ILSI India Monograph Series on
Science for Public Health - 2

Depression and Anxiety: Association with Nutrient Intakes Across the Lifespan

A Systematic Review of Studies

By

Dr. Bani Tamber Aeri

Dr. Preeti Khanna

ILSI INDIA

International Life Sciences Institute India

About ILSI India

International Life Sciences Institute India
www.ilsi-india.org

ILSI India is an entity of the International Life Sciences Institute (ILSI), headquartered in Washington DC. It is a scientific non-profit organization. ILSI India provides scientific inputs and secretariat assistance to the South Asian Region, which includes Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

ILSI India activities primarily focus on local and regional issues and involve leading national and international experts in the deliberations. ILSI India is the leader in the region in focusing attention and devoting resources on critical areas in food and water safety, nutrition, risk assessment, harmonization of food regulations, improvement in the health profile of malnourished children and women, and agriculture sustainability including biotechnology. Special attention is given to the importance of complementary foods and food fortification. All activities follow Principles of Scientific Integrity which are part of ILSI Mandatory Policies.

ILSI India carries out its mission through sponsoring workshops, symposia, conferences, seminars, training programs, research projects, and publications.

ILSI India works closely with scientists from academia, public and private sector.. ILSI India's Board of Trustees is comprised of individuals from industry, academia, government and research organizations who bring a range of expertise, experience, and perspective to their work defining and achieving ILSI India's goals. These individuals are unpaid volunteers who take their scientific and fiduciary responsibilities to the organization seriously. They serve on ILSI India's Board of Trustees as individuals and do not represent their employers. Country Committees have been established in the South Asian Region for management of country programs.

ILSI is a global, non-profit federation dedicated to generating and advancing emerging science and ground-breaking research to ensure foods are safe, nutritious and sustainable, and that they improve planetary and human health and well-being in the 21st century. ILSI convenes scientists at the forefront of research on nutrition, food safety and sustainability, and operates within a framework of the highest principles of scientific integrity. ILSI's trusted experts and volunteers around the world work synergistically and transparently across academia and the public and private sectors.

ILSI envisions a future where its thought leadership positively impacts health and sustainability through decisions informed by science and provides input to overcome global food challenges through collaboration across sectors.

ILSI's work is guided by its Code of Ethics, Scientific Integrity and Organizational Standards of Conduct. ILSI accomplishes this work through its worldwide network of ILSI Entities. ILSI's scientific publications are duly recognized all over the world. They include the journal Nutrition Reviews and the book Present Knowledge in Nutrition. Please visit www.ilsi.org for more information on ILSI and its network.

Depression and Anxiety: Association with Nutrient Intakes Across the Lifespan

A Systematic Review of Studies

International Life Sciences Institute India

CONTENTS

FOREWORD

Mental disorders are increasing globally and among them anxiety and depression are most prevalent. WHO estimates that about 322 million people, constituting 4.4 percent of world population, suffer from depression. In India as per an study published in Lancet Psychiatry in 2020, around 200 million suffer with some kind of mental disorders which include 45.7 million from depression and 44.9 million from anxiety disorders. The incidence of other mental disorders such as Alzheimer's, Parkinson's is also on rise.

Relationship between food and mood is well known and described in ancient Indian literature. The realization that neurological conditions and mental illnesses are caused by fundamental metabolic disturbances like oxidative stress, insulin resistance, inflammation, and more recently by microbiome dysbiosis, has led to attempts for correction of these disorders with lifestyle changes where nutrition assumes a great significance. A number of intervention studies with different kinds of diet and nutrients have been under taken with favorable results. Nutritional Psychiatry and Nutrition Neuroscience are emerging as a discipline for the management of mental disorders.

In order to understand the current status of relationship between nutrition and mental health throughout the life span, ILSI-India commissioned a study on the “Association of Depression and Anxiety with Nutrient Intake”. The authors systematically carried out review of epidemiological studies published during the last 20 years and produced this monograph. The pains taking efforts of the authors and critical analysis of the results are highly appreciated.

It is hoped that this monograph will be of immense benefit to students, researchers, academia, government, industry and society at large and may lead to adoption of suitable strategies in the emerging field of nutritional neuroscience.

Prof. P. K. Seth
Chairman

ABSTRACT

The current systematic review was conducted to understand the relationship and interaction between nutrition and mental health across the lifespan. The search adhered to the guidelines of PRISMA. Around 851 relevant articles published between January 2000 till 15th September 2021 were identified by systematic online search from 6 electronic databases (PubMed, PsycInfo, Science Direct, MEDLINE, Scopus and Google Scholar) and overall, 31 relevant studies were included in the current review as per the inclusion criteria using a 2-stage procedure (based on the title, based on the abstract). Studies that assessed the intake of wholesome diets, dietary components and used standardized measures of dietary assessments and aspects of mental health were included. In the first phase, methodological assessment was performed by two independent reviewers. The American Dietetic Association Quality Criteria Checklist for Primary Research (2016) was used to assess the quality of articles. Further, in the second phase, quality of dietary assessment tool was done using the European Micronutrient Recommendations Aligned Network of Excellence scoring system. The heterogeneity between study definitions of dietary and internalizing symptomatology variables precluded formal meta-analysis. Therefore, we determined a priori for the assessment of research studies by assessing their methodological quality. A narrative synthesis of the findings from the included studies was performed, which was structured around the type of outcome. The results of the review suggest that healthy eating pattern, including green leafy vegetables and fresh fruits, polyunsaturated fatty acids, like alpha-linoleic acid and minerals like magnesium positively impact mental health.

Key words: Mental Health, Nutritional Psychology, Review, Systematic, PRISMA, PICOS

1. INTRODUCTION

The global burden of mental illness is increasing exponentially. The most common mental disorders that are currently prevalent in numerous countries are depression and anxiety disorders [1]. Rapid urbanization and a transition from traditional diet and lifestyle patterns of physical activity have been linked to increases in depression and other mental disorders [2]. In the near future, depression and other common mental disorders will become a part of an epidemic of comorbidity between physical and mental illness, with diet being the critical common determinant [3].

Research evidence suggests that dietary patterns of general population in many Asian and American countries reflect that diets are deficient in many nutrients, especially essential vitamins, minerals, and omega-3 fatty acids. Also, fruits and vegetable consumption is low in Asian countries which further lead to mineral and vitamin deficiencies [4]. A traditional wholesome diet, consisting of foods such as whole grains, legumes, fish, vegetables, fruits and nuts, is more likely to provide the nutrients that provide resilience against the pathogenesis of mental disorders [2,5].

The human brain operates at a very high metabolic rate, and utilizes a substantial quantum of total energy and nutrient intake both in structural development and functioning. It is dependent on amino acids, omega-3 fats, vitamins and minerals for smooth functioning of its neural circuitry [2,5,6,7,8].

Convincing research links have been established between nutritional quality and mental health. Many prospective studies have shown significant associations between healthy dietary patterns and a reduced prevalence of and risk for depression. Prenatal and maternal nutrition is an emerging determinant of later mental health outcomes in children and severe macro and micro nutrient deficiencies during crucial development periods have been implicated in the pathogenesis of depressive and psychotic disorders in children [10-16].

Dietary habits modulate the functioning of the immune system, which also moderates the risk of depression [5]. The antioxidant defense system, which enhances immune response, operates with the support of nutrient cofactors and phytochemicals. Also, neurotrophic factors make essential contributions to the neural plasticity and repair mechanisms throughout life, and these too are affected by nutritional factors [9].

An important feature of the diets of patients suffering from mental illness is the severity of deficiency in the macro and micro nutrients. Studies have indicated that daily supplements of vital nutrients are often effective in reducing patients' symptoms of mental illness. Nutritional supplements containing amino acids have also been found to reduce symptoms, as they are converted to neurotransmitters which in turn alleviate depression and other mental health problems. Converging evidence indicates multiple pathways by which these nutrients can assist in brain function [17,18]. A recent systematic review has confirmed a relation between unhealthy dietary patterns and poorer mental health in children and adolescents [19]. Studies have also reported an early age of onset (particularly in the age of early adolescence) of depression and anxiety disorders [19].

In view of the emerging evidence, it can be said that, diet is a key modifiable intervention target for prevention of initial incidence of these disorders. *Nutritional neuroscience* is an emerging research area highlighting the fact that nutritional factors are intertwined with human cognition, behavior, and emotions [8].

However relatively less attention has been given to the implications of poor dietary intake and patterns for the increasing burden of mental illness across human life span; which is surprising because the brain is dependent on essential nutrients from food for maintaining its structure and function [20]. The current systematic review was conducted to understand the relationship between nutrition and mental health across lifespan and to add knowledge to the growing body of '*Nutritional Neuroscience*'.

2. MATERIALS AND METHODS

2.1. STUDY DESIGN

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement was used for writing up this systematic review.

2.2. SEARCH STRATEGY

An electronic literature search was conducted using the following six electronic databases: PubMed, Science Direct, Google Scholar, Scopus, Medline and PsycInfo. The articles and research studies published between January 2000 till 15th September 2021 were selected. Relevant keywords and index terms "nutrition" or "diet*" or "dietary pattern" or "diet quality" or "food habits" or "nutrition surveys" or "diet surveys" or "food-frequency questionnaire" or "diet records" AND "depression" or "depressive disorder" or "anxiety disorder" or "affect*" or "mental health outcomes" or "depressive symptoms" or "anxiety symptoms" in combination with (and/or) cohorts, cross-sectional, clinical trials, interventions, randomized control trials, longitudinal studies were used to extract articles. Additional publications were identified from references cited in the original articles.

2.3. STUDY SELECTION

Titles and abstracts of all articles retrieved in the initial search were evaluated independently by 2 reviewers (PK and BTA). Articles not meeting the eligibility (inclusion-exclusion) criteria were excluded based on study design, population or exposure, and outcome. The reference lists of relevant review articles identified during this process were also examined to include additional studies. Full-text articles were retrieved if the citation was considered eligible, and subjected to a second evaluation for relevance by the same reviewers. Any disagreements were discussed and resolved by consensus.

2.4. ELIGIBILITY CRITERIA

Relevant articles were retrieved and included if they met the inclusion-exclusion criteria as mentioned below.

