

The Role of Dietary Fiber in Reducing the Risk of Depression Among Young Adults: A Literature Review

Peran Serat dalam Menurunkan Risiko Depresi pada Orang Dewasa : Studi Literatur

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Abstract:

Depression among young adults is on the rise globally, with a prevalence of approximately 2% among those aged 15–24 in Indonesia. One contributing factor is the shift toward modern diets low in dietary fiber, which impacts mental health. Dietary fiber is known to play a crucial role in maintaining gut microbiota balance, reducing systemic inflammation, and influencing the gut-brain axis. This literature review aims to synthesize the latest scientific evidence regarding the role of dietary fiber in reducing the risk of depression among young adults. The study was conducted using literature review method through a search of articles in the PubMed, ScienceDirect, and Google Scholar databases, published between 2020 and 2025. Of the seven studies reviewed, six met the inclusion criteria with a cross-sectional design, and one was a prospective longitudinal study. The study populations included Korea, the United States, Iran, Australia, and China. Although various depression assessment instruments were used (SDS, PHQ-9, HADS, BDI-Y, GHQ), most of studies consistent results indicating that higher dietary fiber intake is associated with a reduced risk of depression, anxiety, and psychological distress. This protective effect is believed to be mediated by anti-inflammatory activity and increased production of short-chain fatty acids (SCFAs).

Keywords: dietary fiber; depression; young adults; gut-brain axis; mental health

1. INTRODUCTION

Depression, a mental health condition, is on the rise worldwide, including in Indonesia. The World Health Organization (WHO) defines mental health as a state of well-being in which every individual can realize their own potential, cope with the stresses of daily life, work productively, and contribute to their community (1). Globally, the World Health Organization (WHO) estimates that approximately 280 million people suffer from depression, and the burden of this disease is further exacerbated by more than 700,000 suicides annually among those aged 15–29(2). Nationally, the prevalence in Indonesia in 2023 was 1.4%, with the highest prevalence of depression among adolescents and young adults (ages 15–24) at 2(3). Research by Wijaya (2023) indicates that, based on gender, women have a higher prevalence of depression (75.8%) compared to men (24.2%), with the most common age range being 20–30 years; this highlights the need for special attention to the productive age group (4).

Concurrently, the past few decades have shown a significant shift in dietary patterns among young adults. This shift is characterized by high consumption of ultra-processed foods, added sugars, and saturated fats, as well as low intake of fiber-rich foods such as fruits, vegetables, and whole grains (5). This Western diet is not only associated with an increased risk of metabolic diseases but also with mental health disorders, including depression (6). Dietary fiber has emerged as a nutrient that plays a role in mental health. In recent years, scientific evidence linking dietary fiber intake to mental health has continued to grow. Several large-scale observational studies have shown a protective association between high fiber intake and a reduced risk of depressive symptoms in the population (7), (8).

Traditionally, dietary fiber is known for its benefits to digestive and cardiometabolic health. However, recent scientific insights have revealed a far more complex relationship between dietary fiber and brain function, which is crucially mediated by the gut-brain axis (9). Results from meta-analyses also indicate that high dietary fiber intake is associated with a protective effect against the risk of depression in adults, with a clear dose-response relationship (10).

The mechanisms underlying the protective effects of dietary fiber against depression are based on various molecular and neuroimmune mechanisms, primarily related to its role as a prebiotic that is, a substrate fermented by the gut microbiota to produce short-chain fatty acids (SCFAs) such as butyrate, acetate, and propionate. These SCFAs have significant neuroactive effects, including the ability to influence brain function through the blood-brain barrier, reduce systemic inflammation and neuroinflammation, and strengthen the integrity of the intestinal barrier (11) (12). Additionally, a high-fiber diet has been shown to reduce inflammatory biomarkers such as C-Reactive Protein (CRP) and interleukin 6 (IL-6), which are known to play a role in increased depression risk (13). Furthermore, dietary fiber can modulate the HPA axis (Hypothalamic-Pituitary-Adrenal), the primary neuroendocrine system regulating the body's response to stress (14). Dietary fiber is also capable of modulating the Hypothalamic-Pituitary-Adrenal (HPA) axis, the primary neuroendocrine system that regulates the body's response to stress and anxiety, thereby contributing to mental homeostasis (15).

