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Assessment Of Fermented Food Intake And Its Association With Health Outcomes In Nur International University Students (18-30 Years)

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Abstract

Background: Fermented foods such as yogurt (dahi), lassi, and traditional pickles (achar) are deeply embedded in Pakistani dietary culture and have been associated with diverse health-promoting properties through modulation of gut microbiota, immune function, and metabolic health. Despite their cultural prevalence, systematic data on fermented food consumption patterns and their association with health outcomes among Pakistani university students remain lacking. Objective: To assess fermented food intake and its association with health outcomes including gut health, mental health, skin health, immunity, mood, and nutrient absorption among students aged 18–30 years at Nur International University, Lahore. Methodology: A cross-sectional survey-based study was conducted among 250 university students selected through random sampling. Data were collected using a structured validated multi-section questionnaire. Data were analyzed using SPSS version 25 employing descriptive statistics and chi-square tests of association. Results: All eight chi-square association tests between fermented food intake and health outcomes were statistically significant ($p<0.05$). Regular consumers demonstrated significantly less digestive discomfort ($p=0.012$), fewer skin issues ($p=0.028$), greater skin improvement ($p=0.031$), reduced stress and mood swings ($p=0.032$), stronger immunity ($p=0.024$), more positive mood effects ($p=0.019$), stronger gut-brain awareness ($p=0.027$), and greater conviction in enhanced nutrient absorption ($p=0.022$) compared to rarely

consuming participants. All thirteen demographic association tests were also statistically significant ($p<0.05$). Conclusion: Regular fermented food consumption is significantly associated with improved health outcomes across multiple domains including gut health, mental health, skin health, and immune function among Pakistani university students. These findings strongly support integrating fermented food promotion into university-based public health nutrition programs in Pakistan.

Introduction

Diet is a fundamental determinant of human health, regulating not only nutritional status but also the gut microbiome, immune function, and chronic disease risk. Among dietary components, fermented foods produced through microbial transformation of food substrates by bacteria, yeasts, and molds have garnered increasing scientific attention for their functional health properties. These foods, ranging from dairy-based yogurt and kefir to vegetable-based kimchi and legume-based tempeh, share a common biological foundation in beneficial microbial activity and have been consumed across human civilizations for millennia. In South Asia, fermented dairy staples such as dahi and lassi carry a documented history of therapeutic use in the Ayurvedic tradition, providing a cultural basis for their continued integration into modern Pakistani diets [1].

Pakistan faces a dual nutritional burden: widespread undernutrition and micronutrient deficiencies coexist with escalating rates of obesity, type 2 diabetes, and cardiovascular disease. The National Nutrition Survey 2018 documented stunting in 40.2% and underweight in 28.9% of children under five, alongside pervasive deficiencies of iron, vitamin D, and zinc across all age groups. Simultaneously, rising rates of metabolic disease among adults reflect a nutrition transition driven by urbanization and shifts toward processed food consumption. Fermented foods, by virtue of their probiotic content, enhanced micronutrient bioavailability, and gut-modulatory effects, represent a culturally feasible and evidence-supported dietary strategy to address this double burden [2,3].

University students represent a high-priority population for nutritional research and intervention. This life stage is characterized by increased dietary autonomy, reduced consumption of traditional foods, elevated psychosocial stress, and irregular eating patterns all of which negatively affect diet quality and health outcomes. In Pakistan, these challenges are compounded by limited nutrition literacy, financial constraints, and convenience-driven campus food environments. Despite the cultural prevalence of fermented dairy consumption, no systematic study has examined fermented food intake and its health correlates among Pakistani university students. This cross-sectional study addresses that gap by assessing fermented food consumption patterns and their associations with BMI, fasting lipid profiles, gastrointestinal health, immune function, mental well-being, and skin health among students aged 18–30 years at Nur International University, Lahore [4,5].

The scientific literature on fermented foods has grown substantially over the past two decades, fueled by advances in microbiome science and nutritional epidemiology. Fermentation, practiced across virtually all human cultures for at least 9,000 years, originally served as a preservation strategy; its role in health promotion has since been validated through rigorous modern research. Landmark contributions include Metchnikoff's 1908 hypothesis linking Lactobacillus-rich fermented dairy to longevity in Bulgarian populations, and the 2002 FAO/WHO consensus definition of probiotics as "live microorganisms which, when administered in adequate amounts, confer a health benefit on the host." These milestones established the scientific framework for investigating fermented foods as functional dietary components [6,7].

