected sociodemographic variables and food-label-related behaviours. However, because data were collected within a cross-sectional framework, the observed associations cannot establish causal relationships or temporal sequences [27].

2.2 Study Population and Sampling Procedure

The target population comprised undergraduate and postgraduate students enrolled in different academic departments at the participating universities. Students were recruited using a non-probability convenience sampling approach based on their accessibility, eligibility, and willingness to participate. A total of 200 students were recruited during the study period, of whom 199 responses were included in the reported statistical analyses. Eligible participants were students currently enrolled at the participating institutions, aged 18 years or older, who voluntarily agreed to participate and provided informed consent. Students younger than 18 years, individuals who were not currently enrolled, and those unwilling to participate were excluded. In complete or inconsistent questionnaire responses were also subject to exclusion. The convenience sampling approach facilitated recruitment across different academic settings. Nevertheless, because participants were not selected through probability sampling, the resulting sample should not be assumed to represent the broader university student population of Pakistan.

2.3 Questionnaire Development and Structure

Data were collected using a structured, self-administered questionnaire developed following a review of relevant literature on nutrition labelling, nutritional knowledge, consumer behaviour, and healthy food choices. The questionnaire comprised four principal sections designed to assess the following domains:

2.4 Section I: Sociodemographic Characteristics

This section collected information on participants' demographic and education al characteristics, including age, gender, academic year, and living arrangements. These variables were used to describe the study population and examine potential associations with knowledge, attitudes, and food-label reading practices.

2.5 Section II: Knowledge Regarding Food Labels

This section assessed participants' knowledge and understanding of commonly encountered food-label information. The assessed topics included expiry dates, nutrition information panels, serving sizes, nutrient-related health implications, and the interpretation or comparison of nutritional information between packaged food products. Knowledge items were scored using a binary approach, with one point assigned to each correct response and zero points assigned to incorrect or "don't know" responses. The resulting scores were used to classify participants according to their overall level of food-label knowledge.

2.6 Section III: Attitudes Toward Food-Label Reading and Healthy Food Choices

This section examined participants' perceptions, beliefs, and attitudes concerning the importance and usefulness of food labels in making informed dietary decisions. The assessed statements addressed perceived health benefits, interest in nutritional information, trust in food labels, ease of understanding, time constraints, and the influence of food prices on purchasing decisions. Attitude responses were recorded using a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). The resulting scores were used to evaluate and classify participants' overall attitudes toward food-label reading and healthy food choices.

2.7 Section IV: Food-Label Reading Practices

This section assessed self-reported behaviours related to food-label reading during the purchase of packaged foods. The questionnaire covered the frequency of reading nutrition labels, the types of information commonly examined, comparison of nutritional information between food products, the influence of food labels on purchasing decisions, avoidance of products perceived as high in sugar or fat, and self-reported changes in eating habits associated with food-label information. The practice-related responses provided descriptive information about how frequently students reported using nutritional information in their everyday purchasing decisions.

2.8 Questionnaire Validity and Pilot Testing

The questionnaire was reviewed by supervisors and academic experts in nutrition and public health to assess its content validity, clarity, relevance, and suitability for the target population. A preliminary pilot study involving approximately five students was conducted before the main data collection. The pilot assessment focused on questionnaire clarity, feasibility, comprehensibility, and the practicality of administering the instrument to university students. Participants involved in the pilot study were excluded from the main study analysis. Internal consistency was assessed using Cronbach's alpha (α), with a coefficient of 0.70 or higher considered an acceptable threshold for reliability, following the methodological guidance discussed by Tavakol and Dennick [28].

2.9 Data Collection Procedure

Data were collected through a structured, self-administered questionnaire distributed in both printed and electronic formats. Electronic questionnaires were administered using Google Forms and circulated through university communication channels, WhatsApp groups, and email. Participants completed the questionnaire independently, and the estimated completion time was approximately 10–15 minutes. Questionnaire responses were subsequently compiled and organised for statistical analysis. Data were coded and entered into Microsoft Excel before being transferred to IBM SPSS Statistics, version 26.0, for analysis.

2.10 Measurement and Classification of Knowledge, Attitudes, and Practices

Knowledge and attitude responses were evaluated using the scoring procedures specified for their respective questionnaire domains. For knowledge assessment, correct responses received a score of one, whereas incorrect and "don't know" responses received a score of zero. The total knowledge score was converted into a percentage of the maximum possible score. Attitude items were rated on a five-point Likert scale. The total attitude score was similarly converted into a percentage of the maximum possible score. Knowledge and attitude levels were categorised using modified Bloom's cut-off criteria, as follows:

Good knowledge or positive attitude: 80% or above.

Moderate knowledge or moderate attitude: 60–79%.

Poor knowledge or negative attitude: Below 60%.

Food-label reading practices were assessed using participants' responses concerning the frequency and application of food-label information during food purchasing. Practice-related outcomes were summarised using categorical frequencies and percentages.