Although various studies on the relationship between dietary fiber and depression have been conducted, most previous studies have focused on the general adult or elderly population. Consequently, evidence specifically focused on the young adult population remains limited and inconsistent. Young adults (aged 18 – 30 years) represent a particularly vulnerable population. This period is characterized by major psychosocial transitions such as, higher education, workforce entry, social restricting, heightened biological stress sensitivity, and a critical window during which gut microbiota composition is still mature and modifiable by dietary habits (25). These factors may render young adults especially susceptible to depression and conversely, particularly responsive to dietary interventions. However, existing narrative reviews on dietary fiber and mental health have not systematically examined this age group separately, nor have they comprehensively discussed the gut-brain axis as a potential biological mediating pathway specific to young adults.

Furthermore, there is a lack of comprehensive reviews exploring the biological mechanisms via the gut-brain axis as a potential mediating pathway in the relationship between dietary fiber intake and mental health. Therefore, this literature review aims to synthesize the latest scientific evidence regarding the role of dietary fiber in reducing

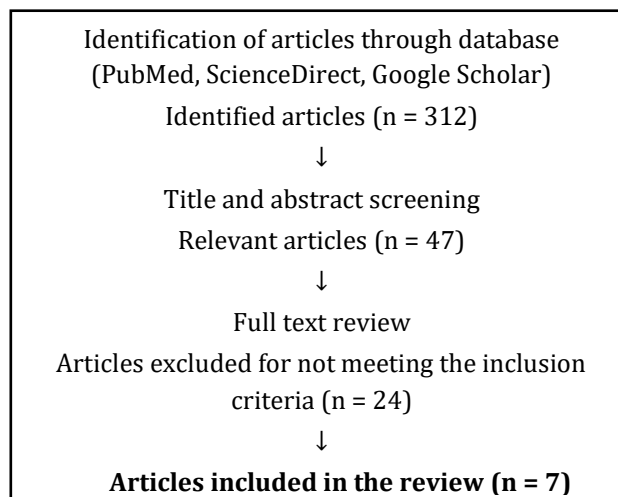
the risk of depression among young adults. The results of this study are expected to provide relevant evidence-based recommendations for preventive strategies and nutritional interventions in mental health management, particularly for the young adult population during their productive years.

2. METHODS

This study employs a literature review approach with a structured literature search to synthesize and summarize the latest scientific evidence. The literature review was conducted through a comprehensive search of three major online databases: PubMed, ScienceDirect, and Google Scholar. The search aimed to identify journal articles examining the relationship between dietary fiber intake and the risk of depression in young adults. Inclusion criteria for this study included: the study population consisted of young adults or adolescents aged 12 – 30 years; the studies were observational (such as cross-sectional or cohort studies) or intervention studies; they were published in journals within the last 5 years; and full-text versions were available in either Indonesian or English. Meanwhile, the exclusion criteria for this study included participants with a history of chronic disease or a diagnosis of severe mental disorders.

Study selection was conducted in several stages, including: (1) Searching for keywords selected according to the research topic. Thus, the keywords used for this literature search were “dietary fiber” OR “fiber intake” AND “Depression” OR “Depressive Symptoms” OR “Mental Health” AND “Young Adult” OR “Adolescents” OR “Adult Population”. The database search was conducted in October 2025. The flow diagram illustrating the article selection process is presented in Figure 1.

Figure 1. Article Selection Flow Diagram



(2) Exploring and selecting article titles, abstracts, and keywords. (3) Reading the full text or conducting a “ ” (selective reading) based on the review criteria established by the researcher. (4) Compiling a reference list based on the relevant studies identified in the second phase. This phase was repeated by the author to complete the literature review.