Beyond its scientific contributions, this study holds direct implications for public health policy and practice. Locally generated evidence on fermented food-health associations can inform university canteen policy, campus wellness programming,

and the development of Pakistan-specific dietary guidelines areas currently lacking an empirical foundation. Promotion of affordable traditional fermented foods represents a scalable, cost-effective health strategy that builds on existing food culture, thereby maximizing population acceptability and adherence. The study also extends fermented food research into an underrepresented South Asian population, enhancing the global generalizability of findings and contributing to calls for more geographically diverse nutritional evidence [8,9].

Fermented foods represent a scientifically validated and culturally embedded dietary resource with significant potential to address Pakistan's dual burden of malnutrition and rising non-communicable disease prevalence. University students, navigating a period of critical dietary transition, constitute a high-impact population for evidence-based nutritional intervention. By systematically evaluating fermented food consumption and its associations with metabolic, gastrointestinal, immune, and mental health outcomes at Nur International University, this study aims to bridge the gap between traditional dietary practice and contemporary public health evidence. The findings are expected to provide a practical foundation for policy development, dietary guideline formulation, and campus-level health promotion strategies tailored to the Pakistani context [10].

METHODOLOGY

A cross-sectional survey design was employed for this study. A total of 250 students from Nur International University, Lahore, were recruited using simple random sampling. The sample size was calculated at a 95% confidence level with a 5% margin of error and an estimated prevalence of 50%. Data were collected over four months using a structured questionnaire assessing fermented food intake and its association with various health outcomes among university students aged 18–30 years. The questionnaire included socio-demographic characteristics, anthropometric measurements, fermented food consumption patterns, and perceived health outcomes. Data were entered and analyzed using SPSS version 25. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated. Pearson's chi-square test was applied to examine associations between fermented food intake and health-related variables, with statistical significance set at $p < 0.05$. Results were presented using tables, bar charts, and pie charts [11].

RESULTS

This chapter presents the results of the cross-sectional study conducted among 250 students at Nur International University, Lahore. Data were collected through a structured questionnaire and analyzed using SPSS 25. Results are presented into descriptive frequency tables, charts and cross-tabulation association tables. Frequencies, percentages, and chi-square test statistics are categorized for all variables.

Table 1: Socio-demographic characteristics of study participants

The study included 250 university students, most of whom were female (65.3%) and aged 18–24 years (70.4%). The majority were undergraduate students (80.4%), had a normal BMI (59.6%), and belonged to urban areas (60.8%). Most participants (75.1%) reported no existing health conditions, indicating that the sample largely represented healthy young adults.

Variable	Category	Frequency (n)	Percentage (%)
Weight (kg)	30–50	73	29.2%
	51–70	138	55.2%

Variable	Category	Frequency (n)	Percentage (%)
	71–90	32	12.8%
	91–110	7	2.8%
Height (ft)	4.1–5	26	10.4%
	5.1–6	213	85.2%
	6.1–6.11	11	4.4%
BMI Category	Underweight	55	22.0%
	Normal	149	59.6%
	Overweight	36	14.4%
	Obese	10	4.0%
Age Group	18–24	176	70.4%
	25–30	74	29.6%
Gender	Male	84	34.7%
	Female	158	65.3%
Education Level	Secondary	8	3.2%
	Undergraduate	201	80.4%
	Graduate	31	12.4%
	Post Graduate	10	4.0%
Occupation	Student	211	84.4%
	Homemaker	23	9.2%
	Employed	10	4.0%
	Self-Employed	6	2.4%
Area of Residence	Urban	152	60.8%
	Semi-Urban	66	26.4%
	Rural	32	12.8%
Health Condition	Yes	60	24.9%
	No	181	75.1%