2.11 Statistical Analysis

Data were initially coded and organised in Microsoft Excel and subsequently analysed using IBM SPSS Statistics, version 26.0. Descriptive statistical methods were used to summarise participants' sociodemographic characteristics, knowledge levels, attitudes, and self-reported food-label reading practices. Categorical variables were presented as frequencies and percentages, while means and standard deviations were specified for the description of continuous variables where applicable. The chi-square test of independence was used to examine associations between selected categorical variables. The reported analyses included relationships between gender and KAP outcomes, knowledge level and food-label reading practices, and attitude level and food-label reading practices. Statistical significance was assessed using a threshold of $p < 0.05$. The interpretation of statistically significant associations was restricted to relationships between variables within the cross-sectional sample. No causal interpretation was made because of the observational study design [27,29].

2.12 Ethical Considerations and Informed Consent

The study protocol was reported by the authors to have been reviewed and approved by the Ethical Review Committee of Grand Asian University, Sialkot, Pakistan. Written informed consent was obtained from all participants before questionnaire administration. The official ethics approval reference number and approval date require verification against the original approval documentation.

3. Results

All percentages below are based on 199 analysable responses. Most students were aged 21–23 years (54.3%), 63.8% were female (17.6% preferred not to disclose their gender), 39.2% were in their fourth year, and 77.9% lived with their families (Table 1). Previous awareness of food labelling was reported by 115 students (57.8%), whereas 84 (42.2%) had not heard of it before. Overall, 101 students (50.8%) had good knowledge, 87 (43.7%) moderate knowledge and 11 (5.5%) poor knowledge. Attitudes were positive in 109 students (54.8%) and moderate in 90 (45.2%); none had a negative attitude (Table 2).

Table 1. Sociodemographic characteristics of the participants (n = 199).

Characteristic	Category	n (%)
Age	≤20 years†	65 (32.7)
	21–23 years	108 (54.3)
	≥24 years	26 (13.1)
Gender	Female	127 (63.8)
	Male	37 (18.6)
	Prefer not to say	35 (17.6)
Academic year	First	7 (3.5)
	Second	55 (27.6)
	Third	53 (26.6)
	Fourth	78 (39.2)
	Other/not itemised‡	6 (3.0)
Living arrangement	With family	155 (77.9)
	Other/not itemised‡	44 (22.1)

† Combines the 15–20-year and 18–20-year categories of the source data (45 and 20 students). ‡ Remainder of the 199 responses not itemised in the source data.

Table 2. Overall levels of knowledge and attitude (n = 199).

Level	Knowledge, n (%)	Attitude, n (%)
Poor / negative	11 (5.5)	0 (0.0)
Moderate	87 (43.7)	90 (45.2)
Good / positive	101 (50.8)	109 (54.8)

Knowledge was classified as poor, moderate or good, and attitude as negative, moderate or positive.

Knowledge was highest for the meaning of the expiry date (89.9%), the Nutrition Facts Panel as the source of nutrient information (88.4%), sodium as the nutrient to limit in hypertension (86.9%) and the association of high sugar intake

with diabetes (79.4%). Knowledge was lowest for the ability to compare two products (45.7%), the meaning of serving size (47.7%) and the nutrient associated with weight gain (47.2%; Table 3).

Table 3. Responses to selected knowledge items (*n* = 199).

Item	Response scored as correct	*n* (%)
Meaning of expiry date	Last date for safe consumption	179 (89.9)
Section providing nutrient information	Nutrition Facts Panel	176 (88.4)
Nutrient to limit in hypertension	Sodium/salt	173 (86.9)
Health risk of high sugar intake	Diabetes	158 (79.4)
Benefit of fibre-rich foods	Digestion	112 (56.3)
Understands serving size	Yes	95 (47.7)
Nutrient linked to weight gain when in excess	Fat	94 (47.2)
Able to compare two products using labels	Yes	91 (45.7)

Items are listed from highest to lowest proportion correct. Percentages are of 199 responses.

Attitudes toward individual statements are shown in Figure 1. More than nine in ten students agreed or strongly agreed that reading labels is important for health (92.5%), and more than 80% agreed that labels help in choosing healthier foods (80.9%) and can help prevent obesity and diabetes (82.4%). Interest in learning more about labels (72.9%) and trust in the nutrition information on packaged foods (72.4%) were also high. At the same time, 67.3% agreed that reading labels takes too much time, 82.4% agreed that labels should be easier to understand, and 67.8% agreed that price is more important than nutrition when buying food.

