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Cook NR, Rosner BA, Hankinson SE, Colditz GA. Mammographic screening and risk factors for breast cancer. American Journal of Epidemiology. 2009 Dec;170(11):1422-32. doi: 10.1093/aje/kwp304.

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Conclusion should elucidate how the results communicate to the theory presented as the basis of the study and provide a concise explanation of the allegation of the findings.

ACKNOWLEDGEMENT

Provide the list of individuals who contributed in the work and grant details where applicable.

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Nutrition Professionals' Dietary Habits and Alignment with Professional Advice: A Survey of Dietitians and Nutritionists

Alzumar Gul Khan, Joat Khalid, Maha Ikram

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The Miracle of The Hive: Apitherapy

OPEN ACCESS

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This article discusses scientific reviews of the applications of honeybee products in human health and nutrition studies. Applications for treating diseases date back many years, but numerous new applications for human health have been discovered in recent times.

Honeybee products have been discovered to possess therapeutic properties even against various types of cancer, and researchers are continuing their studies to uncover other secrets behind the therapeutic properties of honeybee products. These products are consumed due to their high nutritional value and effects on human health; in addition to their anti-oxidant, bacteriostatic, anti-inflammatory, and anti-microbial properties, they are also used in the healing of wounds and burns. Furthermore, therapeutic effects of honeybee products against Covid-19, a disease that significantly affects global health, have also been discovered.

All products produced by bees can be divided into two major groups: animal-derived and plant-derived products. Plant-derived products include honey, pollen, and propolis, which the honey bees collect from flowers and store in their hive. Animal-derived products include royal jelly, beeswax, and bee venom, which the bee produces within its own body. All of these components are vital for the bee, and without them, the bee and the entire hive cannot survive. The component of honey bee products is changeable, via the diversion in plant species, climate, phytogeographic conditions, and supplements of the beekeeper.

The apitherapy encompasses the use of beehive products, including honey, pollen, propolis, royal jelly, and bee venom. Honey and bee products have accompanied humanity throughout history. Honey has sweetened people's lives and provided protection against many diseases. Since then, we have gathered much information about the formation, types, properties, and uses of honey. However, all its secrets have yet to be discovered. Ancient rock paintings of the first hunter-gatherers depict the honeybee as a natural source of medicine. Scientists pay great attention to the natural antioxidants. Honey bees products are gathered from lots of plant resources and generated by honeybees (Apis mellifera). Most of studies demonstrated that some products of honey bees from various countries have dedicate antioxidant property; depend on the amount of various bioactive components. Honey bees products have great effects because of its important compounds and also drug character. As a result, it is largely extincted by most of countries of the world. Apitherapy is used to treat many illnesses and to alleviate pain from wounds both chronic and acute. Bee-assisted therapies have existed for thousands of years, some possibly as old as human medicine itself. Going beyond traditional Western medicine, this therapy helps people achieve better health through a holistic approach in harmony with the beehive, a true gift of nature. Besides the phrase "no fruit," there's something else, but with significant consequences along the chain. Without bees, plants wouldn't bear fruit, and many animals would die because there would be nothing to eat. This would affect not only vegetarianism but also our dietary habits, restructuring relationships and the economy. When we hear the word bee, the first thing that usually comes to mind is honey. Beautiful, delicious, healthy, and sweet honey. But are we truly aware of how important a role they play in our

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existence? We've all heard the famous scientist Albert Einstein say: "If the world were to disappear, humanity wouldn't survive for more than four years." A third of the food people consume comes from insects, and 80% of that is produced by bees. If insects disappeared, there would be no crops, no harvests, and production would be of very low quality. Besides giving us the opportunity to consume quality produce, they are one of the main carriers of approximately half of the planet's vegetation. A world without bees would literally mean a world without fruits, vegetables, nuts, and seeds. And a lack of honey would be the least of humanity's problems.

In conclusion, bee products have proven to be one of the most valuable therapeutic and nutritional substances nature can offer; this demonstrates the great value of beekeeping science.

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Review Article

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Nutrient-Based Interventions for Mental Health: A Psychosomatic Medicine Perspective

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ABSTRACT

The psychosomatic paradigm underlines the complex connection between psychological aspects and physical health. The review will discuss the importance of nutrition in this context, paying attention to the effects that certain elements of the diet have on mental health. The most important nutrients are B vitamins (B6, B12, folate), omega-3 fatty acids, magnesium, vitamin D, and amino acids (tryptophan, tyrosine), which are necessary in the synthesis of neurotransmitters, neuroprotection, and in the modulation of stress responses. The lack of these nutrients is linked with the risk of getting depressed, feeling anxious, and being less cognitive. These findings are transforming the field of psychosomatic medicine into the new trends of personalized nutrition, digital health, and psychoneuroimmunology. Yet, there are obstacles to the implementation of holistic nutrition interventions, such as the necessity of mindfulness-based eating interventions, emotion control during dietary counseling, and efficient behavior change models. By managing psychosomatic-related factors with specific nutritional approaches, there is an excellent opportunity for more successful and individualized healthcare, based on the concept that the mind and body are one inseparable organism. These approaches require further research and integration into the systems in order to optimize them.

INTRODUCTION

Psychosomatic medicine deals with the bidirectional interactions that are complex and multifaceted between the psychological states and physical health [1]. The modern medical practice is slowly appreciating the fact that psychosocial influences, such as chronic stress, emotional conditions, and thoughts, play a major role in the emergence, progression, and treatment of somatic diseases [2]. It is a change from a purely disease-based model to a biopsychosocial one [3]. The key element of this strategy is the paradigm of partnership, which transforms the concept of patients into active partners in their care, thus maximizing engagement and self-management efficacy [4]. The fundamental tenet of psychosomatic medicine is to bring this whole picture into clinical practice, to focus on the evaluation of psychosocial vulnerabilities, and to integrate psychological strategies into prevention and treatment programs [5]. It is an integrated model that is essential in the management of conditions in which mind-body processes are vigorous, like in functional somatic syndromes and chronic illnesses comorbid with

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depression or anxiety [6]. In this paradigm, nutrition comes out as one of the most important modifiable factors at the mind-body interface. Eating habits and macronutrients were directly found to impact neurochemistry and systemic inflammation and stress physiology, which in turn impact mental well-being and psychiatric risk. Nonetheless, there is a need to have a unified review utilizing the application of a psychosomatic lens to nutrient-based intervention towards mental health.

This study aims to consider the importance of the main nutrients in mental health based on the concept of psychosomatic medicine, to address the new tendencies in individualized and technology-enhanced interventions, and to describe the practical issues of implementing holistic approaches to nutrition. It is based on this evidence that we would like to point out avenues of more effective, integrated healthcare that can be both psychologically and physiologically concerned with the well-being. Factors of Psychometric Health.

Psychometric Factors of Health

Emotional States: Long-term stress may adversely affect the physical health and predispose to such conditions as cardiovascular disease, immune dysfunction, and gastrointestinal disorders. Depression may result in the loss of individual health, loss of physical activity, unhealthy diet, and even cause other physical symptoms such as chronic pain or physical exhaustion. Personality Traits: Neuroticism is linked with bad emotional conditions, e.g., anxiety, depression, and stress. The increased neuroticism will imply an increased risk of mental and physical health issues [7]. Extraversion pertains to good social relationships and physical exercises, which help in enhancing mental and physical wellness. Cognitive Factors: The beliefs of the individual regarding his or her health, such as perceived health threatfulness and perceived threat severity, may also affect health-related behavior. Locus of Control: It suggests whether one has the belief that his/her health is in his/her control (through behavior) or it is in God's control (through fortune). Individuals who have an internal locus of control are more prone to healthier behaviors. Psychological Factors: Self-Esteem and Self-Concept: The beliefs that a person holds about themselves influence his or her emotional well-being and the development of personality. High self-esteem correlates with mental health outcomes, whereas low self-esteem correlates with depression and social estrangement. Cognitive Biases: ways of thinking, e.g., optimism or pessimism, are ways of interpreting life events and processes of managing stress. Positive thoughts have been associated with resilience and improved health, whereas negative patterns of thought may worsen emotional problems [7]. Behavioral and Lifestyle Choices: Exercise has a positive effect on mood, stress, and cognitive functioning. Exercise is linked to lower levels of anxiety, depression, and neuroticism. Nutrition and sleep quality affect brain function, mood, and emotional stability. Poor sleep is associated with irritability, cognitive difficulties, and stress sensitivity [8] (Table 1).

Table 1: Psychometric Factors of Health

Psychometric Factors	Function	References
Emotional States	Emotional state refers to an individual's Feelings or moo data particular point in time.	[8]
Personality Traits	Personality characteristics are relatively stable, consistent, and sustainable internal characteristics derived from the behavioral model. Personal attitude, emotions, and habits.	[8]
Cognitive Factors	Cognitive factors apply to psychological processes and activities related to obtaining, treatment, storage, and use of information.	[9]
Psychological Factors	Psychological factors are functional factors that contribute to the development of personality, the maintenance of health and well-being, and the etiology of mental and psychological disorders. behavioral disorders	[10]
Behavioral and Lifestyle Choices	Lifestyle factors refer to the choices and behaviors people make that can have a significant impact on their overall health and well-being.	[11]

Nutrition Intervention Related to Mental Health

Nutrition plays a critical role in mental health, and nutritional interventions can help manage or improve various mental health conditions. Recent publications are mainly concentrated on physical exercise and mental health, and nutrition and food users are less qualified health care professionals. And also, evaluations can be exposed. Here are some keyways in which specific nutrients, dietary patterns, and targeted nutritional interventions impact mental health.

Vitamins B (B6, B12, Folate): Sources are Leafy greens, legumes, whole grains, eggs, meat, and fortified cereals. Impact on Mental Health of B vitamins, particularly B6 (pyridoxine), B12, and folate (B9). They are involved in the production of mood-regulating neurotransmitters such as serotonin, dopamine, and norepinephrine. Low levels of these vitamins have been linked to an increased risk of depression, cognitive decline, and fatigue. This is mainly through the maintenance of neurotransmitter production, protectiveness of neurons against toxins (e.g., by reducing homocysteine), and the general state of cognitive functioning. Thus, a dietary intervention, which implies sufficient consumption of B vitamins in food or

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supplements, can potentially decrease the risk of mood disorders and aid cognitive health, especially among such populations as older adults or those with dietary limitations [12]. Omega-3 Fatty Acids: Flax seeds, chia seeds, walnuts, and fish oil supplements are sources of omega-3 fatty acids. Impacts on the mind The omega-3 fatty acids, particularly EPA and DHA, are omega-3 fatty acids that are anti-inflammatory and are imperative to the health of the brain. Research has demonstrated that they can minimize depression and anxiety symptoms, particularly with patients who are severely depressed. They are also able to enhance thinking abilities and avoid neurodegenerative illnesses. Their mode of action involves the regulation of neurotransmitter systems, stress response, and neuroplasticity. Therefore, supplementation of omega-3 or eating more of it is a valuable adjunctive treatment of mood disorders and general brain health [13]. Magnesium: The multi-vegetables, nuts, seeds, whole grains, beans, and dark chocolate are sources of magnesium. The effect on the psychological health of magnesium is associated with brain function and regulates the hypothalamic-pituitary-adrenal (HPA) axis, so the human body's pressure reaction. Magnesium deficiency is associated with increased anxiety, depression, and irritability. Mechanistically, magnesium aids in controlling neurotransmitter release, reducing neuroinflammation, and promoting neuronal plasticity. Consequently, intervention through magnesium supplementation or increasing magnesium-rich foods in the diet may help alleviate symptoms of anxiety, depression, and chronic stress [14]. Vitamin D: Sources include exposure to sunlight, fatty fish, egg yolks, fortified dairy products, and dietary supplements. The effects of vitamin D receptors on mental health are located in areas of the brain that regulate mood and behavior, and deficiency of this vitamin is associated with increased rates of depression, seasonal affective disorder (SAD), and cognitive impairment. Its mechanisms involve promoting neurotransmitter synthesis, reducing neuroinflammation, and protecting against oxidative stress. Intervention with vitamin D supplementation is therefore recommended for individuals with low serum levels, especially in regions with limited sunlight, to help alleviate depressive symptoms and support brain function [15]. Amino Acids (Tryptophan and Tyrosine): Sources are protein -rich foods such as eggs, turkey, chicken, fish, nuts, seeds, and dairy products. The effects on the mental health of amino acids such as tryptophan and tyrosine are precursors for neurotransmitters such as serotonin and dopamine, which are important mood regulators. Low levels of these amino acids can lead to impaired neurotransmitter function and contribute to mood disorders. Intervention for increasing intake of tryptophan and tyrosine through diet or supplements can help improve the production of serotonin and dopamine, potentially alleviating symptoms of depression and anxiety. Their mechanism is direct: sufficient dietary intake ensures the substrate availability needed for the synthesis of these mood-regulating chemicals. Therefore, a targeted nutritional intervention to increase intake of tryptophan- and tyrosine-rich foods (or specific supplements under guidance) can support the production of serotonin and dopamine, potentially alleviating symptoms of depression and anxiety [16] (Table 2).