3. RESULTS

Based on the identification results, seven relevant journals were identified that met the inclusion criteria used in this study and are listed in Table 1 below:

Table1 . Summary of Literature Review Results

Research Title and Year	Research Design and Sample	Results
<p>Title: Sources of Dietary Fiber Are Differently Associated with the Prevalence of Depression 2020 (16)</p> <p>Year: 2020</p>	<p>Design: This study used a cross-sectional design to examine the relationship between dietary fiber intake and depression in adults in Korea</p> <p>Sample: The study data were drawn from the <i>Korean National Health and Nutrition Examination Survey</i> (KNHANES) conducted from 2012 to 2015, involving 2,960 adults aged 19–64 years</p>	<p>The results of the study indicate that higher dietary fiber intake from seaweed and mushrooms is associated with a lower risk of depression, highlighting the crucial role of dietary fiber in maintaining mental health.</p>
<p>Title: Dietary fiber intake moderates the impact of blood cadmium on depression: A nationally representative cross-sectional study (17)</p> <p>Year: 2024</p>	<p>Design: This study used data from the <i>National Health and Nutrition Examination Survey</i> (NHANES) conducted between 2005 and 2020 with a cross-sectional design.</p> <p>Sample: Study participants were adults aged 20 years and older.</p>	<p>Increasing dietary fiber intake can significantly reduce the depressive effects caused by cadmium (Cd) exposure</p> <p>This study demonstrates that a high-fiber diet can mitigate the harmful effects of environmental pollutants, such as cadmium, on mental health</p> <p>The importance of healthy dietary recommendations, particularly for addressing the impact of environmental toxins on mental health</p>
<p>Title: Dietary Fiber Intake and Psychological Disorders in Adults (18)</p> <p>Year: 2021</p>	<p>Design: This study used a cross-sectional design</p> <p>Sample: Involved 3,363 Iranian adults (aged 18–55) working at 50 health centers</p>	<p>Participants in the highest quartile of dietary fiber intake had a 33% lower risk of experiencing depression (anxiety) compared to those in the lowest quartile</p> <p>The highest dietary fiber intake was associated with a 29% lower risk of high psychological distress.</p> <p>In women, higher fiber intake was associated with a 35% lower risk of depression . However, no significant association was found between increased fiber intake and psychological distress in men</p>
<p>Title: The Association Between Dietary Fiber Intake and Depression Among US Adults: A Cross-</p>	<p>Design: This study used a cross-sectional design utilizing data from the <i>National Health and Nutrition Examination Survey</i> (NHANES) for the period 2005 to 2020</p>	<p>There is a significant negative association between dietary fiber intake and the risk of clinically relevant depression (CRD) as well as clinically significant depression (CSD), particularly among non-</p>

Research Title and Year	Research Design and Sample	Results
<p>sectional Study Based on NHANES Data from 2005 to 2020 (5)</p> <p>Year: 2025</p> <p>Title: Dietary Fiber Intake and Its Association with Depressive Symptoms in a Prospective Adolescent Cohort (20)</p>	<p>Sample: Involved 29,980 adults aged 18 years and older.</p> <p>Design: This study used a prospective observational design with two follow-up periods, at ages 14 and 17</p> <p>Sample: There were 1,260 participants at age 14 and 653 participants at age 17</p>	<p>smokers. This suggests that smoking may reduce the protective effect of fiber intake against the risk of depression.</p> <p>Higher dietary fiber intake was associated with a lower likelihood of clinically significant depressive symptoms in adolescents, suggesting a potential protective effect of a high-fiber diet against depression.</p>
<p>Year: 2020</p> <p>Title: Associations between different types and sources of dietary fiber intake and depressive symptoms in a general population of adults: a cross-sectional study (21)</p>	<p>Design: This study used a cross-sectional design utilizing data from <i>the Tianjin Chronic Low-Grade Systemic Inflammation and Health Cohort Study</i></p> <p>Sample: There were 24,306 participants (mean- an age of 41 years, range 18-91 years)</p>	<p>This study concluded that higher dietary fiber intake, particularly soluble fiber, vegetables, and soy, is associated with a lower prevalence of depressive symptoms in both men and women</p>
<p>Year: 2024</p> <p>Title: Association Between Dietary Fiber Intake and Suicidal Ideation: A cross-sectional survey (22)</p>	<p>Design: This study used a cross-sectional design utilizing data from <i>the National Health and Nutrition Examination Survey (NHANES)</i> for the period 2007-2018</p> <p>Sample: There were 21,865 participants aged 18 years and older</p>	<p>Of the 21,865 participants, 3.6% reported suicidal ideation, while 16.5% were diagnosed with depression</p> <p>Individuals with suicidal ideation had a lower dietary fiber intake of 6.6 g per 1,000 kcal compared to those without suicidal ideation, who had 7.8 g per 1,000 kcal</p> <p>For every 1-gram increase in dietary fiber intake per 1,000 kcal per day, the risk of suicidal ideation decreases by 5% (OR = 0.95)</p> <p>The researchers emphasize the need for further prospective studies and clinical trials to assess the effectiveness of high-fiber diets or fiber supplements in preventing suicidal ideation.</p>