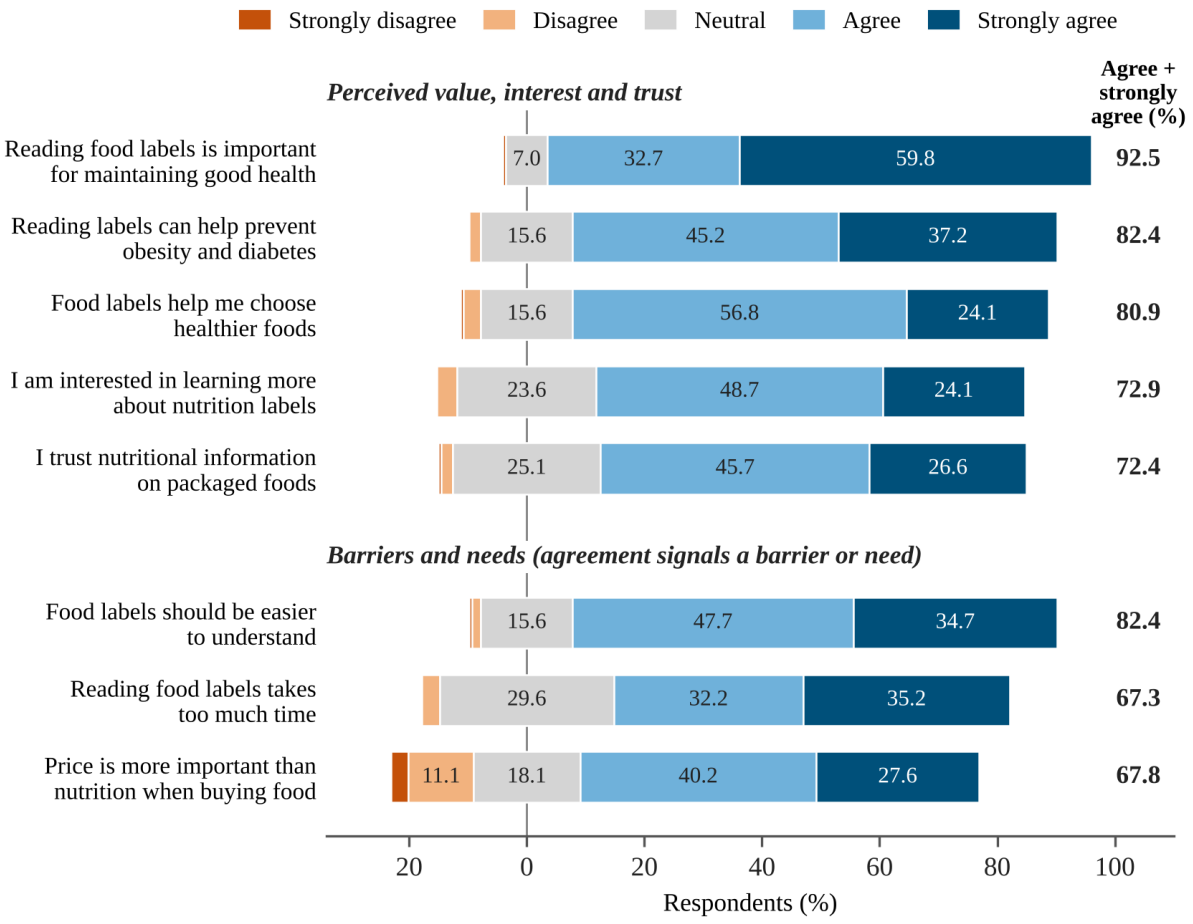


Figure 1. Distribution of responses to attitude statements on food label reading (*n* = 199). Segment values are percentages of respondents; the neutral category is centred on zero. The right-hand column gives the percentage who agreed or strongly agreed.

Label-reading practice was inconsistent (Table 4). Only 20 students (10.1%) always and 89 (44.7%) often read labels before buying packaged foods, whereas 67 (33.7%) did so sometimes, 18 (9.0%) rarely and 5 (2.5%) never. Comparison of labels between products was always done by 37 students (18.6%), sometimes by 114 (57.3%) and never by 48 (24.1%). Students most often checked the expiry date, followed by calorie information, and 30.2% reported having changed their eating habits because of label information.

Table 4. Food-label reading practices of the participants (n = 199).

Practice	Frequency	n (%)
Reads labels before buying packaged foods	Always	20 (10.1)
	Often	89 (44.7)
	Sometimes	67 (33.7)
	Rarely	18 (9.0)
	Never	5 (2.5)
Compares labels between products	Always	37 (18.6)
	Sometimes	114 (57.3)
	Never	48 (24.1)

Percentages are of 199 responses.

Attitude level was significantly associated with practice (χ^2 = 12.445, df = 4, p = 0.014), whereas knowledge level was not (χ^2 = 3.127, df = 4, p = 0.537; Table 5). Knowledge level differed significantly by gender (χ^2 = 24.638, df = 4, p < 0.001), but attitude and practice did not.

Table 5. Chi-square tests of association between sociodemographic, knowledge, attitude and practice variables.

Association tested	χ^2	p
Gender × knowledge	24.638	<0.001†
Gender × attitude	8.595	0.072
Gender × practice	6.998	0.136
Knowledge × practice	3.127	0.537
Attitude × practice	12.445	0.014†

† Statistically significant at p < 0.05.