Table 2: Vitamins and Minerals RDA

Vitamins/ Minerals	RDA	References
B Vitamins (B6, B12, Folate)	The recommended daily allowance of vitamin B12 for adults is 2.4 µg/day.	[17]
Omega-3 Fatty Acids	The National Institutes of Health recommends 1-1.5 grams daily.	[17]
Magnesium	The Recommended Dietary Allowance (RDA) for adults aged 19 to 51 and over is 400 to 420 mg per day for men and 310 to 320 mg for women.	[8]
Vitamin D	Not more than 100 micrograms a day.	[18]

Psychometric Medicine: Emerging Trends and Perspectives

The field of psychometric medicine is changing fast, introducing new devices, technologies, and methods that incorporate psychological testing into mainstream health care. The field is being innovated by emerging trends such as personalized medicine, artificial intelligence (AI), digital health, and psychoneuroimmunology. Specifically, AI and machine learning are becoming more popular to examine complex psychometric data and provide greater accuracy of diagnosis and tailored treatment course of mental diseases. These changes are bound to enhance treatment, prevention, and diagnosis of mental and physical health disorders, and psychometric medicine will be an essential part of contemporary care. Personalized Medicine: With the use of psychometric tests in conjunction with individualized medical information, providers of healthcare can provide more personalized care to both mental and physical conditions. This has the capability of enhancing the efficacy of treatment in such conditions as depression, anxiety, chronic pain, and cardiovascular disease [19]. Psychometric-Based Prediction Models: They are models that use information on personality tests, cognitive tests, and emotional profiles to forecast the risk of numerous health conditions. Psychometric models may be useful in assisting clinicians to identify patients at high risk of some diseases and customizing preventive interventions. As an example, high levels of stress and anxiety can put a person at higher risk of heart disease, and early interventions must be done by lifestyle change [20] (Figure 1).

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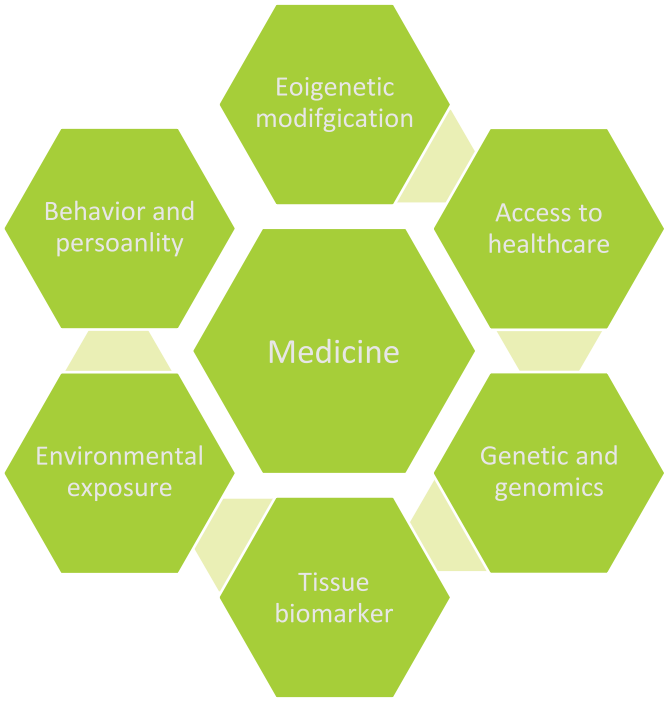

Figure 1: The Role of Psychometric Assessments in Personalized Medicine

Integration with Digital Health and Wearables: The integration of psychometric assessments with digital health tools (e.g., mobile apps, wearables, and telemedicine platforms) is enabling continuous monitoring of mental and physical health. Physiological data (heart rate, sleeping patterns) can be monitored with the help of wearables, whereas psychological (mood, stress, cognitive) data are measured with the help of apps [21] (Figure 2).

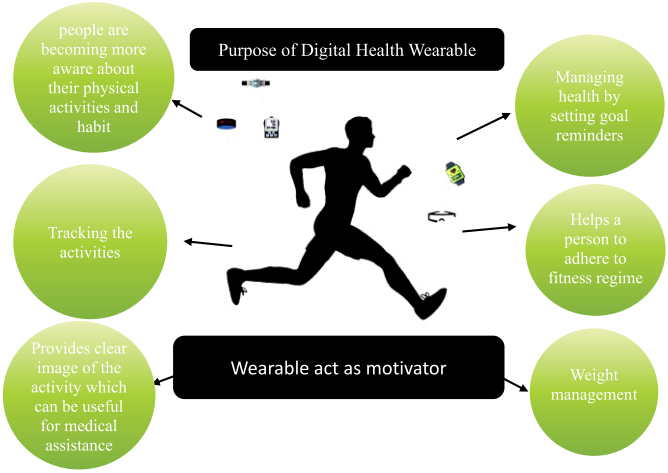

Figure 2: Integration with Digital Health and Wearables

(AI) and Machine Learning

Machine learning and artificial intelligence have been applied to analyze complex data of psychological measurements. The technologies can identify trends in big collections of data that would otherwise be overlooked by human clinicians and provide a bit of insight into the behavior and cognitive capabilities, as well as the emotional conditions of patients. Psychometric tests that are run using AI can make the diagnosis of mental disorders more precise and effective [12].

Trauma-Informed Care and Psychometrics

Psychometric tests are also finding a place in trauma treatment, where the severe effects of trauma on both mental and physical health are realized. Trauma exposure, PTSD symptoms, and emotional resilience assessment tools are gaining prominence in the healthcare environment [22]. With the help of psychometric instruments to frame psychological factors associated with trauma, healthcare providers could provide more personalized, caring care to trauma survivors. This will assist in avoiding traumatization, as well as facilitating long-term recovery, both physical and psychological.

Fundamental Concept of Psychosomatic Disorder

The primary feature of psychosomatic disorders is the fact that mental factors, including emotional stress, mental health, or personality features, have a rather strong impact on physical health. This may lead to the emergence of physical symptoms with a non-explicit organic etiology or worsening of pre-existing medical issues. [23]. These disorders are widely divided into three groups: (1) psychiatric and medical disorders that complicate each other; (2) mental disorders whose development occurs as a direct effect of a medical diagnosis or treatment (e.g., depression after a cancer diagnosis); and (3) somatoform disorders, in which distress is expressed mainly through physical symptoms [24]. An example is when a patient has unexplained chronic pain or fatigue that is inherently connected to some psychological condition, such as depression or chronic stress [25].

CONCLUSIONS

In conclusion, the incorporation of psychosomatic principles is a key to the development of personalised nutrition. The interdependence of mental health with physical health means that efforts can be made to intervene on the person as a unit. In order to achieve this potential, changes in healthcare systems and sustained research are required to transform this holistic paradigm into a viable practice in the mainstream.

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All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

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Practices and Utilization Patterns of Nutrition Screening Tools among Pakistani Dietitians

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ABSTRACT

A high prevalence of malnutrition in Pakistan requires an urgent need to identify at-risk individuals so that they can be provided with immediate nutrition care, especially in hospital and community settings. Therefore, the use of validated nutrition screening tools (e.g., Malnutrition Universal Screening Tool (MUST), SGA, Mini Nutritional Assessment (MNA)) by dietitians for early identification and intervention of nutritional deficiencies is of utmost importance. **Objective:** To evaluate the use of nutrition screening tools among Pakistani dietitians. **Methods:** This cross-sectional study, based on a purposive sampling technique, utilized an online survey form (Google Form) which was launched on different social media platforms, especially WhatsApp groups of Pakistani Dietitians. A total of 87 dietitians participated in the study by filling out this form on a voluntary basis. Data about dietitians' demographics, workplace practices, and screening tools use were collected and analyzed in SPSS version 23.0 and presented in descriptive form (percentages and frequencies). **Results:** Hospitals were the primary setting (89.7%) of dietitians' practices, followed by consulting and community (3.4% both). Mostly dietitians (98.9%) were aware of the Nutrition Screening tools, but only 58.6% currently use the validated nutrition screening tools (e.g., MUST, NRS 2002, MST, MNA, SGA) in their workplace. The most commonly used nutritional assessment tools were SGA (52%), MUST (44%), and MNA (28%). **Conclusions:** While dietitians recognize malnutrition's prevalence, the use of validated nutrition screening tools is limited in their work settings. Therefore, standardized training and policy interventions are recommended to enhance tool utilization and address disparities, particularly in underserved regions.

INTRODUCTION

Nutrition screening is critical in identifying individuals at risk of malnutrition, enabling timely intervention to improve health outcomes. It is defined by the American Society of Parenteral and Enteral Nutrition (ASPEN) and the European Society for Clinical Nutrition and Metabolism (ESPEN) as: "A process to identify an individual who is malnourished, or at risk of malnutrition, to determine if a detailed nutritional assessment is required" [1]. The tools used for Nutrition Screening are structured, evidence-based, and designed to assess key nutritional parameters for evaluating malnutrition. The main features of these tools are that they should be quick, user-friendly, cost-effective, standardized, and validated. By providing a standardized approach to evaluating nutritional status, these tools ensure that individuals at risk of malnutrition are promptly identified and referred for further assessment or intervention [2]. It is worth noting that a nutrition screening tool can be administered rapidly by any clinical or non-clinical healthcare professional, and it should be performed, usually on first contact with a patient, in order to identify the nutritional deficiencies and immediate consideration of nutritional support. Globally, various validated nutrition screening tools—such as the Malnutrition Universal Screening Tool (MUST), Nutrition

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Risk Screening (NRS-2002), and Mini Nutritional Assessment (MNA)- are widely used in clinical and community settings [3]. However, the use of these tools in the healthcare system is quite low in low- and middle-income countries (LMICs) like Pakistan, despite the fact that these countries are still facing a high burden of malnutrition [4]. In Pakistan, although dietitians play a pivotal role in nutritional assessment and intervention, there is limited research on their current practices and the extent to which they utilize standardized screening tools in their work settings. Different studies from diverse regions across the globe highlighted barriers such as lack of training, time constraints, and institutional support as a few factors affecting the adoption of nutrition screening tools [5, 6]. Pakistan has a high burden of malnutrition with both forms, i.e., undernutrition and overnutrition [7]. So, understanding dietitians' practices in nutrition screening is not only important for improving patient care across different settings, but it may also be incorporated in policy development to improve population health.

Since there is no previous study that focused on the use of nutrition screening tools among Pakistani dietitians. There is no any policy on the implementation of a standardized approach for nutrition screening across Pakistani healthcare facilities. This study aimed to evaluate the use of nutrition screening tools among dietitians working across various healthcare settings in Pakistan.

METHODS

This cross-sectional study was conducted from March 2025 to April 2025 by College of Human Nutrition and Dietetics, Ziauddin University. It aimed to investigate the current practices of using Nutrition screening tools among Pakistani dietitians, and for this, a study tool was used, which comprises a self-administered questionnaire encompassing a total of 14 questions. The questionnaire consisted mostly of closed-ended questions and was structured in the following two sections: (I) Demographic Information, including Age, gender, province, education, professional background, years of experience, and practice in a healthcare setting. (II) Questions related to Practices of Nutrition Screening Tools, e.g., use of specific tools (MUST, MNA, NRS-2002, SGA, others) and settings where these tools were applied (hospital, clinic, community setting). A pilot test was conducted with a small sample of 10 dietitians, representing a mix of clinical and academic backgrounds, to assess the questionnaire's face validity, clarity, and content consistency. These participants were asked to complete the draft questionnaire and provide feedback on the relevance of the questions, the clarity of the wording, and the overall flow and time required for completion. Based on their feedback, minor revisions were made to the phrasing of two questions to eliminate ambiguity and improve understanding. The final questionnaire was confirmed to be clear and comprehensive, with an average completion time of approximately 5-7 minutes. As the primary goal of this pilot phase was to ensure the tool's face validity and practical applicability for our target population, a statistical test for reliability, such as Cronbach's alpha, was not calculated at this stage. Purposive sampling technique was used, with the target population consisting of dietitians working in various provinces of Pakistan. Sample size was calculated using OpenEpi, with a 90% confidence level, a 5% margin of error, and an anticipated frequency of 50%. After applying the finite population correction (n=121) based on our previous study [8], the calculated sample size was 84. The questionnaire was sent to the dietitians as a Google Form via social media platforms, mainly different WhatsApp groups of dietitians. The study was based only on a survey questionnaire, and the participation of dietitians to fill out the questionnaire was completely voluntary, which reflects their consent to take part in this study.

The collected data were entered and analyzed in SPSS software version 23.0, and the results were presented in the form of descriptive statistics, i.e., as frequency and percentage.

RESULTS

The study surveyed 87 dietitians from different provinces of Pakistan to assess their knowledge and use of nutrition screening tools in their work settings. The majority (65.5%) of the dietitians were aged 25-34 years, mostly were from Sindh province (69%), followed by Punjab (23%) and KPK (8%). No response was received from Baluchistan and Gilgit-Baltistan. About 39.1% held a Bachelor's degree, and 33.3 % Master's degree. Among 87 dietitians who participated in the study, 55 (63.2%) were registered dietitians, and all are either currently working as a Dietitian or have worked as a dietitian in the past. Mostly dietitians have work experience of 1-5 years (52.9%) and mostly work in hospitals (89.7%) (Table 1).