Based on the results of the review of the seven studies above, there are notable differences and similarities across study design, population measurement instruments, and findings. Six of the seven studies used a cross-sectional design, while one employed a prospective longitudinal design, which provides comparatively stronger temporal evidence (20). Populations were drawn from five countries (South Korea, the United States, Iran, Australia, and China), and depression was assessed using different validated instruments, including the PHQ-9, SDS, BDI-Y, and GHQ. Despite this

methodological and geographic diversity, a consistent pattern emerged: higher dietary fiber intake was inversely associated with the risk of depression, anxiety, psychological distress, and suicidal ideation across all included studies. Notably, studies that examined fiber by type found that fermentable, plant-derived fibers such as those from vegetables, seaweed, and soy yielded stronger protective effects than insoluble fiber, suggesting that the prebiotic and anti-inflammatory properties of soluble fiber are key mediating factors (16,21). Some studies also identified important moderating variables: the protective effect was stronger in women than in men, attenuated among smokers, and extended to environmental contexts such as heavy metal exposure (17,18,19). Collectively, the converging evidence across diverse populations and methods suggests that adequate dietary fiber intake may be associated with a lower risk of depressive symptoms, most plausibly through gut microbiota modulation, short-chain fatty acid production, and reduction of systemic inflammation via the gut–brain axis (23).

4. DISCUSSION

Research on dietary fiber and mental health, particularly depression, shows relatively consistent results. In general, most analyzed studies indicate that high dietary fiber intake is associated with a reduced risk of or fewer depressive symptoms, although the strength and significance of this association vary across populations and study designs. Studies by Lian et al. (2025) and Huang et al. (2024), using data from the National Health and Nutrition Examination Survey (NHANES) in the United States, found that higher fiber intake was negatively associated with depression scores based on the Patient Health Questionnaire-9 (PHQ-9) (19)(22). Similar results were reinforced by a large cohort study in China involving 24,306 adults by Xia et al. (2020). This study found that total fiber intake, soluble fiber, and fiber derived from vegetables and soy were significantly associated with lower depression scores. These findings suggest that the type and source of dietary fiber may influence its protective effects against depression, with easily fermentable fiber tending to provide greater effects through gut microbiota mechanisms (21).

In the study by Swann et al. (2021), which conducted a prospective longitudinal study in a young age group (adolescents aged 14–17 years). Preliminary results from this study indicate that adolescents with higher fiber intake at age 14 have a lower risk of experiencing depression by age 17. Thus, this finding concludes that consuming high-fiber foods plays a role in maintaining mental health during the transition to young adulthood. Young adults (aged 18–30 years) represent an important population in the context of dietary fiber and depression because this developmental stage is characterized by increased vulnerability to mental health disorders, major psychosocial transitions, and the establishment of long-term dietary habits (26). In addition, gut microbiota during young adulthood remains relatively responsive to dietary modification, suggesting that dietary fiber may have a meaningful influence on the gut–brain axis and depressive symptoms (27). The increasing adoption of low fiber, Westernized dietary patterns among young adults further highlights the importance of this population in nutritional psychiatry research and preventive public health strategies (28).