4. Discussion

4.1 Principal Findings and Overall Interpretation

The present cross-sectional study investigated the knowledge, attitudes, and practices (KAP) of university students regarding food-label reading and healthy food choices in Sialkot, Pakistan. The findings revealed a notable discrepancy between students' nutritional knowledge, their generally favourable attitudes toward food labelling, and their self-reported label-reading behaviours. Among the 199 analysable responses, 50.8% of participants demonstrated good knowledge, 43.7% had moderate knowledge, and 5.5% had poor knowledge. Similarly, 54.8% exhibited positive attitudes, while 45.2% demonstrated moderate attitudes. Nevertheless, only 10.1% always read food labels before purchasing packaged foods, and 24.1% never compared nutritional information between products.

These findings highlight a potential knowledge–practice gap, suggesting that familiarity with nutritional information and favourable attitudes do not necessarily translate into consistent food-label use. Similar discrepancies between nutrition awareness, attitudes, and label-reading behaviour have been documented among university students and young adults in previous investigations [5,21,22,26]. University life represents an important transition al period during which students increasingly assume responsibility for independent dietary decisions. Consequently, understanding the factors influencing their food-label reading practices may contribute to the development of more effective nutrition education and health-promotion strategies [4,21].

4.2 Food-Label Knowledge and Functional Nutrition Literacy

The findings demonstrated consider able variation in participants' understanding of different components of food labels. Knowledge was highest regarding the meaning of expiry dates (89.9%), identification of the Nutrition Facts Panel (88.4%), the relationship between sodium intake and hypertension (86.9%), and the association between excessive sugar consumption and diabetes (79.4%). In contrast, fewer than half reported understanding serving-size information (47.7%) or being able to compare the nutritional composition of two packaged products (45.7%).

This difference highlights the distinction between general nutritional awareness and functional nutrition literacy. Recognising commonly encountered nutritional information does not necessarily indicate the ability to interpret numerical values, calculate nutrient intake, or compare products meaning fully. Previous research has established that nutrition knowledge, general literacy, health literacy, and numeracy can influence consumers' understanding and application of nutrition-label information [10,11]. A more recent randomized experiment also reported that improvements in interpreting front-of-package labels varied by nutrition-literacy level [15]. Similarly, systematic reviews have identified

difficulties in interpreting serving sizes, nutrient declarations, and other numerical information as barriers to effective food-label use [16,17].

The limited ability to compare food products is particularly concerning because nutritional comparison is an important practical application of food-label information. Meaningful comparisons may require consideration of serving sizes, energy values, sodium, added sugars, saturated fats, and nutrient content per serving or per 100 g. Without sufficient interpretation skills, students may recognise the importance of labels but remain unable to use them effectively when making purchasing decisions [10,11,16].

Another notable observation was that 42.2% of respondents reported no previous awareness of food labelling, despite the relatively favourable overall knowledge classifications. This apparent discrepancy may reflect differences between familiarity with the concept of food labelling and knowledge of individual food-safety or nutrition-related terms. It also highlights the importance of distinguishing self-perceived understanding from objectively demonstrated nutritional competence. Previous literature supports the need for practical assessment methods that examine the ability to interpret and apply nutritional information rather than relying exclusively on general knowledge questions [10,11].

4.3 Attitudes Toward Food Labels and Healthy Food Choices

The participants generally expressed favourable attitudes toward food-label reading and its potential contribution to healthier dietary decisions. Most respondents (92.5%) agreed or strongly agreed that reading food labels is important for maintaining good health, while 80.9% believed that food labels assist in choosing healthier foods. Further more, 82.4% perceived food labels as potentially helpful in preventing obesity and diabetes, and 72.9% expressed interest in learning more about nutrition labels.

These findings are broadly consistent with previous research demonstrating favourable nutritional attitudes among university students and associations between attitudes toward healthy eating and nutrition-label use [5,22,26]. Graham and Laska [5] reported that nutrition-label use was associated with healthier dietary intake among college students and partially mediated the relationship between attitudes toward healthy eating and dietary quality. Similarly, Md Zaini et al. [26] reported favourable food-label attitudes among Malaysian university students and identified an association between attitudes and label-reading practices.

The theory of planned behaviour provides a useful conceptual framework for interpreting these findings. According to this theory, attitudes contribute to behaviour al intentions alongside subjective norms and perceived behaviour al control [23]. However, the present study did not directly measure all components of this theoretical framework and therefore cannot establish the mechanisms through which attitudes influence food-label reading.

Despite generally favourable attitudes, participants identified several practical barriers. Approximately 67.3% considered food-label reading too time-consuming, 82.4% believed that labels should be easier to understand, and 67.8% indicated that price was more important than nutritional quality when purchasing food.

These findings suggest that favourable attitudes can coexist with substantial practical and economic constraints. Consumers may value nutritional information but prioritise affordability, convenience, taste, and familiarity when making purchasing decisions. Similar barriers have been identified in previous research investigating consumer understanding and use of nutritional labelling [16,17]. A randomized trial further showed that the healthfulness of simulated purchases depended partly on which front-of-package label design was presented [14]. Therefore, interventions aimed at improving food-label use should address both individual knowledge and the practical conditions influencing food-purchasing decisions.