2.5. INCLUSION CRITERIA

Articles were included if they:

(1) Examined wholesome diet (traditional whole diet, consisting of foods such as whole grains, legumes, fish, vegetables, fruits and nuts) and diet components;

(2) Included measurements of dietary components using any one of them (24-hour recall, Food Frequency Questionnaire, Semi-Quantitative Food Frequency Questionnaire, Food Diary, Food Habit, Food Records);

(3) Included depressive symptoms, depression, anxiety symptoms, anxiety, mental health outcomes, psychological distress as an outcome measure;

(4) Included valid measures of mental health outcomes;

(5) Were conducted primarily on humans;

(6) Were published in English language.

2.6. EXCLUSION CRITERIA

Articles were excluded if they:

(1) Examined impact of individual nutritional supplements and medications on overall health;

(2) Examined impact of meal replacement products (liquid shakes, protein mixtures) on mental health;

(3) Used psychological therapies as a treatment for psychosocial problems;

(4) Focused on a subgroup of individuals with specific nutritional needs that are different from the general population.

Studies were deemed ineligible if they included those with a chronic condition (e.g. CVD, T2DM, cancer, hypertension); and, those comprising participants with eating disorders and breast-feeding women were excluded as these conditions were considered to be potentially confounding factors. The PICOS (Participants, Intervention, Comparator, Outcomes, Study Design) criteria was used and is listed in Table 1.

2.7. DATA SYNTHESIS

The heterogeneity between study definitions of dietary and internalizing symptomatology variables precluded formal meta-analysis. Therefore, we determined a priori for the assessment of research studies by assessing their methodological quality.

2.8. ASSESSMENT OF METHODOLOGICAL QUALITY

Articles considered for inclusion after the second evaluation were assessed for methodological quality independently by 2 reviewers (PK and BTA). The American Dietetic Association Quality

Criteria Checklist for Primary Research (2016) was used to assess the quality of articles. The articles were rated based on 2 scales: relevance and validity. Articles were rated for 4 questions addressing relevance to practice and 10 validity questions addressing scientific importance. First the articles were rated for relevance assessment. If all the 4 answers for relevance assessment were "yes" than the articles were further screened for validity assessment. For the validity assessment, the reviewers assigned "Yes" if the criterion was met, "No" if the criterion was not met, "Unclear" if the criterion was not clearly described, or "NA" (not applicable) if the criterion did not apply to the study. All the 10 questions (including sub questions) for all the articles were tabulated and depending upon the scores they were assigned a rating of positive, negative or neutral. Any disagreements that arose between the reviewers were resolved through discussion. Positive articles with a >/= 6 "Yes" for the validity questions and with a "Yes" for all 4 relevance questions were considered methodologically rigorous and were included. Negative articles with < 6 "No" or "Unclear", did not meet the criteria of a strong quality study and were therefore excluded. If at least one of the answers to the priority validity questions (item no. 2,3,6,7) was "No" or "Unclear," the articles were rated "Neutral," and these were subjected to a second quality assessment.

In the second phase, the quality of dietary assessment tool used in the articles which were categorized as "Neutral" in first quality assessment was assessed. All the "Neutral" articles used a Food Frequency Questionnaire (FFQ) to assess dietary intake. If a validated FFQ was used, full text of the study was retrieved and assessed by using the European Micronutrient Recommendations Aligned Network of Excellence scoring system (EURRECA; Serra-Majem et al, 2009). 5 variables were considered for scoring, namely; sample and sample size of the study, statistics to assess validity, data collection, seasonality and supplements.

This allowed for classification of studies according to their methodological quality [23] (Table 2) as very good/excellent, score >/= 5; good, score 3.5 < /= < 5; acceptable/reasonable, score 2.5</= <3.5 and poor, score <2.5. If the FFQ was not validated, it was rated "poor." Neutral articles that used a "poor" dietary assessment tool were excluded.

2.9. DATA EXTRACTION

Potentially relevant articles were screened for eligibility based on titles and abstracts. If deemed potentially eligible, the full text publication was retrieved and reviewed (PK). Data was extracted by two independent reviewers (PK and BTA) and entered into a predefined data extraction form. Discrepancies in data extraction were discussed and resolved by consensus.

The following information was extracted: author, publication year and country, study design, study duration (for cohort studies), sample size, number of cases and controls (if available), dietary assessment tool and validation method (if applicable), method of identifying dietary patterns, dietary patterns identified, mental health assessment tool, anthropometric assessment methods (if applicable), biochemical assessment (if applicable) confounders adjusted for in analysis, statistical analysis and main findings.

3. RESULTS

3.1. SEARCH RESULTS

A flowchart detailing the process of study selection is shown in Figure 1. The search yielded 881 citations (excluding duplicates). Hand-searching of a reference list of review articles further identified 18 references. Initial screening of title and abstract excluded 749 citations. Full texts for eligible citations were obtained for further evaluation. Assessment of methodological quality was performed on 85 full-text articles. The final number of articles eligible for inclusion in this review was 31 (Table 3a, 3b and 4).

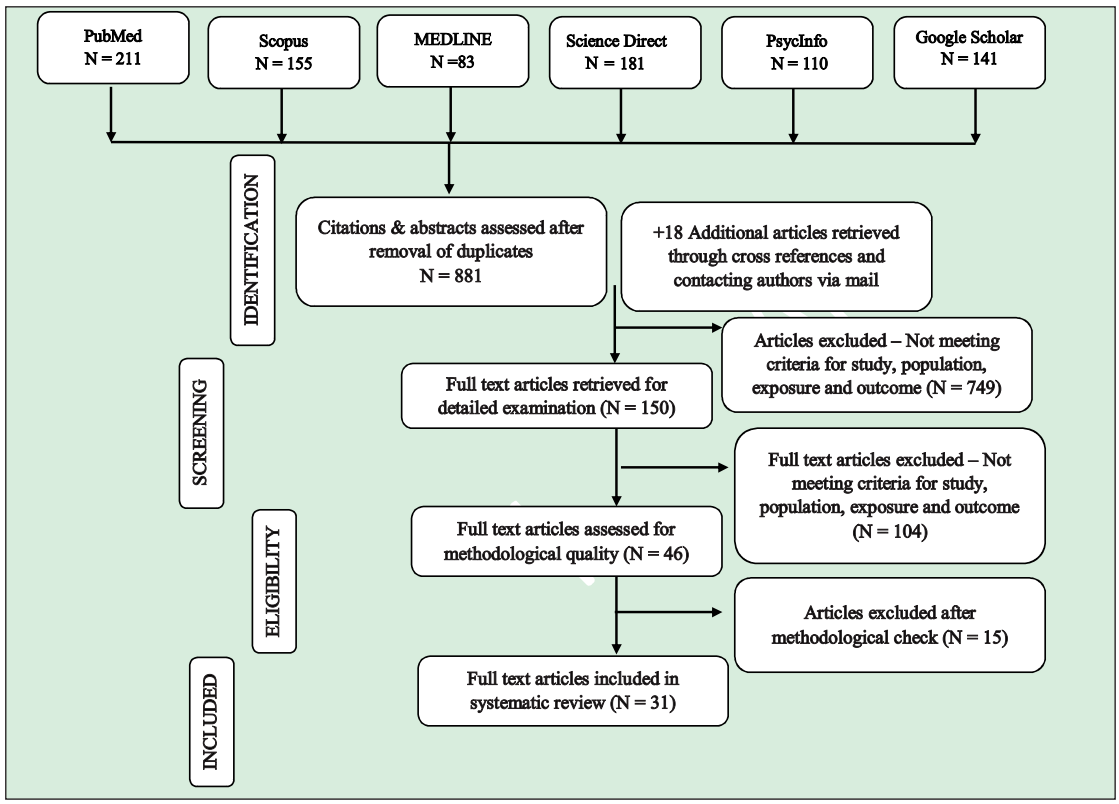

Figure 1: Flowchart of Study Selection Process

3.2. QUALITY ASSESSMENT

All 46 full-text articles scored "Yes" to all the relevance questions and were subjected to validity assessment. Out of a maximum of 10 "Yes" answers for the validity questions, the highest score was 9 and the lowest score was 2. Eleven studies were rated negative, scoring 5 "Yes," and were excluded. Seven studies were rated "Neutral." These neutral studies were subjected to the European Micronutrient Recommendations Aligned Network of Excellence scoring system. Four of the neutral studies used a non-validated FFQ to assess dietary intake and were therefore eliminated from this review. These 4 eliminated studies used either a self-constructed FFQ with no mention of whether they were validated or a modified versions of validated FFQs that were not revalidated. The FFQs in the remaining 3

neutral studies were rated "good," scoring between 3.5 and 5. Thus 31 studies finally qualified in the quality criteria.

3.3. POPULATION AND DESIGN

The characteristics of the studies included in this review are presented in Table 3a and 3b. **10 studies were conducted in Australia** [23,24,25, 27-32,65], **4 in Japan** [42,48,51,52], **2 each in Spain** [33, 34], **USA** [35,36], **India** [37], **England** [39,40] respectively and **1 each in Canada** [41], **Ireland** [43], **Peru** [44], **Switzerland** [45] , **London** [46] , **Netherlands** [49] and **Iran** [66]. **1** cross national study in **China, India, Mexico, Russia, South Africa** and **Ghana** [50], **1** study conducted in three South Asian countries – **Bangladesh, India** and **Nepal** [38] , **1** combined study in **4 European countries** – Netherlands, Amsterdam, United Kingdom and Germany [26].

The total number of participants ranged from 67 to 60,404. Participants comprised of young children (6-18 months), early adolescents (11-13 years), adolescents (14-17 years), university students, young adults (18-30 years), pregnant women (singleton mother, 17 weeks of gestation), middle-aged adults (35-50 years) and older adults (55- 74 years).

3.4. DESCRIPTION OF THE STUDIES

Out of 31 studies which met the quality assessment criteria, data were derived from **10 cross sectional** [24, 25, 26, 30, 37, 38, 42, 45, 50, 65], **4 COHORT** [36, 39, 40, 51], **3 Randomised Control Trials (RCTs)** [26, 27, 46,], **5 Longitudinal** [23,33,34,41,49], **5 Prospective Cohorts** [28, 31, 32, 35,52], **1 Case Control** [66] **1 Quasi-Experimental** [29] , **1 follow up study** of 3 years [48] and **1 secondary data analysis** of demographic health survey [44] studies .