However, upon further analysis, the researchers found that fiber intake and depressive symptoms likely do not act in isolation. However, this study concludes that other factors, such as a healthy and regular diet, low levels of inflammation, and low body fat, also play a role in reducing depressive symptoms in young adults, in addition to high-

fiber food consumption (20). This study also indicates that the effects of fiber are not isolated but part of complex interactions within a balanced diet, particularly among younger age groups undergoing biological and psychosocial development (20). Evidence in young adults is further strengthened by a subgroup analysis of NHANES, which demonstrates a significant protective effect of fiber in the 20–39 age group (24). Meanwhile, a study by Jiang et al (2023) assessing the interaction between fiber intake and exposure to the heavy metal cadmium (Cd) found that high fiber consumption can minimize the negative effects of cadmium (Cd) on depression. These findings may suggest that fiber also has potential through detoxification mechanisms or the binding of heavy metals in the gut (17).

The biological mechanisms described by these seven studies are relatively similar. Dietary fiber can improve mental health through a bidirectional interaction between the digestive system and the central nervous system (gut-brain axis) by stimulating the growth of gut microbiota that produce short-chain fatty acids (SCFAs), such as butyrate and propionate (9). These SCFAs help reduce systemic inflammation, strengthen the integrity of the blood-brain barrier, and enhance the synthesis of neurotransmitters such as serotonin and dopamine (16). Additionally, high-fiber foods are generally rich in other micronutrients like folate, magnesium, and polyphenols, which contribute to neural function and emotional balance (25).

Specifically for young adults, direct evidence remains a significant limitation of this review, as none of the included studies were designed specifically for this age group. Most were conducted in general adult populations spanning wide age ranges (e.g., 18–91 years), making it difficult to isolate the effects attributable specifically to young adults. This is an important limitation that should be acknowledged when interpreting the findings. Nevertheless, a subgroup analysis of the NHANES study indicates that fiber intake has a protective effect in the 20–39 age group, which falls within the young adult category (19). This suggests that adopting a high-fiber diet during one's productive years has the potential to serve as a long-term strategy for preventing depression.

Several important methodological limitations of the included studies must be acknowledged. First, the predominance of cross-sectional designs (five of seven studies) prevents establishing causal directionality it is equally plausible that depression leads to reduced dietary fiber intake rather than the reverse (reverse causality). Second, most studies relied on self-reported dietary recall or FFQ instruments, which are prone to recall bias and measurement error. Third, residual confounding from unmeasured lifestyle variables (physical activity, sleep, socioeconomic status) cannot be excluded. These limitations mean the results should be interpreted as associations, not causal relationships. Future prospective studies and randomized controlled trials (RCTs) specifically targeting young adults are needed to confirm and extend these findings.

5. CONCLUSION

Overall, this literature review concludes that dietary fiber plays a significant protective role in maintaining mental health, particularly against the risk of depression and other related psychological symptoms. This protective effect is fundamentally mediated through the gut-brain axis, which involves stimulation of Short-Chain Fatty Acid (SCFA) production by gut microbiota, reduction of systemic inflammation and neuroinflammation, and positive modulation of the Hypothalamic-Pituitary-Adrenal

(HPA) axis that regulates the stress response. Although most of the available evidence is observational, these findings consistently indicate that increased consumption of fiber sources such as vegetables, fruits, whole grains, and legumes is strongly correlated with a reduced risk of depression, particularly among young adults who are vulnerable to psychosocial stress. Some studies suggest a dose-response relationship where each 1-gram increase in fiber intake per 1,000 kcal is associated with a 5% reduction in the risk of mental disorders further reinforces fiber's potential as a nutritional intervention.

Based on the synthesized evidence, the findings of this study have important practical implications. These recommendations can serve as a reference for policymakers (stakeholders) and the government to intensify public health campaigns promoting increased consumption of high-fiber foods (e.g., aiming for 4–5 servings of vegetables and fruits) in accordance with current dietary guidelines. Furthermore, these findings provide a foundation for the development of evidence-based preventive strategies and nutritional interventions targeting young adults. To strengthen these conclusions and establish causal relationships, further research is crucial, particularly through long-term prospective studies and randomized controlled trials (RCTs) focusing on the specific effects of dietary fiber on improving depressive symptoms in young adults.

