

FOOD QUALITY MANAGEMENT AND PATIENT SAFETY IN HEALTH CARE

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Food insecurity is a serious public health issue, which highlights the necessity for access to nutritious and quality food. With the increasing awareness of appropriate food handling methods, consumer behaviour has emerged as a critical area of interest. This study focuses on the impact of demographic characteristics on participants' dietary choices and behaviours. In this aspect, a cross-sectional study was conducted to investigate the factors involved. The results of the study were analysed through descriptive statistics, correlation and regression analysis. Statistical analysis of the factors such as age and education with food quality, purchasing pattern of fresh and processed food, and food nutritional labels all showed significant impact, indicating a moderately positive but significant correlation of age and education with food quality and nutritional choices, except processed food purchasing behaviour, which showed a significant but negative correlation with age. The study also indicated through the Regression Predictor Model that consumer choices are driven most significantly by participants' income range. The study concluded that consumer prioritisation of high-quality food and good nutritional value impacts their food choices, which is largely affected by age, education and income range.

1. Introduction

1.1 Food Quality and Nutritional Attributes

The global food system is a set of procedures through which food is produced and distributed to consumers. There are various factors that influence this system. To facilitate the farm-to-fork approach, different international standards are followed. One of these standards hugely focuses on food quality. A set of characteristics, i.e., physical, chemical, and sensory properties of any food product that dictates the overall performance in the market and influences consumer decision-making, is called food quality (Anis et al., 2022). A number of factors, including safety, nutrition, and acceptability by consumers of a food product, determine food quality. In recent decades, the demand for high-quality food products has tremendously increased. This high demand can be due to the increasing market pressure and knowledgeable consumers, as well as due to the health concerns (Okpala and Korzeniowska, 2023). According to human civilisation, around 690 million people have a shortage of food. Similarly, the second type of malnutrition destruction results from the 677.6 million obese people, or 13.1 % of the global population (Soni and Khan, 2023). Based on the interplay between personal traits that influence food choices and obesogenic settings, the

high prevalence of overweight and obesity, particularly in metropolitan areas, can be linked to a decrease in the quality of diet, physical activity and lifestyle (Chen and Antonelli, 2020).

Food is composed of protein, lipids, and carbohydrates as well as a few significant elements, i.e., vitamins, minerals and additives that are noted on nutrition labels (Meijer et al., 2021). Inadequate nutrition can lead to deficiencies and related health problems (Awuchi et al., 2020). The significance of how nutritional information on food labels is helping consumers make more informed choices is developing. Important factors include assessment of significant nutrients in daily meal preparation, as well as their perception of accepting and/or rejecting nutrients. Nutritional labels are promisingly used by consumers who place a high value on nutrition.

1.2 Public Health

Over the past 20 years, foodborne disease (FBD) has become a significant and expanding public health and financial concern in numerous countries, including Pakistan (Ismail et al., 2021). In Pakistan, it is common to contract hepatitis, typhoid, influenza, animal-borne infections, aerosolised dust, and soil contact diseases due to unhygienic and unsanitary conditions, absence of proper food standards, and poverty (Al-Shareef et al., 2023). Patient safety is defined as a health care discipline that emerged with the evolving complexity in health care systems and the resulting rise of patient harm in health care facilities, according to the World Health Organization (WHO) (Al-Worafi, 2023). One of the main preventable risks that are linked to patient safety is dietary errors (Ente and Ukpe, 2022). Stunting indicates chronic or repeated undernourishment, while underweight indicates current nutritional status brought on by inadequate or unbalanced intake and/or underlying disease (Huang et al., 2021). Underweight and/or stunting have been linked to negative health outcomes for the individual as well as an increased likelihood of unfavourable life conditions, especially in vulnerable groups. On the other hand, obesity and overweight have been connected to early mortality and the start of non-communicable diseases (Baxter et al., 2023).

1.3 Food Safety

Food safety in service establishments is seriously threatened by food handlers who lack sufficient food safety knowledge (Ahmed et al., 2021). Because there is no monitoring, surveillance, or infection control in place, it is difficult to provide accurate estimates for foodborne illnesses in Pakistan. One of the main causes of aflatoxin contamination and Mold growth is improper handling and storage of milk, cereal grains, and nuts. Numerous studies show that heavy metals are present in a wide variety of foods (Akhtar, 2015). Rise in consumer awareness has led to consumers choosing good quality and nutritious food, as consumers' choices are more inclined towards the quality, safety and overall nutritional content of the food product rather than the price (Çakmakçı and Çakmakçı, 2023). However, purchasing of food products has been dependent on several factors, likely the affordability, accessibility, brand reputation, safety, cultural values, and quality of food (Chen and Antonelli, 2020). According to studies conducted in the food industry, the quality of food has a significant impact on the customer experience (Hidayat et al., 2020). Other than quality and safety of food, nutritional attributes are of utmost importance for patient safety, as several studies have strongly suggested the impact of various nutrients in food on consumption patterns and purchasing behaviour of individuals.