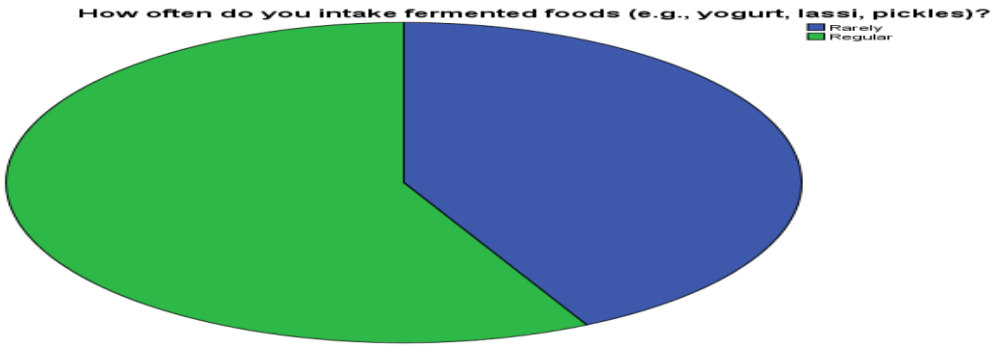
Variable	Category	Frequency (n)	Percentage (%)
Total		**250**	**100%**

Table 2. Fermented food intake and gut health outcomes

The findings showed that digestive issues were common among students, with 46.0% reporting symptoms sometimes and 22.0% very often. Most participants believed that fermented foods improved digestion, with 42.3% agreeing and 17.7% strongly agreeing. The most frequently reported benefits of fermented foods were improved digestion (36.8%), enhanced immunity (27.6%), and better mood (17.6%), indicating positive perceptions of their overall health benefits.

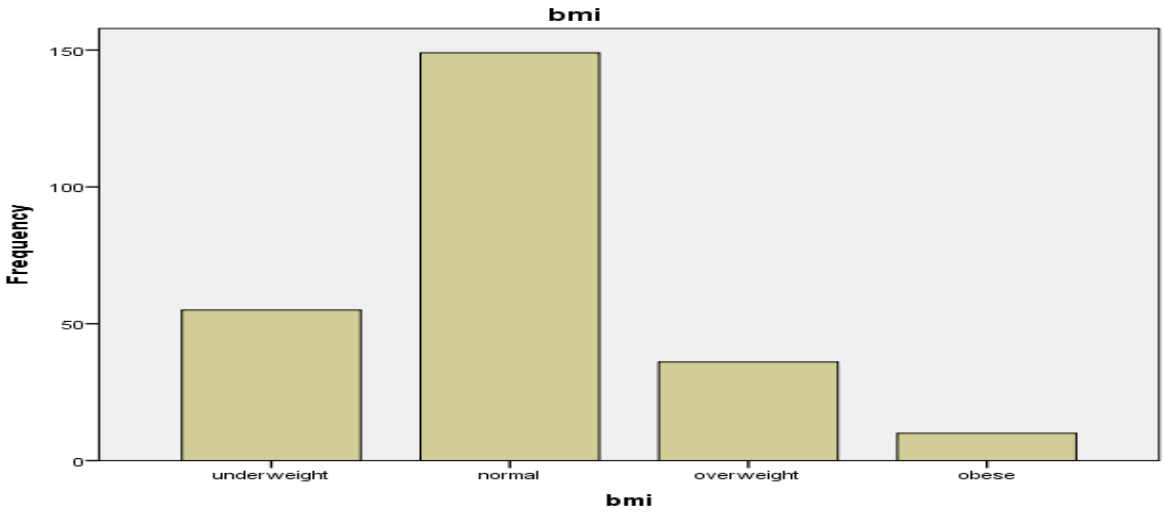
Variable	Category	Frequency (n)	Percentage (%)
Digestive Discomfort	Very Often	55	22.0%
	Sometimes	115	46.0%
	Rarely	57	22.8%
	Never	23	9.2%
FF Improve Digestion	Strongly Agree	44	17.7%
	Agree	105	42.3%
	Neutral	74	29.8%
	Disagree	21	8.5%
	Strongly Disagree	4	1.6%
Fermented Foods Help With	Improving Digestion	92	36.8%
	Boosting Immunity	69	27.6%
	Enhancing Mood	44	17.6%
	Skin Health	17	6.8%
	Reducing Chronic Disease	12	4.8%
	Don't Know	11	4.4%
	Weight Management	5	2.0%
Total		**250**	**100%**

Figure 2: Fermented Food Intake



The figure shows that most participants were regular consumers of fermented foods, while a smaller proportion consumed them rarely or never. This indicates that fermented foods are commonly included in the diet of the participants.