Table 1: Sociodemographic Data of the Study Participants (n=87)

Parameters	Category	n (%)
Age	18-24 Years	10 (11.5%)
	25-34 Years	57 (65.5%)
	35-44 Years	12 (13.8%)
	45-64 Years	8 (9.2%)
	65 Years and Older	0 (0%)
Province	Sindh	60 (69%)
	Punjab	20 (23%)

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	Baluchistan	0 (%)
	Khyber Pakhtunkhwa	7 (8%)
	Gilgit-Baltistan	0 (%)
Academic Qualification	Bachelor's Degree	34 (39.1%)
	Enrolled in a Master's Degree Program	18 (20.7%)
	Master's Degree	29 (33.3%)
	Enrolled in a Doctoral Degree Program	4 (4.6%)
	Doctoral Degree	2 (2.3%)
Registered Dietitian	Yes	55 (63.2%)
	No	32 (36.8%)
Are you currently working as a Dietitian, or have you worked as one in the past?	Yes	87 (100%)
	No	0 (0%)
Working Experience	Less Than 1 Year	10 (11.5%)
	1-5 Years	46 (52.9%)
	6-10 Years	18 (20.7%)
	11-15 Years	6 (6.9%)
	16-20 Years	3 (3.4%)
	Over 20 Years	4 (4.6%)
Dietitians' work settings	Hospital	78 (89.7%)
	Community	3 (3.4%)
	Academic	1 (1.1%)
	Research	1 (1.1%)
	Private Corporation	1 (1.1%)
	Consulting	3 (3.4%)
Kinds of population participants are currently working in their work setting	Adult	24 (27.6%)
	Adult; Geriatrics	10 (11.5%)
	Pediatrics	2 (2.3%)
	Pediatrics; Adult	16 (18.4%)
	Pediatrics; Adult; Geriatrics	35 (40.2%)

All the dietitians agreed that Malnutrition is a prevalent problem in the Pakistani population, and Early Nutrition intervention will help to maintain the health of individuals and lead to speedy recovery from illness. Almost all of them (98.9%) were aware of the Nutrition Screening Tools; only (58.6%) used the validated tools for nutrition screening (Table 2).

Table 2: Dietitians' Knowledge and Use of Nutrition Screening Tools (n=87)

Items	Category	n (%)
Do you agree that "Malnutrition is a prevalent problem in the Pakistani population?	Yes	87 (100%)
	No	0 (0%)
Do you agree that "Early Nutrition intervention will help maintain the health of individuals and lead to speedy recovery from illness"?	Yes	87 (100%)
	No	0 (0%)
Are you well familiar with the "Nutrition Screening Tools?	Yes	86 (98.9%)
	No	1 (1.1%)
Do you currently use, or have you previously used, validated nutrition screening tools (e.g., MUST, NRS 2002, MST, MNA, SGA) in your workplace?	Yes	51 (58.6%)
	No	36 (41.4%)

The most commonly used nutritional assessment tools were SGA 28 (52%), MUST 21 (44%), and MNA 16 (28%) (Figure 1).

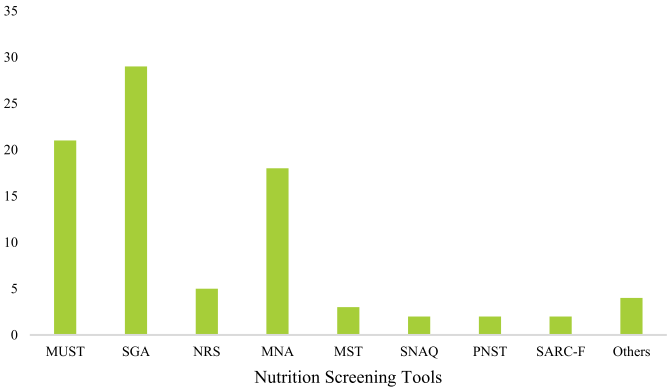

Figure 1: Frequency of use of different Nutrition Screening Tools among Pakistani Dietitians

*MUST= Malnutrition Universal Screening Tool, SGA= Subjective Global Assessment, NRS=Nutritional Risk Screening, MNS=Mini Nutrition Assessment, SNAQ= Short Nutritional Assessment Questionnaire, PNST=Pediatric Nutrition Screening Tool, SARC-F= Strength, Assistance with walking, rising from a chair, climbing stairs, and falling. The "Other" category refers to MUAC, weight machine, own methods, and BMI

DISCUSSION

The findings of this study revealed that all the dietitians are concerned and acknowledge the prevalence of malnutrition in the Pakistani population. Most of the dietitians are from Sindh, followed by Punjab and Khyber Pakhtunkhwa. But the lack of representation from regions like Baluchistan and Gilgit-Baltistan reflected the scarcity of dietitians in these regions. This study showed that the majority of dietitians (89.7%) worked in hospitals, where they play a critical role in the management of nutrition care in inpatient and outpatient settings. In hospitals, the patients are usually directed to dietitians before and after surgery, given dietary advice, or consulted in cases when physicians recommend a patient to visit a dietitian in order to address their nutritional problems. However, in either case, there is a limited use of nutrition screening tools to identify nutritionally at-risk individuals, as reflected in our study, where 58.6% of dietitians used these screening tools. So, there is a need for standardization and validation of these tools to ensure their efficiency across varied patient populations [9]. This study also showed that although almost all the dietitians are aware of these tools, not all of them practice them in their daily routine. It is an alarming situation that in many countries, the use of these tools in hospital settings is mandatory as a part of standardized nutrition care, but in our country, there is no such recommendation or policy for its mandatory implementation. Globally, the progress in the field of

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nutrition and dietetics is increasing, and the suggestions of introducing artificial intelligence-based systems in hospital settings to estimate patients' nutrient intake are being given focus in order to enhance the accuracy of nutrition screening with an aim to lessen the burden on healthcare professionals [10]. This study also revealed that, next to the hospitals, private consultation and work in the community settings are the two other domains of dietitians. In a community setting, dietitians play a prime role in the prevention of malnutrition via early detection and intervention programs [11]. So, whether in hospitals, community settings, daycare facilities, or long-term care, a proper diet is a foundation factor to address or reduce the risk of malnutrition. The importance of the use of validated nutrition screening tools in evaluating the patients' nutritional status is highlighted in a study that focused on the identification of such suitable tools for cancer patients and survivors so that they can receive proper nutritional guidelines before and after the treatment process [12]. In this survey, more than half of the dietitians used screening tools, but it is surprising to note that a survey conducted on American pediatric dietitians revealed that most do not use a validated nutritional screening tool to identify early feeding dysfunctions in children that impact their overall nutritional care [13]. Similarly, another study emphasizes the need for the use of validated nutritional screening tools in the pediatric population by registered dietitian nutritionists (RDNs) [14]. This study showed that at least three identified parameters/criteria for the diagnosis of malnutrition were adapted by registered dietitians and nutritionists (RDN) in our country. This result is aligned with the Academy of Nutrition and Dietetics/American Society for Parenteral and Enteral Nutrition (ASPEN) indicators for diagnosing malnutrition in hospitalized adults [15]. Another review emphasizes the need to improve clinical outcomes in patients with severe medical conditions through early identification of malnutrition using effective screening tools. It highlighted that by increasing awareness of healthcare professionals about malnutrition, timely intervention can be provided [16]. In this study, various tools were reported to be used by dietitians, with the most common ones including SGA (52%), MUST (44%), and MNA (28%). The application of different screening tools among dietitians reflects that dietitians can use different tools to identify at-risk individuals. These findings can be compared with the studies [17-19], which showed the use of somewhat similar tools in their studied hospital settings, i.e., MUST, NRS-2002, and MST. However, limited awareness and use of some tools, e.g., SNAQ, SCAR-F, and PNST, among Pakistani dietitians showed their limited knowledge in this regard. In addition, the choice of screening tool often depends on some elements, including that it is easy to use, does not take much time, and to which population it must be applied. These findings correlate with the previous study [20]. which showed different tools used in their study setting, e.g., most commonly measuring Body mass index is utilized (62.0%) to identify perioperative nutritional risk, followed by MUST (57.9%), Percentage weight loss (19.8%), MST (1.7%), SNAQ (1.7%), and Nutrition Risk Screen 2002 (NRS-2002) (0.8%). This survey sheds light on educating dietitians for using nutrition screening tools in their work settings to improve the assessment and management of their clients or patients who are at nutritional risk. In addition, it also emphasized the addition of validated nutrition screening tools in all community and hospital settings as a component of standardized nutrition care practice.

Online social media sampling creates selection biasness on tech-savvy dietitians and therefore may have excluded international dietitians who have limited access to internet services in far-off areas. The limited sample (n=87) that has disproportional provincial representation (69% of Sindh) restricts national generalizability. Self-reporting can exaggerate real tool use in place of social desirability. The cross-sectional design only records the existing practices without evaluating the changes through time or the causes of not using them. The programs to develop the workforce must consider the geographical differences by encouraging dietitians to work in underserved provinces. The study of the comparative effectiveness of various screening tools among Pakistani populations would reveal the best tool to use in the local settings.

CONCLUSIONS

In conclusion, this study demonstrates that although most dietitians are knowledgeable about a range of nutrition screening tools, their routine utilization in clinical and community practice remains limited. This gap between awareness and practice highlights the need for structured policies, standardized guidelines, and targeted training to support the consistent implementation of validated nutrition screening tools across healthcare settings. Strengthening their routine use may facilitate early identification of individuals at nutritional risk and contribute to improved nutrition care and clinical outcomes.

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Authors' Contribution

Conceptualization: MJ
Methodology: MJ, YS, NTS
Formal analysis: AM
Writing and Drafting: MJ, YS, NTS, AM, NN
Review and Editing: MJ, YS, NTS, AM, NN

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

All the authors declare no conflict of interest.

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Exploring the Influence of Social Media–Driven Nutrition Misinformation on Dietary Practices: A Qualitative Study

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ABSTRACT

The use of social media like Instagram, TikTok, and YouTube has changed how young adults get nutrition information. But uncontrolled content usually propagates false information that can be applicable to food habits and well-being. **Objectives:** To study the effects of social media on the dietary beliefs and practices of young adults in Pakistan, the prevalent forms of nutrition misinformation are to be identified, and how users rate the information they find online and react to influencer recommendations. **Methods:** Miniature thematic analysis qualitative examination was utilized in 20 young adults (19-32 years old) enlisted into the University of the Punjab, Lahore. The university was chosen since it is a symbol of a number of students whose population is quite large, and due to its diversity, it enabled access to young adults who are active social media users. Semi-structured in-depth interviews were carried out either face to face or through the internet, tape recorded, and transcribed word for word. The thematic method of data analysis was based on the six-step method by Braun and Clarke. **Results:** Five major themes emerged. Participants often used the advice of influencers on nutrition, evaluated credibility with popularity but not evidence, and were in doubt after receiving conflicting information. Purchasing high-dose vitamin D supplements without a previous diagnosis of vitamin D deficiency had been reported another time. **Conclusions:** Social media has a tremendous influence on dietary beliefs and behaviors by transmitting nutrition misinformation amongst young adults in Pakistan.

INTRODUCTION

Within the last several years, the application of social media systems like Instagram, TikTok, and YouTube has become more widespread. This has significantly influenced the means of access as well as the involvement of the health and nutrition information [1]. Through them, people have been able to share and reach a broad spectrum of people around the world in the shortest way [2]. Nonetheless, social media is not strictly regulated, and this is the reason why misleading information can easily propagate without being confirmed [3]. The more literature exists regarding the matter, the greater the evidence that such a plethora of nutrition information that spreads on social media is unverified and lacks evidence-based knowledge provided by health professionals. This complicates the ability of the users to differentiate the right instruction and erroneous information [4]. Some of the previous studies have shown that myths related to nutrition on social media have a great connection with poor feeding habits [5, 6]. The reviews of online sources in social media tend to demonstrate that most of the popular posts

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support unbalanced diets, overrate the usefulness of supplements, or fad diets with no clinical support [7, 8]. Such misinformation is persuasive, and this fact can be explained by several mechanisms. Additionally, misinformation becomes more critical and memorable in a better-looking form (e.g., a short video, before-and-after pictures, etc.), which leads to a greater effect on food habits. This practice leads to the adjustment of evidence-based non-evidential dietary habits and practices among the followers [9]. According to several studies, it is also possible that the incorrect information on social networks such as TikTok and Instagram can help to legitimize the incorrect eating habits, mainly among adolescents [10]. Although there are these concerns, the relationship between social media and health outcomes is complicated. There are some studies indicating that positive health messages and food literacy can be disseminated by the digital platform as well, in case evidence-based content is covered by qualified professionals [11]. The high prevalence of false posts still seems to pose a problem to social health communication and food choices [12]. Although the effects of social media on nutrition behaviors have been extensively studied in high-income countries, the study on the subject regarding low and middle-income countries, such as Pakistan, has limited research [13, 14]. The current literature largely relies on quantitative research that is incapable of depicting the way people perceive and respond to information available online [15, 16].

In particular, digital health literacy, which is the ability to critically evaluate online health content, remains underexplored. There are still gaps that exist in the literature, even with increased global concern. To start with, the existing research on the subject in the low and middle-income nations, and Pakistan is no exception, is almost entirely quantitative in its surveys because surveys cannot yield the detailed information about how people perceive, evaluate, and internalize the information presented on online nutrition platforms. This study aimed to study the effects of social media on the dietary beliefs and practices of young adults in Pakistan, the prevalent forms of nutrition misinformation, and how users rate the information they find online and react to influencer recommendations.