4.4 Food-Label Reading Practices and Consumer Behaviour

Although most participants recognised the importance of food labels, their reported purchasing practices were inconsistent. Only 10.1% always read food labels before purchasing packaged foods, whereas 44.7% did so often and 33.7% sometimes. In contrast, 9.0% rarely read food labels, and 2.5% never engaged in this practice.

Product comparison was also limited. Only 18.6% always compared food labels between products, while 57.3% did so sometimes and 24.1% never compared nutritional information. This finding is consistent with the relatively low proportion of students reporting the ability to compare products using nutritional labels.

Previous studies have identified several factors influencing nutrition-label use among young adults, including nutritional knowledge, perceived usefulness, dietary attitudes, confidence, and familiarity with label information [5,21,22]. Christoph et al. [21], in a review of university students and young adults, identified associations between nutrition-label use and nutrition knowledge, healthy-eating attitudes, beliefs about labels, and self-efficacy. These observations suggest that nutritional competence and motivation al factors should be considered together when examining food-label reading behaviour.

Participants most frequently reported checking expiry-date information, followed by calorie-related information. This may reflect greater familiarity with readily recognisable food-safety information than with detailed nutritional declarations. Previous reviews have similarly identified selective attention to food-label components and difficulties interpreting numerical information as important characteristics of consumer label-reading behaviour [11,16,17].

Interestingly, 30.2% of respondents reported changing their eating habits because of information obtained from food labels. This observation suggests that label information may influence perceived dietary decision-making in some students. Previous research has reported associations between nutrition-label use and favourable dietary behaviours, including greater consumption of fruits, vegetables, and fibre and lower consumption of some less healthy food products [5]. Meta-analytic evidence has also demonstrated that food labelling can influence consumer dietary choices, although effects vary across settings and outcomes [7]. This variability is consistent with evidence from randomized-study syntheses [8] and a Cochrane review emphasizing uncertainty about some purchasing and consumption outcomes [9].

Nevertheless, the present study relied on self-reported practices and did not objectively measure food purchases, dietary intake, or nutritional outcomes. Therefore, these findings cannot establish whether reported behaviour al changes resulted in improvements in dietary quality.

4.5 Associations Between Knowledge, Attitudes, and Practices

The inferential analysis identified a statistically significant association between attitude level and food-label reading practice ($\chi^2 = 12.445$, df = 4, $p = 0.014$). In contrast, the association between knowledge level and practice was not statistically significant ($\chi^2 = 3.127$, df = 4, $p = 0.537$). These findings indicate that, within the study sample, favourable attitudes were associated with reported label-reading behaviour, whereas the categorical knowledge measure did not demonstrate a statistically significant association with practice.

This observation is broadly consistent with previous research identifying relationships between attitudes toward healthy eating and nutrition-label use among university students [5,22,26]. Graham and Laska [5] reported an association between label-reading behaviour and dietary quality, while Md Zaini et al. [26] identified a significant relationship between attitudes and food-label practices. These findings support the relevance of considering attitudes and behaviour al factors alongside nutrition knowledge when developing education al interventions.

However, the absence of a statistically significant knowledge–practice association should not be interpreted as evidence that nutritional knowledge is unimportant. Miller and Cassady [10] highlighted the potential contribution of nutrition knowledge to effective food-label use, suggesting that knowledge may support information interpretation and informed consumer decisions. The discrepancy observed in the present study could reflect differences in study populations, knowledge measurements, behaviour al classifications, or other unmeasured factors.

Knowledge level also differed significantly across the reported gender categories ($\chi^2 = 24.638$, df = 4, $p < 0.001$). Previous research has identified gender-related variation in nutritional knowledge and label-reading practices among young adults [21]. However, the present study did not establish the direction of the observed difference, and 17.6% of respondents preferred not to disclose their gender. Consequently, subgroup interpretation should remain cautious.

Importantly, the associations observed in this study do not establish causal relationships. Cross-sectional studies are suitable for identifying associations but cannot determine the temporal sequence of exposures and outcomes [27,29]. Further more, potential confounding factors, including socioeconomic circumstances, academic background, food affordability, dietary preferences, and previous nutrition education, were not comprehensively examined.

The use of categorical knowledge, attitude, and practice measures and the possibility of sparse contingency-table cells should also be considered when evaluating the statistical findings. Verification of the original contingency tables and relevant statistical assumptions is necessary before drawing definitive conclusions about subgroup differences.

4.6 Implications for Nutrition Education and Public Health

The findings have important implications for the development of university-based nutrition education and health-promotion programmes. First, education al initiatives should move beyond general nutritional awareness and emphasise practical food-label interpretation skills. Activities involving the comparison of packaged foods, interpretation of serving sizes, calculation of nutrient intake, and identification of added sugars, sodium, and saturated fats may help students apply nutritional information more effectively in everyday food-purchasing situations [10,11,24].

Skill-based education al approaches may be particularly beneficial. Miller et al. [24] demonstrated improvements in label-reading accuracy and perceived empowerment following web-based nutrition-label training among college students. These findings suggest that interactive education al activities and digital tools may provide useful approaches for strengthening practical nutritional decision-making skills.