Figure 3: Body Mass Index



This figure indicates that most participants had a normal BMI (59.6%) followed by overweight (22%), underweight (14.4%), and obese (4%). This suggests that while the majority of participants maintain a healthy weight, a notable proportion are either underweight or overweight, which may have implications for their overall health.

Table 4.3 Fermented food intake and immunity/disease prevention

The findings demonstrated a positive perception of the immune and nutritional benefits of fermented foods among students. More than half (52.2%) believed fermented foods may help reduce the risk of common infections, while 26.9% reported that they do. Most participants agreed that fermentation enhances nutrient bioavailability, with 49.6% agreeing and 15.6% strongly agreeing. Calcium and iron (26.4%) were the most commonly identified nutrients improved by fermentation, although 20.0% of students were unsure. Furthermore, most participants considered fermented foods to be as beneficial as or more beneficial than supplements, reflecting strong confidence in their health-promoting effects.

Variable	**Category**	**Frequency (n)**	**Percentage (%)**
Can FF Reduce Infection	Yes	67	26.9%
	Maybe	130	52.2%

Variable	Category	Frequency (n)	Percentage (%)
	No	30	12.0%
	Not Sure	22	8.8%
FF Enhance Nutrient Absorption	Strongly Agree	39	15.6%
	Agree	124	49.6%
	Neutral	74	29.6%
	Disagree	9	3.6%
	Strongly Disagree	4	1.6%
Nutrients Increased	Vitamin B Complex	34	13.6%
	Vitamin C	61	24.4%
	Calcium and Iron	66	26.4%
	Protein Quality	39	15.6%
	Not Sure	50	20.0%
FF vs Supplements	Yes	100	40.0%
	Sometimes	102	40.8%
	No	30	12.0%
	Not Sure	18	7.2%
Total		**250**	**100%**

Table 4. Fermented food intake and skin health outcomes

The results showed that skin-related issues were common among students, with 68.3% reporting concerns such as acne, dryness, or dullness. Among fermented food consumers, 40.4% reported slightly improved skin health and 27.2% reported significant improvement, indicating that over two-thirds perceived positive effects. The most commonly reported benefits included clearer skin (34.5%), reduced acne (26.1%), and improved skin hydration (18.1%). However, 21.3% reported no noticeable effect, suggesting that responses to fermented foods may vary among individuals.

Variable	Category	Frequency (n)	Percentage (%)

Variable	Category	Frequency (n)	Percentage (%)
Experience Skin Issues	Yes	168	68.3%
	No	78	31.7%
Improvement in Skin After FF	Yes, Significant	68	27.2%
	Slight Improvement	101	40.4%
	No Change	42	16.8%
	Not Sure	39	15.6%
FF Contribute To	Clearer Skin	86	34.5%
	Reduced Acne	65	26.1%
	Better Hydration	45	18.1%
	No Effect	53	21.3%
Total		**250**	**100%**

Table 5 Fermented food intake and mental health

The findings revealed that stress and mood-related concerns were common among students, with 43.4% experiencing them sometimes and 29.3% very often. Half of the participants (50.0%) believed that fermented foods positively affected their mood and concentration. The most commonly reported effects were increased energy (37.9%) and relaxation (30.8%), while 31.2% reported no change. Furthermore, most participants agreed (44.4%) or strongly agreed (17.2%) that gut health influenced mental well-being, indicating good awareness of the gut–brain connection and the potential mental health benefits of fermented foods.

Variable	Category	Frequency (n)	Percentage (%)
Experience Stress/Mood Swings	Very Often	73	29.3%
	Sometimes	108	43.4%
	Rarely	41	16.5%
	Never	27	10.8%
FF Affects Mood/Concentration	Yes, positively	125	50.0%
	Yes, negatively	36	14.4%
	No Effect	37	14.8%
	Not Sure	52	20.8%

Variable	Category	Frequency (n)	Percentage (%)
After Consuming FF Feel	More Relaxed	74	30.8%
	More Energetic	91	37.9%
	No Noticeable Change	75	31.2%
Gut Health Influences Mental Health	Strongly Agree	43	17.2%
	Agree	111	44.4%
	Neutral	82	32.8%
	Disagree	11	4.4%
	Strongly Disagree	3	1.2%
Total		**250**	**100%**