METHODS

This study employed a qualitative descriptive design using thematic analysis, as described by Braun and Clarke. This approach was appropriate for exploring individuals' experiences, beliefs, and decisionmaking- processes related to social media nutrition information. This study was conducted in the University of the Punjab, Lahore, from November to December, 2025. This study was conducted to explore the influence of nutrition-related information that is present on social media on dietary beliefs and practices among young adults in Pakistan. The reason this study selected the qualitative approach was that it allows an in-depth understanding of the thoughts and experiences of people. Such in-depth exploration is difficult to achieve through a quantitative study design. Participants were recruited through campus advertisements (flyers and university social media groups) and snowball sampling, with initial contacts made through student societies. Purposive sampling was applied to ensure diversity in gender (11 females, 9 males), age (range 19–31 years), educational level (undergraduate and graduate), and occupation (students, private employees, freelancers). All participants reported active use (≥2 hours/day) of at least one social media platform (Instagram, TikTok, or YouTube) for nutritionrelated- content. Participants were recruited through a combination of strategies. First, printed flyers were posted on university notice boards across the University of the Punjab campus. Second, an announcement was shared in university-affiliated student WhatsApp groups. Interested individuals contacted the research team, and purposive sampling was then applied to ensure diversity in gender, age, educational level, and occupation. Initial contacts also led to snowball sampling, where enrolled participants referred peers who met the inclusion criteria. The strategy was used to achieve a diverse sample (although active social media users were still purposively targeted). The initial age bracket was 18-35 years. No participants aged 18 and above 31 volunteered in the recruitment, with the rest of the criteria. The last sample was the people aged between 19 and 31 years, which is also within the target range of the population of interest, which is the young adults. The results section now states: A total of 20 participants (11 females, 9 males) were interviewed, with ages ranging from 19 to 31 years (mean 24.6 ± 4.1). Individuals who had any kind of professional expertise in nutrition or healthcare were excluded, so that we can focus on the general social media user population. After 20 participants, data saturation was achieved, as no new themes were found. For data collection, semi-structured, in-depth interviews were conducted either face-to-face or through online platforms, depending on the preference and availability of the participants. Informed consent was obtained from all the participants before the data collection. To maintain confidentiality, unique codes were assigned to each participant, such as P1, P2, etc. All the participants took part in the study voluntarily. Participants were informed that they could withdraw at any

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stage of the study. Based on the existing literature and our study objectives, we developed an interview guide. These interviews lasted between 30 and 60 minutes. With the consent of participants, we audio-recorded the interviews. The interviews were transcribed word-for-word to maintain accuracy. The lead researcher (a female PhD candidate with training in public health nutrition) conducted most interviews. Her background in nutrition may have influenced participants' responses, particularly regarding the perceived credibility of nutrition information. To mitigate this, she explicitly stated her role as a researcher seeking to understand experiences rather than as a nutrition expert. The second researcher independently coded a subset of transcripts to challenge interpretations and enhance reflexivity.

Thematic analysis was based on the six phases of Braun and Clarke. Inductive coding was the main mode that gave themes the opportunity to emerge through the data and not the pre-existing classification [17]. The first five transcripts were first coded by two researchers, followed by a comparison and final resolution with a unanimous decision made with other codes, thus making it to a preliminary codebook. Transcripts other than these were coded with this codebook, and after that, they were refined. All the authors reviewed the final themes and agreed upon them. Data management was done in NVivo 14 software, but the coding was performed manually so as to have in-depth exposure to the data. This paper is based on the Consolidated Criteria of Reporting Qualitative Research (COREQ) checklist.

RESULTS

Twenty participants (11 female, 9 male) were interviewed, and the mean age was 24.6 ± 4.1 years (range: 19-31). The mean hours of social media use were 3.2hours +0.9 hrs. Instagram, TikTok, or YouTube were claimed to be used by all respondents to get nutrition-related information. The majority of the participants said that they regularly visit social media platforms, especially Instagram, TikTok, and YouTube, even to get simple information associated with diet and nutrition. Interpretation of the interview data using the thematic analysis showed that five broad themes described the impact of nutrition misinformation as a result of social media on dietary beliefs and behaviours: Trust in influencers over professionals, Confusion due to conflicting information, Adoption of fad diets and supplement misuse, Limited digital health literacy, and social reinforcement of dietary behaviours (Table 1).

Table 1: Demographic Characteristics

Participant ID	Age (years)	Gender	Education Level	Occupation	Social Media Usage (hrs/day)	Primary Platform Used
P1	19	Female	Undergraduate	Student	3	Instagram
P2	21	Male	Undergraduate	Student	4	TikTok
P3	22	Female	Undergraduate	Student	2	Instagram
P4	30	Male	Graduate	Private Job	3	YouTube
P5	20	Female	Undergraduate	Student	3	TikTok
P6	28	Male	Graduate	Freelance Designer	4	Instagram
P7	21	Female	Undergraduate	Student	5	Instagram
P8	31	Male	Graduate	Software Engineer	2	YouTube
P9	22	Female	Undergraduate	Student	4	TikTok
P10	29	Male	Graduate	Teacher	3	YouTube
P11	21	Female	Undergraduate	Student	3	Instagram
P12	29	Male	Graduate	Private Job	2	TikTok
P13	20	Female	Undergraduate	Student	4	Instagram
P14	32	Male	Graduate	Research Assistant	3	YouTube
P15	19	Female	Undergraduate	Student	3	TikTok
P16	28	Male	Graduate	Private Job	4	Instagram
P17	23	Female	Undergraduate	Student	3	TikTok
P18	26	Male	Graduate	Office Job	2	YouTube
P19	22	Female	Undergraduate	Student	3	Instagram
P20	27	Male	Graduate	Freelance Worker	4	TikTok

The five themes have been compiled into a better structure with subthemes where necessary. It has now been demonstrated in the Results section that Thematic analysis revealed two general categories (1) Information appraisal and trust (Theme 1: Trust in influencers over professionals; Theme 2: Limited digital health literacy; Theme 3: Confusion due to conflicting information) and (2) Behavioural consequences (Theme 4: Adoption of fad diets

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and supplement misuse; Theme 5: Social validation of dietary behaviours). One of them, the subthemes are now clearly defined within a single theme (e.g., under Theme 1, subthemes: Relatability over expertise, Visual appeal as credibility). This hierarchy makes a differentiation and prevents overlap of concepts.

Theme 1: Trust in Influencers Over Professionals

The majority of the participants expressed more trust in an influencer on social media compared to a qualified healthcare professional. The reason is that they see such influencers as more relatable and closer since they are visually engaged with these influencers. This faith has highly influenced their food preferences. One of the respondents explained, I trust that these influencers know me better than a dietitian who provides a list of food to eat every day. (P3) One of the respondents shared, I follow someone on TikTok who posts tips on what to eat each day. She is not a nutritionist, but her outcomes are lifelike and inspire me to follow her. (P7) This trend describes a change in the perceived credibility, when informality and appearance are prioritized over qualifications. This level of trust may directly affect eating habits, with subjects having taken on diet regimens and supplements that influencers were selling without consulting anyone.

Theme 2: Confusion Due to Conflicting Information

The majority of participants noted that there is conflicting information concerning nutrition, which they feel disoriented about, available online. This translates to confusion and anxiety over healthy eating. One of the participants told me, " One day I saw it is better, the second day somebody told me, on the carbs it is not the problem. I do not know what I take to be true because I read different posts on the same food (P10), and all of them tell me something different. It is quite puzzling, really; it is so confusing. (P1) This theme demonstrates that there is confusion with the existence of conflicting information available online.

Theme 3: Adoption of Fad Diets and Supplement Misuse

Several interviewees said that because of internet-based information, they became followers of trendy diets or used supplements. They were largely doing it without knowing the right dosages and potential risks of overdose or toxicity. One of the participants explained that he tried to use a detox juice two weeks ago, as everyone on the Internet said that it makes you lose weight in no time (P16). Most interviewees replied regarding the use of supplements, with one of them stating that they purchased vitamin D supplements simply because they were advertised by an influencer. I did not realize that the dose was high or even necessary on my part (P12). Such practices bring out the fact that the wrong information directly affects the health-related practices of individuals.

Theme 4: Limited Digital Health Literacy

Many participants claimed that they judge the credibility of online content based on likes, comments, or the physical appearance of the influencers rather than searching for evidence. A participant said, "If a post has lots of likes and shares, I automatically think it must be true." (P4) Another claimed that, "I rarely check who wrote it. I just follow what everyone else is doing." (P9) The lesser digital health literacy, there are increased chances of nutritional myths affecting dietary patterns of people.

Theme 5: Social Validation of Dietary Behaviors

Participants claimed that when they adopt new dietary trends, they get appreciation through likes and comments online, which makes them feel that they are on the right track. A participant told that, "When I post about the smoothie I make from a trend, my friends like it, and it encourages me to continue it." (P8) Another said, "Seeing others trying the same diet online motivates me to follow it, even if I'm unsure about its safety." (P11) This theme highlights that how peer influence increases the adoption of dietary behaviors that can be very harmful.

Diversity within participant characteristics: Although there was extensive consistency in the themes among the sample, minor differences were found. The female respondents (n=11) more often indicated that they had tried fad diets (e.g., detox juices, keto) than the male respondents (n=9). Greater confusion based on the contradicting information was correlated with higher social media use (4 hours/day and above); all of the six participants who used the media at least 4 hours per day reported this as a significant problem. There were no clear differences based on the occupation; however, students (n=14) tended to label social validation as effective, more than the employed participants (n=6). These trends indicate that the effect of misinformation might be balanced by gender and the degree of usage, but the limited sample does not allow for conclusive remarks.

DISCUSSION

It is qualitative research where we examined how misinformation that relates to food and nutrition exists in social media and has affected the dietary beliefs and practices among young adults in Pakistan. The results of the paper showed that the eating patterns of the population of our study were grounded on a variety of factors, such as the trust in influencers, confusion because of the conflicting information, the use of fad diets and supplements, poor digital health literacy, and social validation. Although the majority of the influencers do not

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have the relevant qualifications, especially in the nutrition and health fields, people readily trust them. This was also observed in earlier studies that social media influencers are highly influential on health-related behavior since they are perceived to be real and relatable [18, 19]. Likewise, a study by Djafarova and Rushworth established that young users of social media have a greater tendency to believe influencers than traditional experts, as their content might be more appealing to the eye [20]. This tendency is alarming because some unqualified people can transfer erroneous or dangerous nutrition information, and the population can be affected. The other outstanding theme that we identified is the misunderstanding created by conflicting nutrition information. Many participants reported that they find difficulty in distinguishing between accurate and inaccurate dietary advice, as there are many different nutrition-related opinions and myths. This finding is also supported by a few previous studies, which indicate that exposure to unreliable health information can lead to uncertainty, mistrust, and poor decision-making [21, 22]. Kington et al. highlighted that the rapid spread of health-related misinformation on social media contributes to confusion, and it also leads to lower adherence to evidence-based guidelines [23]. The current study extends this understanding by focusing on how such confusion is experienced at an individual level and how it affects their dietary choices. The adoption of fad diets and the misuse of dietary supplements are also very important issues. It is an important behavioral outcome of exposure to wrong information. Participants reported engaging in practices such as detox diets, keto diets, water diets, and fruit diets influenced by social media. Many participants also reported taking supplements for aesthetic benefits without the advice of a doctor. These findings are consistent with existing literature that links social media exposure to unhealthy dieting behaviors and increased supplement use [24]. Moreover, because of the promotion of supplements are being promoted more on social media by influencers, individuals have begun to consume supplements without any medical care or deficiency [25]. A lot of them responded that they attempt to determine whether they read the right or wrong nutrition information they located on social media. However, they consider it based on the popularity of that news, i.e., likes, shares, reach, etc., instead of seeking the scientific evidence of the same. This result confirms the earlier study that a digital health literate influences the ways in which individuals make judgments about any source of health-related information that they encounter online [26]. The prevailing results suggest the role of social validation in sustaining behavior regarding possibly suicidal eating behaviors.

The analysis was done in one university in Lahore, which might not be transferred to other areas or non-student groups. The participants' self-reporting of the data may have affected the recall bias and the social desirability bias, especially in a situation where data was being collected around a socially sensitive subject like supplement misuse. Face-to-face and online interviews were done, and this has added to the accessibility but because of the interaction dynamics, there was the possibility of differences in depth of responses. Recommendations are proposed as actionable. To begin with, higher education institutions need to teach digital health literacy skills during orientation sessions where students are taught to verify the credibility of their sources, look for evidence citations, and rely on fact-checking tools. Second, there is a need to have public health campaigns engage popular influencers to help spread evidence-based messages regarding nutrition by building up the trust that the participants had in them.

CONCLUSIONS

In conclusion, this study demonstrates the possibility of how social media influences eating ideologies using misinformation. It emphasizes the necessity to enhance digital health literacy and reliable online nutrition information, and address the public health problems of misinformation online.

Authors' Contribution

Conceptualization: IF
Methodology: AM
Formal analysis: MI
Writing and Drafting: AF
Review and Editing: IF, MI, AM, MA

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

All the authors declare no conflict of interest.

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Valorization of Mango (*Mangifera indica*) Peel Waste as a Functional Nutritional Resource with Antioxidant Potential

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ABSTRACT

Reducing food waste through full resource utilization has positive effects on the economy, climate, and food security. In order to meet future demand, more food must be produced due to the growing population. The *Mangifera indica* L. (mango) is a widely consumed tropical fruit that is grown and consumed in tropical places worldwide. When mango-based products like juices and purees are made, the peel and kernel are wasted. Mango peel was a good source of nutrients with antioxidant properties. **Objectives:** To assess the nutritional composition and antioxidant activity of mango peel. **Methods:** The nutritional values were determined by using AOAC methods, and the antioxidant activity of water and methanol extract was determined by using the DPPH assay at 517 nm. **Results:** Study outcome depicted that mango peels have protein (4.30 ± 0.22%), fiber (4.75 ± 0.30%), ash (3.52 ± 0.26%), carbohydrates (78.72 ± 1.80%), and energy Kcal/100g (336 ± 3.45). The results of its antioxidant activity showed that at concentrations of 0.2–1.0 mg/ml, the methanol extract exhibited the highest percentage inhibition (DPPH), ranging from 38.70 ± 1.03 to 81.65 ± 2.50%, while the water extract showed the lowest percentage inhibition (20.10 ± 0.70–56.30 ± 1.95%) compared to the standard antioxidant BHA (28.70 ± 0.90 65.40 ± 1.95%). There were significant differences found in various extracts and BHA ($p<0.005$). **Conclusions:** The results of the study showed that mango peel contained nutrients, and its methanolic extracts had significant antioxidant activity, allowing better use of this waste.