2. Methodology

2.1 Study Design

The design of the research is an observational, cross-sectional study. This design is supplemented with a questionnaire-based survey. The research design is in a descriptive manner that determines the impact of consumer education on their informed food choices, along with the factors that link food to patient safety in Pakistan. This study meets the ethical criteria for human non-procedural investigations on the registration number SE RKEB 160/2025 of the Institutional Review Board.

The target population of the study are consumers from Pakistan. A simple random sampling technique is used to collect information. Inclusion criteria are the population from Pakistan, aged between 20 and 50 y. Gender has been categorised into two: male and female. There is no restriction on education level and employment, as male or female students, unemployed and employed are included in this study. After determining the target population, the inclusion and exclusion criteria of the sample, the sample size was calculated using the WHO sample size calculator. The sample size is 300 participants. A common formula for sample size calculation is:

$$(1) \quad n = \frac{z^2 \cdot p \cdot (1 - p)}{E^2} - a$$

2.2 Data Collection

Data collection for this study was conducted using a structured questionnaire designed to gather relevant and comprehensive information from participants. The current questionnaire was developed through a comprehensive review of food frequency questionnaires and existing validated questionnaires related to food intake and health problems (Pan et al., 2023) and food quality and its diversity in meals (Herforth et al., 2024). The questionnaire was distributed through social media platforms. The reliability of the questionnaire was evaluated through Cronbach's alpha value (0.81). Informed consent was gained after providing detailed electronic information about the purpose of the study and data management and protection.

2.3 Data Analysis

A combination of quantitative and qualitative strategies was used for the analysis of results. Qualitative analysis is based on semantic analysis, through which the factors that are associated with a change in consumer perception for food products are evaluated. Quantitative analysis is done through descriptive analysis for a cross-sectional study, as well as chi-square analysis and linear regression to find out the significance of the relationship between different factors. All the analyses were conducted using SPSS software.

3. Results

A total of 300 individuals from the target population (aged 20–50 y) were initially approached. After applying exclusion criteria, incomplete questionnaires (missing data), terminal illness, and inability to read English, a final sample of 224 participants was included in the analysis.

3.1 Socio-Demographic Data

Descriptive analysis of the data showed the socio-demographic data of the study. The age, gender, education level and income range of the participants were recorded. Table 1 shows the relative frequency and percentages of the variables. 52.25 % of the participants were male, and 47.8 % were female. In terms of age distribution, the participants were divided into five categories, i.e., under 18 y of age to above 45 y of age. Another important aspect of the study is to analyse the knowledge (education) level of the participants to evaluate the impact of consumer education on participants' dietary choices and behaviours. The educational backgrounds of respondents were quite varied; most of them were graduates (52.2 %) or were doing undergraduate studies (31.7 %). Another important factor was considered to evaluate the socio-economic status of the participants. Socio-economic status widely influenced the food purchasing behaviour of the participants. For such reason, the monthly income range is being assessed. The table showed that participants are widely distributed in lower income, 25.4 %, lower-middle, 27.2 %, middle class, 15.2 %, upper- 5.8 % and upper-class income of about 26.3 %. This data depicted the variance in the individual socio-economic status, with around 50 % of the participants belonging to the lower and lower-middle classes.