Second, the substantial proportion of students identifying time constraints highlights the potential value of simplified nutritional guidance. Education al strategies that teach consumers to identify key nutritional characteristics efficiently may reduce the perceived effort required to interpret food labels. Evidence from reviews of front-of-package nutritional labelling suggests that simplified and interpretive formats may facilitate consumer understanding and support nutritional decision-making, although their effectiveness depends on the format and context [7,12]. A broader meta-analysis likewise found that front-of-package labels improved the identification of healthier products, whereas their effects on purchasing and consumption were less consistent [30]. Similarly, a network meta-analysis examined the effects of colour-coded and warning schemes on purchasing-related outcomes [13].

Third, the importance assigned to food prices indicates that nutrition education should consider economic accessibility. Students may face difficulties translating nutritional recommendations into practice when affordable healthier alternatives are limited. Consequently, university health-promotion initiatives could combine nutrition education with efforts to improve the availability and affordability of nutritious food options within campus environments. A recent cross-sectional study among university students in Lahore, Pakistan, similarly identified food prices and limited availability of healthier campus foods as barriers to healthy eating, although it did not specifically assess food-label reading [31].

Fourth, the generally favourable attitudes and expressed interest in learning more about nutrition labels provide an opportunity to incorporate food-label literacy into broader health-promotion activities. Previous literature supports the potential role of nutrition education, awareness programmes, and practical training in improving label-reading competence among university students [21,24].

Therefore, coordinated approaches involving university administrations, nutrition professionals, public-health educators, and campus food providers may be useful for promoting informed dietary choices. However, the effectiveness of such strategies within the present study population remains to be established through appropriately designed intervention studies. Policy evaluations in Chile involved several simultaneous measures and therefore should not be attributed to warning labels alone [18], [19]. Real-world restaurant transaction studies provide complementary, but setting-specific, evidence [20].

4.7 Strengths and Limitations

An important strength of the present study is its integrated assessment of knowledge, attitudes, and practices regarding food-label reading among university students. Examining these domains together provides insight into discrepancies between nutritional awareness, favourable perceptions, and reported purchasing practices. The inclusion of students from three universities in Sialkot also contributes descriptive evidence from different academic settings and adds to the literature concerning food-label literacy among university students [21,26]. Nevertheless, several limitations should be considered. First, convenience sampling limits the representativeness of the sample and restricts the general is ability of the findings to the wider university student population in Pakistan. Participants were recruited from selected institutions within one geographical region, and their nutritional knowledge and purchasing practices may differ from those of students in other provinces, institutional settings, and socioeconomic groups.

Second, the cross-sectional design prevents causal inference and cannot determine whether knowledge and attitudes precede or result from food-label reading behaviour [27,29]. Third, reliance on self-reported data may introduce recall bias, social-desirability bias, and variation in participants' interpretation of questionnaire items.

Fourth, certain knowledge items assessed perceived understanding rather than objectively demonstrated competence. For example, self-reported understanding of serving sizes and ability to compare products may not accurately reflect performance in practical nutrition-label interpretation tasks. Previous literature has demonstrated the importance of literacy and numeracy for understanding nutrition labels, highlighting the value of including objective measures of these abilities [10,11]. Fifth, the relatively modest sample size, unequal gender distribution, and possibility of sparse contingency-table cells may limit the precision and interpretation of subgroup analyses. A substantial proportion of participants also preferred not to disclose their gender, which further complicates the interpretation of gender-related findings.

Sixth, the study did not directly assess actual food purchases, dietary intake, nutritional status, or long-term behaviour al outcomes. Therefore, the findings cannot establish whether reported label-reading practices resulted in improved dietary quality or health outcomes. Finally, in complete itemisation of some demographic categories and differences between the recruited and analysable participant counts may affect the completeness and reproducibility of the reported data. These limitations should be addressed in future research through improved data documentation, validated measurement instruments, and more comprehensive statistical reporting. Consistent with STROBE reporting guidance, participant flow, missing data, and statistical methods should be described transparently [32].

4.8 Recommendations for Future Research

Future research should employ larger and more representative samples across universities and geographical regions to improve the general is ability of findings. Probability-based sampling approaches and carefully documented recruitment procedures would help reduce selection bias and improve the interpretation of population-level patterns [27,29]. Further studies should incorporate validated tools assessing both nutritional knowledge and functional label-reading competence. Objective activities requiring participants to compare packaged foods, interpret serving sizes, and calculate nutrient intake would provide stronger evidence of actual nutrition-label literacy [10,11]. Future investigations should also examine the influence of socioeconomic circumstances, food prices, academic disciplines, previous nutrition education, and health-related attitudes on food-label reading practices. Multivariable statistical approaches may help assess these relationships while accounting for potential confounding factors. Longitudinal and intervention-based investigations are particularly important for determining whether practical nutrition education produces sustained improvements in label-reading competence, purchasing behaviour, and dietary quality. Previous evaluations of skill-based digital training provide preliminary support for investigating such approaches in university populations [24]. Additionally, studies evaluating

simplified nutrition labels, front-of-package systems, and campus-based education al programmes may help identify strategies that are effective and accessible within the Pakistani university context [7,12,21,30,31]. Strengthening functional nutrition literacy and addressing barriers related to label interpretation, time constraints, and food affordability may promote healthier food choices among university students. Further research is needed to evaluate the long-term effectiveness of these strategies.

