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Exploring Indian Heritage: The Gut-Friendly Benefits Of Curd For Stress Resilience In College Students

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ABSTRACT

Background:
The gut–brain axis mediates bidirectional communication between the gastrointestinal tract and the central nervous system, influencing stress responses, emotional well-being, and gut health. Chronic stress, particularly among college students, can disrupt this axis, leading to adverse psychological and gastrointestinal outcomes. Probiotics have gained attention as psychobiotics capable of modulating stress and mental health. Curd, a traditional fermented dairy product commonly consumed in India, is a natural and affordable source of probiotics; however, its role in stress modulation remains inadequately explored.

Aim:
To assess the effect of daily curd consumption on stress levels, mental well-being, gastrointestinal health, and academic performance among college students.

Material and Methods:
A randomized controlled study was conducted among 100 undergraduate students aged 18–30 years. Participants were allocated into a case group (n = 50), who consumed 200 g of homemade curd daily containing *Lactobacillus acidophilus* and *Bifidobacterium bifidum* (10^6 CFU/mL) for 8 weeks, and a control group (n = 50) with no curd intake. Stress levels, mental well-being, gastrointestinal health, and academic performance were evaluated at baseline and post-intervention using validated questionnaires: Perceived Stress Scale-10 (PSS-10), Warwick–Edinburgh Mental Well-Being Scale (WEMWBS), Digestive Health Questionnaire (DHQ), and Academic Performance Scale (APS). Statistical analysis was performed using SPSS, with $p < 0.05$ considered statistically significant.

Results:
The curd-consuming group demonstrated a significant reduction in stress levels, with severe stress decreasing from 20% to 2.5% ($p < 0.001$). Mental well-being scores improved significantly ($p = 0.003$), while gastrointestinal health showed notable improvement, with good health scores increasing from 65% to 87.5% ($p = 0.039$). Academic performance showed modest but significant improvement ($p = 0.039$). No significant changes were observed in the control group.

Conclusion:
Regular consumption of curd significantly reduces stress and improves mental well-being and gastrointestinal health among college students, supporting its potential role as a simple, culturally acceptable, psychobiotic dietary intervention.

Keywords: Gut–brain axis, Curd, Probiotics, Stress resilience, Mental well-being, Gastrointestinal health, College students, Psychobiotics, Fermented foods.

INTRODUCTION

The gut-brain axis is a dynamic bidirectional communication network linking the brain and gut. It integrates neural, hormonal, and immune pathways to regulate gastrointestinal and neurological functions and is significantly influenced by the gut-microbiota. However, stress disrupts this axis, altering gut microbiota composition and triggering a hormonal cascade involving cortisol, corticotropin-releasing hormone (CRH), and adrenocorticotropic hormone (ACTH). These changes contribute to microbial imbalances that exacerbate conditions like anxiety, depression, and stress, highlighting the critical role of the gut-brain axis in mental health (1,2,3).

Stress, defined by the World Health Organization (WHO) as "the reaction to a real or imagined threat, which triggers a cascade of physiological and psychological responses" (WHO, 2023), has become a pressing concern among university students due to its substantial impact on mental health and academic outcomes (4). The Centre for Disease Control and Prevention (CDC) further emphasizes that stress can be acute or chronic, and if left unchecked, can lead to a range of health problems, including anxiety, depression, and digestive issues (CDC, 2020) (5). Recent studies reveal that stress prevalence among this population is alarmingly high. For instance, a study conducted in Agra reported that 64.4% of undergraduate students experience moderate stress, and 21.3% face high stress, with urban students and females being more prone to it (6).

Among medical students, the scenario is equally concerning. A longitudinal study showed a striking rise in psychological distress within six months of starting medical education attributed to academic pressures and environmental factors (7). Additionally, veterinary students in India report 94% experiencing stress, driven primarily by academic-related stressors such as workload and examinations (8).

Chronic stress disrupts gut microbiota composition, leading to systemic inflammation and exacerbating stress-related symptoms (9,10). Emerging research highlights the role of probiotics, beneficial microorganisms, in modulating the gut-brain axis, enhancing resilience, and reducing stress through neurotransmitters like serotonin and gamma-aminobutyric acid (GABA) (2,3).

The concept of a gut-mind connection dates to ancient Greece, where philosophers such as Hippocrates, Plato, and Aristotle postulated the centrality of the gut in overall health. The father of modern medicine, Hippocrates, famously stated, "All disease begins in the gut," an insight echoed in modern research on the microbiota-gut-brain axis (11). Ayurveda, India's traditional medical system, similarly acknowledges curd, a fermented dairy product, as a therapeutic agent for improving digestion, immunity, and mental clarity (10,18). Modern studies corroborate these traditional insights, demonstrating the psychobiotic potential of fermented foods in promoting mental well-being (13,19,23).

