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The effect of the Mediterranean diet on mental disorders: a systematic review

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Abstract. The Mediterranean diet (MD) is considered one of the most typical anti-inflammatory diets and has been widely studied. The benefits of MD for cardiovascular and nervous systems have been discussed, including significant antioxidant and anti-inflammatory effects, and regulation of brain-derived neurotrophic factor (BDNF). However, the impact of MD on mental disorders has not been fully studied. This systematic review selected several existing studies on the effects of MD on mental disorders and hopes that future research can determine the specific impact of MD on mental disorders. Results: For ADHD, the group taking omega-3 fatty acid supplements showed a significant decrease in BIS-11c scores after 8 weeks There is still controversy over whether following MD can prevent depression from occurring, the effect of MD on depression and refractory depression is not significant (all, $p>0.05$). MD has a significant impact on preventing postpartum depression. The higher the compliance of pregnant women with MD, the lower the incidence rate of postpartum depression ($\beta=-0.236$, $p=0.027$). MD also has a preventive effect on depression in the elderly, moderate and high adherence to MD can significantly reduce the incidence rate of common mental disorders, and moderate and high adherence to MD are protective factors against common mental disorders (OR: 0.59; 95% CI: 0.35-0.98 and OR: 0.42, 95% CI: 0.18-0.96, respectively).

Keywords: Mediterranean Diet, Mental Health, Mental Disorder, Depression, Anxiety.

1. Introduction

With the rapid development of the social economy, and culture, and the severe impact of post-Covid-19 on society and individuals as a whole, people's work and study pressures are growing with each passing day, and the incidence rate of mental disorders has increased significantly worldwide. According to WHO reports, as of 2019, approximately 301 million people worldwide suffer from anxiety disorder, 280 million people suffer from depressive disorder, and 40 million people suffer from bipolar disorder. The lifetime prevalence of anxiety and depression disorders in the population is 4-10%, with the number of female patients with mental disorders being 1.5-2.5 times higher than that of males [1]. Compared to those without mental disorders, patients with mental disorders have a higher probability of suicide and self-injury. Mental disorders are one of the main causes of mortality, especially among young adults. In the 21st century, they have become an increasingly serious public health problem, which seriously weakens social functions such as learning and work performance, and brings a huge burden to individuals, families, and society. Therefore, psychiatrists have the responsibility to diagnose and treat diseases, and assess and prevent the risk of suicide and self-injury, and there is badly in need to identify

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modifiable risk factors. In addition to the impact of genetic, neurobiochemical, neuroendocrine, and other changes on susceptibility to mental illness, dietary habits also have a significant impact on mental health. Godo's study showed that monounsaturated fatty acids have a positive effect on the nervous system, with EPA being a precursor of anti-inflammatory cytokines that can regulate metabolic processes, DHA is responsible for the fluidity and integrity of neuronal membranes; Polyunsaturated fatty acids can regulate sleep habits [2].

Mediterranean diet (MD) is considered one of the most typical anti-inflammatory diets. Olive oil is the main source of fat in MD, which contains a large amount of monounsaturated fatty acids and can adjust the ratio of high and low-density lipoprotein cholesterol in human plasma. Therefore, MD can significantly reduce the risk of cardiovascular diseases such as atherosclerosis, hyperlipidemia, and coronary heart disease, it can also reduce the risk of stroke and memory loss. The mechanism of action of MD on human health is complex. In addition to its significant antioxidant effect, it can also regulate brain-derived neurotrophic factor (BDNF). Research has found that MD can also reduce the risk of stress-related mental disorders such as stroke, hypomnesia, depressive disorder, and anxiety disorder [3]. However, there is still insufficient research on how MD affects mental health.

The main purpose of this study is to explore whether there is an association between MD and mental health, what kind of association there is, and whether it can serve as a practical and feasible prevention strategy and adjuvant treatment for mental disorders.