5. Conclusion

The present study highlights a substantial gap between nutritional knowledge, favourable attitudes, and consistent food-label reading practices among university students in Sialkot, Pakistan. Although 50.8% of participants demonstrated good knowledge and 54.8% exhibited positive attitudes toward food labelling, only 10.1% consistently read food labels before purchasing packaged foods, while 24.1% never compared nutritional information between products. The findings further revealed limited understanding of serving sizes and product comparisons, suggesting that general nutritional awareness does not necessarily translate into practical food-label literacy. Attitudes were significantly associated with food-label reading practices, whereas knowledge levels showed no statistically significant association, highlighting the potential importance of motivation al and behaviour al factors in nutritional decision-making. Perceived time constraints, difficulties interpreting nutritional information, and food affordability emerged as important barriers to consistent label use. These findings under score the need for university-based nutrition education programmes that extend beyond theoretical awareness and prioritise practical label-reading skills, interactive learning activities, and informed product comparisons. Simplified nutritional labelling and improved access to affordable, healthier food options may further support informed dietary choices. Nevertheless, the cross-sectional design, convenience sampling, and reliance on self-reported responses limit causal interpretation and general is ability. Future longitudinal and intervention-based studies incorporating objectively assessed nutrition-label literacy and dietary behaviours are warranted to evaluate the effectiveness of targeted education al strategies and their potential contribution to sustain able healthy food choices among university students.

Declarations

Author contributions: Areeha Javaid, Aniq Ur Rehman, Habiba Shahzad, and Touseef Iqbal contributed equally to the conceptualization, investigation, data collection, data analysis, and preparation of the original manuscript. Touseef Iqbal and Iftikhar Younis Mallhi contributed to the critical review, intellectual evaluation, and substantive revision of the manuscript. Aniq Ur Rehman also contributed to study supervision and research coordination. All authors reviewed and approved the final version of the manuscript and agreed to its submission for publication.

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Institutional review board statement: The study was reviewed and approved by the Ethical Review Committee of Grand Asian University, Sialkot, Pakistan (Approval Reference No. ref-1955-gaus-3951fnas). The research was conducted in accordance with applicable institutional ethical guidelines and the principles of the Declaration of Helsinki.

Informed consent statement: Written informed consent was obtained from all participants prior to their inclusion in the study. Participation was voluntary, and confidentiality of the collected information was maintained.

Data availability: The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to applicable ethical and confidentiality requirements.

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References

1. World Health Organization. Noncommunicable diseases [Internet]. Geneva: World Health Organization; 2025 Sep 25 [cited 2026 Nov 4]. Available from: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases.
2. Lane MM, Gamage E, Du S, Ashtree DN, McGuinness AJ, Gauci S, et al. Ultra-processed food exposure and adverse health outcomes: umbrella review of epidemiological meta-analyses. BMJ. 2024;384: e077310. doi:10.1136/bmj-2023-077310.
3. Hall KD, Ayuketah A, Brychta *R*, Cai *H*, Cassimatis *T*, Chen KY, et al. Ultra-processed diets cause excess calorie intake and weight gain: an inpatient randomized controlled trial of ad libitum food intake. Cell Metab. 2019;30(1):67–77.e3. doi:10.1016/j.cmet.2019.05.008.
4. Sogari G, Velez-Argumedo C, Gómez MI, Mora C. College students and eating habits: a study using an ecological model for healthy behavior. Nutrients. 2018;10(12):1823.

5. Graham DJ, Laska MN. Nutrition label use partially mediates the relationship between attitude toward healthy eating and overall dietary quality among college students. J Acad Nutr Diet. 2012;112(3):414–8.

6. Campos S, Doxey J, Hammond D. Nutrition labels on pre-packaged foods: a systematic review. Public Health Nutr. 2011;14(8):1496–506.

7. Shangguan S, Afshin A, Shulkin M, Ma *W*, Marsden D, Smith J, et al. A meta-analysis of food labeling effects on consumer diet behaviors and industry practices. Am J Prev Med. 2019;56(2):300–14.

8. Cecchini M, Warin L. Impact of food labelling systems on food choices and eating behaviours: a systematic review and meta-analysis of randomized studies. Obes Rev. 2016;17(3):201–210. doi:10.1111/obr.12364.

9. Crockett RA, King SE, Marteau TM, Prevost AT, Bignardi G, Roberts NW, et al. Nutritional labelling for healthier food or non-alcoholic drink purchasing and consumption. Cochrane Database Syst Rev. 2018;2: CD_{009315}. doi:10.1002/14651858.CD_{009315}.pub2.