The prevalence of stress among university students underscores the urgency to explore accessible, culturally significant interventions. Probiotic-rich fermented milk products, such as strains of *Lactobacillus casei Shirota* have been shown to reduce cortisol levels and mitigate academic stress (15). Curd, a staple food in India, offers a natural and affordable source of probiotics. Unlike expensive commercial probiotic supplements, curd is widely consumed and culturally ingrained, making it a practical intervention for improving mental well-being. Despite its potential, there is limited research on curd's efficacy as a mental health intervention.

This study aims to bridge this knowledge gap by evaluating curd's impact on reducing stress, enhancing mental well-being, improving gastrointestinal health, and supporting academic performance among college students.

2. OBJECTIVES OF THE STUDY

1. To study the effect of curd consumption on stress levels in college students
2. To study the efficacy of curd as a probiotic food in promoting mental well-being.
3. To correlate curd consumption with gastrointestinal health improvements.
4. To evaluate its impact on academic performance.

3. REVIEW OF LITERATURE

Recent literature highlights the role of the gut microbiome in modulating stress and mental health, marking the significance of a lively, bidirectional communication between the gut-brain axis. (1,3,10)

Chronic stress can have long term alterations on the gut microbiota. (9,10). The altered microbiota composition triggers a hormonal cascade involving cortisol, CRH, and ACTH. This, in turn, further leads to an imbalance in the gut microbiome, potentially impacting overall health. (1,2,20).

Stress and its prevalence.

Recent studies reveal that stress prevalence among the student population is alarmingly high. A study conducted for comparative analysis of stress levels in undergraduate students in Agra, reported that 64.4% of undergraduate students experience moderate stress, and 21.3% face high stress, with urban students and females being more affected (6).

The trends in medical students' stress, physical and emotional health throughout training, have been studied and are indicative of increasing stress and fatigue during their course of study. (7,26).

Emerging research has thrown light on the role of probiotics in reducing stress through neurotransmitters like serotonin and gamma-aminobutyric acid (GABA) (2,3). Furthermore, recent studies have found probiotic supplementation useful in the treatment of clinical conditions like anxiety and spectrum disorders as well. (13,16)

Probiotics in Mental Well-being.

Numerous studies suggest that consuming probiotics can improve mental health (2,19). WHO, along with the International Scientific Association for Probiotics and Prebiotics defines probiotics as "live microorganisms that, when administered in adequate amounts, confer a health benefit to the host." (17)

Due to the emerging benefits of probiotics on mental health, they are also regarded as Psychobiotics (21,23). They are bringing out marked improvements in neurological, systemic, cognitive, and emotional functions. (20, 23)

Among the myriads of mental health problems, Mixed Anxiety and Depression (MAD) is a challenging aspect. (13) The impact of curd (also known as yogurt) is emerging as an interesting field of study in mitigating this aspect and improving the interaction between diet, gastrointestinal health, and mental well-being. (13,16).

Gut Health and relationship with Stress.

Probiotics, such as those found in fermented milk, can positively affect gut microbiota and, subsequently, stress levels, as shown in a recent study related to effect of intake of traditional fermented Mexican beverage on academic stress in medical students. (14). The fermented beverage made with *L. plantarum* sp. and *B. bifidum* were found effective in reducing stress symptoms along with a significant decrease in plasma pro-inflammatory cytokines such as IFN-γ and TNF-α as compared to the placebo group. (14) Some more studies have effectively concluded milk fermented with yogurt cultures plus Lactobacillus casei strains, such as *L. casei Shirota* were able to modulate the physical and immunological symptoms in subjects under academic examination stress (14,15,24).

Cultural Importance and Relevancy.

In Indian culture, curd has been a revered food for centuries, not only as a nutritious staple but also for its medicinal properties. Ayurveda, the traditional Indian system of medicine, emphasizes curd's role in promoting digestion, immunity, and mental clarity (12,18).

