

Association between FODMAP intake and depressive symptoms in Indonesian university students

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ABSTRACT

Depression is common among university students and may be influenced by dietary patterns. Fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAPs) affect gastrointestinal function and may interact with the gut–brain axis; however, evidence on FODMAP intake and depressive symptoms remains limited and inconsistent.²¹ The aim of the study is to examine the association between FODMAP intake and depression levels among university students.²² Analytic observational study with a cross-sectional design was conducted from September to November 2025. Total 156 students from the Faculty of Dentistry were selected using simple random sampling. Questionnaire was used to collect data on sex, living arrangement, physical activity, sleep duration, social media use duration, FODMAP intake, and depression level. FODMAP intake was assessed using a Food Frequency Questionnaire (FFQ)⁵ and categorized as frequent or infrequent. Depressive symptoms were measured using the Patient Health Questionnaire-9 (PHQ-9)¹¹ and categorized as not depressed (score 0–4) or depressed (score ≥ 5).¹⁶ Chi-square test was used to determine the association between FODMAP intake and depression levels with a significance level of $p < 0.05$. Our study results showed that most participants were female (81.4%) and reported infrequent FODMAP intake (79.5%). Depression (PHQ-9 ≥ 5) was observed in 63.5% of participants. Depression was present in 62.5% of students with frequent FODMAP intake and 63.7% of those with infrequent intake.¹ There was no statistically significant association between FODMAP intake and depression level ($p = 1.000$). FODMAP intake was not associated with depression level. Future studies using more sensitive dietary assessment and controlling for potential confounders are warranted.

Keywords: FODMAP; depression; university students; food frequency questionnaire; PHQ-9

⁴INTRODUCTION

Depression is one of the most prevalent mental health problems among young adults, including university students[1] The university period represents a transitional phase that is particularly vulnerable to psychosocial stress due to academic demands, changes in the social environment, and pressure to achieve academic performance. University students therefore constitute a population with a high academic burden ⁶ and an increased risk of mental health disorders, including depression.[2]

The development of depression is influenced by multiple factors, including biological,[3] psychological,[4] and environmental determinants.[5] Lifestyle-related factors such as insufficient sleep, low physical activity, and excessive social media use have also been associated with increased depressive symptoms among university students. In recent years, nutritional factors have gained attention as potential determinants of mental health.[6]

²⁴ Nutrition plays a crucial role in brain function and mood regulation. An unbalanced dietary pattern may influence inflammatory pathways, neurotransmitter metabolism, and gut microbiota homeostasis.[6] Consequently, growing interest has emerged ⁶ in understanding the relationship between diet, gastrointestinal health, and mental health.

⁷ Fermentable Oligosaccharides, Disaccharides, Monosaccharides, and Polyols (FODMAPs) are a group of short-chain carbohydrates that are poorly absorbed in the small intestine and subsequently fermented by colonic bacteria.[7] This fermentation process ⁶ may alter gut microbiota composition and the production of metabolites involved in the gut–brain axis. A study by Eswaran [8] reported a significant association between FODMAP restriction and reduced depression levels in a single-blind experimental study among ¹² patients with irritable bowel syndrome (IBS). Similar findings were reported by Bellini [9] who conducted a ¹² longitudinal study in IBS patients and demonstrated an association between reductions in anxiety and depression and adherence to a low-FODMAP diet (LFD).

In contrast, Sloan [10] suggested that improvements in psychological symptoms among IBS patients were secondary to improvements in gastrointestinal symptoms, rather than a direct effect of dietary intervention. The study also reported a significant association between reduced *Bifidobacterium* abundance and LFD implementation. In another study, Kuzmin [11] reported that reductions in gut microbiota diversity may have negative effects on psychological outcomes in non-clinical populations.

In the Indonesian dietary pattern context, FODMAP consumption patterns among university students may be relatively limited due to the predominance of traditional dietary habits compared with diets rich in processed foods high in polyols, fermentable disaccharides, or fructans. Staple carbohydrate intake in Indonesia is largely based on rice, which contributes a relatively low FODMAP load compared with wheat-based cereals that are high in fructans.[12] Tempeh, a fermented soybean product commonly consumed in Indonesia, has been reported by Rizzo et al.[13] to be relatively low in FODMAP content after fermentation, as this process reduces certain oligosaccharides; therefore, tempeh may not contribute galacto-oligosaccharides to the same extent as unprocessed soybeans. However, the frequent use of garlic and onion-based seasonings, which are rich in fructans, is characteristic of Indonesian cuisine and may substantially increase total dietary FODMAP exposure.[14] In addition, certain tropical fruits and processed food products may contribute fructose or polyols. Consequently, the Indonesian dietary FODMAP profile appears to be shaped by an interaction between staple foods with relatively low FODMAP content and culinary practices that incorporate high-FODMAP seasonings.[15]

Although the association between low-FODMAP diets and mental health has been extensively studied in clinical populations, evidence in non-clinical populations such as university students remains limited and inconsistent. Therefore, this study aimed to examine the relationship between FODMAP intake and depression levels among university students.