3.5. MEASURES OF MENTAL HEALTH

Table 4 displays the instruments used to measure outcome and exposure variables. We present data from studies in which mental health was treated as the exposure variable separately from studies exploring diet as the exposure. The most commonly used instruments to measure mental health were Centre for Epidemiologic Studies Depression Scale (CESD; n=6), Child Behavior Checklist (CBCL; n=4) Patient Health Questionnaire (PHQ; n=2), Hospital Anxiety Depression Scale (HADS; n= 2); Composite International Diagnostic Interview (CIDI-2 &Short Form; n=2) and General Health Questionnaire (GHQ; n=2). Apart from these Edinburg Postnatal Depression Scale (EPDS), PedsQL, Short Mood and Feelings Questionnaire, Children's Depression Inventory, Youth Inventory, Kessler Psychological stress Scale (K 10), Montgomery-Asberg Depression Rating Scale (MADRS), Warwick-Edinburg Mental Wellbeing Scale (WEMWBS) Mental Health Inventory (MHI), WHO Quality of Life Scale (WHOQOL), Inventory of Depressive Symptomatology (IDS), Beck Anxiety Inventory (BAI), Beck Depression Inventory (BDI), Fear Questionnaire, MINI International Neuropsychiatric Interview 5.0, PHQ-9 patient health questionnaire, IDS-SR30 inventory of depressive symptoms self-rated, GAD-7 generalized anxiety disorder-7, Euro-Quol-5D-5 L were also used to assess mental health.

3.6. MEASURES OF DIET AND FOOD INTAKE

Dietary intake was most commonly measured using variations of a Food Frequency Questionnaire (FFQ n = 11) including Commonwealth Scientific and Industrial Research Organization (CSIRO) FFQ (n=2), Dietary Questionnaire for Epidemiological Studies (DQES) FFQ (n=2), Food Frequency Questionnaire by Cancer Council of Victoria (n=2), Dutch Food Frequency Questionnaire (n=1), EPIC Food Frequency Questionnaire (n=1), FFQ-GA2LEN Food Frequency Questionnaire (n=1). Other measures include 24 hour recall (n=1), Food Habits Questionnaire (n=1), Semi Quantitative FFQ (n=1), Kreece Plus Food Questionnaire (n=1), Food Diary (n=1), EPIC Food Frequency Questionnaire (n=1), Diet History Questionnaire (n=1), Food Records (n=1) and Country specific and standardized fruit and vegetable list (n=1). Apart from these, standardized diet related questions, dietary diversity scores, minimum meal frequency value, minimum diet value, food deprivation/household hunger scale (n=1), diet quality and adherence to Japanese food guide (n=1) were also used for assessment of food intake.

3.7. MEASURES OF ANTHROPOMETRIC AND BIOCHEMICAL ASSESSMENT

Most common anthropometric assessment was the Body Mass Index (BMI) (n=16). Body fat analysis via TANITA (bioelectrical impedance) (n=1), Waist circumference (n=2), waist-hip ratio (n=1) and MUAC (n=1) were also assessed in the studies.

Two studies also assessed biochemical parameters.

3.8. KEY FINDINGS

Key results of the total **31** studies are reviewed in Table 3a, 3b and 4. Of the **31** studies, **27** studies explored the relationship between diet, diet quality, dietary patterns and mental health using diet as an exposure outcome. Of these 27 studies, **six** explored intake of fruits and vegetables[25,38,41,44,45,50], **four** explored the relationship of various nutrients [24,30,39,51], **two** explored intake of fish [23, 35], **two** studies explored the adherence to Japanese dietary guidelines [48,52], **one** explored intake of fried foods [42], **one** explored intake of unsaturated fatty acids [24] and **two** explored prudent and western dietary patterns[65,66]. **Two** studies also explored the association of Body Mass Index (BMI) and weight status with mental health outcomes [28,40]. It was also seen that **two** studies explored the relationship between diet quality and mental health[29,43], **one** explored the relationship between dietary diversity and mental health outcomes (assessed by Developmental Milestones Checklist II) [37], **one** explored the relationship between dietary patterns and mental health outcomes (assessed by CBCL) [31] , **one** examined relationship between infant's feeding pattern and mental health outcomes (assessed by CBCL) [36] and **two** studies explored the association between Mediterranean diet and mental health [33, 49].

In studies which examined association of dietary quality and dietary patterns with mental health

outcomes, significant associations were seen with healthy eating patterns like the Mediterranean diet, consumption of green leafy vegetables, fresh fruits, fish and positive and better mental health outcomes (assessed by CESD, CBCL, PHQ, MHI, IDS, BAI) [24, 31,44,46, 49,50]. Significant associations were also seen between intakes of specific nutrients like alpha-linoleic acid [24], and magnesium [30] and positive mental health outcomes (assessed by CESD-10, CIDI, PHQ, Mental Health Inventory, CBCL respectively). On the other hand, unhealthy eating scores [46], consumption of sweet drinks and take away foods [29], red meat [32], western dietary patterns (confectionaries and red meat consumption) and was found to be significantly associated with poor mental health [65,66].

When the relationship between mental health and diet quality was explored using mental health as the exposure variable, data were limited. However, two out four [33, 34, 36, 37] of these studies demonstrated that poor mental health is significantly associated with low adherence to Mediterranean diet pattern (including vegetables, cereals, olive oil) [33,49]. Poor mental health was also associated with low fruit consumption (less than 5 servings a day) [38] and with increased consumption of sweet foods and sweet drinks in infants [36].

4. DISCUSSION

Our aim was to review the existing literature to determine the relationship between diet and mental health, with a focus on depression and anxiety across the human lifespan. Studies conducted on different population groups (infants, early and late adolescents, university students, young, middle aged, pregnant women and older adults) were included in this review to understand and elaborate the relationship of diet and mental health across the entire lifecycle.

Due to heterogeneity in the tools used for assessment of dietary intake and mental health outcomes, meta-analysis could not be performed. But the results of the review suggest that healthy eating pattern, including green leafy vegetables and fresh fruits and intake of polyunsaturated fatty acids, like alpha-linoleic acid and minerals like magnesium have a positive impact on mental health. On the other hand, consumption of sweet drinks and take away foods, red meat, confectionaries and baked products are significantly associated with poor mental health outcomes.

A robust research evidence suggests that diet is essential to mental health, across the lifespan, although there are particular periods of rapid development. Prenatal and postnatal diet is important not only for the mental health of the mother[54] but also has implications for mental development and cognition of her offspring [55,56]. This suggests the potential to target the nutritional status of a woman during pregnancy in order to positively influence future mental health outcomes in children and adolescents[57].

As in other domains of health, childhood meal patterns have an impact on the future health of the adolescent[58]. Unfortunately, many studies

have reported that young people are eating well below dietary recommendations. They are increasingly reliant on nutrient poor foods which are high in sugar and saturated fatty acids such as soft drinks, confectionary items, and baked snacks. These dietary patterns are not only significantly related to obesity and non-communicable diseases, but they also critically impact the brain development and mental health as well[59]. Consumption of diet, and snacks which are high in saturated fats, sugar and salt has been linked to behavioral and emotional problems in children, which has further been linked to mental disorders in adulthood[60].

During adolescence, teenagers have greater independence to food choices and begin to establish dietary habits that will carry through adulthood[61]. This period is also critical, as it is typically during this phase that mental disorders emerge for the first time[62]. Globally, researchers have consistently demonstrated that diet quality is important to mental health of young people transitioning into adulthood[29,63,64]. Existing systematic reviews confirm a relationship between diet quality and mental health in children and adolescence[64]. This research evidence suggests the importance of establishing healthy snacks with nutrient rich diets that support brain development and lays the foundation for a healthy adulthood.

It is now well known that consumption of energy dense, nutrient poor, highly processed foods, and a transition from traditional dietary pattern to western diets along with insufficient physical activity are major causes of non-communicable diseases.

These dietary risk factors associated with physical illness are also associated with increased risk of mental illness, which is now a growing international concern and priority [20].

Mental health problems therefore carry a significant burden of disease across the lifespan and many knowledge and research gaps still exist in reporting prevalence and risk factors for such problems. Little attention has been given to the implications of low quality diets and poor dietary patterns in increasing the burden of mental health problems, which is surprising, given the brain's requirements for essential nutrients from food for its structure and function[6,7,8]. There are very limited dietary interventions investigating mental health outcomes [27] highlighting the need for more research in this area of nutritional neuroscience. Research is also required to establish the use, efficacy, composition, constituents and dosage of diets and individual nutrients in humans for prevention and management of mental disorders [53]. Nutritional medicine should now be considered as a mainstream element of psychiatric practice, with research, education, policy, and health promotion supporting this new framework. Diet and its constituents are key modifiable risk factors for the prevention of mental disorders. There are now consistent mechanistic, observational and interventional data to suggest diet quality may be a modifiable risk factor for mental illness. Diet and its bioactive components have been recognized among the modifiable risk factors, possibly influencing their pathogenesis.

5. OTHER POTENTIAL CONFOUNDERS

Clearly, diet is not the only determinant of mental health. Nevertheless, a number of the studies failed to include important potential confounders and effect modifiers. These include race, ethnic, or religious affiliation, social norms, socio economic status as well as lifestyle behaviors that directly affect health [e.g., smoking, and alcohol use (wine was included in a study examining the adherence to Mediterranean diet)] and the physiologic determinants of dietary intake. Given that when compared to the general population, individuals who follow a vegetarian diet tend to be more health-conscious, more physically active, more highly educated, consume less alcohol, be nonsmokers, it is essential for future studies to include detailed information on participants' health and behavioral histories and current characteristics.

6. STRENGTHS AND LIMITATIONS

This exhaustive and comprehensive systematic review had several strengths, first including our priori decision to conduct the assessment of research studies by assessing their methodological quality of studies conducted on different population groups and different geographical locations. This decision allowed for a clear and yet rigorous assessment. A second strength was our decision to limit our primary outcomes to well-defined mental disorders (i.e., depression, anxiety, and related symptoms) and a limited number of secondary outcomes (e.g., quality of life). This focus allowed for a concise yet rigorous review and ameliorated the effects of poorly operationalized psychological phenomena. For example, by excluding results on disordered eating, dietary restraint, orthorexia, and personality (e.g., neuroticism), we avoided the potential misclassification and concomitant pathologizing of those who simply wish to avoid specific foods or food groups (e.g., vegans).