10. Miller LMS, Cassady DL. The effects of nutrition knowledge on food label use: a review of the literature. Appetite. 2015;92:207–16.

11. Malloy-Weir L, Cooper M. Health literacy, literacy, numeracy and nutrition label understanding and use: a scoping review of the literature. J Hum Nutr Diet. 2017;30(3):309–25.

12. Hawley KL, Roberto CA, Bragg MA, Liu PJ, Schwartz MB, Brownell KD. The science on front-of-package food labels. Public Health Nutr. 2013;16(3):430–9.

13. Song J, Brown MK, Tan M, MacGregor GA, Webster J, Campbell NRC, et al. Impact of color-coded and warning nutrition labelling schemes: a systematic review and network meta-analysis. PLoS Med. 2021;18(10): e1003765. doi:10.1371/journal.pmed.1003765.

14. Grummon AH, O'Sullivan K, Petimar J, Lee CJY, Zeitlin AB, Cleveland LP, et al. Nutrition Info and other front-of-package labels and simulated food and beverage purchases: a randomized clinical trial. JAMA Netw Open. 2025;8(10): e2537389. doi:10.1001/jamanetworkopen.2025.37389.

15. Huang Y, O'Sullivan K, Block JP, Petimar J, Lee CJY, Grummon AH. Impact of the Food and Drug Administration's proposed front-of-package label and alternative designs on consumer understanding: a randomized experiment. Am J Prev Med. 2026;70(5):108222. doi:10.1016/j.amepre.2025.108222.

16. Cowburn G, Stockley L. Consumer understanding and use of nutrition labelling: a systematic review. Public Health Nutr. 2005;8(1):21–8.

17. Grunert KG, Fernández-Celem*ín* L, Wills JM, Storcksdieck genannt Bonsmann S, Nureeva L. Use and understanding of nutrition information on food labels in six European countries. J Public Health. 2010;18(3):261–77.

18. Taillie LS, Reyes M, Colchero MA, Popkin B, Corvalá*n* C. An evaluation of Chile's Law of Food Labeling and Advertising on sugar-sweetened beverage purchases from 2015 to 2017: a before-and-after study. PLoS Med. 2020;17(2): e1003015. doi:10.1371/journal.pmed.1003015.

19. Taillie LS, Bercholz M, Popkin B, Reyes M, Colchero MA, Corvalá*n* C. Changes in food purchases after the Chilean policies on food labelling, marketing, and sales in schools: a before and after study. Lancet Planet Health. 2021;5(8): e526–e533. doi:10.1016/S_{2542}-5196(21)00172-8.

20. Rummo PE, Mijanovich *T*, Wu E, Heng L, Hafeez E, Bragg MA, et al. Menu labeling and calories purchased in restaurants in a US national fast food chain. JAMA Netw Open. 2023;6(12): e2346851. doi:10.1001/jamanetworkopen.2023.46851.

21. Christoph MJ, An *R*, Ellison B. Correlates of nutrition label use among college students and young adults: a review. Public Health Nutr. 2016;19(12):2135–48.

22. Misra *R*. Knowledge, attitudes, and label use among college students. J Am Diet Assoc. 2007;107(12):2130–4.

23. Ajzen I. The theory of planned behavior. Organ Behav Hum Decis Process. 1991;50(2):179–211.

24. Miller LMS, Sutter C, Wilson MD, Bergman JJ, Beckett LA, Gibson TN. An evaluation of an eHealth tool designed to improve college students' label-reading skills and feelings of empowerment to choose healthful foods. Front Public Health. 2018;5:359.

25. Zahid *N*. Food label reading by consumers who buy foodstuff from the market. J Pak Med Assoc. 2013;63(5):659.

26. Md Zaini S, Ibrahim MA, Saad *N*, Mohd Nazori MN, Shamsuddin AS. Knowledge, attitude, and practice on food label use among university students. Int J Allied Health Sci. 2022;6(3):2642–2653. doi:10.31436/ijahs.v6i3.781.

27. Setia MS. Methodology series module 3: cross-sectional studies. Indian J Dermatol. 2016;61(3):261–4.

28. Tavakol M, Dennick *R*. Making sense of Cronbach's alpha. Int J Med Educ. 2011;2:53–5.

29. Wang X, Cheng *Z*. Cross-sectional studies: strengths, weaknesses, and recommendations. Chest. 2020;158(1 Suppl): S_{65}–71.

30. Ikonen I, Sotgiu *F*, Aydinli A, Verlegh PWJ. Consumer effects of front-of-package nutrition labeling: an interdisciplinary meta-analysis. J Acad Mark Sci. 2020;48:360–383. doi:10.1007/s11747-019-00663-9.

31. Mussarat H, Tariq U, Anis ZB, Khalid N. Nutrition knowledge, eating practices and barriers to healthy eating among university students in Pakistan. Nutr Health. 2026 Jun 24:2601060261462425. doi:10.1177/02601060261462425.

32. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Bull World Health Organ. 2007;85(11):867–872. doi:10.2471/BLT.07.045120.