INTRODUCTION

Every year, over 1.3 billion tons of food are lost or wasted between the point of production and the point of consumption. In addition, the United Nations estimates that to feed the world's anticipated population by 2050, food demand must rise by 70%. According to the United Nations' 2015 Revision, the current global population of 7.3 billion is predicted to rise to about 9.7 billion by 2050, and it appears to be growing by nearly 30 million people annually. In the European Union, 89 million tons of food waste are produced annually [1]. The decrease in food waste results in increased economic output and a decrease in greenhouse gas emissions that fuel climate change. The mango (*Mangifera indica* L.) is one of the most frequently grown and consumed tropical fruits in the world due to its high vitamin and antioxidant content. Over 50 million tons of mangoes are produced globally each year. Large countries like Pakistan, India, Bangladesh, China, Mexico, Indonesia, Brazil, Thailand, and the Philippines cultivate

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and sell mangoes worldwide [2]. Nevertheless, processing mangoes results in a significant quantity of waste primarily composed of peels and kernels, which, depending on the variety and techniques employed, account for 35–60% of the fruit's weight [3]. In the fruit processing, the peels account for about 15–60% of waste products, which are generally superfluous [4]. The management of this waste highlights a lost opportunity to employ these materials and resolve environmental issues. Mango peels and kernels have been found to contain polyphenols, carotenoids, proteins, essential fatty acids, and dietary fiber that support healthy digestion, blood sugar control, and cholesterol lowering [5]. Antioxidants may reduce the risk of chronic illness by getting rid of free radicals. Mango peel contains antioxidants called beta-carotene and lutein that improve eye health and guard against age-related macular degeneration. It also contains unsaturated fatty acids, which lower low-density lipoprotein cholesterol (LDL) and enhance cardiovascular health, and several cancers are made more likely by chronic inflammation. Mangiferin, present in mango peel, inhibits pro-inflammatory cytokines to decrease inflammation [6]. Gallic and ellagic acids found in mango peels cause cancer cells to undergo apoptosis and reduce the growth of cancer [7].

Although mango processing waste is abundant in Pakistan, especially in the summer season, with a great amount of mango peels, there was limited research to get a complete nutritional profile and antioxidant activities of locally grown mango varieties' peels. Mechanistic understanding of the antioxidant activity observed was limited by the absence of identification and quantification of specific bioactive compounds (such as mangiferin, gallic acid, ellagic acid, and polyphenols) in the sample using advanced analytical techniques. This study aimed to assess the nutritional facts and antioxidant activity of mango peels, which would be wasted during processing.

METHODS

This experimental study was conducted at the Pakistan Council of Scientific and Industrial Research (PCSIR), Laboratories Complex, Lahore, Pakistan, from July 2025 to August 2025. Ten Kg mangoes (chonsa variety) were bought in July 2025 from the local market in Lahore from ten various places. Before analyzing, the samples were collected, cleaned, and washed. The ripe mangoes were peeled before being chopped into small pieces, cleaned with tap water, blanched for 10 minutes at 95°C, drained, and allowed to cool at room temperature. After that, it was dried at 60°C by a hot air oven (local PCSIR Made) for 24 hours [8]. A simple grinder machine (Made in Japan) was used to grind the dried peel into a fine powder, which was then sieved to produce a final mass of particles with a diameter of 0.6 mm (Figure 1).

Figure 1: Mango Fruit, Its Peel, and Powder

The AOAC methodologies [9] were used to determine the mango peel powder's moisture and ash content, fat, crude protein, and crude fiber. The difference between the total proximate composition and 100% was used to calculate the total soluble carbohydrate as follows: Carbohydrates = 100 – (crude proteins + crude fats + moisture + ash + crude fiber). The energy values (Kcal/100 g) were computed by multiplying the fat and carbohydrate values by nine and four, respectively, and then adding up the results in kilocalories. The antioxidant activity in mango peel powder was measured by using the 2,2-Diphenyl-1-picrylhydrazyl (DPPH) radical scavenger [10]. Test tubes were filled with 0.1 ml of different concentrations (0.2-1 mg/ml) of mango peel water and methanol extracts, followed by the addition of 2.9 ml of a 0.1 mM methanolic solution of DPPH and vigorous shaking. For half an hour, the tubes were left at room temperature. As previously mentioned, the control was made without any extract. At 517 nm, the samples' absorbance variations were measured. Antioxidant activity was computed using the formula below, which was represented as the percentage inhibition (% I). DPPH Antioxidant activity (% I) = $Abs_{blank} - Abss_{ample} / Abs_{blank} \times 100$.

Three replications of each experiment were used in this investigation, and the findings were shown as ± standard deviation. The t-test and ANOVA were used to statistically examine the data, which were gathered in triplicate. The graphics were created using SPSS version 21.0 [11].

RESULTS

The yield of mango peels, pulp, and kernel content is shown below, showing that the yield of edible portion/pulp was 70.10 ± 0.72%, the yield of peels was 13.70 ± 0.42%, and the yield of kernels was 16.20 ± 0.55% (Figure 2).

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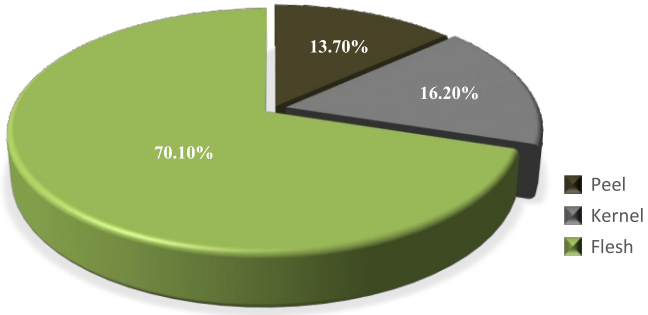

Figure 2: Percentage Yield of Mango Peel, Pulp/Flesh, and Kernel

The mango peel powder included 5.34 ± 0.37% moisture, 3.37 ± 0.24% fat, 4.65 ± 0.02% protein, 4.08 ± 0.09% ash, 5.51 ± 0.32 fiber, 81.29 ± 0.78% carbohydrates, and energy 336 ± 3.45 Kcal/100 (Table 1).

Table 1: Nutritional Facts of Mango Peel Powder

Sr. No.	Parameters	Values (g/100g)
1	Moisture	5.34 ± 0.37
2	Ash	3.52 ± 0.26
3	Fat	3.37 ± 0.24
4	Fiber	4.75 ± 0.30
5	Protein	4.30 ± 0.22
6	Carbohydrate	78.72 ± 1.80
7	Energy (Kcal/100g)	336 ± 3.45

Data were represented ± standard deviation

The results revealed that the methanol extracts had a substantial antioxidant capacity ranging from 38.70 ± 1.03 to 81.65 ± 2.50%. Standard synthetic antioxidant BHA (28.70 ± 0.90 to 65.40 ± 1.95%) and water extract (20.10 ± 0.70–56.30±1.70%) at the same concentration of 0.2–1.0 mg/ml. There were significant differences found in various extracts and BHA ($p<0.005$). (At concentration 0.2-1.0 mg/ml)(Figure 3).

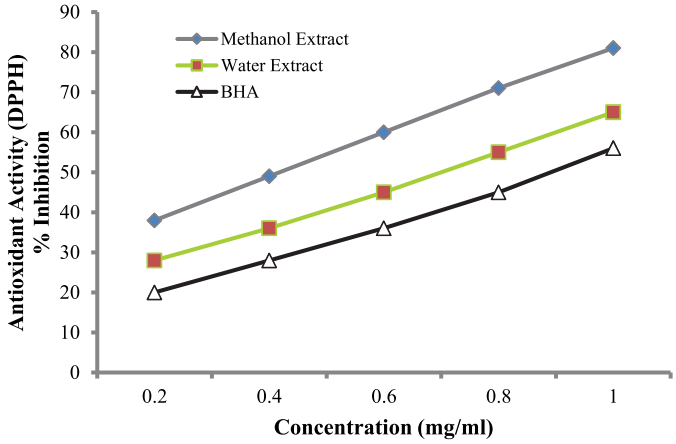

Figure 3: Antioxidant Activity (DPPH) % Inhibition of Mango Peel Powder

DISCUSSION

An intriguing line of inquiry is the potential to transform food industry waste byproducts into useful food additives and natural antioxidants. The yield of mango peels, pulp, and kernel content, and the nutritional and antioxidant qualities of dried mango peel powder were all examined in this study. According to the literature, the edible pulp ranged 62.3-70.2% of the fresh fruit, whilst the peel makes up 13.6-21.4% and kernel 15.2-20.5% [12, 13]. The current study results were within above mention results. Fruits are an essential component of our diet and are frequently consumed by most people worldwide either at random or as a "custom of dessert" following meals. These fruits have a highly important nutritional makeup, although the nutritional makeup of different fruit kinds varies significantly as well [14]. Mango fruits are an important source of vitamins, phytochemicals, and minerals, according to a wealth of research. Mangoes also provide vital elements like calories, proteins, lipids, carbohydrates, dietary fiber, and phenolic compounds. Similar findings were reported in another study, which showed the values of protein, fat, and ash in mango peel powder, which ranged from 1.4-6.9%, 1.6-4.4%, and 1.1-4.2%, respectively [15]. According to earlier findings, the peel has substantial levels of crude fiber (8%), pectin (13%), and carbohydrates (80%) together with respectable amounts of proteins (4%) and lipids (2%) [16]. The antioxidant activity of mango peel powder was determined by DPPH assay, also called the scavenging assay, which is an antioxidant technique that relies on hydrogen atom donation to reduce DPPH radicals. As a result, the hue changes from violet or purple to pale yellow, signifying the creation of stable molecules [17, 18]. Antioxidants found in mango peel have pharmacological effects that improve health, including reducing oxidative stress, which can lead to cancer, diabetes, and cardiovascular disease [19]. Mango peel polyphenols reduce oxidative stress in vitro, indicating that frequent consumption may improve health [20]. The antioxidant activity in the methanol extract is higher than that of the water extract because methanol is the best solvent for the extraction of antioxidant compounds like polyphenols [21]. The mangiferin, the primary phenolic compound of mangos, which is a member of the xanthone class, is present in higher amounts in the methanol extract than in the water extract [22]. The potential of the bioactive compounds found in mango peel to lower the risk of a number of illnesses, including cancer, Parkinson's disease, Alzheimer's disease, and cataracts, has been well-documented. One of the main ingredients in mango peels, mangiferin, has been particularly linked to a decreased risk of cancer. Furthermore, functional substances with antibacterial, anti-diabetic, anti-inflammatory, and anti-

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carcinogenic qualities include protocatechuic acids and β-carotene [23]. Gallate-type compounds, such as penta-O-galloyl-glucoside, have been shown in pharmaceutical research to exhibit a variety of bioactivities, such as anti-tumor, antioxidant, anti-cardiovascular, and hepatoprotective properties [24, 25]. Mango peel, which contains natural protein, fiber, and antioxidants, can be utilized to separate active ingredients and incorporate them into a variety of processed foods, such as baked goods, breakfast cereals, pasta, snacks, drinks, and energy bars, with both financial and health advantages [26]. Mango peel's sugars can be used to produce bio-ethanol, which will help build renewable energy sources, and it can be used in animal feed. In keeping with the ideas of the circular economy, these applications boost the value of mango byproducts across industries and encourage sustainability.

Despite these promising outcomes, the study was limited by a relatively small sample size and the absence of in vivo investigations due to resource constraints. Therefore, future research should focus on optimizing extraction methodologies, evaluating bioavailability and safety through in vivo studies, and exploring the incorporation of mango peel into innovative functional food products with enhanced health benefits.

CONCLUSIONS

The findings of this study demonstrate that mango peel is a valuable source of bioactive and nutritional compounds, including proteins, dietary fibre, and phenolic constituents with significant antioxidant potential. These results highlight the promising role of mango peel as a sustainable raw material for the development of value-added functional foods and nutraceutical applications. Utilisation of mango-processing byproducts not only reduces agro-industrial waste but also contributes to environmental sustainability and resource recovery within the food industry. Furthermore, the study emphasises the importance of advancing research on efficient compound extraction, recovery technologies, and targeted industrial applications to ensure commercial feasibility and long-term product sustainability.