In a study conducted to signify the efficacy of curd in clinical depression, there has been greater reduction in mental health disorders when the diet is enhanced with probiotics. (19,21,22) Curd is a choice preference due to its ready availability in Indian households and cost- effectiveness. (13,22) It shows well documented probiotic properties and improvement in gut immunity, which also has a positive impact on cognitive functions. (25) As such, manipulating the gut microbiota and their functions via probiotics and health behaviors is a promising therapeutic strategy. (19)

Table 1: Summary of Key Studies

Author	Year	Population	Findings	Implications
Shrivastava U et al.	2024	Undergraduate students at St John's college, Agra	Substantial moderate to high stress in college students	Targetedstress management to support student well-being
Mallaram GK et al.	2024	First-year Students of Women's Medical College in South India	Increase in stress during period of study	Accessible mental health interventions
Mukherjee A et al.	2024	Patients with mixed anxiety and depression (MAD)	Significant improvement in Quality of Life	Integrative therapy with probiotics
Cocean AM et al.	2024	Database collection, general clinical population	Enhanced potential in treatment of neurological disorders	Therapeutic potentialas psychobiotics
Inchekar et al.	2023	Database collection	Beneficial for digestive health	Therapeutic usage of Curd in Ayurveda
Chen P et al.	2022	Website of Science Core Collection	Relationship between gut-brain axis and probiotic treatment	Potential usage of probiotics in enhancing Quality of Life

4. MATERIALS AND METHODS

Study Design

This is an Assessment of **Behaviour, Change and Communication** study employing **Randomized Controlled Trial (RCT)** design to study the gut-friendly benefits of curd on stress resilience in college students.

Study Setting

Randomized Control Trial with study settings at the Narayana Medical College Department of Microbiology, Andhra Pradesh has been done.

Sampling

- **Subjects**: Undergraduate college students aged 18-30
- **Sample size:** a total of 100 participants, divided into:
  - **Cases:** 50 students consuming 200g homemade curd daily, with LAB – 10^6 CFU/ml, specifically *Lactobacillus acidophilus* and *Bifidobacterium bifidum*)
  - **Control**: 50 students with No curd intake
- **Study Duration**: 8 weeks.

Inclusion Criteria:

1. Healthy individuals
2. Willingness to consume curd daily for 8 weeks
3. No current probiotic medication, or supplement use.

Exclusion Criteria:

1. Current probiotic medication, or supplement use
2. Dairy intolerance, vegan, or allergies

Intervention Groups

Group A: Curd supplementation (200g daily – homemade curd with LAB – 10^6 CFU/ml, specifically *Lactobacillus acidophilus* and *Bifidobacterium bifidum*)
Group B: Control (No curd intake)

Data Collection Procedure:

Data has been collected using standard **questionnaires** designed to assess relevant information. The key variables assessed include:

1. Stress level
2. Mental Well-being
3. Gastrointestinal health
4. Academic Performance.

Questionnaires used:

1. **Perceived Stress Scale – PSS 10**: This is a 10 item, 5-point Likert-type scale used to assess stress levels, ranging from low to severe.
2. **Warwick-Edinburgh Mental Well-Being Scale – WEMWBS 14-item**: It is a 14 item, 5-point Likert scale that measures mental wellbeing, ranging from Above average to Low.
3. Digestive Health Questionnaire designed by World Gastroenterology Organization:

   It is a 5-point, supplemental questionnaire with 12 items, used for gastrointestinal health. It is modifiable as per the intervention and assesses the participant, ranging from good health to poor health.
4. **Academic Performance Scale**: It is a self-administered, 8 items, 5- point scale used to assess the effects

of interventions on academic performance in students, ranging from excellent performance to moderate and failing performance.

Baseline Assessment: Perceived Stress scale and other questionnaires filled at 0 week. Intervention given.

Follow-Up Assessments: Same measures after 8 weeks, using the same questionnaires.

Data Analysis:

- Statistical tools were used to analyze the collected relevant data.
- Comparison and correlation analysis between within- group changes and inter- group changes due to curd consumption were done, using SPSS software.
- Statistical significance (p-value) was determined using appropriate methods (e.g. – Chi- square tests or Wilcoxon signed Rank tests).
- P value < 0.05 was considered significant.

Confidentiality:

- Informed consent is taken from all participants, ensuring that privacy and confidentiality of data are upheld.
- Collected data was managed with strict confidentiality.
- All identifiable student information was anonymized during analysis to protect privacy.
- Access to subject data was limited to the investigator and the supervising guide.

Ethical Considerations

- The study was initiated only after obtaining Ethical approval from the Institutional Ethics Committee (IEC).
- Participants were informed about the purpose and methodology of the study, and informed consent taken prior to their inclusion.

5. RESULTS

CASES:
Out of the 50 case participants, 9 discontinued after pre-intervention and 1 was excluded following exclusion criteria. The remaining 40 were analyzed for the relevant comparative value for four variables: Stress level (PSS), Mental Well-Being (WEMWBS), Gastrointestinal Health (DHQ), Academic Performance (APS).