2. Methods

Scientific literature was searched and retrieved through PubMed and ScienceDirect using the keywords "Mediterranean Diet," "Mental disorder," "Mental Health," "Anxiety," and "Depression. This study has screened research papers published between 2019 and 2024 on the relationship between MD and mental disorders. The inclusion criteria are as follows: Randomized Clinical Trial study projects, the use of effective dietary assessment tools to quantify adherence to MD, with clearly defined diagnostic criteria for mental disorders. The exclusion criteria are as follows: Non-English literature, research design does not belong to RCT(n=13), those focused on Alzheimer's disease, cognitive decline, diabetes, cognitive behavioral therapy, and irritable bowel syndrome (IBS) (n= 12), adherence to MD only (n= 11) and study protocol only (n= 9) (see Figure 1). Finally, this study screened and analyzed 7 articles.

3. Results

This study selected 7 articles as research subjects, of which 4 were carried out in Spain, 2 in Iran, and 1 in Brazil [4-10].

3.1. Characteristics of included studies

These studies involved a total of 3342 participants, and the sample size, measurement methods of exposure and outcome, and results of each study are shown in Table 1. Based on different research objectives, this study divides included studies into five groups: children with attention-deficit/hyperactivity disorder, adult subjects, depressive disorder patients, pregnant women, and elderly subjects. Among them, one study studied whether MD can improve the impulsive behavior of ADHD patients [4]. Two studies considered whether MD can prevent depression or improve depressive symptoms among adult participants [5, 10]. Two studies examined whether MD can improve depressive symptoms among depressed patients [6, 8]. One study studied whether MD can reduce the incidence rate of postpartum depression among pregnant women [7]. One study considered whether MD can reduce the incidence rate of common mental disorders among elderly participants.

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Table 1. Characteristics of the included studies on MD to mental disorders.

Literature	Population	Follow-up	Exposure and Outcome Measurements	Key Results
[4]	n=60 (68% boys) Age: 10.7 y	8 weeks	KIDMED score; Changes in BIS-11c scores	BIS-11c scores showed minor changes across groups with no significant differences.
[5]	n=2531 (46% men) Age: 58.1 y	12 months	IPAQ-SF; MEDAS; DSM-IV Depression (CIDI, PHQ-9)	MHBC intervention had no significant effect on depression onset or symptom reduction.
[6]	n=94 (26% men) Age: 48.1 y	12 months	Session attendance; Depression severity (BDI-II)	LMP and MBCT improved quality of life; no significant difference in BDI-II scores.
[7]	n=52 Age: 33.4 y	17th week of gestation until birth	Exercise attendance; MD	Higher MD adherence linked to lower postpartum depression risk.
[8]	n=60 Age: 37.1 y (12% men)	12 weeks	Compliance checks every 4 weeks	Significant reduction in DASS scores; no difference between control and intervention groups after adjusting for compliance.
[9]	n=545 (43% men) Elderly ≥60 y	12 months	Mediterranean Diet Score (MDS)	Moderate to high MDS adherence associated with lower CMD prevalence.
[10]	n=3176 (50% men) Age: 18-55 y	12 months	DS-FFQ; HADS; GHQ	High MIND diet adherence linked to lower anxiety, depression, and psychological distress scores.