MATERIALS AND ¹⁰METHODS

This study employed an analytic observational design with a cross-sectional approach. The study was conducted at the Faculty of Dentistry, Universitas Trisakti, which was selected based on the availability and characteristics of the target population relevant to the study objectives. Data collection was carried out from September to November 2025.

The target population comprised undergraduate students enrolled at the Faculty of Dentistry, Universitas Trisakti, during the period of September to November 2025. The accessible population included students who met the predefined inclusion and exclusion criteria. Participants were selected using a simple random sampling method during the study period.

Inclusion criteria were as follows: active undergraduate students; willingness to participate as indicated by completion of informed consent; and completion of the questionnaire in full. Exclusion criteria included: ²³a history of diagnosed mental disorders (e.g., major depressive disorder, schizophrenia, bipolar disorder, or anxiety disorders); pregnancy or breastfeeding; current use of psychotropic medications, including ²⁰antidepressants (e.g., fluoxetine, sertraline), antipsychotics (e.g., olanzapine, risperidone), or sedatives (e.g., diazepam, lorazepam), which may affect mood or depression levels; presence of chronic diseases that may influence psychological status or metabolism (e.g., cancer, autoimmune diseases, severe liver disease, chronic irritable bowel syndrome); adherence to a strict medical diet; and current academic leave.

¹⁷Sample size calculation for this cross-sectional study was performed using formulas for both infinite and finite populations. For an infinite population, the sample size was calculated using the following formula:

$$n_0 = (Z^2 \times p \times q) / d^2$$

where n_0 is the minimum required sample size, Z is the standard normal value at a 95% confidence level (1.96), p is the estimated prevalence of the studied outcome (2% or 0.02)[1], q is $1 - p$, and d is the desired precision (0.01). Based on this calculation, the required sample size for an infinite population was 753.

For a finite population, the sample size was adjusted using the following formula:

$$n = n_0 / (1 + n_0 / N)$$

where n is the adjusted sample size and N is the total population size (170). The calculated minimum sample size for the finite population was 138. To account for potential incomplete data or dropouts, an additional 15% was added, resulting in a final required sample size of 163 participants.

Primary data were collected using an online survey administered through Google Forms. Demographic and characteristic questionnaire was used to obtain informed consent and collect participant information, including age, sex, living arrangement, sleep duration per day, weekly physical activity duration, daily social media use, and medical history. Additional screening questions related to the exclusion criteria were also included.

FODMAP intake was assessed using a short Food Frequency Questionnaire (FFQ) consisting of 54 food items.[16] The FFQ evaluated the frequency of consumption of foods containing

fructose, lactose, oligosaccharides, and polyols. Response options included: never, 1–3 times ⁹ per month, 1–3 times per week, 4–6 times per week, once per day, and more than once per day. For analysis, consumption frequency was categorized as frequent (>1 ⁴ time per day, once per day, 1–3 times per week, 4–6 times per week) or infrequent (1–3 times per month, <1 time per month, never). Participants were classified as having frequent FODMAP intake if more than 50% of their responses fell into the frequent category; otherwise, they were classified as having infrequent FODMAP intake.

Depression levels were ¹⁸ assessed using the Patient Health Questionnaire-9 (PHQ-9), a validated screening tool consisting of nine items that evaluate depressive symptoms over the previous two weeks. ⁸ PHQ-9 scores were categorized as minimal depression (0–4), mild (5–9), moderate (10–14), moderately severe (15–19), and severe depression (20–27).[17]

Data processing included editing, coding, data entry, and data cleaning prior to analysis. ¹⁴ Data analysis included univariate and bivariate analyses. Univariate analysis was conducted to describe the distribution of each study variable and was presented as frequencies and percentages. Variables analyzed included sex, living arrangement, sleep duration, physical activity, social media use, FODMAP intake, and depression level. ⁵ Bivariate analysis was performed using the Chi-square test to assess associations between independent variables (FODMAP intake, living arrangement, sleep duration, physical activity, and social media use) and depression level. ¹⁵ A p-value <0.05 was considered statistically significant.

RESULTS

Table 1 presents the characteristics of the 156 respondents. Most participants were female (127; 81.4%) and lived independently (96; 61.5%). Low levels of weekly physical activity were reported by 122 respondents (78.2%), while insufficient sleep duration was reported by 135 respondents (86.5%). High daily social media use was reported by 126 respondents (80.8%). Most respondents had infrequent FODMAP intake (32; 20.5%), and the majority were classified as depressed (99; 63.9%).