Our study also had limitations. Due to heterogeneity between studies definitions of dietary and internalizing symptomatology variables formal meta-analysis could not be conducted. First, we excluded non- English language studies, that could potentially bias our results in favor of “Western” norms which include Western dietary patterns. For example, our selection criteria excluded papers published in languages other than English. (e.g., Japanese, Hindi) and in non-English databases. Nevertheless, our review included a large sample from Japan and India; so, this limitation may be trivial.

Second, despite the high confidence we place in our finding that healthy eating patterns, wholesome diet and it's components are linked to psychological disorders, study designs and lack of rigor precluded valid inferences of temporality and causality.

Lastly, inferences from our results are only as accurate as the data collected by the included studies. Given that all studies relied on self-reported dietary status, there is the possibility of misclassification because self-reported dietary consumption.

7. CONCLUSIONS

The purpose of this review was to provide evidence to address both public health concerns and future research. Overall, the scientific literature examining the relation between the consumption or avoidance of wholesome diets, specific dietary components and food groups and mental health varied substantially in both rigor and validity of interpretation. Higher quality studies suggested that those who consumed healthy eating pattern, including green leafy vegetables and fresh fruits and intake of polyunsaturated fatty acids, like alpha-linoleic acid and minerals like magnesium have a positive impact on mental health. On the other hand, consumption of sweet drinks and take away foods, red meat, confectionaries and baked products are significantly associated with poor mental health outcomes. With respect to public health at large, the consumption of sweet drinks and take away foods, red meat, confectionaries and baked products may be a behavioral and modifiable marker that signifies poorer mental health. Study designs and/or a lack of rigor precluded inference of causal relations and none should be inferred. However, our study supports consumption of wholesome and traditional whole diet, consisting of foods such as whole grains, legumes, fish, vegetables, fruits and nuts have mental health benefits.

REFERENCES

1. GBD 2016 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet 2017;390:1211–59.
2. Logan AC, Jacka FN. Nutritional psychiatry research: an emerging discipline and its intersection with global urbanization, environmental challenges and the evolutionary mismatch. J Physiol Anthropol. 2014;33:22.
3. Jacka FN, Sacks G, Berk M, Allender S. Food policies for physical and mental health. BMC Psychiatry. 2014;14:132.
4. Uraiwan K, Nawi Ng, Hoang Van Minh, et al. Fruit and vegetable consumption in rural adults population in INDEPTH HDSS sites in Asia. Glob Health Action. 2009;2: 10.3402.
5. Berk M, Williams LJ, Jacka FN, et al. So depression is an inflammatory disease, but where does the inflammation come from? BMC Med. 2013;11:200.
6. Bourre JM. Effects of nutrients (in food) on the structure and function of the nervous system: Update on dietary requirements for brain, part 1: micronutrients. J Nutr Health Aging. 2006;10(5):377–85.
7. Bourre JM. Effects of nutrients (in food) on the structure and function of the nervous system: update on dietary requirements for brain. Part 2: macronutrients. J Nutr Health Aging. 2006;10(5):386–99.
8. Rao T S, Asha M, Ramesh B, Jagannatha Rao K. Understanding nutrition, depression and mental illnesses. Indian J Psychiatry. 2008;50(2):77–82.
9. Molendijk ML, Bus BA, Spinhoven P, et al. Serum levels of brain-derived neurotrophic factor in major depressive disorder: state-trait issues, clinical features and pharmacological treatment. Mol Psychiatry. 2011;16:1088–95.
10. Lai JS, Hiles S, Bisquera A, Hure AJ, McEvoy M, Attia J. A systematic review and meta-analysis of dietary patterns and depression in community-dwelling adults. Am J Clin Nutr. 2014; 99:181–97.
11. Psaltopoulou T, Sergentanis TN, Panagiotakos DB, Sergentanis IN, Kosti R, Scarmeas N. Mediterranean diet, stroke, cognitive impairment, and depression: a meta-analysis. Ann Neurol. 2013;74:580–91.
12. Nanri A, Mizoue T, Poudel-Tandukar K, et al, and the Japan Public Health Center-based Prospsective Study Group. Dietary patterns and suicide in Japanese adults: the Japan Public Health Center-based Prospective Study. Br J Psychiatry. 2013;203:422–27.
13. Jacka FN, Ystrom E, Brantsaeter AL, et al. Maternal and early postnatal nutrition and mental health of off spring by age 5 years: a prospective cohort study. J Am Acad Child Adolesc Psychiatry. 2013;52:1038–47.
14. Steenweg-de Graaff J, Tiemeier H, Steegers-Theunissen RP, et al. Maternal dietary patterns during pregnancy and child internalizing and externalising problems. The Generation R Study. Clin Nutr. 2014;33:115–21.
15. Brown AS, Susser ES, Lin SP, Neugebauer R, Gorman JM. Increased risk of aff ective disorders in males after second trimester prenatal exposure to the Dutch hunger winter of 1944–45. Br J Psychiatry. 1995;166:601–06.
16. Susser ES, Lin SP. Schizophrenia after prenatal exposure to the Dutch Hunger Winter of 1944–1945. Arch Gen Psychiatry. 1992;49:983–88.
17. Shaheen Lakhan SE, Vieira KF. Nutritional therapies for mental disorders. Nutr Jr. 2008;7:2.
18. American Psychiatric Association: Diagnostic and statistical manual of mental disorders. 4th ed. Washington DC, 2000.
19. O'Neil A, Quirk SE, Housden S, et al. Relationship between diet and mental health in children and adolescents: a systematic review. Am J Public Health. 2014;104:e31–42.
20. Parletta et al. Nutritional modulation of cognitive function and mental health. Journal of Nutritional Biochemistry. 2013;24:725–743.
21. Evidence analysis manual: Steps in academy evidence analysis process. April 2016.
22. Serra-Majem L, Andersen L, Henrı´que-Sa´nchez P, Doreste-Alonso J, Sa´nchez-Villegas A, Ortiz-Andrelluchi A, Negri E and Vecchia C. Evaluating the quality of dietary intake validation studies. British Journal of Nutrition. 2009;102, S3–S9.
23. Kylie J. Smith, Kristy Sanderson, Sarah A. McNaughton, Seana L. Gall, Terry Dwyer, Alison J. Venn, Longitudinal Associations Between Fish Consumption and Depression in Young Adults, *American Journal of Epidemiology*, Volume 179, Issue 10, 15 May 2014, Pages 1228–1235
24. Daley, Patterson et al. Unsaturated fat intakes and mental health outcomes in young women from the Australian Longitudinal Study on Women's Heath. Public Health Nutrition. 2014;18(3):546–553
25. Nguyen B, Ding D, Mihrshahi S. Fruit and vegetable consumption and psychological distress: cross sectional and longitudinal analyses based on a large Australian sample. BMJ Open. 2017;7:e014201.
26. Bot M, Brouwer IA, Roca M, et al. Effect of Multinutrient Supplementation and Food-Related Behavioral Activation Therapy on Prevention of Major Depressive Disorder Among Overweight or Obese Adults With Subsyndromal Depressive Symptoms: The MooDFOOD Randomized Clinical Trial. *JAMA*. 2019;321(9):858–868.
27. Jacka et al. A randomised controlled trial of dietary improvement for adults with major depression (the 'SMILES' trial).BMC Medicine. 2017;15:23.
28. Hoare, et al. Depressive symptomatology, weight status and obesogenic risk among Australian adolescents: a prospective cohort study. BMJ. 2016;6(3).
29. Jacka FN, Kremer PJ, Berk M, de Silva-Sanigorski AM, Moodie M, et al. A Prospective Study of Diet Quality and Mental Health in Adolescents. PLoS ONE. 2011;6(9): e24805.
30. Black, Allen et al. Low dietary intake of magnesium is associated with increased externalising behaviours in adolescents. Public Health Nutrition. 2015;18(10):1824-1830.
31. Oddy et al. The association between dietary patterns and mental health in early adolescence. Preventive Medicine. 2009;49:39–44.
32. Robinson et al. Lifestyle and demographic correlates of poor mental health in early adolescence. Journal of Paediatrics and Child Health. 2011;47:54–61.
33. Voltas, Arija, et al. Longitudinal study of psychopathological, anthropometric and sociodemographic factors related to the level of Mediterranean diet adherence in a community sample of Spanish adolescents. Public Health Nutrition. 2016;19(10):1812-1822.