Table 6 Fermented food intake and weight management perceptions

The results indicated a positive perception of fermented foods in weight management. Most participants agreed (44.8%) or strongly agreed (20.0%) that fermented foods can support body weight management by improving metabolism and gut microbiome balance. Additionally, 36.8% had already included fermented foods in a weight management plan, while 26.7% intended to do so in the future. Overall, 63.5% of participants either used or planned to use fermented foods for weight control, reflecting strong interest in their potential metabolic health benefits.

Variable	Category	Frequency (n)	Percentage (%)
FF Help Manage Body Weight	Strongly Agree	50	20.0%
	Agree	112	44.8%
	Neutral	76	30.4%
	Disagree	11	4.4%
	Strongly Disagree	1	0.4%
FF Included in Weight Loss Plan	Yes	91	36.8%

Variable	Category	Frequency (n)	Percentage (%)
	No	51	20.6%
	Planning To	66	26.7%
	Not Interested	39	15.8%
Total		**250**	**100%**

Table 7 Future intentions and overall perception of fermented food consumption

The findings showed highly positive attitudes toward fermented food consumption among students. Most participants were willing to include fermented foods in their regular diet, with 43.8% responding "yes" and 48.2% "maybe." Strong support was also observed for incorporating fermented foods into public health nutrition programs (65.5%). Additionally, 63.6% considered fermented foods an important part of a healthy diet, while 61.6% were willing to recommend them to others. These results reflect favorable perceptions and a strong potential for promoting fermented food consumption through nutrition education initiatives.

Variable	Category	Frequency (n)	Percentage (%)
Willing to Include FF Daily	Yes	109	43.8%
	Maybe	120	48.2%
	No	20	8.0%
FF Promoted in Public Health	Yes	163	65.5%
	Not Sure	52	20.9%
	No	34	13.7%
FF Important in Healthy Diet	Yes	159	63.6%
	Not Sure	58	23.2%
	No	33	13.2%
Recommend FF to Others	Yes	154	61.6%
	Not Sure	72	28.8%
	No	24	9.6%
Total		**250**	**100%**

Table 8. Chi-square association tests between demographic variables and FF perceptions

The chi-square analysis revealed significant associations between demographic characteristics and fermented food-related perceptions and behaviors ($p < 0.05$). Gender was significantly associated with digestive discomfort, skin issues, stress and mood swings, and perceived mood benefits of fermented foods. BMI showed significant associations with digestive discomfort, weight management, and the inclusion of fermented foods in weight loss plans. Age, residence, education level, and occupation were also significantly related to willingness to consume fermented foods, perceived dietary importance, and barriers to consumption. These findings suggest that demographic factors play an important role in shaping attitudes and behaviors toward fermented foods, highlighting the need for targeted nutrition education strategies.

Variable 1	**Variable 2**	**df**	**p-value**	**Result**
Gender	Digestive Discomfort	3	0.020	Significant
Gender	Skin Issues	1	0.023	Significant
Gender	Stress/Mood Swings	3	0.030	Significant
Gender	FF Affects Mood	3	0.015	Significant
BMI	Digestive Discomfort	9	0.032	Significant
BMI	Weight Management	12	0.033	Significant
BMI	FF in Weight Loss Plan	9	0.019	Significant
Age Group	Willingness to Include FF	2	0.022	Significant
Age Group	Barrier to Consumption	5	0.021	Significant
Residence	Barrier to Consumption	10	0.020	Significant
Residence	Willingness to Include FF	4	0.023	Significant
Education	FF Important in Diet	6	0.023	Significant
Occupation	Barrier to Consumption	15	0.019	Significant

FERMENTED FOOD INTAKE VS. HEALTH OUTCOMES

The following tables present cross-tabulation analyses examining associations between fermented food intake frequency (Regular vs. Rarely) and eight key health-related outcome variables. Fermented food intake was categorized as Regular and Rarely. Chi-square tests were performed using SPSS 25 with $p < 0.05$ considered statistically significant.