Authors' Contribution

Conceptualization: MKS
Methodology: MKS
Formal analysis: NZ, HKA, AK
Writing and Drafting: MKS, IA, KS
Review and Editing: MKS, NZ, NKA, AK, IA, KS

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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Use of AI-Based Agents and Chatbots for Dietary and Nutrition Recommendations Among Adults: Patterns, Trust, and Behavioral Influence

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ABSTRACT

Artificial intelligence (AI)-based chatbots and conversational agents are increasingly consulted by adults seeking dietary and nutrition-related guidance, yet population-level patterns of use, trust, and behavioral influence remain insufficiently characterized. **Objectives:** To assess use patterns of AI chatbots for dietary recommendations among adults, and examine trust, verification behavior, professional consultation, and sociodemographic associations, and to examine trust, verification behavior, professional consultation, and their sociodemographic and inter-variable associations. **Methods:** A cross-sectional survey was conducted among 200 adults using a structured, self-administered questionnaire; descriptive statistics, the chi-square test, and Spearman's rank-order correlation were applied. **Results:** Sixty-nine percent (n=138) of the sample reported using AI chatbots for dietary advice. Most commonly, ChatGPT (69.6%), primarily for weight management (27.5%), every week (37.7%). Most users perceived AI recommendations as reliable (76.8%) and trustworthy (79.7%), and 73.9% reported that AI had influenced their food choices; however, only 29.0% had consulted a qualified professional. AI use was significantly associated with age and gender ($p<0.050$) but not education. Reliability, trust, and influence were strongly and positively intercorrelated ($\rho=0.92–0.95$), while verification behavior showed negative correlations with trust and reliability ($\rho=-0.316$ to -0.346), suggesting that greater trust may paradoxically reduce critical appraisal of AI-generated advice. **Conclusions:** AI chatbots are widely used and trusted for dietary guidance despite limited professional oversight, highlighting a need for structured digital nutrition literacy and closer integration of AI tools with professional dietetic care.

INTRODUCTION

As generative artificial intelligence (AI) is rapidly spreading across society, adults are turning to conversational AI tools like ChatGPT, Gemini, and DeepSeek to seek health-related information, particularly about their diet and nutrition. Since the launch, ChatGPT has been rapidly embraced, and its always-on, conversational nature makes it an attractive addition or alternative to conventional dietetic counseling [1]. Experimental evaluations suggest these tools can provide broadly appropriate dietary guidance: "ChatGPT responses for non-communicable disease management are rated as appropriate in more than half to nearly three-quarters of cases," and "overall, the diet quality scores for the CHATBOT-generated diet plans for weight loss were satisfactory, with a wide range of accuracy in matching the prescribed caloric targets and macronutrient balance across the different CHATBOTs" [2]. Systematic and scoping reviews also identify personalized, scalable coaching by AI chatbots as a potential intervention to support healthy eating and physical activity, and weight loss [3, 4], whilst AI-powered mobile nutrition applications have been associated with better goal engagement and meal adherence [5]. Meanwhile, direct comparisons

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between advice from AI-powered chatbots and that of dietitians continue to show that these tools lack individualization, portion accuracy, and nutrient estimation, with several studies pointing to the fact that AI is not yet a replacement for credentialed nutrition counselling [6-9]. In parallel to these accuracy discussions, more studies have been conducted on the degree of public trust and acceptance of AI in the healthcare context. A significant minority of the general adult population is now seeking health information from AI chatbots, while trust in AI in health-related queries is somewhat lower than in other practical or technical queries [10, 11]. Trust, perceived usefulness, and social influence are key factors in chatbot adoption, regardless of age, as revealed in studies on technology acceptance [12, 13]. In addition, young adults have become more reliant on social media and AI-generated information sources that can be misleading when it comes to nutrition information and, at times, quite unreliable [14]. Ethical reflections also caution about the potential harm of unsupervised usage of chatbots related to weight and dietary behaviors for vulnerable groups like those who are prone to disordered eating [15]. In lower-resource settings like Pakistan, there is some positive evidence of increased and yet fragmented knowledge of AI in healthcare among the public and healthcare providers, and also the increased use of AI-generated chatbots and medical websites for self-directed health choices, such as self-medication [16-18]. While this growing body of work has investigated the technical accuracy of AI-generated dietary content in experimental settings, or the AI's acceptance in the broader healthcare landscape, a small number of quantitative studies on the actual use of, and trust in, AI dietary content by ordinary adults, as well as the extent to which this use leads to changes in dietary behaviors, has so far been conducted.

However, few population-level quantitative studies have explored how ordinary adults actually use AI chatbots for dietary and nutrition decisions, how much they trust these messages, whether they verify them, or whether they measurably influence their food choices, despite the growing body of work on the technical accuracy of AI-generated dietary content in experimental settings, or on the acceptance of AI in the broader healthcare landscape. There is a specific lack of linkages between patterns of using AI chatbots and trust, verification behavior, professional consultation, and sociodemographic characteristics in one adult sample. The purpose of this study, therefore, was to investigate the extent to which adult users of AI chatbots use them for dietary recommendations and what they use them for, how often they use them, what platform they use the chatbot on, perceived reliability, trust, verification behavior, behavioral influence, and professional consultation, as well as their socio-demographic and inter-variable associations.

METHODS

This cross-sectional survey was conducted at the Department of Nutrition and Dietetics, University of Management and Technology from September 2025 to November 2025. All participants provided informed consent before participation. A quantitative survey was conducted among adults aged 18 years and above using a structured, self-administered questionnaire administered online. Adults who were able to provide informed consent and who had internet access were eligible for inclusion; individuals below 18 years of age, those who declined consent, and those with incomplete or duplicate responses were excluded. For this study, 'adults' were defined as community-dwelling individuals aged 18 years or older, irrespective of their occupation or socioeconomic status, who had access to the internet and were capable of providing informed consent. Participants were recruited using a non-probability convenience sampling technique, consistent with comparable cross-sectional surveys [16, 18]. They were approached through university email lists, social media platforms (e.g., Facebook, WhatsApp), and academic forums, with a link to the survey shared in these groups. The sample size was calculated using the formula for cross-sectional studies. Assuming a 50% proportion of adults reporting AI chatbot use for dietary advice (to maximize sample size), a 95% confidence level, and a 7% margin of error, the minimum required sample size was 196. The final analytic sample comprised 200 adults. The structured questionnaire was developed by the research team based on a review of relevant literature. It was pre-tested on a small sample of 10 adults to assess clarity and comprehensiveness, and minor wording adjustments were made based on their feedback. The final questionnaire captured sociodemographic characteristics (age, gender, and educational attainment); patterns of AI chatbot use (purpose, frequency, and platform used); and perceptions of AI-generated dietary advice. Perceptions were measured using four-point Likert-type items (1=Disagree to 4=Strongly Agree) assessing perceived reliability, trust in AI, verification behavior, and the influence of AI on dietary choices. Additionally, participants were asked whether they had consulted a doctor, dietitian, or nutritionist regarding AI-obtained dietary advice.

Statistical analysis was conducted using SPSS version 26.0. Descriptive statistics (frequencies and percentages) summarized sociodemographic characteristics and patterns of AI use. Because the perception and behavior variables were measured on an ordinal Likert scale

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(1=Disagree to 4=Strongly Agree), non-parametric procedures were selected. The chi-square test was employed to examine associations between AI use and sociodemographic characteristics (age group, gender, education). Spearman's rank-order correlation was used to examine inter-relationships among perceived reliability, trust, verification behavior, and behavioral influence. A p-value of less than 0.050 was considered statistically significant.

RESULTS

A total of 200 adults were included in the study. Among the participants, 74 (37.0%) belonged to the 18–24-year age group, followed by 66 (33.0%) aged 25–34 years, 40 (20.0%) aged 35–44 years, and 20 (10.0%) aged 45–54 years; no participants were aged ≥55 years. Females constituted 102 (51.0%) of the sample, while males accounted for 98 (49.0%). Regarding educational attainment, 120 (60.0%) were undergraduates, and 90 (40.0%) were postgraduates. Overall, 138 (69.0%) of participants in this convenience sample reported having used an AI-based chatbot or agent to obtain dietary or nutrition-related recommendations, whereas 62 (31.0%) reported that they had never used AI for this purpose (Table 1).

Table 1: Sociodemographic Characteristics and Use of AI for Dietary Recommendations

Variables	Category	n (%)
Age Group	18-24 Years	74 (37.0%)
	25-34 Years	66 (33.0%)
	35-44 Years	40 (20.0%)
	45-54 Years	20 (10.0%)
	≥55 Years	0 (0.0%)
Gender	Female	102 (51.0%)
	Male	98 (49.0%)
Education	Undergraduate	120 (60.0%)
	Postgraduate	80 (40.0%)
AI Use	Yes	138 (69.0%)
	No	62 (31.0%)

Among the 138 participants who reported using AI for dietary or nutrition-related recommendations, weight loss or weight management was the most commonly reported purpose (n=38, 27.5%), followed by meal planning (n=22, 15.9%), healthy eating recommendations (n=20, 14.5%), and calorie or nutrient information (n=20, 14.5%). Food substitutions or recipes were reported by 18 (13.0%) participants, while 12 (8.7%) used AI for supplement-related information and 8 (5.8%) for disease-specific dietary advice. Regarding frequency of use, weekly use was the most common pattern (n=52, 37.7%), followed by monthly use (n=40, 29.0%) and rare use (n=34, 24.6%); daily or almost-daily use was reported by 12 (8.7%) participants. ChatGPT was the most commonly used AI tool, reported by 96 (69.6%) AI users, followed by DeepSeek (n=22, 15.9%) and Gemini (n=20, 14.5%) (Table 2).

Table 2: Patterns and Purposes of AI Use for Dietary Recommendations

Variables	Category	n (%)
Purpose of AI Use	Weight Loss / Weight Management	38 (27.5%)
	Meal Planning	22 (15.9%)
	Healthy Eating Recommendations	20 (14.5%)
	Calorie / Nutrient Information	20 (14.5%)
	Food Substitutions / Recipes	18 (13.0%)
	Supplements	12 (8.7%)
	Disease-Specific Dietary Advice	8 (5.8%)
Frequency of AI Use	Daily / Almost Daily	12 (8.7%)
	Weekly	52 (37.7%)
	Monthly	40 (29.0%)
	Rarely	34 (24.6%)
AI Tool Used	ChatGPT	96 (69.6%)
	DeepSeek	22 (15.9%)
	Gemini	20 (14.5%)

Among AI users, 86 (62.3%) participants agreed, and 20 (14.5%) strongly agreed that AI-generated dietary recommendations were reliable; 22 (15.9%) were neutral, and 10 (7.2%) disagreed, so that 106 (76.8%) participants overall expressed agreement or strong agreement regarding the reliability of AI-generated dietary recommendations. Similarly, 88 (63.8%) participants agreed, and 22 (15.9%) strongly agreed that they trusted AI to provide useful information about nutrition and diet, while 18 (13.0%) were neutral and 10 (7.2%) disagreed; overall, 110 (79.7%) participants expressed a positive level of trust in AI for nutrition-related information. Verification of AI-generated recommendations was highly prevalent: 88 (63.8%) participants agreed, and 42 (30.4%) strongly agreed that they verified AI-generated dietary recommendations using another source before following them; 8 (5.8%) were neutral, and none disagreed, so that 130 (94.2%) participants reported agreement or strong agreement with verifying AI-generated dietary recommendations. Regarding the influence of AI on food or dietary choices, 80 (58.0%) participants agreed, and 22 (15.9%) strongly agreed that AI-generated dietary recommendations had influenced their food or dietary choices, while 36 (26.1%) were neutral and none disagreed; overall, 102 (73.9%) participants reported that AI-generated recommendations had influenced their dietary choices. Despite this relatively high level of trust and reported influence, consultation with qualified professionals was less common: only 40 (29.0%) AI users

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reported consulting a doctor, dietitian, or nutritionist regarding dietary advice obtained from AI, whereas 98 (71.0%) had not consulted a nutrition or medical professional (Table 3).

Table 3: Perceptions, Trust, Verification, and Influence of AI-Generated Dietary Recommendations

Variables	Response	n (%)
AI Recommendations are Reliable	Disagree	10 (7.2%)
	Neutral	22 (15.9%)
	Agree	86 (62.3%)
	Strongly Agree	20 (14.5%)
I Trust AI to Provide Useful Nutrition Information	Disagree	10 (7.2%)
	Neutral	18 (13.0%)
	Agree	88 (63.8%)
	Strongly Agree	22 (15.9%)
I Verify AI Recommendations Using Another Source	Disagree	0 (0.0%)
	Neutral	8 (5.8%)
	Agree	88 (63.8%)
	Strongly Agree	42 (30.4%)
AI Recommendations Influenced my Food / Dietary Choices	Disagree	0 (0.0%)
	Neutral	36 (26.1%)
	Agree	80 (58.0%)
	Strongly Agree	22 (15.9%)
Consulted Doctor / Dietitian / Nutritionist	No	98 (71.0%)
	Yes	40 (29.0%)

Chi-square analysis revealed a significant association between AI use and age group (χ^2=35.45, df=3, p<0.001). AI use was also significantly associated with gender (χ^2=13.05, df=1, p<0.001). No significant association was observed with educational level (χ^2=0.06, df=1, p=0.802) (Table 4).

Table 4: Sociodemographic Characteristics by AI Use Status

Variables	Category	AI Users, n (%)	Non-users, n (%)
Age Group	18–24 Years	52 (70.3%)	22 (29.7%)
	25–34 Years	58 (87.9%)	8 (12.1%)
	35–44 Years	24 (60.0%)	16 (40.0%)
	45–54 Years	4 (20.0%)	16 (80.0%)
Gender	Female	82 (80.4%)	20 (19.6%)
	Male	56 (57.1%)	42 (42.9%)
Education	Undergraduate	82 (68.3%)	38 (31.7%)
	Postgraduate	56 (70.0%)	24 (30.0%)

Spearman correlation analysis was conducted among AI users (n=138). Spearman's rank-order correlation analysis demonstrated strong associations among perceived reliability, trust, verification behavior, and influence on dietary choices. Perceived reliability was very strongly and positively correlated with trust in AI (ρ=0.946, p<0.001) and with the reported influence of AI on dietary choices (ρ=0.940, p<0.001), and trust in AI was also very strongly and positively correlated with influence on dietary choices (ρ=0.921, p<0.001). Verification behavior showed significant negative correlations with perceived reliability (ρ=−0.316, p<0.001), trust in AI (ρ=−0.346, p<0.001), and influence on dietary choices (ρ=−0.245, p=0.003) (Table 5).