34. Aparicio, Canals, et al. Emotional Symptoms and Dietary Patterns in Early Adolescence: A School-Based Follow-up Study. J Nutr Educ Behav. 2017;49:405-414.
35. Li, Dai et al. Fish consumption and severely depressed mood, findings from the first national nutrition follow-up study. Psychiatry Research. 2009;190:103–109.
36. Vollrath ME, Tonstad S, Rothbart MK, Hampson SE. Infant temperament is associated with potentially obesogenic diet at 18 months. Int J Pediatr Obes. 2011;6(2-2):e408-e414.
37. Larson, Young et al. A Cross-Sectional Survey in Rural Bihar, India, Indicates That Nutritional Status, Diet, and Stimulation Are Associated with Motor and Mental Development in Young Children. J Nutr. 2017;147:1578–85.
38. Bishwajit, Leary et al. Association between depression and fruit and vegetable consumption among adults in South Asia. BMC Psychiatry. 2017;17:15.
39. Mishra, McNaughton et al. Intake of B vitamins in childhood and adult life in relation to psychological distress among women in a British birth cohort. Public Health Nutr. 2009;12(2):166–174.
40. Molyneaux, Poston et al. Obesity, antenatal depression, diet and gestational weight gain in a population cohort study. Arch Womens Ment Health. 2016;19:899–907.
41. Kingsbury, Dupuis et al. Associations between fruit and vegetable consumption and depressive symptoms: evidence from a national Canadian longitudinal survey. Epidemiol Community Health. 2016;70:155–161.
42. Yoshikawa et al. Association between frequency of fried food consumption and resilience to Young Adults. Am J Epidemiol. 2014;179(10):1228–1235.
43. Meegan, Perry et al. The Association between Dietary Quality and Dietary Guideline Adherence with Mental Health Outcomes in Adults: A Cross-Sectional Analysis. Nutrients. 2017;9.
44. Wolniczak I, CaÂceres-DelAguila JA, Maguiña JL, Bernabe-Ortiz A. Fruits and vegetables consumption and depressive symptoms: A population-based study in Peru. PLoS ONE. 2017;12(10): e0186379.
45. Richard et al. Associations between fruit and vegetable consumption and psychological distress: results from a population-based study. BMC Psychiatry. 2015;15:213.
46. Phillips G, Bottomley C, Schmidt E, et al. Well London Phase-1: results among adults of a cluster-randomised trial of a community engagement approach to improving health behaviours and mental well-being in deprived inner-city neighbourhoods. J Epidemiol Community Health. 2014;68:606–614.
47. Forsyth AK, Williams PG, Deane FP. Nutrition status of primary care patients with depression and anxiety. Aust J Prim Health 2011;18(2):172–6.
48. Nanri A, Nagai C, Kochi T. Diet quality and depressive symptoms among workers. Clinical Nutrition 39 (2020) 1951e1957
49. Gibson-Smith D, Bot M, Brouwer I, et al. Association of food groups with depression and anxiety disorders. European Journal of Nutrition (2020) 59:767–778.
50. Gehlich K, Beller J, ange-Asschenfeldt B, et al. Fruit and vegetable consumption is associated with improved mental and cognitive health in older adults from non-Western developing countries. Public Health Nutrition 2018: 22(4), 689–696.
51. Choda N, Wakai K, Naito M, et al. Associations between diet and mental health using the 12-item General Health Questionnaire: cross-sectional and prospective analyses from the Japan Multi-Institutional Collaborative Cohort Study. Nutrition Journal (2020) 19:2
52. Okubo R, Matsuoka Y, et al. Diet quality and depression risk in a Japanese population: the Japan Public Health Center (JPHC)-based Prospective Study. Scientific Reports (2019) 9:7150
53. Sarris, J. Nutritional Psychiatry: From Concept to the Clinic. Drugs **79,** 929–934 (2019).
54. Baskin R, Hill B, Jacka FN, O'Neil A, Skouteris H. The association between diet quality and mental health during the perinatal period. A systematic review. Appetite. 2015;91:41–7.
55. Pina-Camacho L, Jensen SK, Gaysina D, Barker ED. Maternal depression symptoms, unhealthy diet and child emotional-behavioural dysregulation. Psychol Med. 2015;45:1851–60.
56. Barker ED, Kirkham N, Ng J, Jensen SK. Prenatal maternal depression symptoms and nutrition, and child cognitive function. Br J Psychiatry. 2013;203:417–21.
57. O'Neil A, Itsiopoulos C, Skouteris H, Opie RS, McPhie S, Hill B, et al. Preventing mental health problems in offspring by targeting dietary intake of pregnant women. BMC Med. 2014;12:208.
58. Heim C, Newport DJ, Mletzko T, Miller AH, Nemeroff CB. The link between childhood trauma and depression: Insights from HPA axis studies in humans. Psychoneuroendocrinology. 2008;33:693–710
59. Adair LS, Popkin BM. Are child eating patterns being transformed globally? Obes Res. 2005;13:1281–99.
60. Jacka FN, Ystrom E, Brantsaeter AL, Karevold E, Roth C, Haugen M, et al. Maternal and early postnatal nutrition and mental health of offspring by age 5 years: A prospective cohort study. J Am Acad Child Adolesc Psychiatry. 2013;52:1038–47.
61. Mikkila V, Rasanen L, Raitakari OT, Pietinen P, Viikari J. Longitudinal changes in diet from childhood into adulthood with respect to risk of cardiovascular diseases: The cardiovascular risk in young Finns study. Eur J Clin Nutr. 2004;58:1038–45.
62. Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. Arch Gen Psychiatry. 2005;62:593–602.
63. Jacka FN, Kremer PJ, Leslie, ER Berk M, Patton GC, Toumbourou JW, et al. Associations between diet quality and depressed mood in adolescents: Results from the Australian Healthy Neighbourhoods Study. Aust N Z J Psychiatry. 2010;44:435–42.
64. Oellingrath IM, Svendsen MV, Hestetun I. Eating patterns and mental health problems in early adolescence—A cross-sectional study of 12-13-year-old Norwegian school children. Public Health Nutr. 2014;17:2554–62.
65. Shakya PR et al., Association between dietary patterns and adult depression symptoms based on principal component analysis, reduced-rank regression and partial least-squares, Clinical Nutrition. 2019. https://doi.org/10.1016/j.clnu.2019.12.011
66. Nouri Saeidlou S, Kiani A, Ayremlou P. Association between Dietary Patterns and Major Depression in Adult Females: A Case-Control Study. J Res Health Sci. 2021; 21(1): e00506.

Table 1: PICOS Criteria for Inclusion and Exclusion of Studies

PARAMETER	INCLUSION CRITERIA	EXCLUSION CRITERIA
Participants	• Young Children (6-18 months) • Early Adolescents (11-13 years) • Adolescents (14-17 years) • University Students • Young Adults (18-30 years) • Pregnant Women (Singleton Mother, 17 Weeks of Gestation) Middle-Aged Adults (35-50 years) Older Adults (55- 80 years)	Population Groups with Mental Illness Taking Nutritional Supplements, Medications and Other Psychological Therapies as a Treatment
Intervention	• Nutrition Supplemental (Folic Acid -400 mcg/day+ Vitamin B_{12} - 100mcg/day), Mental Health Literacy and Physical Activity Information • Personalized Dietary Advice and Nutritional Counselling • Behaviour Change Communication Related to Healthy Eating, Physical Activity and Mental Well Being	
Comparator	• Control Groups (Same Population Groups) without Intervention	
Outcomes	• Association of Nutrition and Mental Health (When both are Considered as Exposure Variables)	
Study Design	• Longitudinal • Cross Sectional • Randomised Control Trials • COHORT • Case Control • Quasi Experimental • Prospective • Secondary Data Analysis of Demographic Surveys • Prospective Analysis of COHORT Studies	Narrative Reviews Systematic Reviews

Table 2. Scoring System to Assess the Quality of the Nutrient Intake Validation Studies

Step 1 Quality of the Validation Study Score the Studies According to :

Variables in General	Specific Variable	Points	Score
1. Sample and Sample Size	Non-Homogeneous Sample (Sex, SES, Smoking and Obesity) n > 100 (n > 50 for Biomarkers)	0·5	
		0.5	
2. Statistics: Group level	Compare/Test Mean or Median or Difference	1	
Correlations: (select only one of the three types, choosing type with the highest score)	Correlation	0·5	
	Adjusted Correlations (energy)	1	
	Deattenuated or Intraclass Correlations	1.5	
Agreement	Classification or Bland & Altman Plot	0·5	
3. Data Collection	Gathered by Face to Face Interview	1	
4. Seasonality	Considered	0·5	
5. Supplements	Included and Data Considered in Analysis	1.5	
		Total Score (S)	=Σ

Total score 'S' may range from a minimum of 0 (for all studies) to a maximum of 7

Source: Serra-Majem L, Andersen L, Henrı´que-Sa´nchez P, Doreste-Alonso J, Sa´nchez-Villegas A, Ortiz-Andrelluchi A, Negri E and Vecchia C. Evaluating the quality of dietary intake validation studies. British Journal of Nutrition. 2009;102, S3–S9.

Table 3a: General Details of the Study and Design for the Studies Included in the Systematic Review

S.No.	Author and Year	City and Country	Study Design	Population	Sample Size	Objectives
1	Smith, Sanderson, et al, 2014	Australia	Longitudinal	Adults, 26-36 year (38% Males, 62% Females); selected from Childhood Determinants of Adult Health - CDAH, School Children 7-11 years	1386	To Examine Longitudinal Associations between Fish Consumption and Onset of Depression.
2	Kingsbury, Dupuis, et al, 2015	Canada	Longitudinal; Every 2 years from 2002/2003 to 2010/2011, Participants Completed Self Reports of Daily Fruit and Vegetable Consumption, Physical Activity, Smoking and Symptoms of Depression and Psychological Distress	Adults, 18 years and above; Selected from National Population Health Survey.	8353	To Examine Associations between Fruit and Vegetable Consumption and Depression Across Multiple Time Points.
3	Daley, Patterson, et al, 2014	Australia	Cross Sectional Analysis of Longitudinal Data	Adult Women, 25-30 years; Selected from Australian Longitudinal Study on Women's Health (ALSWH)	7653	To Determine if Associations Exist between a Range of Unsaturated Fatty Acid Intakes and Mental Health Outcomes.
4	Voltas, Arija, et al, 2016	Reus, Spain	Longitudinal	Adolescents	241	To Identify Psychopathological, Anthropometric and Socio-demographic Factors that may Influence the Risk of Low Mediterranean Diet Adherence.
5	Nguyen, Dong, et al, 2017	New South Wales, Australia	Cross Sectional and Prospective	Adults, >/=45 years	60,404	To Investigate the Association between Fruit and Vegetable Consumption and the Prevalence and Incidence of Psychological Distress in Middle-aged and Older Australians.
6	Yoshikawa, Nishi, et al, 2016	Japan	Cross Sectional	Adults, 21-66 years	751	To Examine the Association between Frequency of Fried Food Consumption and Resilience to Depression.
7	Bishwajit, O'Leary, et al, 2017	3 South Asian Countries Bangladesh, India, Nepal	Cross Sectional	Adults, 18 years and above; Selected from WHO's World Health Survey	14,133	To Examine the Association between Fruits and Vegetable Consumption and Depression.