Table 2: Percentage analysis in Cases for Pre and Post Intervention

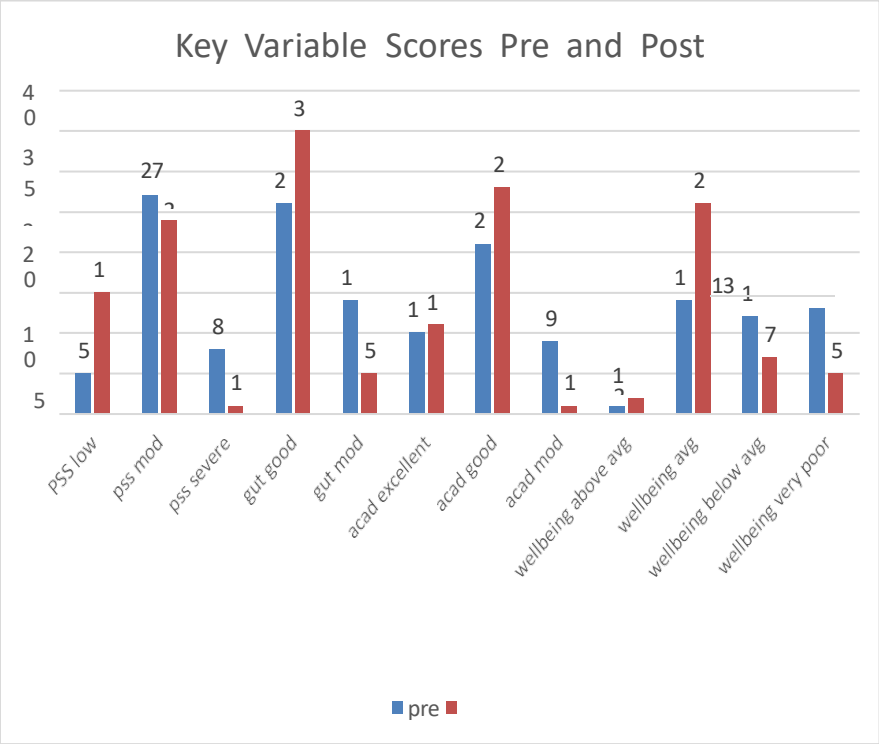
PSS	**Pre-Int**	**Post-Int**
Low Stress	5 (12.5%)	15 (37.5%)
Moderate	27 (67.5%)	24 (60%)
Severe	8 (20%)	1 (2.5%)
WEMWBS Score		
Above Average	1 (2.5%)	2 (5%)
Average	14 (35%)	26 (65%)
Below Average	12 (30%)	7 (17.5%)
Very Low	13 (32.5%)	5 (12.5%)
DHQ Score		
Good Health	26 (65%)	35 (87.5%)
Moderate	14 (35%)	5 (12.5%)

APS Score		
Excellent Performance	10 (25%)	11 (27.5%)
Good	21 (52.5%)	28 (70%)
Moderate	9 (22.5%)	1 (2.5%)
Total	**40** (100%)	**40** (100%)

- **Perceived Stress Scale (PSS-10): 12.5%** cases experienced low stress before intervention to **37.5%** in post intervention. **20%** experience severe stress in pre- intervention, with effective reduction post-intervention to **2.5%**.
- **Warwick-Edinburgh Mental Well-Being Scale: 35%** have an average score, with an increase to **65%**. There is a decrease in very low scores, from **32.5%** to **12.5%** in post- intervention.
- **Gastrointestinal Health Scale: 65%** of the cases have good gastrointestinal health, with positive increase to **87.5%** post-intervention. Moderate health is **35%** pre- intervention to **12.5%** post evaluation.
- **Academic Performance Scale: 22.5%** of cases have moderate performance, with effective reduction to **2.5%** in post-intervention.

Figure 1: Comparison of Key variables in Cases for within-group changes

CONTROLS:



Out of the 50 control participants, 7 discontinued after pre-intervention. The remaining 43 were analyzed for the relevant data, comparatively for the four key variables, namely, Stress level (PSS), Mental Well-being (WEMWBS), Gastrointestinal Health (DHQ), and Academic Performance (APS).