Table 5: Spearman Correlation Matrix for AI-Related Variables

Variables	Reliability	Trust	Verification	Influence
Reliability	1.000	0.946**	-0.316**	0.940**
Trust	0.946**	1.000	-0.346**	0.921**
Verification	-0.316**	-0.346**	1.000	-0.245*
Influence	0.940**	0.921**	-0.245*	1.000
*p<0.005, **p<0.001	–	–	–	–

Overall, 69.0% of participants reported using AI-based chatbots or agents for dietary or nutrition-related recommendations. Weight loss and weight management were the most frequently reported purposes of AI use, while weekly use was the most common pattern, and ChatGPT was the most commonly used AI tool. Most AI users expressed trust in and perceived the reliability of AI-generated dietary information, and 73.9% reported that AI recommendations had influenced their food or dietary choices. Although 94.2% reported verifying AI-generated recommendations using another source, only 29.0% had consulted a doctor, dietitian, or nutritionist regarding dietary advice obtained from AI

DISCUSSION

Our finding that 69.0% of participants reported using AI chatbots for dietary recommendations is substantially higher than the approximately one-third of adults reported in a 2026 KFF tracking poll for general health information [14]. This discrepancy suggests the current finding is partially supported by the literature but represents a higher proportion of reported use, likely attributable to our sample being younger and more digitally engaged. The high proportion of participants aged 18–34 years (70.0%) aligns with previous research consistently reporting that younger adults are the most frequent users of AI for health information [10, 14], and this association is strongly supported by Kauttonen *et al.* [12]. ChatGPT was the most commonly used tool (69.6%), followed by DeepSeek (15.9%) and Gemini (14.5%). This dominance is strongly supported by the literature, with Ponzo *et al.* and Kirk *et al.* both utilizing ChatGPT in their comparative studies [1, 6]. The most prevalent reason was weight loss or weight management (27.5%), followed by meal planning (15.9%). This is in line with previous systematic reviews [3, 4] which found that chatbots are an emerging weight loss coaching tool. This may be because structured medical nutrition therapy is a resource-intensive intervention [15] and is thus popular, and AI provides an accessible option. A remarkable result was the high degree of trust and perceived reliability, with 76.8% saying they trusted AI to give them reliable recommendations and 79.7% saying they trusted AI. This is somewhat at odds with the general sentiment that there is relatively low trust in AI for health-related queries [10, 14].

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Kauttonen *et al.* noted that transparency was a major barrier to adoption of AI in healthcare [12]. The current results are corroborated by Presiado *et al.* who found that perceived usefulness and trust were influential in the acceptance of chatbots [11]. The level of trust seen could be context-dependent, as users may view dietary advice as a less risky area. Interestingly, 94.2% of the AI users said they checked AI suggestions with a different source. This high rate of verification is a discovery and is not widely reported. The negative correlation between verification and trust (ρ = -0.346, $p<0.001$, n=138), however, indicated that the more trustworthy participants were the least likely to verify, and the more dubious were the most likely to verify. This is similar to the notion of automation bias [10, 11] in which users become overly dependent on automated systems. Almost three-quarters (73.9%) said that AI recommendations had impacted their food choices. The values of reliability, trust, and influence are very high and positive, which are consistent with the Unified Theory of Acceptance and Use of Technology (UTAUT) [11, 13], but are very high for these constructs and may not be sufficiently separated in our measurement process. This warrants caution in interpreting them as independent predictors of behavioral influence (ρ=0.921-0.946) warrant careful interpretation. These are very high correlations indicating high conceptual similarity between these constructs—especially since they were measured on single-item scales instead of multi-item scales. These correlations do not represent three separate determinants of behavioral influence but rather were likely due to the fact that participants who had positive attitudes toward AI were likely to have positive attitudes toward AI in all aspects [19-22]. The results of the bivariate Chi-square analysis revealed significant associations with age and gender in relation to AI use, and no association was found with educational level. This result is consistent with prior research [10, 14] that showed a higher prevalence of reported use of AI among younger adults. The rates were higher for females (80.4%) than for males (57.1%) and are similar to those found by Sadiq *et al.* who found that nutrition-related digital content is particularly targeted to young women [17]. This is also confirmed by Kauttonen *et al.* who also yielded null results for education acceptance of AI [12]. The current results corroborate the evidence presented by Habib *et al.* and Mahdi *et al.* in the Pakistani context, indicating the rise of self-directed health decisions driven by AI [16, 18].

This study has a few limitations. Because of the cross-sectional design, causal inferences cannot be made. Recall and social-desirability bias may occur with self-reported data. Limitations for generalizability are related to the non-probability convenience sampling. The distribution of age was skewed, with no participants 55 years and older; thus, the observed relationship between age and AI use may not apply to older adults. For future research, two types of sampling designs: longitudinal and representative designs are suggested.

CONCLUSIONS

While not fully endorsed by health professionals, AI-powered chatbots, such as ChatGPT, are now a trusted source of nutrition advice for adults and have a significant impact on their dietary choices. There is a clear need for structured digital nutrition literacy initiatives and for AI tools to be more deeply integrated with care provided by professionals to better align with the demonstrated food literacy needs of people, given the perceived gaps between these food literacy needs and the actual accuracy of AI-generated nutrition advice. The issue of measurement should be taken into consideration when interpreting the relationships among these variables, and future research should use validated multi-item scales to better distinguish these theoretically distinct variables.

Authors' Contribution

Conceptualization: AN
Methodology: AN
Formal analysis: AN
Writing and Drafting: SND, AN
Review and Editing: SND, AN

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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Nutrition Professionals' Dietary Habits and Alignment with Professional Advice: A Survey of Dietitians and Nutritionists

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ABSTRACT

Dietitians and nutritionists are trusted messengers of dietary guidance, yet whether their personal eating behaviors mirror the recommendations they deliver to clients remains insufficiently documented, particularly outside high-income settings. **Objectives:** To describe the self-reported dietary habits of practicing dietitians and nutritionists and to determine how consistently their professional nutrition knowledge translates into personal dietary practice. **Methods:** A descriptive cross-sectional survey was conducted among 70 practicing dietitians and nutritionists recruited through professional networks using non-probability convenience sampling. A structured, self-administered online questionnaire captured sociodemographic and professional characteristics alongside (maximum achievable score: 36; theoretical maximum with all items at 4 points: 44, but after reverse-scoring selected items, the maximum achievable score was 36) and a 3-item Practice Score (maximum achievable score: 14; theoretical maximum: 15, but one item used a 3-point scale reducing the maximum to 14). **Results:** The mean Dietary Habit Score was 25.94 ± 2.95 and the mean Practice Score was 9.94 ± 1.61. Although 71.4% rated their overall dietary habits as good or very good, only 17.1% reported that their diet was "completely" consistent with the advice they give clients, and workload (24.3%) and lack of time (21.4%) were the most-cited barriers. Dietary Habit Score varied significantly by qualification level (p=0.047) but not by gender, experience, or work setting. The correlation between the two composite scores was weak and non-significant (r=–0.227, p=0.059). **Conclusion:** Nutrition professionals possess strong dietary knowledge but only partially practice what they preach, underscoring the need for workplace-level support to close this knowledge–practice gap.

INTRODUCTION

The global burden of non-communicable diseases (NCDs) is seen as the major cause of death in the world, with nutrition professionals now at the forefront of efforts to prevent NCDs, and poor dietary patterns are one of these contributors that can be modified [1]. As nutrition educators, the dietitian or nutritionist is trained to take the science of nutrition and provide personal nutrition counseling; this practice is assumed to rest at least tacitly on expectations that this person will live up to the counseling advice that he/she gives others. However, other health-care workers have been the focus of an increasing number of studies, which show that nutrition information does not necessarily lead to healthier individual nutrition habits [2]. Systematic and qualitative reviews of nurses, another group with above-average health literacy, also report irregular meal timing, convenience and packaged food consumption, and frequent overeating or skipping meals, primarily as a result of shift work, the number of patients they care for, stress in the job, and lack of access to healthy food in the workplace [3, 4]. These are corroborated by evidence from Pakistan [5-7]. Healthy eating behavior was observed to be limited, with use of the

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cafeteria food, fewer healthy food choices, inadequate breaks, and work-related stress identified as the most common barriers. In a cross-sectional survey of healthcare providers conducted at two Taxila hospitals, 1/4 reported healthy eating behavior overall [8]. The qualitative study conducted among healthcare professionals in Karachi also shows structural and workload-related constraints for translating nutrition knowledge into practice [9]. Personal nutrition practices often differed from the nutrition advice trainees would recommend to clients for nutrition professionals who were nutrition trainees, as revealed by a survey of graduate clinical nutrition students in the U.S. [10] (knowledge–practice gap may start early in the professional career). In line with this, the assessment of nutrition undergraduates in Lahore revealed that many of the young nutrition professionals found their own diet inconsistent with the nutrition advice they were being taught [11]. In a larger set of student-received literature, psychosocial stressors, workload, and living conditions are shown to have an impact on diet even among students with above-average nutrition literacy [12-14]. Even a student survey by a Pakistani university since the COVID-19 pandemic has reported on the mixed behavior among students in relation to recommended eating practices [15]. Although a lot of studies have been conducted on the eating patterns of healthcare professionals, there is not much evidence that dietitians and nutritionists adhere to the recommendations that they give to their clients, particularly in Pakistan and South Asia. This gap can be crucial for crediting counselling, for professional role modelling and for public trust. Thus, this study aimed to evaluate self-reported dietary habits and practices, and their agreement with the professional recommendations, in addition to determining their relationship with sociodemographic and professional characteristics.

METHODS

The study was a descriptive, cross-sectional survey conducted at the Department of Public Health, University of the Punjab, Lahore, from November 2025 to January 2026 for a period of 8 weeks. Convenience sampling using snowball referrals was used to reach qualified dietitians and nutritionists in the sampling process, and they were recruited from professional associations, hospital/clinic networks, and nutrition-related social media groups. The participants were eligible if they held a Bachelor's degree or above in Nutrition, Dietetics, or related disciplines and practiced in clinical, academic, research, public health, or private nutrition and dietetics practice setting who had signed informed consent. Those who were still in their undergraduate studies, who did not have a relevant qualification, or who answered parts of the questions were not included. A total of 70 respondents (72.9% of a possible 96) returned the survey. Inferential analyses were performed mainly to explore patterns and test hypotheses, and only to infer patterns at the level of the population because of the small sample size and non-probability sampling. The target sample size was calculated using the single population proportion formula: $n = Z^2 \times p(1-p) / d^2$, where Z = 1.96 (95% confidence level), p=0.500 (estimated proportion of nutrition professionals with healthy dietary habits, as no prior Pakistan-specific data were available), and d = 0.10 (10% margin of error). This yielded a minimum required sample of 96 participants. However, due to the non-probability convenience sampling method and time constraints of the data collection period (8 weeks), a total of 70 complete responses were obtained, giving a response rate of approximately 73% from the 96 approached potential participants. The achieved sample size of 70 provides limited statistical power for detecting small effect sizes; moreover, subgroup analyses involving small groups (e.g., PhD holders, n=7; public health setting, n=4) should be interpreted with caution and are primarily exploratory. This yielded a minimum required sample of 96 participants. However, due to the non-probability convenience sampling method and time constraints of the data collection period (8 weeks), a total of 70 complete responses were obtained, giving a response rate of approximately 73% from the 96 approached potential participants. A structured, self-administered online questionnaire was used to collect data, with the use of Google Forms. Recruitment through social media and online platforms may have introduced selection bias by preferentially including nutrition professionals who are active on digital platforms and potentially more health-conscious. This limitation should be considered when interpreting the findings. The purpose of the study was explained, and participants were made anonymous so that they could be assured of transparency. Pre-testing of the questionnaire was carried out with 10 dietitians for clarity and comprehension. The content validity was evaluated by three experts, and the values of I-CVI ranged from 0.83 to 1.00, and the S-CVI/Ave was 0.92. The developed scales had good internal consistency, with Cronbach's alpha of 0.74 for the 11-item Dietary Habit Score (DHS) and 0.71 for the 3-item Practice Score (PS). The questionnaire consisted of three parts: (i) sociodemographic and professional characteristics; (ii) an 11-item DHS that was rated using a 4-point scale: breakfast frequency, snack skipping, fruit and vegetable consumption, fast-food and sugar-sweetened beverage, packaged/ultra-processed snacks, late eating, and water intake; (iii) an open-ended question inquiring about a healthy diet. The maximum possible score for each was 36,

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with a range of 17- 32; higher scores reflected better dietary practices. (iii) was a 3-item PS on nutrition label reading, nutrition knowledge in food choices, and consistency between personal food choices and nutrition recommendations from a professional. A maximum score of 14 could be achieved, as one of the items was scored on a 3-point scale, and the scores observed while the practices were being evaluated ranged from 7–13, with higher scores representing better practices. In addition, participants assessed their overall dietary habits on a single item covering all five categories of the diet (Poor to Excellent) to give a subjective assessment in addition to the composite scores.