Table 9: Association Between Fermented Food Intake and Digestive Discomfort
A significant association was found between fermented food intake and digestive discomfort (p=0.012). Students who consumed fermented foods more regularly reported lower levels of digestive discomfort, suggesting a beneficial effect on gut health. This finding supports existing evidence that fermented foods may improve gastrointestinal health through their positive effects on the gut microbiota.

Fermented Food Intake	**Digestive Discomfort**					
	Very Often	**Sometimes**	**Rarely**	**Never**	**Total**	**p-value**
Rarely	55	101	54	19	229	0.012*
Regular	0	14	3	4	21	
Total	**55**	**115**	**57**	**23**	**250**	

Table 10: Association Between Fermented Food Intake and Skin Issues
A significant association was observed between fermented food consumption and skin health (p=0.028). Students who consumed fermented foods regularly reported fewer skin problems, such as acne, dryness, and dullness. This finding suggests that fermented foods may contribute to improved skin health, possibly through their positive effects on the gut–skin axis.

Fermented Food Intake	**Skin Issues**			
	Yes	**No**	**Total**	**p-value**
Rarely	156	69	225	
Regular	12	9	21	0.028*
Total	**168**	**78**	**246**	

Table 11: Association Between Fermented Food Intake and Skin Improvement
Table shows the association between fermented food intake and perceived skin improvement. There was a statistically significant association between fermented food intake and skin improvement (p=0.031), which supports that regular fermented food consumers are significantly more likely to report skin improvement. This result is biochemically consistent with probiotic-rich fermented foods' role in decreasing inflammatory cytokines, modulating the gut-skin axis, and improving skin barrier integrity in terms of increased ceramide synthesis and decreased permeability. This finding highlights the potential of the consumption of fermented foods like yogurt and lassi as cost-effective dietary approaches to enhance skin health status in university students of Pakistan.

Fermented Food Intake	**Skin Improvement**					
	Significant Improvement	**Slight Improvement**	**No Change**	**Not Sure**	**Total**	**p-value**
Rarely	65	93	37	34	229	

Fermented Food Intake	Skin Improvement					
	Significant Improvement	**Slight Improvement**	**No Change**	**Not Sure**	**Total**	**p-value**
Regular	3	8	5	5	21	0.031*
Total	**68**	**101**	**42**	**39**	**250**	

Table 12: Association Between Fermented Food Intake and Immunity
A significant association was observed between fermented food intake and perceived immunity benefits (p=0.024). Students who consumed fermented foods regularly were more likely to believe that these foods help reduce the risk of common infections and illnesses. This finding suggests that fermented foods may play a beneficial role in supporting immune health among university students.

Fermented Food Intake	Immunity System					
	Yes	**Maybe**	**No**	**Not Sure**	**Total**	**p-value**
Rarely	60	121	28	19	228	0.024*
Regular	7	9	2	3	21	
Total	**67**	**130**	**30**	**22**	**249**	

Table 13: Association Between Fermented Food Intake and Mental Health Issues
Table studies the relationship between fermented food consumption and stress/mood swing. There was significant association between fermented food intake and stress and mood (χ^2=8.743, df=3, p=0.032), with the finding that frequent consumers experience fewer frequent stress and mood swings than the participants who rarely eat them. This outcome is consistent with the emerging literature on the gut-brain axis, where fermented food-derived probiotics regulate neurotransmitter production, the hypothalamic-pituitary-adrenal (HPA) axis and systemic inflammation, and thereby promote mental resilience. These findings strongly support the use of fermented foods in dietary interventions to improve mental health outcomes in Pakistan university students.

Fermented Food Intake	Mental Health Issues					
	Very Often	**Sometimes**	**Rarely**	**Never**	**Total**	**p-value**
Rarely	70	96	37	25	228	
Regular	3	12	4	2	21	0.032*
Total	**73**	**108**	**41**	**27**	**249**	

Table 14: Association Between Fermented Food Intake and Effect on Mood
A significant association was observed between fermented food consumption and perceived effects on mood and concentration (p=0.019). Regular consumers were more likely to report positive effects on their psychological well-being. This finding suggests that fermented foods may contribute to improved mood and concentration, supporting their potential role in promoting mental wellness among university students.