Table 3: Percentage analysis in Controls for Pre and Post Intervention

PSS	**Pre-Int**	**Post-Int**
Low Stress	1 (2.3%)	1 (2.3%)
Moderate	40 (93%)	41 (95.4%)
Severe	2 (4.7%)	1 (2.3%)
WEMWBS Score		
Above Average	5 (11.6%)	4 (9.4%)
Average	5 (11.6%)	15 (34.8%)
Below Average	33 (76.8%)	7 (16.3%)
Very Low	0	17 (39.5%)
DHQ Score		
Good Health	24 (55.8%)	29 (67.4%)
Moderate	13 (30.2%)	11 (25.6%)
Poor Health	6 (14%)	3 (7%)
APS Score		
Excellent Performance	5 (11.6%)	8 (18.6%)
Good	26 (60.5%)	19 (44.2%)
Moderate	4 (9.4%)	9 (20.9%)
Poor	5 (11.6%)	5 (11.6%)
Failing	3 (6.9%)	2 (4.7%)
Total	**43** (100%)	**43** (100%)

- **Perceived Stress Scale (PSS 10): 2.3%** have low stress, **95.4%** have moderate stress and **2.3%** have low stress, post-evaluation.

  Warwick Edinburgh Mental Well-Being Scale: **11%** of the controls have average well-being to **34.8%** post evaluation. **76.8%** are below average, with a decrease to **16.3%** post score. **39.5%** shows very low score, with 0 controls in pre- evaluation to **39.5%** in post evaluation.

- **Gastrointestinal Health Scale: 67.4%** controls have good gastrointestinal health, **25%** with moderate and **7%** with poor health in the post intervention**.** No major change is seen.
- **Academic Performance Scale**: **60.5%** have good performance with decrease to **44.2%** in the post evaluation. **9%** have moderate performance with a slight increase to **20%** post-evaluation.

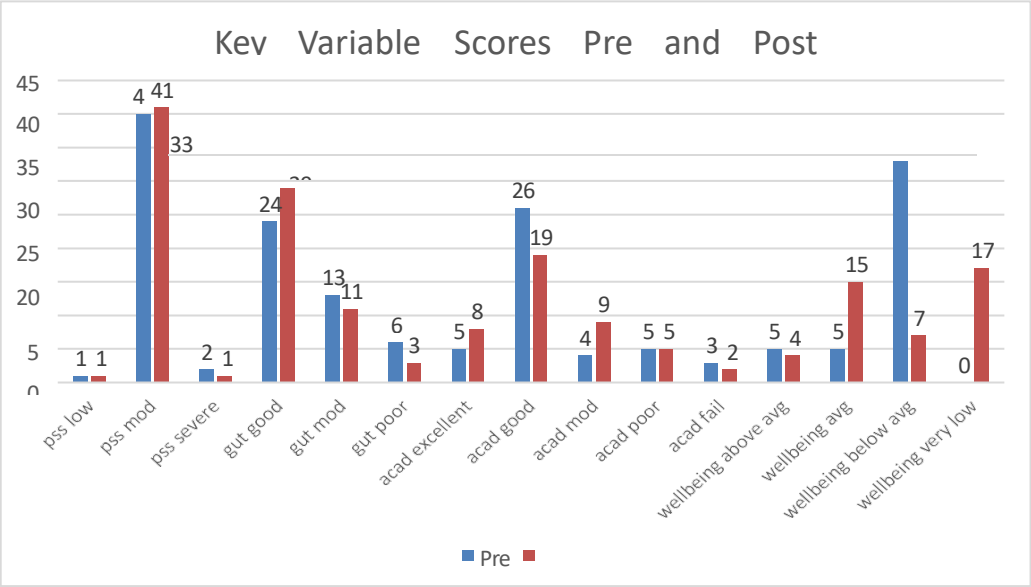


Figure 2: Comparison of Key variables in Controls for within-group changes

Table 4: Comparison of Key Variables in Cases

	N	Mean	Std. Deviation (SD)
PSS Total Score A	40	2.07	.572
DHQ Total Score A	40	1.35	.483
APS Total Score A	40	1.97	.698
WEMWBS Total Score A	40	2.93	.888
PSS Score B	40	1.65	.533
DHQ Score B	40	1.13	.335
APS Score B	40	1.75	.494
WEMWBS Score B	40	2.37	.774

Test Statistics[a]

	pss score - pss total score	dhq score - dhq total score	aps score - aps total score	wemwbs score - wemwbss core
Z	**-3.545[b]**	**-2.065[b]**	**-2.065[b]**	**-2.947[b]**
P value	**.000**	**.039**	**.039**	**.003**