Table 3a: General Details of the Study and Design for the Studies Included in the Systematic Review

S.No.	Author and Year	City and Country	Study Design	Population	Sample Size	Objectives
8	Meegan, Perry et al, 2017	Ireland	Cross Sectional; Selected from the Cork and Kerry Diabetes and Heart Study	Middle-Aged Adults	2047	To Examine Potential Associations between Dietary Quality, Dietary Composition and Compliance with Food Pyramid Recommendations with Depressive Symptoms, Anxiety and Well Being.
9	Larson, Young, et al, 2017	Bihar, India	Cross Sectional Survey	Young Children; 6-18 Months Age	2838	To Examine Nutritional, Psychosocial Environmental, and Household Correlates of Child Development; To Identify Mediators between Dietary Diversity and Mental Development.
10	Bot et al, 2019	Four different European Countries (The Netherlands: GGZ in Geest and Vrije Universiteit Amsterdam, Amsterdam; United Kingdom: University of Exeter; Germany: University of Leipzig, Spain: University of Balearic Islands, with 250 Subjects Recruited Per Site)	2 × 2 Factorial Randomized Controlled Prevention Trial	Adults Aged 18 to 75 years old	1025 Adults Subsyndromal Depressive Symptoms were Randomly Allocated to the 4 Groups: Placebo without Therapy (n = 257), Placebo with Therapy (n = 256), Multinutrient Supplements without Therapy (n = 256), and Multinutrient Supplements with Therapy (n = 256)	The Primary Objective of the MooDFOOD Prevention Trial was to Examine the Feasibility and Effectiveness of Two Different Nutritional Strategies to Prevent a New Episode of MDD in High-Risk Overweight Persons with Subsyndromal Symptoms of Depression. A Secondary Objective is to Examine Potential Mediators and Moderators of the Beneficial Effects (if any) of these Nutritional Strategies.
11	Jacka, O'Neil, et al, 2017	Melbourne, Australia	Single Blind - Randomised Control Trial	Adults; 35-45 years	67; Intervention Group - 33; Control Group - 34	To Investigate Efficacy of a Dietary Improvement Program for the Treatment of Major Depressive Episodes.
12	Mishra, McNaughton, et al, 2008	England, Scotland & Wales	Cohort	From Birth till 53 years	636 Women	To Investigate Whether Prospectively Measured Childhood and Adult Dietary Intakes of Thiamin, Riboflavin, Niacin, Folate, Vitamin B_6 and Vitamin B_{12} were Related to Psychological Distress of Women in Mid-Age.
13	Molyneaux, Poston, et al., 2016	South West England	Cohort	Pregnant Women	13,314	To Examine Relationship between High Pre-Pregnancy BMI and Antenatal Depression; whether BMI and Antenatal Depression Interact to Predict Diet and Gestational Weight (GWG).
14	Hoare, et al, 2016	Australia	Prospective Cohort Study	Secondary School Students; 13years and 15 years at Followup	634	To Examine Cross-Sectional and Longitudinal Associations between Obesogenic Risk Factors, Weight Status and Depressive Symptomatology.

Table 3a: General Details of the Study and Design for the Studies Included in the Systematic Review

S.No.	Author and Year	City and Country	Study Design	Population	Sample Size	Objectives
15	Aparicio, Canals, et al, 2017	Schools in Reus, Spain	3 years Longitudinal Prospective Study	Adolescents; 13 years	165	To Examine the Relationship between Early Emotional Symptoms and Dietary Patterns Over 3 years in a School-Based Sample.
16	Jacka, Kremer, et al, 2011	Australia	Quasi Experimental	Adolescents; 11-18 years	3040	To Investigate Relationships between Measures of Diet Quality and Adolescent Mental Health.
17	Wolniczak, Caseres-DelAguila, et al, 2017	Peru	Secondary Data Analysis of Demographic Health Survey	18-75+ years	25,848	To Evaluate Association between Consumption of Fruits and/or Vegetables and Depressive Symptoms.
18	Li, Dai, et al, 2011	USA	Prospective Analysis of Cohort	25-74 years	5068	To Assess Low Frequency of Fish Consumption as a Risk Factor for Depressive Mood.
19	Richard, Rohrmann, et al, 2015	Switzerland	Cross Sectional	15+years	20,220	To Examine Association of the Swiss Daily Recommended Fruit and Vegetable Intake with Psychological Distress.
20	Black, Allen, et al, 2014	Australia	Cross Sectional; Selected from the Raine (Western Australian Pregnancy Cohort) Study	14-17 years	684	To Examine the Prospective Association between Dietary Intakes of Zn and Mg and Internalising and Externalising behaviour Problems in Adolecsents.
21	Oddy, Robinson, et al, 2009	Australia	Prospective Study; Selected from the Raine (Western Australian Pregnancy Cohort) Study	14 years	1598	To Investigate the Associations between Dietary Patterns and Mental Health in Early Adolescence.
22	Robinson, Kenndall, et al, 2011	Australia	Prospective Study; Selected from the Raine (Western Australian Pregnancy Cohort) Study	14 years	1860	To Determine the Constellation of Lifestyle and Demographic Factors that are Associated with Poor Mental Health in an Adolescent Population.
23	Vollrath,Tonstad, et al, 2011	USA	Norwegian Mother and Child Cohort Study	Singleton Mothers;17 Weeks of Gestation	20,266	To Investigae Infant's Temperament at 18 months with Feeding of Food and Drinks that may increase the Risk of Later Obesity.

Table 3a: General Details of the Study and Design for the Studies Included to the Systematic Review

S.No.	Author and Year	City and Country	Study Design	Population	Sample Size	Objectives
24	Phillips, Bottomley, et al, 2014	London	Cluster Randomised Trial	Adults; 38 years	3986; 1938 Adults in Intervention Group and 1948 Adults in Control Group	To Determine the Effectiveness of The Programme in Improving Healthy Eating, Physical Activity and Mental Well-Being in Multiple Deprived Communities.
25	Gehlich, Beller et al, 2018	China, India, Mexico, Russia, South Africa and Ghana	Cross Sectional; Cross National - Multistage Cluster Sampling Design	Adults; 50 years or Older	28 078	To Examine the Contribution of Fruit and Vegetable Consumption to Mental and Cognitive Health in Older Persons.
26	Deborah Gibson-Smith et al, 2020	Netherlands	Longitudinal, Cohort	Adults, 18–65 years of Whom 1979 (66.4%) were Female	The Baseline Sample Consists of 2981 Patients [of which 2329 (78%) with a Lifetime Depressive or Anxiety Disorder]	To Examine the Association Between the Individual Food Groups of the Mediterranean Diet Score (MDS), in Isolation and in Combination, With Depression and Anxiety (Symptom Severity and Diagnosis).
27	Ryo Okubo et al, 2019	Japan	Prospective Cohort Study	40–59 years	1112	The Study Aimed to Determine Whether Higher Adherence to the Japanese Food Guide Reduced the Risk of Depression.
28	Shakya et al 2019	Adelaide, Australia	Longitudinal Cohort - Cross Sectional Data Set	Adults Aged 18 years	1743	The Study Aimed to Determine the Association Between Dietary Patterns, Derived by Principal Component Analysis (PCA), Reduced-Rank Regressions (RRR) and Partial Least-Squares (PLS), and DepS Among Adults Using a Cohort Study In Australia.
29	Choda et al, 2020	Japan	Multi-Institutional Collaborative Cohort Study - Crossectional Survey at the Baseline	Middle Aged Japenese, 35–69 years	6697	The Study Aimed to Investigate Associations Between Dietary Intake of Nutrients (Macronutrients, Vitamins, Calcium, and Fatty Acids) and Food Groups (Fish, Meat and Chicken, Dairy Products, and Vegetables) and Mental Health Among Middle-Aged Japanese in Cross-Sectional and Prospective Studies.
30	Nanri et al, 2020	Japan	3-year Follow-Up Survey	19 - 68 years	909 Workers	The Study Aimed to Investigate the Association of Adherence to the Japanese Dietary Guidelines with Depressive Symptoms in a Japanese Working Population.
31	Saeidlou et al, 2021	Urmia, Iran	Case Control Study	Adult Females Suffering from Major Depression within the Age Range from 19 to 65 years	170 Cases and 340 Controls	The Study Aimed to Determine the Association between Dietary Patterns and Major Depression in Adult Females.

Table 3b: Geographical Distribution of Studies and Design for the Studies Included to the Systematic Review

Colour Bar	Type of Study	No. of Studies	Place	
	CROSS SECTIONAL	10	AUSTRALIA	10
	LONGITUDINAL	5	JAPAN	4
	RCTs	3	USA	2
	COHORT	4	SPAIN	2
	PROSPECTIVE COHORT	5	INDIA/NEPAL/BANGLADESH	1
	QUASI EXPERIMENTAL	1	IRELAND	1
	SECONDARY DATA ANALYSIS	1	INDIA	1
	FOLLOW UP	1	ENGLAND, SCOTLAND,WALES	1
	CASE CONTROL	1	SOUTH WEST ENGLAND	1
	TOTAL	31	PERU	1
			LONDON	1
			INDIA/MEXICO/RUSSIA/SOUTH AFRICA/GHANA	1
			NETHERLANDS	1
			SWISS	1
			EUROPE COMBINED	1
			CANADA	1
			IRAN	1
			TOTAL	31

Table 4: Characteristics of the Study Exposure and Outcomes for the Studies Included to the Systematic Review (P. 26-43)

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
1	Smith, Sanderson, et al, 2014	Composite International Diagostic Interview (CIDI), CIDI-Auto 2.1 - Computer Assisted Telephone Interview.	Food Habits Questionnaire and Food Frequency Questionnaire with 127 Items. The Number of Fish Items was Increased to Reflect Current Consumption Patterns. Nine Types of Fish and Seafood Items (Canned Fish, Fresh Fish, Frozen Fish, Fried Fish, Mussels/Oysters, Lobster/Crayfish/Yabbies, Calamri.Squid, Prawns and other Seafood) were Included. Estimate of the Intake was Recorded for Previous 12 Months and Weekly Equivalents were Calculated for Each Item.	Hight, Weight, BMI	No	No	Yes, General Population	Percentages; Poisson Regression Analysis	In this Longitudinal Study, Higher Fish Consumption was Associated with a Significantly Lower Risk of having a Depressive Episode in Women, but not in Men during Approximately 5 years of Follow Up. Prevalence of Lifetime Depression (ever having Depression/Dysthymia) was Higher in Study Group than in General Australian Population. During Follow-Up 13% Men and 18.8% Women had a Depressive Episode. In Total, 533 Men and 853 Women Completed the FFQ. Fish Consumption at Baseline was the Same for both Men and Women: 2 Times/Week. Fish was Consumed >/= 2 Times/Week by 320 (60%) Men and 506 (59.3%) Women. Most commonly Consumed Fish were Canned Fish and Fresh Fish. Fish Oil or Evening Primrose Oil Supplements were Used at Least Once Per Month by 69% Men and 14% Women.Very Few Participants Used Omega-3 Fatty Acid