References

1. "Mental health." Accessed: Oct. 14, 2025. [Online]. Available: <https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response>
2. "World mental health report: Transforming mental health for all." Accessed: Oct. 14, 2025. [Online]. Available: <https://www.who.int/publications/i/item/9789240049338>
3. "Indonesian Health Survey (SKI) 2023," Health Development Policy Agency | BKKP Ministry of Health. Accessed: Oct. 14, 2025. [Online]. Available: <https://www.badankebijakan.kemkes.go.id/hasil-ski-2023/>
4. A. Evan Wijaya, E. Asmin, and L. B.E. Saptanno, "Levels of Depression and Anxiety in the Productive Age Group," *J. Ilm. Kesehat. Sandi Husada*, vol. 12, no. 1, pp. 150–156, June 2023, doi: 10.35816/jiskh.v12i1.916.
5. Lane, Melissa et al., "Ultra-Processed Food Consumption and Mental Health: A Systematic Review and Meta-Analysis of Observational Studies, *Nutrients*. 2022 Jun 21;14 (13): 2568.doi: 10.3390/nu14132568
6. F. N. Jacka et al., "A randomized controlled trial of dietary improvement for adults with major depression (the 'SMILES' trial)," *BMC Medicine*, vol. 15, no. 1, p. 23, Dec. 2017, doi: 10.1186/s12916-017-0791-y.
7. O'Neill, Simone, Michelle Mineha, Catherine R Knight-Agarwal, and Murray Turner., "Depression, Is It Treatable in Adults Utilising Dietary Interventions? A Systematic Review of RCTs", *Nutrients*, 14(7):1398. doi: 10.3390/nu14071398.
8. Aslam, Hajara, et al., "Fiber Intake and Fiber Intervention in Depression and Anxiety: A Systematic Review and Meta Analysis of Observational Studies and Randomized Controlled Trials, *Nutr Rev*.2023 NoV 25;82(12):1678-1695.doi:10.1093/nutrit/nuad143.

9. Verma et al., "Gut-Brain Axis: Role of Microbiome, Metabolomics, Hormones, and Stress in Mental Health Disorders", *Cells* 2024, 13(17):1436. DOI: 10.3390/cells13171436
10. M. Molendijk, P. Molero, F. Ortuño Sánchez-Pedreño, W. Van Der Does, and M. Angel Martínez-González, "Diet quality and depression risk: A systematic review and dose-response meta-analysis of prospective studies," *J. Affect. Disord.*, vol. 226, pp. 346–354, Jan. 2018, doi: 10.1016/j.jad.2017.09.022.
11. E. Fock and R. Parnova, "Mechanisms of Blood–Brain Barrier Protection by Microbiota-Derived Short-Chain Fatty Acids," *Cells*, vol. 12, no. 4, p. 657, Feb. 2023, doi: 10.3390/cells12040657.
12. Islam et al., "Evaluation of inflammatory cytokines in drug-naïve major depressive disorder: A systematic review and meta-analysis", *J. Inflamm* 2023. Res. doi: 10.1177/03946320231198828
13. Pieters, T, T Van Der Gronde, and L Van der Velde., " *The possible role of the Microbiota-Gut-Brain-Axis in the etiology of MDD.* *Eur. Psychiatry* 2022, 65(S1). DOI: 10.1192/j.eurpsy.2022.1453
14. J. A. Rusch, B. T. Layden, and L. R. Dugas, "Signaling cognition: the gut microbiota and hypothalamic-pituitary-adrenal axis," *Front. Endocrinol.*, vol. 14, p. 1130689, June 2023, doi: 10.3389/fendo.2023.1130689.
15. C.-S. Kim, S. Byeon, and D.-M. Shin, "Sources of Dietary Fiber Are Differently Associated with Prevalence of Depression," *Nutrients*, vol. 12, no. 9, p. 2813, Sept. 2020, doi: 10.3390/nu12092813.
16. S. Jiang, Y. Qiao, X. Zhou, D. Zhang, Z. Du, and G. Zhang, "Dietary fiber intake moderates the impact of blood cadmium on depression: a nationally representative cross-sectional study," *BMC Public Health*, vol. 24, no. 1, p. 3559, Dec. 2024, doi: 10.1186/s12889-024-21146-9.
17. F. Saghafian et al., "Consumption of Dietary Fiber in Relation to Psychological Disorders in Adults," *Front. Psychiatry*, vol. 12, p. 587468, June 2021, doi: 10.3389/fpsy.2021.587468.
18. S. Lai, Y. Zeng, T. Li, Y. Li, Y. An, and X. Ouyang, "The Association Between Dietary Fiber Intake and Depression Among US Adults: A Cross-Sectional Study Based on NHANES Data From 2005 to 2020," *Food Sci. Nutr.*, vol. 13, no. 7, p. e70605, July 2025, doi: 10.1002/fsn3.70605.
19. O. G. Swann et al., "Dietary fiber intake and its associations with depressive symptoms in a prospective adolescent cohort," *Br. J. Nutr.*, vol. 125, no. 10, pp. 1166–1176, May 2021, doi: 10.1017/S0007114520003426.
20. Y. Xia et al., "Associations between different types and sources of dietary fiber intake and depressive symptoms in a general population of adults: a cross-sectional study," *Br. J. Nutr.*, vol. 125, no. 11, pp. 1281–1290, June 2021, doi: 10.1017/S0007114520003566.
21. H. Huang, J. Fu, K. Lu, Y. Fu, P. Zhuge, and Y. Yao, "Association between dietary fiber intake and suicidal ideation: a cross-sectional survey," *Front. Nutr.*, vol. 11, p. 1465736, Oct. 2024, doi: 10.3389/fnut.2024.1465736.
22. K. Berding et al., "Feed your microbes to deal with stress: a psychobiotic diet impacts microbial stability and perceived stress in a healthy adult population," *Mol.*