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

- **PSS**: Cases have a mean score of 2.07 (SD = .572) in pre-intervention, while in post, mean value is 1.65 (SD = .533). The score difference stands at -3.545. P-value (0.000) indicates there is *high significance* in this measure.
- **WEMWBS**: The mean score of cases in pre- intervention is 2.93 (SD = .888) and the mean value is 2.37 (SD = .774) in post intervention. The score difference (based on positive Wilcoxon ranks) is -2.947. P-value (0.003) is indicative of *high significance* in this measure.
- **DHQ**: Cases have a mean score of 1.35 (SD = .483) in pre-intervention, and mean value of 1.13 (SD = .335) in post intervention. The difference stands at -2.065 (based on positive Wilcoxon ranks). P-value (0.039) indicates this measure is *significant*.
- **APS:** Cases have a mean score of 1.97 (SD = .698) in pre-intervention compared to post mean value of 1.75 (SD = .494). The score difference is -2.065. P-value (0.039) depicts that significance is present.

Table 5: Comparison of Key Variables in Controls.

	N	Mean	Std. Deviation
PSS score A	43	2.02	.266
DHQ score A	43	1.58	.731
APS Score A	43	2.42	1.074
WEMWBS score A	43	3.53	.984
PSS score B	43	2.00	.218
DHQ score B	43	1.40	.623
APS score B	43	2.40	1.072
WEMWBS score B	43	2.86	1.060

Test Statistics[a]

	pss score B - pss score A	**dhq score B - dhq score A**	**aps score B - aps Score A**	**Wemwbs score B - wemwbs score A**
Z	**-.447[b]**	**-1.795[b]**	**.000[c]**	**-3.431[b]**
P value	**.655**	**.073**	**1.000**	**.001**

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. The sum of negative ranks equals the sum of positive ranks.

- **PSS**: Controls have a mean score of 2.02 (SD = .266) in pre-intervention compared to mean value of 2.00 (SD = .218). P-value (0.655) indicates there is no statistical significance.

- **WEMWBS**: The mean score of controls in pre- intervention is 3.53 (SD = .984) compared to mean score of 2.86 (SD = .1.080) in post intervention. The score difference is -3.431 (based on positive Wilcoxon ranks). Here, p-value (0.001) *shows significance*.
- **DHQ**: With a mean score of 1.58 (SD = .731) in pre-intervention and mean of 1.40 (SD = .623) in post intervention in controls, the p-value (0.073) indicates this measure is not significant.
- **APS**: Controls have a mean score of 2.42 (SD = 1.074) in pre-intervention, while post mean value is 2.40 (SD = 1.072). P-value (1.000) highlights no significance in this measure.

Table 6: Categorical Relation for Variables between Cases and Controls (Pre- and Post Intervention)

	PSS Score A	PSS Score B	DHQ Score A	DHQ Score B	APS Score A	APS Score B	WEMWBS Score A	WWMWBS Score B
	Asymptotic Significance (2-sided)							
Pearson Chi-Square	0.013	0.000	0.049	0.048	0.017	0.004	0.000	0.018
Likelihood Ratio	0.01	0.000	0.016	0.013	0.004	0.001	0.005	0.015
Linear-by-Linear Association	0.0492	0.000	0.095	0.017	0.031	0.001	0.005	0.021

The table highlights significant relations for four key categorical variables between cases and controls using Pearson Chi-Square test. These variables are Perceived Stress (PSS), Gastrointestinal Health (DHQ), Academic Performance (APS) and Mental Well-Being (WEMWBS).

Score A is calculated for both groups and derived with respect to pre- intervention; Score B is derived for both the groups for post-intervention evaluation.

- There is significant change highlighted in the groups in PSS scale (p-value <0.05).
- With p-value <0.05, there is significance in cases and controls in mental well-being.
- There is Significance depicted in Gastrointestinal health between cases and controls. (p- value <0.05).
- There is slight significance in academic measures (p-value <0.05).