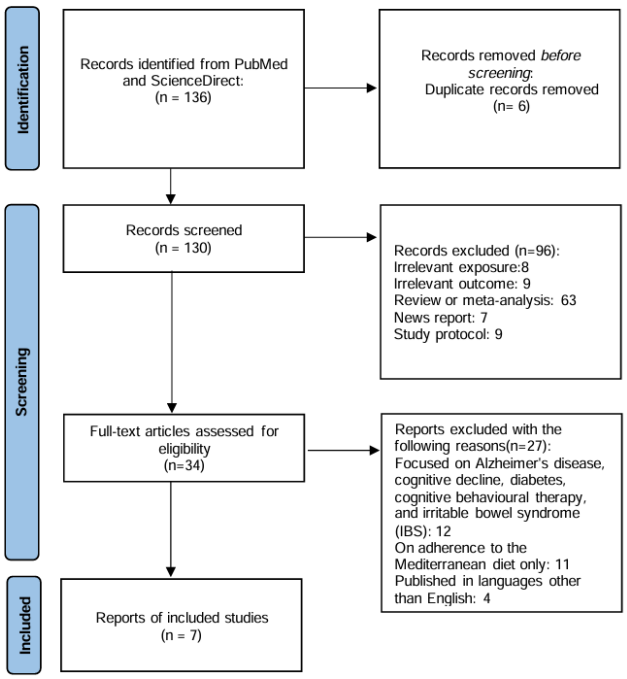

Figure 1. Screening process for literature related to MD and mental disorders or mental health (Original).

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Table 2. Studies population.

Study Population	Number of Studies	Reference
Children with Attention-Deficit/Hyperactivity Disorder	1	[4]
Adult Subjects	2	[5, 10]
Depressive Disorder Patients	2	[6, 8]
Pregnant Women	1	[7]
Elderly Subjects	1	[9]

3.2. The effect of MD on ADHD patients

Martin divided children with ADHD into four groups to observe the effect of MD on each group: 76 ADHD patients aged 6-16 years were assigned to a control group based on their usual diet and 3 intervention groups based on MD (Group 1 received usual diet. Group 2 received MD. Group 3 received omega-3 fatty acid supplements. Group 4 received MD and omega-3 fatty acid supplements.). The results indicate that only those children in Group 3 are showing a significant decrease in BIS-11c scores after 8 weeks of intervention. There was no statistically significant difference in BIS-11c scores among the other three groups after 8 weeks of intervention, indicating that ADHD patients receiving omega-3 fatty acid supplements exhibited less impulsive behavior compared to the other two intervention and control groups [4].

3.3. The effect of MD on adult subjects

Irene investigated whether a multiple health behavior change intervention (including MD, physical activity, and smoking cessation) could prevent depressive episodes and reduce depressive symptoms in baseline nondepressed populations [5]. The researchers randomly assigned participants to an intervention group and a control group in a 1:1 ratio. The intervention group and the control group received a 12-month MHBC intervention and annual care, respectively. The results showed that MHBC intervention had no significant effect on preventing the onset of major depressive disorder (OR 1.35; 95% CI: 0.62-2.86; p=0.449), MHBC intervention also had no significant effect on reducing depressive symptoms (Mean difference: 0.60, p=0.681).

Asma Salari Moghaddam et al. investigated the relationship between adult compliance with the MIND diet and the odds of mental disorders [10]. Researchers divided participants into four groups based on their compliance with the MIND diet (Q1~Q4, with the Q1 group having the highest compliance and the Q4 Group having the lowest compliance). The results showed that the group with the highest compliance had a lower incidence rate of depression (OR: 0.68; 95% CI: 0.53-0.89) and psychological distress (OR: 0.68; 95% CI: 0.52-0.89) compared to the group with the lowest compliance, but there was no significant association between MIND compliance and the incidence rate of anxiety (OR: 0.72; 95% CI: 0.51-1.03).

3.4. The effect of MD on depressive disorder patients

Aurora Garcia et al. investigated whether a lifestyle modification program (LMP) is effective for patients with treatment-resistant major depression (TRD) [6]. The researchers randomly assigned participants to three groups (placebo, MBCT, or LMP) in a 1:1:1 ratio, with each intervention conducted remotely and followed up for 12 months. From Table 1, we can see that there was no significant difference in DBI-II scores among the three groups (all, p>0.05), indicating that LMP and MBCT have no significant effect on patients with TRD.

Nima Radkhah et al. investigated the relationship between MD and mental disorders in patients with mental disorders [8]. The researchers randomly assigned participants in a 1:1 ratio to the MD and control groups and followed up for 12 weeks. The results indicate that compliance with MD has no significant effect on mental disorders, which may be due to participants' low compliance with MD, which is related to their economic status.