Table 1: Socio-demographic data of the participants

Variable	Frequency	Percentage
Male	117	52.2 %
Female	107	47.8 %
Age (y)		
Under 18	17	7.6 %
18-25	58	25.9 %
26-35	41	18.3 %
36-45	26	11.6 %
Above 45	82	36.6 %
Education Level		
Secondary	36	16.1 %
Undergraduate	71	31.7 %
Graduate/ Post Graduate	117	52.2 %
Family Income Range		
Lower income	57	25.4 %
Lower-Middle	61	27.2 %
Middle income	34	15.2 %
Upper-Middle	13	5.8 %
Upper Income	59	26.3 %

3.2 Statistical Analysis of Food Intake and Nutrition Preferences

This study explored the statistical correlation between demographic factors, food intake, and nutrition preferences to analyse patterns that evaluate participants' dietary choices and behaviours. Table 2 shows the Pearson correlation analysis of the importance of food quality when choosing products with age. The data shows that the $p < 0.001$ value is statistically significant, indicating that there is a significant relation between the food quality and age groups. Moderate positive correlation $R (0.393)$ that suggests that as age increases, individuals tend to place greater importance on food quality when making purchasing decisions. The correlation coefficient $R (0.410)$ indicates a moderate positive correlation between them, stipulating that as the age increases, the consumer practice of checking food labels while purchasing also increases. Consumer food consumption is highly affected by their purchasing habits. This study showed

a moderate positive correlation (0.412) between age and purchasing fresh fruits and vegetables as part of their grocery shopping and a negative low correlation (-0.228) of processed food consumption. The level of significance of correlation is statistically significant ($p < 0.01$) in both analyses shown on the Table 3.

Table 2: Correlation analysis of food quality with age

		Age	How important is food quality for you when choosing products?	How often do you check food labels for nutritional information before purchasing?
Age	Pearson Correlation	1	,393**	,410**
	Sig (2 tailed)		0	0
	N	224	224	224

**Correlation is significant at the 0.01 level (2-tailed).

Table 3: Correlation analysis of purchasing behavior pattern of fresh foods and processed food with age

		Age	How often do you purchase fresh fruits and vegetables as part of grocery shopping?	What proportion of your food purchases are processed or packaged foods?	When purchasing food, how important is the nutritional content (e.g., vitamins, calories, or ingredients)?
Age	Pearson Correlation	1	,412**	-,228**	-0,089
	Sig (2 tailed)		0	0,001	0,186
	N	224	224	224	224

**Correlation is significant at the 0.01 level (2-tailed).

In this study, the nutritional content of the food is described as the amount and quality of essential nutrients and calories in the food. Participants were asked to indicate the importance of nutritional content as a factor that drives their food purchasing behaviour. It shows that around 54.4 % of the participants indicated that nutrition content is an important/Very Important factor while purchasing food. However, most of the participants indicated that it was an important aspect while purchasing. There was no statistically significant ($p > 0.01$) relation between the nutritional content and age.

3.3 Impact of consumer education on participants' dietary choices and behaviour

It is important to evaluate the impact of consumer education on participants' dietary choices and behaviours. Table 4 shows a significant but modest positive correlation ($r = 0.139$, $p = 0.038$) between participants' education level and their belief that poor food quality contributes to long-term health problems. Similarly, the importance of food quality in relation to education ($r = 0.210$, $p = 0.002$) shows a significant positive correlation. This suggests that individuals with higher education levels are more likely to recognise the link between diet quality and future health risks.

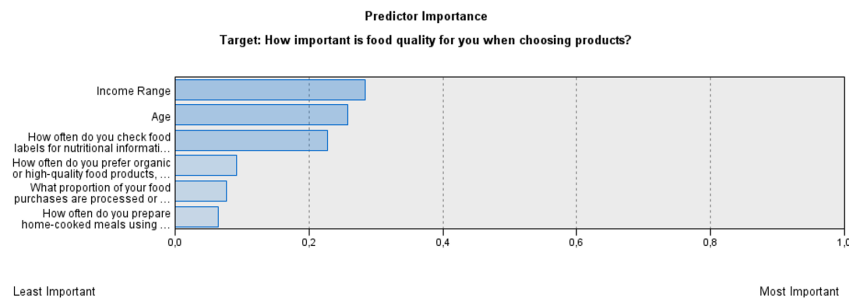


Figure 1: Regression Model: Predictor of consumer food quality choices

Table 4: Correlation analysis of education with consumer food purchasing and preparing habits

		Education Level	How often do you believe poor food quality contributes to long-term health problems?	How important is food quality for you when choosing products?	How often do you prepare home-cooked meals using whole, unprocessed ingredients?
Education	Pearson Correlation	1	,139*	,210*	,114*
	Sig (2 tailed)		0,038	0,002	0,09
	N	224	224	224	224

3.4 Regression Model: Predictor of consumer behavior

According to this model, participants' income range is the most significant predictor of how much weight they give to food quality when making product selections, closely followed by their age and how often they read food labels. Other variables, such as the degree of intake of processed meals and a preference for organic foods, have less of an impact (Figure 1). This implies that socioeconomic variables and well-informed purchasing practices have a major role in determining food quality.