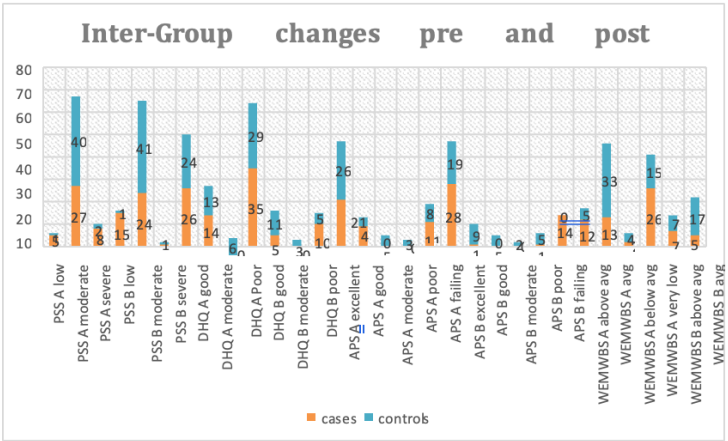


Figure 3: Comparison of Key Variables between cases and controls

DISCUSSION

This study aimed to examine the gut-friendly benefits of curd consumption for stress resilience, mental well-being, gastrointestinal health, and academic performance among college students. Using a Randomized Controlled Trial, significant differences were observed in outcomes between curd consumers (cases) and non-curd consumers (controls). Healthy participants were assessed qualitatively on the basis of four key variables, namely, Stress level, Mental Well-being, Gastrointestinal health, and Academic Performance. The present study demonstrated that daily consumption of curd containing *Lactobacillus acidophilus* and *Bifidobacterium bifidum* strains showed significant reduction in stress levels amongst college students, with enhancement in mental well-being as well as an improvement in their gastrointestinal health, when compared to the control group with no intake.

Stress Level:

The Perceived Stress Scale (PSS) developed by Cohen et al. is used to assess the stress levels in individuals. Its results reveal a profound impact of curd consumption. Participants experiencing severe stress dropped from 20% to 2.5%, while those reporting low stress increased from 12.5% to 37.5% after intervention. Cases had p-value<0.05, indicative of significant change. Mainly, participants showed significant improvement in coping up with stressful tasks and feeling less nervous or stressed. In contrast, the control group demonstrated negligible changes in stress levels.

This can be due to the probiotics in curd (*Lactobacillus acidophilus and Bifidobacterium bifidum*) modulating the gut-brain axis, and reducing stress by regulating cortisol secretion (1,2,20) This finding aligns with previous studies that underscored the role of probiotics in regulating cortisol levels and promoting emotional resilience, via the bidirectional gut-brain connection. (1,2,9,20) and also aligns with the findings of *Márquez-Morales L et al.* highlighting the effect of probiotics in reducing stress and inflammatory cytokines. (14) Similarly, study conducted by *Marcos et al.*, showed positive effect of *L. casei* strains in yogurt cultures for mitigating academic stress. (24) These findings confirm the potential of dietary probiotics, specifically curd, as a non-invave, cost-effective strategy for stress management**.**

Mental Well-Being:

The Warwick-Edinburgh Mental Well-Being Scale (WEMWBS) is used to assess mental health and well-being. This scale indicated a notable improvement in mental health, with “Above average” scores increasing from 2.5% to 5%, “Average” score increasing from 35% pre- evaluation to 65% in the post evaluation and “very low” scores decreasing from 32.5% to 12.5% in the case group. Mainly, participants reported feeling more relaxed and energetic, with improved behavioral relationships. Cases had p-value<0.05, indicative of significant change. While the control participants exhibited no such significant improvements.

This is due to the probiotic strains in curd, producing neurotransmitters like serotonin and gamma-aminobutyric acid (GABA), which are pivotal in mood regulation and anxiety reduction. (23) The positive impact of Lactic acid Bacteria used in probiotic food on mental health closely aligns with the gut-brain connection, as seen in prior studies highlighting the significance between probiotic supplementation and mental health. (10,25) It also correlates with previous studies by *Mukherjee A et al.* and *Ansari F et al.*, where administering probiotics, like curd, is used as a therapeutic measure to mitigate various mental health disorders, including spectrum disorders and mixed anxiety and depression (MAD). (13,16) *Dziedzic et al.* (2024) highlighted that Lactobacillus strains could alleviate symptoms of depression and anxiety through psychobiotic effects (21). The results validate the psychobiotic effects of curd, aligning with other research that highlights probiotics' role in addressing mental health challenges like anxiety and depression.

Gastrointestinal Health:

The Digestive Health Questionnaire (DHQ) developed by the World Gastroenterology Organization is used as a supplemental scale to assess gastrointestinal health. The scores evaluated showed an increase in case participants with good gastrointestinal health from 65% to 87.5% and a reduction in moderate gastrointestinal health from 35% to 12.5%. Cases had p- value<0.05, indicative of significant change. Mainly, Participants reported decreased constipation, bloating and diarrheal conditions after intervention, with significant relief both physically and mentally. In contrast, the control group saw minimal change, with a slight increase in good gastrointestinal health but no significant shifts. This is due to the probiotics in curd which enhance gut microbiota diversity, thus improving digestion and reducing abdominal distension, constipation, and diarrhea. (12,27) These benefits are supported by studies like *Kato- Kataoka et al.*, which also linked fermented food to stress reduction and better digestion. (15) These results highlight the positive effect of fermented food, especially traditional probiotics such as curd consisting of *L. acidophilus* and *B. bifidum* strains on digestive health. The beneficial effect is linked to enhancement of the release of bioactive enzymes by the gut microbiota, as elucidated from a previous study by *Mathur H et al.,* that signified health benefits of Lactic Acid Bacteria fermentates (25) and it also relates with the findings of *Inchekar et al.*, which highlights the Ayurvedic role of curd in digestion. (12) This reinforces curd's efficacy in improving gastrointestinal health and highlights its dual benefits for physical and mental health.