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
									Fortified Margarine for Cooking (10 Men, 11 Women) or as a Spread (13 Men, 25 Women). Women who Ate Fish >/= 2 Times/Week at Baseline had a 25% Lower Risk of having Depression During Follow Up than those who Ate Fish <2 Times/Week. For Men, Baseline and Follow Up Fish Consumption was not Associated with the Risk of Depression.
2.	Kingsbury, Dupuis, et al, 2015	Composite International Diagnostic Interview Short Form (CIDI-SF); Kessler Psycholo-gical Distress Scale (K6)	The Daily Frequency of Fruit and Vegetable Consumption was Using the Following Questions {How often do you Usually Eat Fruit?; How often do you (usually) Eat Green Salad?; How often do you (Usually) Eat Carrots?; How Many Servings of Other Vegetables do you Usually Eat?} Total Fruit and Vegetable Intake was Assessed by Combining the Responses to Questions Regarding Daily Consumption Frequency of Fruits, Green Salad, Carrots and Other Vegetables. Juices and Potatoes were not Included, due to their Strong Association with Unhealthy Foods and Lack of Nutritional Value.	No	No	No	No	Percentages; Generalised Estimating Equations (GEE) Regression Models	Fruit and Vegetable Consumption at Each Cycle was Inversely Associated with the Next Cycle Depression and Psychological Distress. However, Once Models were Adjusted for Other Health-Related Factors, these Associations were Attenuated.

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
3.	Daley, Patterson, et al, 2014	Centre for Epidemilogical Studies Depression Scale (CESD-10)	Dietary Questionnaire for Epidemiological Studies (DQES) Version 2, Developed by Cancer Council Victoria. It is 74 Item FFQ that Assesses Usual Dietary Intakes for the Previous 12 Months.	Hight, Weight, BMI	No	No	No	Mean +/- SD; Logistic Regression Analysis	Statistically Significant Associations between Higher Intakes of Alpha-Linolenic Acid and Decreased Likelihood of Depressive Symptoms Indicated by CESD-10. Furthermore, Higher Intakes of n-6 fatty Acids and Linoleic Acid were associated with Decreased Likelihood of Self-Reported Diagnosed Anxiety and Higher Intakes of n-9 Fatty Acids and Oleic Acid were Associated with Increased Likelihood of Self-Reported Diagnosed Anxiety.
4.	Voltas, Arija, et al, 2016	Screen for Childhood Anxiety Related Emotional Disoders, Children's Depression Inventory, Youth's Inventory-4 and Eating Disorder Inventory-2	Krece Plus Food Questionnaire	Height, Weight, BMI, Body Fat (Bioelectrical Impedance via Tanita)	No	No	No	Chi-Square, Student's T Test, ANOVA, Logistic Regression	Socio-Economic Status was a Protective Factor for Low MD Adherence and a Risk Factor for High BMI. Regardless of SES, Depression was Involved with Risk of Low Adherence. Girls with Lower MD Adherence Presented Significantly Higher Scores for Eating Disorders. They also Presented Higher Depression Symptoms than Girls with High Adherence. These Results Highlight the Influence of Psychosocial Factors on Levels of MD Adherence.

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
5.	Nguyen, Dong, et al, 2017	Kessler Psychological Distress Scale (K 10)	Short Validated Questions: About How Many Serves of Fruit do You Usually Have Each Day? About How Many Serves of Vegetables Do You Usually Eat Each Day?	Hight, Weight, BMI	No	No	No	Mean +/- SD; Logistic Regression Analysis	At Baseline, 5.6% Reported Psychological Distress. After a Follow Up of 2.7 years, 4% of those Who did not Report Distress at Baseline Reported Distress at Follow Up. At Baseline, Fruit and Vegetable (Consumption Considered Separately or Combined), was Associated with A Lower Prevalence of Psychological Distress Even after Adjustment for Socio-demographic Characteristics and Lifestyle Risk Factors. It was also Associated in a Lower Incidence of Psychological Distress in Minimally Adjusted Models. In Fully Adjusted Models, most of these Associations were Significant at Medium Intake Level but no Significant Association was seen at Highest Level of Intakes.
6.	Yoshikawa, Nishi, et al, 2016	Centre for Epidemilogical Studies Depression Scale (CES-D); Resilience Scale (RS 14)	Food Frequency Questionnaire	No	No	No	No	Mean +/- SD; Regression Analysis; Preacher and Hayes Bootstrap Script	Significant Associations between Frequency of Fried Food Consumption and Total CES-D Score, between Frequency of Fried Food Consumption and Total RS-14 Score and between Total RS - 14 Score and CES-D Score. Significant Indirect Association of Frequency of Fried Foods on CES-D Score Through RS-14 (as a Mediating Variable) was Established Through Bootstrap Analysis.

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
7.	Bishwajit, O'Leary, et al, 2017	Self Reported Depression; Respondents were asked During the Last 12 Months have you had a Period Lasting Several Days when you Felt Sad, Empty or Depressed. 1. Yes 2. No; Overall in Last 30 Days ,How Much of a Problem Did you have with Feeling Sad, Low or Depressed? 1. None 2. Mild 3. Moderate 4. Severe and 5. Extreme	Self Reported; How many Servings of Fruit do you Eat on a Typical Day? a. <5 Servings a Day b. 5 Servings a Day c. >5 Servings a Day.	No	No	No	No	Percentages; Multivariant Regression Analysis	Prevalence of Self Reported Depression During past 12 Months were Respectively 39%, 17.7% and 49.9% for Bangladesh, India and Nepal. In India those who Consumed Less than Five Servings a Day, the Odds of Severe-Extreme and Mild-Moderate SRD were Respectively 3.5 Times and 42 % Higher in Bangladesh, and 2.9 Times and 42% Higher in Nepal Compared to those who Consumed Less than Five Servings a Day During Last 30 Days.
8.	Meegan, Perry et al, 2017	Centre for Epidemiologic Studies Depression Scale (CES-D); Hospital Anxiety Depression Scale (HADS), WHO-5 Well Being Index	EPIC Food Frequency Questionnaire, Modified USDA Food Pyramid (to Include Foods Commonly Eaten in Ireland) and Dietary Score was Calculated Using FFQ	Height, Weight, BMI, Waist Circumference	No	No	No	Mean +/- SD; Logistic Regression Analysis	Dietary Quality, but not Dietary Composition or Guideline Adherence, was Associated with Well Being. Those with Higher Dietary Quality were More Likely to Report Well Being Realtive to Those with Low Dietary Quality. This Result was Significant among Females and Non-Obese Individuals. No Associations between any Dietary Measures with Anxiety or Depressive Symptoms were Observed. These Results Highlight the Importance of Dietary Quality in Maintaining Optimal Psychological Well Being.

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment-	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
9.	Larson, Young, et al, 2017	Develop-mental Milestones Checklist II	Child's Dietary Diversity Score, Minimum Meal Frequency Value, and Minimum Diet Value were Created According to WHO Guidelines. Food Deprivation was Assessed Through Mother's Report with the Use of Household Hunger Scale	Length, Weight, Mid Upper Arm Circumference (MUAC)	Haemoglobin	No	No	Mean +/- SD; Multiple Linear Regression Analysis	In Children, Length-for-Age (LAZ), Dietary Diversity and Psychosocial Stimulation were Significant Correlates of Motor Development Scores in Children 6-11 Months, Dietary Diversity and Stimulation and Mental Health in Children 12-18 Months. Stimulation, Gross Motor Developmental and Fine More Development were Significant Mediators in the Relation between Dietary Diversity and Mental Development.
10.	Bot et al, 2019	MINI International Neuropsychiatric Interview 5.0, PHQ-9 Patient Health Questionnaire, IDS-SR30 Inventory of Depressive Symptoms Self-Rated, GAD-7 Generalized Anxiety Disorder-7, Euro-Quol-5D-5 L Euro-Qol Instrument EQ-5D-5 L	FFQ-GA2LEN Food Frequency Questionnaire, TEFQ-R 18 Three-Factor Eating Questionnaire, Food Behaviour and Sutainability. The F-BA Consisted of Specific Nutritional Advice on Improving Food-Related Behaviors (e.g. having Regular meals per day; Reducing Snacking; Mindful Eating) and Making Dietary Shifts Towards a Healthy Mediterranean Style Diet. This MooDFOOD Diet Recommended the Following Intakes for Ten Different Food Groups: 300-400 g/Day Vegetables, 2-3 Pieces of Fruit/Day, 3 Times	Height, Weight, BMI, Waist Circumference	Yes, Multi-Nutrient Adherence, Health Indicators, Markers of Disease	Daily Multinutrient Supplements (1412-mg Omega-3 Fatty Acids, 30-µg Selenium, 400-µg Folic Acid, and 20-µg Vitamin D3 Plus 100-mg Calcium) vs Placebo and 21 Individual or Group Therapy Sessions vs None (Blinded to Researchers) for 1 year. Participants	Yes; Placebo Supplements	Regression Models	This Study Showed that Multinutrient Supplements Containing Omega-3 PUFAs, Vitamin D, Folic Acid, and Selenium Neither Reduced Depressive Symptoms, Anxiety Symptoms, nor Improved Health Utility Measures. Food-Related Behavioral Activation Therapy had a Significant Effect on Reduction in Anxiety Symptoms at 12 Months. Food-Related Behavioral Activation Therapy was Related to Lower MDD Onset, with an Effect Size Compa-rable with that Reported in (Meta-Analytic)