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3.5. The effect of MD on pregnant women

Marta Flor Alemany et al. investigated whether MD can prevent postpartum depression [7]. Pregnant women were randomly assigned to the intervention group and the control group in a 1:1 ratio, and the intervention group and the control group were trained in exercise programs and kept their regular activities from the 16th week of pregnancy until giving birth. The results indicate that there is a negative linear correlation between MD adhesion and retroperitoneum depression, that is, the higher the MD adherence, the lower the incidence rate of postpartum depression ($\beta=-0.236$, $p=0.027$).

3.6. The effect of MD on elderly subjects

Amália Almeida Bastos et al. investigated the relationship between adherence to MD and common mental disorders in elderly subjects [9]. Researchers divided the participants into the Traditional MDP group and the Brazilian MDP group. The results showed that after adjusting sociodemographic factors such as gender and age, moderate and high adherence to MD can significantly reduce the incidence rate of common mental disorders, and moderate and high adherence to Traditional MDP are protective factors for CMD (OR: 0.59; 95% CI: 0.35-0.98 and OR: 0.42, 95% CI: 0.18-0.96, respectively), while any level of adherence to the Brazilian MDP was not significantly correlated with CMD (OR: 0.80; 95%CI: 0.42-1.52; OR: 0.53, 95%CI: 0.22-1.25).

4. Discussion

This review aims to summarize existing clinical trial literature and investigate the relationship between MD and mental disorders. It is worth noting that MD is widely used in improving metabolism and promoting health, which can reduce the incidence rate of cardiovascular diseases by about 30% [11]. There is evidence that MD can make diabetes patients have better blood sugar control than the general diet. In addition, following MD can significantly improve their quality of life.

The mechanism by which MD affects mental disorders is complex. For ADHD, patients who followed a simple MD or a combination of MD and omega-3 fatty acid supplements did not show significant improvement in impulsive symptoms. However, ADHD patients who took omega-3 fatty acid supplements showed a significant decrease in BIS-11c scores after 8 weeks, and their symptoms were relieved [4]. There is still controversy over whether following MD can prevent depression from occurring [5, 10]. In addition, the effect of MD on depression and refractory depression is not significant (all, $p>0.05$) [6]. However, the MD has a significant effect on preventing postpartum depression. The higher the compliance of pregnant women with MD, the lower the incidence rate of postpartum depression ($\beta=-0.236$, $p=0.027$) [7]. MD also has a preventive effect on depression in the elderly, moderate and high adherence to MD can significantly reduce the incidence rate of common mental disorders, and moderate and high adherence to Traditional MDP are protective factors for CMD (OR: 0.59; 95% CI: 0.35-0.98 and OR: 0.42, 95% CI: 0.18-0.96, respectively).

MD is widely used in improving metabolism and promoting health, which can reduce the incidence rate of cardiovascular diseases by about 30% [11]. There is evidence that MD can make diabetes patients have better blood sugar control than the general diet [12]. However, the relationship between MD and mental illness, as well as its mechanism of action on the nervous system, is still unclear, and there is a significant gap in this field. It is hoped that future research can accurately measure the specific relationship between MD and mental illness.

5. Conclusion

This study reviewed clinical trials published between 2019 and 2024, focusing on the relationship between the Mediterranean diet (MD) and psychiatric disorders such as anxiety and depression. Seven studies from Spain, Iran, and Brazil were included, covering different populations: children with ADHD, adults, patients with depression, pregnant women, and the elderly. Studies were searched through PubMed and ScienceDirect, focusing on RCTs that used reliable dietary assessment tools and clear diagnostic criteria for mental disorders. Non-English literature and studies that did not meet specific criteria were excluded.

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The review found that MD combined with omega-3 supplementation significantly reduced impulsivity in children with ADHD. However, the diet alone had limited effects on preventing or alleviating depressive symptoms in adults and patients with depression. In contrast, high MD adherence was associated with reduced postpartum depression in pregnant women and a reduction in common mental disorders in the elderly. Further research is needed to clarify the relationship between MD and mental health, especially its mechanism of action on the nervous system.

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