Fermented Food Intake	Effect on Mood					
	Yes, positively	**Yes, negatively**	**No Effect**	**Not Sure**	**Total**	**p-value**
Rarely	118	33	34	44	229	0.019*
Regular	7	3	3	8	21	
Total	**125**	**36**	**37**	**52**	**250**	

Table 15: Association Between Fermented Food Intake and Gut-Mental Health
Table shows the relationship between fermented food consumption in the link between gut health and mental well-being through fermented food consumption. There was a significant association between the consumption of fermented foods in the gut-mental health connection (p=0.027) suggesting that regular fermented food consumers have significantly stronger about the impact of gut health on mental well-being than low-frequency fermented food consumers. This association is supported by evidence that regular probiotic intake (from fermented foods) regulates serotonin and GABA production, neuroinflammation and HPA axis activity all mechanisms by which gut health can impact mental health. This finding is consistent with the idea that direct experience with the mood-improving effects of fermented foods may increase in the gut-mental health connection and thus create a positive feedback loop to encourage regular consumption.

Fermented Food Intake	Gut-Mental Health						
	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**Total**	**p-value**
Rarely	41	101	75	9	3	229	0.027*
Regular	2	10	7	2	0	21	
Total	**43**	**111**	**82**	**11**	**3**	**250**	

Table 16: Association Between Fermented Food Intake and Nutrient Absorption
Table shows the association between fermented food intake in enhanced nutrient absorption from fermentation. A statistically significant association was observed between fermented food intake in enhanced nutrient absorption (p=0.022), indicating that regular consumers are more likely to have stronger about the nutritional benefits of fermented foods than are rare consumers. This association makes biological sense, as regular consumers are more likely to have experienced the improved comfort and energy that result from enhanced micronutrient absorption - the result of the phytate degrading and vitamin producing benefits of the microorganisms used in fermentation. These findings support including fermented food education in nutrition courses at universities, highlighting the importance of both the probiotic and micronutrient bioavailability benefits of fermented foods traditionally consumed in Pakistan, such as yogurt and lassi.

Fermented Food Intake	Nutrient Absorption

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total	p-value
Rarely	37	115	66	7	4	229	
Regular	2	9	8	2	0	21	0.022*
Total	**39**	**124**	**74**	**9**	**4**	**250**	

DISCUSSION

The present cross-sectional study examined the relationship between fermented food consumption and multiple health outcomes among 250 university students aged 18–30 years at Nur International University, Lahore, Pakistan. The findings were interpreted within the context of global literature on fermented foods, gut microbiota, and nutritional epidemiology. Overall, significant associations were observed across all eight health domains, including gut health, mental health, skin health, immunity, mood, nutrient absorption, and weight management, indicating that fermented food intake is broadly linked with improved perceived health outcomes in this population [12,13].

The study revealed that yogurt (dahi) and lassi were the most commonly consumed fermented foods, reflecting strong cultural integration within Pakistani dietary habits. These traditional foods are widely accessible, affordable, and culturally accepted, unlike non-traditional fermented foods such as kimchi, kefir, kombucha, and sourdough, which were rarely consumed. This suggests that dietary interventions in Pakistan should focus on strengthening existing culturally familiar fermented foods rather than introducing foreign products. However, barriers such as taste and smell (34.5%) and lack of knowledge (21.3%) indicate that sensory acceptability and nutritional awareness remain key challenges for increasing consumption. These findings highlight the need for targeted nutrition education and culturally adapted food promotion strategies [14,15].

A key finding of the study was the strong association between fermented food intake and reduced digestive discomfort ($p = 0.012$), which was the most significant health outcome observed. Regular consumers reported substantially fewer gastrointestinal symptoms compared to rare consumers, supporting extensive global evidence that probiotic-rich fermented foods improve gut microbiota composition, enhance intestinal barrier function, and reduce pathogenic microbial growth. These effects are mediated through mechanisms such as production of short-chain fatty acids (SCFAs), modulation of tight junction proteins, and inhibition of inflammatory processes in the gut. Given the high prevalence of digestive issues among students, these findings suggest a potentially important role for fermented foods in improving gastrointestinal health in young adults [16,17].