3.5 Analysis of Factors Influencing the Importance of Food Quality in Consumer Choices

The multiple regression analysis (Table 7) examined the extent to which age, gender, education level, and income range predict the importance placed on food quality when selecting products. Results indicated that both age ($\beta = 0.268$, $t = 3.364$, $p < .001$) and income range ($\beta = 0.234$, $t = 3.363$, $p < .001$) were statistically significant predictors, suggesting that older individuals and those with higher income levels are more likely to prioritise food quality during purchasing decisions. In contrast, gender ($\beta = 0.039$, $t = 0.567$, $p = .571$) and education level ($\beta = 0.079$, $t = 1.193$, $p = .234$) were not significant predictors, indicating limited influence on the importance attributed to food quality.

Table 7: Regression Analysis of Factors Influencing the Importance of Food Quality in Consumer Choices

Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.
	B	Std. Error	Beta			
1	(Constant)	2.764			8.144	.000
	Age	.197	.059	.268	3.364	.001
	Gender	.081	.142	.039	.567	.571
	Education Level	.110	.092	.079	1.193	.234
	Income Range	.157	.047	.234	3.363	.001

a. Dependent Variable: How important is food quality for you when choosing products?

4. Discussion

The study reveals significant factors that influence consumer dietary choices. These factors are being analysed relating the knowledge of consumers regarding food quality, safety and nutrition (importance of quality, food labels and national quality of food) with consumer food purchasing behaviour and practices (fresh food consumption, processed food consumption, nutritional content of food, home-cooked food practices). These parameters were evaluated on the basis of the consumer's demographic data (education level and age).

The results are in line with a study by Dongli Mei that also showed various components such as sex, age, career, family health status and socio-economic status influencing eating behaviours of residents in China (Mei et al., 2022). The study showed a significant impact of age on consumer food choices, depicting that as the age increases, individuals tend to place greater importance on food quality. The reason to categorise the age of the participants was to analyse the differences in consumer choices among adolescents, adults, and older adults. However, the frequency of those under 18 y of age (adolescents and children) was reportedly less (7.6 %), which might be due to the reason that adults play a role in the development of their children's dietary patterns which not only includes the purchasing of food but also modelling food-related behaviours (Mei et al., 2022). Correlation of age groups with food quality is statistically significant, supported by a study which showed that adolescents, and young adults (18-30 y) are more inclined towards functional, processed and convenience foods that might compromise the quality of food however, older adults (above 30 y old) are more attracted towards higher quality-assured, organic and nutrient-dense foods (Rai et al., 2023). Similarly, the older age group (above 45 y) had a better level of understanding and practice. As supported by the findings from a study conducted in Portugal, there is a positive association ($p = 0.019$) between the understanding of the label information present on food and the age group of the participants (Silva et al., 2022). Consumers with a low level of interest in fresh foods were mainly referred to as young and less educated.

Similarly, the influence on consumer purchasing habits largely depends on consumer education level. The study showed that consumer knowledge is significantly affected by their beliefs and practices. The higher level of education has also been depicted to increase the nutrition knowledge of participants. A study by Scalvedi has shown that consumer change their perception about the food upon gaining knowledge. However, young people with rural background and low education level were associated with low nutrition knowledge and unhealthy eating habits (Scalvedi et al., 2021). These results showed that nutritional content is a significant factor in consumer food choices. A study conducted in the US also emphasises the

association of education with diet quality varied by race and ethnicity (education: P for interaction $< .001$) (McCullough et al., 2022). Another study also showed the impact of dietary patterns on health outcomes, suggesting that high-quality food, physical activity, and education are associated with a low risk of liver diseases (Vilar Gomez et al., 2022). Regression analysis of the current study data also aimed to support the hypothesis that various demographic factors, including age, gender, education and income range, had an influence on consumer choices, which eventually affected patient safety. The results imply that consumers' purchasing behaviour towards high food quality is significantly influenced by age and income, which may be a reflection of older and wealthier people's greater purchasing power and health consciousness.

5. Conclusion

The study concluded that age, education level and income range of the participants had a significant effect on consumer prioritisation of food quality in Pakistan. Individuals with higher education levels were more likely to recognise the link between diet quality, its nutritional attributes and future health risks than people with lower levels. And people in older age groups and with higher income levels were more inclined towards good quality and nutritional food even during their hospital stay.

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