- Psychiatry, vol. 28, no. 2, pp. 601–610, Feb. 2023, doi: 10.1038/s41380-022-01817-y.
23. A. Evan Wijaya, E. Asmin, and L. B.E. Saptanno., “Levels of Depression and Anxiety in the Working-Age Population,” *J. Ilm. Kesehatan. Sandi Husada*, vol. 12, no. 1, pp. 150–156, June 2023, doi: 10.35816/jiskh.v12i1.916.
 24. Norouzasl, Reyhane, Sheida Zeraattalab Motlagh, Ahmad Jayedi, and Sakine Shab Bidar., “Efficacy and safety of n-3 fatty acids supplementation on depression: a systematic review and dose–response meta-analysis”. *Br. J. Nutr* 2024. doi: 10.1017/S0007114523002222.
 25. K. Wolitzky-Taylor, A. Wen, N. Freimer, and M. G. Craske, “Anxiety and Depression in Emerging Adults: The STAND Program as a Model of Scalable Screening and Intervention,” *Neuropsychopharmacology*, vol. 51, pp. 244–258, 2026, doi: 10.1038/s41386-025-02174-4.
 26. V. Rossa-Roccor, C. G. Richardson, R. A. Murphy, and A. M. Gadermann, “The Association Between Diet and Mental Health and Wellbeing in Young Adults within a Biopsychosocial Framework,” *PLOS ONE*, June 3, 2021, doi: 10.1371/journal.pone.0252358.
 27. M. A. Heiskanen et al., “Association of Long-Term Habitual Dietary Fiber Intake since Infancy with Gut Microbiota Composition in Young Adulthood,” *J. Nutr.*, vol. 154, no. 2, pp. 744–754, Feb. 2024, doi: 10.1016/j.tjnut.2024.01.008.
 28. H. Zhang, M. Li, L. Mo, J. Luo, Q. Shen, and W. Quan, “Association Between Western Dietary Patterns, Typical Food Groups, and Behavioral Health Disorders: An Updated Systematic Review and Meta-Analysis of Observational Studies,” *Nutrients*, vol. 16, p. 125, Jan. 2024, doi: 10.3390/nu16010125.