IBM SPSS Statistics version 26.0 was used to analyse the data. Frequencies, percentages, means, and standard deviations were summarized for the sociodemographic and dietary variables. Shapiro–Wilk test was used to verify normality of the Dietary Habit Score (DHS) and the Practice Score. Independent-samples *t*-tests and one-way ANOVA were employed for data that were normally distributed, and Mann–Whitney U and Kruskal–Wallis tests were used for data not normally distributed and/or data that were insufficient in number for subgroups. Rank-order correlation (Spearman) was used to determine the relationship between DHS and Practice Score. Levene's test was used to check the homogeneity of variance. There were categorical variables that were examined for associations using chi-square or Fisher's exact tests. A value of *p*<0.050 was considered as being statistically significant. The effect sizes Cohen's d and eta-squared (η^2) were calculated for t-tests and ANOVA, respectively, and Cohen's f^2 was calculated for regression analysis (where applicable). No adjustment for multiple testing was made for this exploratory study with a small sample size (N=70) and eight independent comparisons; thus, findings, including the nominally significant qualification level result (p=0.047), were interpreted with caution. Where appropriate, exact p-values, effect sizes, and 95% confidence intervals were reported.

RESULTS

Out of the 70 respondents, the majority were female (81.4%) and aged between 20–30 years (64.3%). Just over half held a bachelor's degree in Nutrition/Dietetics (51.4%), while 32.9% held an MS/MPhil and 10.0% a PhD. Most participants had relatively limited professional experience, with 28.6% having practiced for less than one year and 38.6% for one to five years; only 12.9% had more than a decade of experience. Hospital/clinical settings were the most common workplace (35.7%), followed by private practice/clinic (25.7%) and research (18.6%) (Table 1).

Table 1: Sociodemographic and Professional Characteristics of Respondents (n=70)

Variables	Category	n (%)
Age (years)	20-25	24 (34.3%)
	26-30	21 (30.0%)
	31-35	14 (20.0%)
	36-40	6 (8.6%)
	>40	5 (7.1%)
Gender	Female	57 (81.4%)
	Male	13 (18.6%)
Qualification	BS Nutrition/Dietetics	36 (51.4%)
	MS/MPhil	23 (32.9%)
	PhD	7 (10.0%)
	Other	4 (5.7%)
Professional Experience	<1 Year	20 (28.6%)
	1-5 Years	27 (38.6%)
	6-10 Years	14 (20.0%)
	>10 Years	9 (12.9%)
Work Setting	Hospital/Clinical	25 (35.7%)
	Private Practice/Clinic	18 (25.7%)
	Research	13 (18.6%)
	Academia	10 (14.3%)
	Public Health	4 (5.7%)

The study summarizes self-reported dietary behaviors. Most respondents reported eating breakfast daily (37.1%) or on 4–6 days per week (35.7%), and only one participant (1.4%) rarely/never ate breakfast. Meal skipping was infrequent, with 41.4% reporting they "rarely" skipped a main meal and 20.0% "never." Fruit and vegetable intake reached the commonly recommended ≥5 servings/day in only 32.9% of respondents, while 28.6% consumed 1–2 servings or fewer. Fast-food consumption of 3 or more times per week was reported by 32.9% of the sample, and sugar-sweetened beverages were consumed daily by 15.7%. Packaged/ultra-processed snacks were consumed 3 or more times weekly by half the sample (50.0%), and 40.0% reported a daily water intake below the commonly recommended 1.5 L (Table 2).

Table 2: Self-Reported Dietary Behaviors of Nutrition Professionals (n=70)

Behaviors	Category	n (%)
Breakfast Frequency	Daily	26 (37.1%)
	4-6 Days/Week	25 (35.7%)
	1-3 Days/Week	18 (25.7%)
	Rarely/Never	1 (1.4%)
Main Meal Skipping	Never	14 (20.0%)
	Rarely	29 (41.4%)
	Sometimes	23 (32.9%)
	Often	4 (5.7%)

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Fruit and Vegetable Servings/ Day Fast Food Frequency	<1	3 (4.3%)
	1–2	17 (24.3%)
	3–4	27 (38.6%)
	≥5	23 (32.9%)
	<1 Time/Week	17 (24.3%)
	1–2 Times/Week	30 (42.9%)
	3–4 Times/Week	20 (28.6%)
	≥5 Times/Week	3 (4.3%)
Sugar-Sweetened Beverage Frequency	Never/Rarely	20 (28.6%)
	1–2 Times/Week	30 (42.9%)
	3–4 Times/Week	9 (12.9%)
	Daily	11 (15.7%)
Packaged/UPF Snack Frequency	Never/Rarely	10 (14.3%)
	1–2 Times/Week	25 (35.7%)
	3–4 Times/Week	26 (37.1%)
	Daily	9 (12.9%)
Late-Night Eating	Never	22 (31.4%)
	Rarely	26 (37.1%)
	Sometimes	17 (24.3%)
	Often	5 (7.1%)
Daily Water Intake	<1 L	3 (4.3%)
	1–1.5 L	28 (40.0%)
	1.5–2 L	28 (40.0%)
	>2 L	11 (15.7%)

Descriptive statistics for the composite scores are presented. The mean Dietary Habit Score was 25.94 ± 2.95 (range 17–32 of a possible 36), and the mean Practice Score was 9.94 ± 1.61 (range 7–13 of a possible 14). When categorized by the self-rated "Overall Dietary Habits" item, 34.3% of participants rated their habits as "very good" and 37.1% as good, while a combined 21.5% rated their habits as only fair or poor (Table 3).

Table 3: Dietary Habit Score, Practice Score, and Overall Self-Rated Dietary Habits (n=70)

Measures	Results
Dietary Habit Score, Mean ± SD (Range; Max=36)	25.94 ± 2.95 (17–32)
Practice Score, Mean ± SD (Range; Max=14)	9.94 ± 1.61 (7–13)
Pearson correlation (Dietary Habit Score × Practice Score)	r = –0.227, p = 0.059
Overall Dietary Habits – Poor, n (%)	2 (2.9%)
Overall Dietary Habits – Fair, n (%)	13 (18.6%)
Overall Dietary Habits – Good, n (%)	26 (37.1%)
Overall Dietary Habits – Very good, n (%)	24 (34.3%)
Overall Dietary Habits – Excellent, n (%)	5 (7.1%)

The study presents indicators of knowledge–practice alignment. While the large majority reported "always" (50.0%) or often (31.4%) reading nutrition labels, and 65.7% said they "often" or "always" applied their nutrition knowledge to their own food choices, only 17.1% reported their personal diet was "completely" consistent with the advice they give clients; 54.3% said it was "mostly" consistent and 28.6% only "partially" consistent. Workload (24.3%), lack of time (21.4%), and stress (20.0%) were the three most frequently cited barriers to practicing what they preach, together accounting for nearly two-thirds of responses, followed by food cravings (15.7%) and the cost of healthy foods (11.4%) (Table 4).

Table 4: Alignment Between Nutrition Knowledge, Personal Practice, and Reported Barriers (n=70)

Variables	Category	n (%)
Nutrition Label Reading	Never	3 (4.3%)
	Sometimes	10 (14.3%)
	Often	22 (31.4%)
	Always	35 (50.0%)
Apply Nutrition Knowledge to Own Diet	Rarely	6 (8.6%)
	Sometimes	18 (25.7%)
	Often	29 (41.4%)
	Always	17 (24.3%)
Diet Consistent with Professional Advice	Partially	20 (28.6%)
	Mostly	38 (54.3%)
	Yes, Completely	12 (17.1%)
Main Reported Barrier	Workload	17 (24.3%)
	Lack of time	15 (21.4%)
	Stress	14 (20.0%)
	Cravings	11 (15.7%)
	Cost Of Healthy Foods	8 (11.4%)
	Social/Family Commitments	4 (5.7%)
	Food Availability	1 (1.4%)

Associations between sociodemographic/professional characteristics and the two composite scores are shown. Dietary Habit Score differed significantly by qualification level ($F=2.80$, $p=0.047$) $\eta^2=0.11$. Post-hoc pairwise comparisons using Tukey's Honestly Significant Difference (HSD) test revealed no statistically significant differences between individual qualification groups, likely due to the small subgroup sizes (BS: n=36, MS/MPhil: n=23, PhD: n=7, Other: n=4). The overall ANOVA result should therefore be interpreted with caution, with PhD holders reporting the lowest mean score (23.57) and respondents with "other" qualifications the highest (28.25). Practice Score did not differ significantly by qualification ($F=1.33$, $p=0.272$). Although the direction of the association is consistent with a knowledge–practice gap, the p-value exceeds the conventional threshold for statistical significance (Table 5).

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Table 5: Association of Dietary Habit Score and Practice Score with Sociodemographic and Professional Characteristics

Variables	Dietary Habit Score, (Mean ± SD)	Practice Score, (Mean ± SD)	Test Statistic	p-value	Effect Size (95% CI)
Gender					
Male	26.23 ± 3.10	9.54 ± 1.70	t=0.39 (DHS)	0.700 (DHS)	DHS: d = 0.09 (−0.51, 0.69)
Female	25.88 ± 2.90	10.04 ± 1.58	t=−1.01 (PS)	0.318 (PS)	PS: d = −0.25 (−0.85, 0.35)
Qualification					
BS	25.81 ± 2.85	9.61 ± 1.55	F=2.80 (DHS)	0.047* (DHS)	DHS: η^2 = 0.11 (0.01, 0.24)
MS/MPhil	26.48 ± 2.75	10.13 ± 1.62	F=1.33 (PS)	0.272 (PS)	PS: η^2 = 0.06 (0.00, 0.16)
PhD	23.57 ± 3.40	10.57 ± 1.90	—	—	—
Other	28.25 ± 3.50	10.75 ± 1.45	—	—	—
Experience					
<1 Year	24.85 ± 3.20	10.25 ± 1.75	F=1.31 (DHS)	0.278 (DHS)	DHS: η^2 = 0.06 (0.00, 0.15)
1–5 Years	26.30 ± 2.80	10.04 ± 1.60	F=0.90 (PS)	0.448 (PS)	PS: η^2 = 0.04 (0.00, 0.12)
6–10 Years	26.50 ± 2.65	9.36 ± 1.50	—	—	—
>10 Years	26.44 ± 2.95	9.89 ± 1.55	—	—	—
Work Setting					
Hospital/Clinical	25.56 ± 3.00	9.92 ± 1.65	F=0.84 (DHS)	0.507 (DHS)	DHS: η^2 = 0.05 (0.00, 0.13)
Private Practice	26.22 ± 2.85	9.78 ± 1.58	F=0.90 (PS)	0.468 (PS)	PS: η^2 = 0.05 (0.00, 0.13)
Research	27.08 ± 2.70	10.62 ± 1.50	—	—	—
Academia	25.30 ± 3.05	9.40 ± 1.70	—	—	—
Public Health	25.00 ± 3.15	10.00 ± 1.60	—	—	—

*Statistically significant at p<0.050. DHS = Dietary Habit Score; PS = Practice Score. CI = Confidence Interval; d = Cohen's d; η^2 = Eta-squared

DISCUSSION

This study aimed to describe the self-reported dietary habits of practicing dietitians and nutritionists and determine how consistently their professional knowledge translates into personal practice. The key finding was that while nutrition professionals demonstrated generally favorable dietary behaviors and high engagement with nutrition information, only 17.1% reported their personal diet was completely consistent with the advice they give clients. This knowledge-practice gap was primarily attributed to workload, time constraints, and stress rather than lack of knowledge. The extent to which participants did report complete alignment between personal diet and nutritional advice from professionals (only 17.1%) is similar to other studies reporting a gap between nutrition professionals and nutrition trainees. Personal nutrition practices also varied from that of the advice trainees would give to their clients, as revealed by a cross-sectional survey of graduate clinical nutrition students in the United States [10]. A novel finding was the significant association between qualification level and Dietary Habit Score (p=0.047), with PhD-qualified respondents reporting the lowest scores (23.57) and those with "other" qualifications the highest (28.25). This contrasts with prior literature, which has more often examined years of experience or evidence-based-practice competencies than academic qualification as a correlate of professional behavior [2, 16]. A tentative, hypothesis-generating explanation is that higher academic attainment may correlate with research- and academia-heavy roles that impose greater time demands, potentially reducing opportunity for healthy eating; however, the cross-sectional design precludes causal interpretation, and the small subgroup sizes (PhD, n=7; Other, n=4) mean this finding requires confirmation in larger, adequately powered samples. The absence of significant differences by gender, experience, or work setting supports the interpretation that the knowledge–practice gap is representative of the profession broadly rather than confined to a specific subgroup, consistent with the gender-neutral patterns reported in other nutrition-related research from Pakistan [17-20] and in the wider health-professional literature [4, 5]. This supports the conclusion that specialized nutrition knowledge alone does not protect against the workplace, time, and stress-related pressures that shape the food environment in which nutrition professionals operate, and argues against any assumption that expertise renders this group immune to the same occupational barriers faced by other healthcare workers.

The relatively small, convenience sample of respondents is a limitation of this study, and respondents were heavily recruited from online professional networks, which may have led to selection and social-desirability bias in reporting dietary behavior. The small sample size also precluded adjustment for potential confounders such as

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age, years of experience, and work setting, which may have influenced the observed associations. Future studies with larger samples should employ multivariable regression models to adjust for these potential confounders.

CONCLUSIONS

Dietitians and nutritionists in this sample possessed strong nutrition knowledge and generally favorable dietary habits, yet fewer than one in five felt their personal diet fully matched the advice they give clients. Workload, time constraints, and stress—not lack of knowledge—emerged as the principal barriers to practicing what they preach. Addressing these occupational barriers, rather than knowledge gaps alone, may be key to closing the knowledge–practice divide among nutrition professionals.

Authors' Contribution

Conceptualization: JK
Methodology: JK
Formal analysis: JK
Writing and Drafting: AGK
Review and Editing: AGK, JK, MI

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

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