Table 1. Distribution of subject characteristics (N=156)

Variables	Frequency (n)	Percentage (%)
Sex		
Female	127	81.4
Male	29	18.6
Living arrangement		
With family	60	38.5
Independent	96	61.5
Physical activity		
Poor	122	78.2
Adequate	34	21.8
Sleep duration		
Poor	135	86.5
Adequate	21	13.5
Social media use duration		
Low	30	19.2
High	126	80.8

FODMAP intake		
Frequent	32	20.5
Infrequent	124	79.5
Depression level		
Not depressed	57	79.5
Depressed	99	63.5

Table 2 presents that most subjects with frequent FODMAP intake were classified as depressed (62.5%). A similar pattern was observed among subjects with infrequent FODMAP intake, with the majority also classified as depressed (63.7). There was no statistically significant association between FODMAP intake and depression level ($p=1.000$)

Table 2 Association between FODMAP intake and depression levels in university students

Variables	Depression levels				p value [@]
	Not depressed		Depressed		
	n	%	n	%	
FODMAP intake					
Female	12	37.5	20	62.5	
Male	45	36.3	79	63.7	1.000

[@]Chi-square test

DISCUSSION

Based on univariate analysis of 156 respondents, the majority of participants were female (127; 81.4%), reflecting the increasing representation of women in medical and dental education reported in previous studies.[18,19] Similar patterns have also been observed across Asia.[20] Thus, the sex distribution in this study reflects broader demographic trends rather than a population imbalance.

Most respondents lived independently (61.5%), while the remainder lived with their families, consistent with findings among health science students.[21] Living alone has been associated with increased anxiety and depressive symptoms, whereas living with family may provide protective social support.[22] Therefore, living arrangements may represent an important contextual factor influencing students' mental health in this population

Low levels of physical activity were reported by 78.2% of respondents, in line with previous findings among dental students.[23] Although physical activity is known to have protective effects against depression.[24] The intensive dental curriculum imposes substantial academic demands and time constraints that may limit opportunities for regular exercise.[25] The intensive dental curriculum imposes substantial academic demands and time constraints that may limit opportunities for regular exercise.

Insufficient sleep was highly prevalent, with 86.5% of respondents reporting ≤ 7 hours of sleep per day. This finding is consistent with studies reporting poor sleep quality and short sleep duration among medical and dental students. [26] Reduced sleep duration has been linked to academic demands, stress, irregular schedules, and nighttime screen exposure,[27] and is a

recognized risk factor for depression.[24] Thus, sleep deprivation appears to be a major contributor to depressive symptoms in this study population.

High social media use was reported by 80.8% of respondents, consistent with previous reports among medical and dental students.[27,28] High usage has been associated with academic needs, stress coping, procrastination, and increased screen exposure,[29] and may exacerbate depressive symptoms when combined with sedentary behavior.[30] Therefore, digital lifestyle factors may play a meaningful role in students' mental health.

Dietary assessment indicated that most respondents had infrequent FODMAP intake (79.5%), reflecting generally low exposure to high-FODMAP foods. This pattern likely relates to traditional dietary habits dominated by rice-based meals, which provide relatively low FODMAP levels compared with wheat-based foods.[12] As a result, limited variability in FODMAP intake may have reduced the ability to detect associations with depression.

Similarly, commonly consumed foods such as tempeh contain relatively low FODMAP levels due to fermentation.[13] Although frequent use of onion- and garlic-based seasonings may increase cumulative FODMAP exposure.[15] Overall, FODMAP intake among Indonesian students appears modest and shaped by a balance between low-FODMAP staples and selective high-FODMAP ingredients.[15]

In this study, 63.5% of respondents were classified as depressed, consistent with previous reports of high depression prevalence among dental students.[31] This burden has been linked to intensive curricula, clinical responsibilities, sleep disturbances, evaluative pressure, and limited social support.[32] Together, these findings suggest that depressive symptoms in this

population arise from multifactorial influences. Consistent with this interpretation, previous Indonesian research has reported significant associations between sociodemographic characteristics and psychopathology, highlighting the importance of contextual psychosocial factors. [33] Therefore, the high prevalence of depression observed in this study may reflect broader non-dietary influences rather than dietary FODMAP intake alone.

Despite the high prevalence of depression, no significant association was observed between FODMAP intake and depression levels ($p = 1.000$). Similar proportions of depression were found in both frequent and infrequent FODMAP intake groups, indicating that variation in FODMAP consumption did not meaningfully influence depression in this non-clinical population.

This finding contrasts with studies reporting improvements in depressive symptoms following low-FODMAP diets among patients with irritable bowel syndrome.[8,9,34,35]. However, it is consistent with findings by Sloan et al.[10] and Kuzmin et al.[11], which suggests that psychological improvements occur mainly in clinical populations and are secondary to improvements in gastrointestinal symptoms. Although low-FODMAP diets have been proposed to influence mental health via modulation of the gut–brain axis and inflammatory pathways,[7,36] These mechanisms appear more pronounced in individuals with gastrointestinal dysfunction or significant dysbiosis. [9]

Several limitations should be acknowledged, including the cross-sectional design, reliance on FFQ-based dietary assessment, and limited variability in FODMAP intake. Nevertheless, this study provides preliminary evidence that FODMAP intake alone may not be a dominant determinant of depression among university students.

CONCLUSION

No significant association was observed between FODMAP intake and depression levels among university students. Future studies are recommended to employ longitudinal or interventional designs with more detailed dietary assessments to further clarify the role of FODMAP intake in mental health outcomes.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

ETHICAL APPROVALS

This study was approved by the Research Ethics Committee, Faculty of Medicine, Universitas Trisakti (No. 005/KER/FK/10/2025). Informed consent was obtained from all individual participants included in the study.

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