Academic Performance:

The Academic Performance scale is a self-administered scale to assess one's academic potential. Improvements in academic performance were modest. "Good" performance increased from 52% to 70%, while "moderate" or "poor" performance decreased from 22.5% to 2.5%. However, academic improvements were less pronounced than other variables, with external factors like study habits and intrinsic motivation likely influencing these outcomes. The Enhanced mental well-being and reduced stress contributed indirectly to improved academic performance, as supported by *Márquez-Morales et al*., who found cognitive improvements in students consuming probiotics. (14) and, *Kato-Kataoka et al.* suggested that improved gut health and psychological resilience could indirectly support better academic outcomes. (15) This suggests curd's potential in promoting cognitive function but emphasizes the need for multifaceted approaches to academic success.

Comparison between groups:

Across all variables, the case group showed statistically significant improvements compared to control group in stress levels, gastrointestinal health, and mental well-being. While coming to the Academic performance, improvements were less significant but still notable among cases. This might suggest that the benefits of curd consumption manifests more prominently in physiological and psychological domains rather than cognitive tasks within the study's short durati These findings highlight the transformative potential of culturally relevant, accessible dietary interventions like curd.

Practical Implications:

The study underscores the utility of curd as an accessible, cost-effective intervention in:

- Public Health Integration: Incorporating curd into dietary guidelines could address mental health challenges in academic populations.
- Cultural Relevance: As a staple food in India, curd represents a viable alternative to expensive commercial probiotics.
- Nutritional Empowerment: Traditional probiotics like curd can be utilized as a simple, self-care strategy to improve gastrointestinal health.
- Holistic Health: The dual benefits for gut and mental health highlight curd as a cornerstone of preventive health strategies.

Strengths of the study:

1. A randomized controlled design ensures reliable and unbiased data collection.
2. Validated scales provided robust and credible measurements.
3. Focus on a culturally relevant intervention enhances applicability to Indian populations.

Weaknesses of the study:

1. Limited sample size restricts generalizability.
2. Self-reported measures may introduce bias.
3. The short duration of the study (8 weeks) may not capture long-term effects.
4. Absence of objective biomarkers like cortisol levels or microbiota profiling limits mechanistic insights.

Recommendations

1. **Future Research:** Conduct longitudinal studies to examine the long-term effects of curd consumption on stress resilience, mental health, GI health and academic outcomes.
2. **Biomarker Analysis:** Include cortisol levels and microbiota profiling for deeper physiological insights.
3. **Community Programs:** Promote awareness of curd's benefits in managing stress and enhancing mental health.
4. **Targeted Interventions:** Explore the impact of varying dosages and formulations of probiotic curd on diverse populations.
5. **Policy Integration:** Advocate for the inclusion of probiotics in dietary guidelines to address mental health challenges, particularly in academic and high-stress settings.

CONCLUSION

This study confirms the efficacy of curd consumption in reducing stress, improving mental well-being, and enhancing gastrointestinal health among college students. It offers a scientifically validated and culturally significant solution to stress resilience, demonstrating the untapped potential of traditional Indian dietary practices in modern health interventions.

Curd as a Functional Food:

- Curd consumption significantly reduces stress levels and improves gastrointestinal health and mental well-being.

Probiotic Benefits:

- The presence of probiotics such as *Lactobacillus* and *Bifidobacterium* sp. in curd supports gut-brain axis modulation, enhancing stress resilience and promoting emotional stability.

Holistic Impact:

- Traditional probiotics like curd can contribute to holistic strategies for a comprehensive well-being including mental health and gastrointestinal health.

Cultural and Practical Relevance:

- Curd offers a cost-effective, culturally accepted, and readily available solution for managing stress, particularly in resource-limited settings.

These findings establish curd as a promising intervention for stress management and mental health enhancement, especially amongst young adults. It also serves as a culturally relevant means to improve overall health, thus highlighting the rich Indian heritage and its traditional practices for holistic well-being.

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