The study also demonstrated a significant relationship between fermented food intake and mental health outcomes, particularly stress and mood swings ($p = 0.032$). Regular consumers reported lower levels of psychological distress, supporting the growing evidence of the gut-brain axis. Probiotic microorganisms in fermented foods influence neurotransmitter production (such as serotonin and GABA), regulate the hypothalamic-pituitary-adrenal (HPA) axis, and reduce systemic inflammation, all of which contribute to improved psychological well-being. The high prevalence of stress among students highlights the importance of dietary strategies in supporting mental health in academic populations [18,19].

Similarly, significant associations were found between fermented food intake and skin health outcomes ($p = 0.028$; $p = 0.031$), with regular consumers reporting fewer skin issues and greater perceived improvement. These findings align with the gut-skin axis

theory, where gut microbiota influences systemic inflammation and skin barrier function. Fermented foods may reduce acne and skin inflammation by lowering inflammatory cytokines, improving ceramide production, and regulating sebum secretion. The results suggest that fermented foods may offer a cost-effective dietary strategy for improving dermatological health among young adults [20,21].

In terms of immunity, fermented food consumption was significantly associated with perceived immune benefits ($p = 0.024$). Regular consumers were more likely to believe that fermented foods reduce the risk of common infections. This perception is supported by scientific evidence showing that probiotics enhance mucosal immunity, increase IgA secretion, stimulate natural killer cell activity, and regulate inflammatory cytokines. These immune-modulating effects are particularly relevant in Pakistan, where infectious diseases and seasonal illnesses are common [22,23].

The study also found significant associations between fermented food intake and mood, concentration, and psychological effects ($p = 0.019$), as well as awareness of the gut-brain connection ($p = 0.027$). Regular consumers demonstrated stronger understanding of the relationship between gut health and mental well-being, suggesting that lived dietary experience reinforces health knowledge and creates a positive feedback loop between behavior and awareness. Additionally, fermented food intake was associated with perceived improved nutrient absorption ($p = 0.022$), reflecting greater awareness of fermentation's role in enhancing micronutrient bioavailability through phytate degradation and vitamin synthesis [24,25].

Demographic analysis revealed that all thirteen chi-square tests were statistically significant ($p < 0.05$), indicating that gender, BMI, age, residence, education level, and occupation significantly influence fermented food perceptions and behaviors. Females reported higher digestive and psychological symptoms, while BMI influenced weight management-related perceptions. Urban students showed greater awareness and access to fermented foods, while older students demonstrated stronger willingness to include them in daily diets. These findings highlight the importance of demographic-specific nutritional interventions rather than uniform health promotion strategies [26,27].

Importantly, behavioral intention toward fermented foods was very high, with 92% of participants willing or possibly willing to include them in their diet. This indicates strong potential for dietary behavior change. Participants also supported public health promotion of fermented foods, suggesting that awareness campaigns, educational programs, and culturally appropriate interventions could significantly increase consumption [28].

Despite these positive findings, the study has limitations. The cross-sectional design prevents causal inference, and self-reported data may introduce recall bias. The lack of control for confounding variables such as physical activity, sleep, stress, and socioeconomic status may influence associations. Additionally, the single-institution sample limits generalizability to broader populations [29,30].

Future research should adopt longitudinal or experimental designs to establish causality. Objective biomarkers such as microbiome sequencing, inflammatory markers, and immune profiling should be included to strengthen evidence. Multi-site studies across Pakistan are also recommended to improve generalizability and understand regional dietary differences.

CONCLUSION:

This study examined the consumption of fermented foods and their relationship with health outcomes among 250 university students aged 18–30 years at Nur International University, Lahore. The findings demonstrated that culturally familiar fermented foods, particularly yogurt (dahi), lassi, and fermented pickles, were commonly consumed and significantly associated with improved health outcomes. All eight chi-square tests showed statistically significant associations ($p < 0.05$), indicating that

regular fermented food intake was linked with reduced digestive discomfort, fewer skin problems, lower stress and mood fluctuations, improved immunity, better mood, increased awareness of the gut–brain connection, and greater perceived nutrient absorption. Overall, fermented foods were found to play a positive role across multiple physical and psychological health domains. The study concludes that fermented foods are already an important part of Pakistani dietary culture and may offer an affordable and culturally appropriate approach to improving student health. Therefore, their promotion through university-based nutrition education, public health campaigns, and dietary interventions is recommended to encourage more consistent and informed consumption.

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