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
			Fish/Week, Reduction to 300 g/Week for Meat, 3 Times/Week Pulses or Legumes, Choosing Whole Grain Products, 3 Servings/Day of Low-Fat Dairy Products, Olive Oil as Principal Source for Cooking, Limiting Processed Foods, Limiting Soft Drinks, and Alcoholic Beverages in Moderation.			were Allocated to Placebo without Therapy (n = 257), Placebo with Therapy (n = 256), Supplements without Therapy (n = 256), and Supplements with Therapy (n = 256).			Studies of Psychological Interventions for Depression. In a Post Hoc Analysis, a More Beneficial Effect of Food-Related Behavioral Activation Therapy on Depressive Symptoms for Those with Higher Baseline Depression Scores was Observed.
11	Jacka, O'Neil, et al, 2017	Montgomery-Asberg Depression Rating Scale (MADRS); Hospital Anxiety and Depression Scale (HADS)	7 Day Food Diary; Food Frequency Questionnaire by Cancer Council of Victoria.	Height, Weight, BMI	No	Yes, Personalised Dietary Advice and Nutrition Counselling Support, Including Motivational Interviewing, Goal Setting and Mindful Eating, from a Clinical Dietician in Order to Support Optimal Adherence to Recommended Diet (Modi Med Diet). Primary Focus was on Increasing Diet Quality by Supporting the Consumption of the Following Food: Whole Grains, Vegetables, Fruits, Legumes, Low Fat and Unsweetened Dairy Foods, Raw and Unsalted Nuts, Fish, Lean Red Meats, Chicken, Eggs and Olive Oil and Reducing Intake of Sweets, Refined Cereals, Fried Foods, Fast Foods, Processed Meats, Sugary Drinks.	Yes; Social Support Group	Mixed Model Repeated Measures Analysis of Variance (MMRM)	The Intervention Group (Dietary Support Group) Demonstrated Significantly Greater Improvemnet in MADRS Scores between Baseline and 12 Weeks than the Control (Social Support). The Dietary Support Group also Demonstrated Significantly Greater Improvement from Baseline to 12 Weeks on the HADS Scale as well. A Sensitivity Analysis, Testing Departures from Missing at Random (MAR) Assumption for Dropouts, Indicated that the Impact of the Intervention was Robust to Violations of MARS Assumptions.

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
12	Mishra, McNaughton, et al, 2008	General Health Questionnaire (GHQ)	Dietary Intake in Childhood (at 4 years) Measured by 24 Hour Recall and in Adulthood by a 5 Day Food Record.	BMI	No	No	No	Percentages, ANOVA	Responses to the GHQ-28 Reveal that 25% of Women at the age 53 years were in a Psychologically Distressed State, as Indicated by a Score Greater than 4 and 9% of the Women had a GHQ-28 Score of 10 or More. Lower Dietary Vitamin B_{12} Intake at 53 was Associated with Higher Psychological Distress at that Age. Women in the Lowest Third of Vitamin B_{12} Intake in Adulthood had a Higher GHQ-28 Score. There were no Other Significant Associations between Dietary Vitamin B Intake in Childhood or Adulthood and Psychological Distress in the Cohort.
13	Molyneaux, Poston, et al., 2016	Edinburg Postnatal Depression Scale	Food Frequency Questionnaire	BMI	No	No	No	Linear Regression	Obese Women had Significantly Higher Odds of Antenatal Depression than Normal Weight Controls after Adjusting for Socio-demographics and Health Behaviours. Every Unit Increase in Pre-Pregnancy BMI was Associated with Approximately 3% Higher Odds of Antenatal Depression. There was no Evidence for an Interaction of Depression and BMI on either Diet or Gestational Weight Gain.

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
14	Hoare, et al, 2016	Short Mood and Feelings Questionnaire	Diet Related Questions were Used from the Adolescent Behaviours, Attitudes and Knowlegde Questionnaire (ABAKQ).	BMI	No	No	No	Multiple Variant Analysis	Increased Physical Activity was Associated to Lower Depressive Symptomatology among Males. Sweet Drink and Take Away Consumption were Associated with Higher Levels of Depressive Symptomatology among Females at Follow Up. Males who were Classified as Overweight or Obese at Baseline, and Remained so Over the Study Period , were at Increased Risk of Depressive Symptomatology at Followup. Inactivity Among Males Over 2 years Study Period was Predictive of Higher Depressive Symptomatology Scores at Follow Up. For Females , those who Increased their Consumption of Take Aways During the Study Period were at Increased Risk for Developing Depressive Symptoms.
15	Aparicio, Canals, et al, 2017	Screen for Childhood Anxiety and Related Emotional Disorders; Children's Depression Inventory; Youth Inventory-4; Eating Disorders Inventory	Semi Quantitative Food Frequency Questionnaire.	BMI	No	No	No	Multiple Logistic Regression	Girls with Emotional Symptoms Scored Significantly Lower in Assessments for Mediter-ranean Diet and Physical Activity than did Girls who had no Emotional Symptoms. Approx. 39.68% of Girls with Emotional Symptoms Showed High Adherence to a Sweet and Fatty Food Pattern. After Adjusted Logistic Regression, Girls with Emotional Symptoms were 4 Times as Likely to have High Adherence to a Sweet and Fatty Food Pattern. No Differences were Observed among Boys.

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
16	Jacka, Kremer, et al, 2011	Self Reported Information on Mental Health; Pediatric Quality of Life Inventory (PedsQL)	Self Reported Information on Nutrition; Healthy Diet Scores.	BMI	No	No	No	Multiple Linear Regression	Cross Sectional-Dose Response Relationships were Identified between Measures of Both Healthy (Positive) and Unhealthy (Inverse) Diets and Scores on Emotional Subscale of PedsQL, Before and After Adjustments. Higher Healthy Diet Scores at Baseline Predicted Lower PedsQL Scores at Follow Up. Improvements in Diet Quality were Associated with Improved Mental Health at the Follow-up Period.
17	Wolniczak, Caseres-DelAguila, et al, 2017	Patient Health Questionnaire (PHQ)	Self Reported Consumption of Fruits and Vegetables.	No	No	No	No	Poisson Regression Models	Subjects in the Lowest Tertiles of Fruits and Vegetables Consumption had Greater Prevalence of Depressive Symptoms. This Association was Stronger with Foods than Vegetables.
18	Li, Dai, et al, 2011	Centre for Epidemiologic Studies Depression Scale (CES-D)	3month Food Frequency Questionnaire.	Yes	No	No	No	Multivariate Models	% of Severely Depressed Moods in Men and Women were 11.7 and 17.89 Respectively. The Odds Ratio were Higher in Males than Females. Low Fish Consumption was a Risk for SDM among Men.
19	Richard, Rohrmann, et al, 2015	Mental Health Inventory (MHI)	Food Frequency Questionnaire.	BMI	No	No	No	Multinomial Logistic Regression	Subjects Fulfilling the 5-a Day Recommendation had Lower Odds of Being Highly or Moderately Distressed than Individual Consuming Less Fruits and Vegetables.

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
20	Black, Allen, et al, 2014	Child Behaviour Checklist (Youth Self Report Form)	Food Frequency Questionnaire by Common Wealth Scientific and Industrial Research Organisation (CSIRO).	BMI	No	No	No	Prospective Univariate	Higher Dietary Intake of Mg was Significantly Associated with Reduced Externalising Behaviours. There was a Trend Towards Reduced Externalising Behaviours with Higher Zn Intake.
21	Oddy, Robinson, et al, 2009	Child Behaviour Checklist (4-18 years)	Food Frequency Questionnaire.	BMI	No	No	No	Linear Models	Higher Total, Internalizing (Withdrawn/Depressed) and Externalizing (Delinquent/Aggressive) CBCL scores were Significantly Associated with the Western Dietary Pattern, with Increased Intakes of Takeaway Foods, Confectionary and Red Meat. Improved Behavioural Scores were Significantly Associated with Higher Intakes of Leafy Green Vegetables and Fresh Fruit (Components of the Healthy Pattern).
22	Robinson, Kenndall, et al, 2011	Child Behaviour Checklist (4-18 years)	Food Frequency Questionnaire by Common Wealth Scientific and Industrial Research Organisation (CSIRO).	No	No	No	No	Linear Regression	Adolescents with Higher Intakes of Meat and Meat Alternatives and 'Extras' Foods had Poorer Mental Health Status. Adverse Socio-economic Conditions, Higher Hours of Screen Use and Ever Partaking in the Health Risk Behaviours of Smoking and Early Sexual Activity were Significantly associated with Increasing CBCL Scores, Indicative of Poorer Functioning.

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
23	Vollrath, Tonstad, et al, 2011	Child Behaviour Checklist (1.5-5 years); Hopkins Symptom Checklist (For Mothers)	Mothers Reported Children's Food Intake.	No	No	No	No	Logistic Regression	After Controlling for Confounders, Infant Temperament Dimensions at 18 Months were Significantly Associated with Mothers' Feeding of Potentially Obesogenic Foods and Drinks Independent of Mothers' Negative Affectivity. Infants who were More Internalizing were More Likely to be Given Sweet Foods, Sweet Drinks, and Drinks at Night; Infants who were More Externalizing were More Likely to be Given Sweet Food and Sweet Drinks; and Infants who were More Surgent were More Likely to be Given Drinks at Night.
24	Phillips, Bottomley, et al, 2014	Warwick-Edinburg Mental Well-being Scale (WEMWBS)	Self Reported Healthy Eating: Eating 5 or More Servings of Fruits and Vegetables in a Day.	No	No	Yes; Behaviour Change Communication Related to Healthy Eating, Physical Activity and Mental Well Being	Yes	Hayes and Moulton Methods for Pair Matched Cluster Randomised Trials; Linear Regression Analysis	The Baseline Findings Showed Intervention and Control Neighbourhoods to be Similar in Terms of Demographic Characteristics and Primary Health Outcomes. There was no Evidence of Impact on Primary Outcomes: Healthy Eating, Physical Activity and Mental Well-Being. There was Evidence of Impact on Some Secondary Outcomes. Unhealthy Eating Score (Frequency of Fried Food, Savoury Snacks, Cakes, Puddings, Sweets / Chocolates, Sugary Drinks) was Lower in Intervention Group and also the Proportion of Residents Thinking that People Living in their Neighbourhood Pulled Together to Improve it was Higher Intervention Neighbourhoods.

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
25	Gehlich, Beller et al, 2018	WHO Quality of Life Scale (WHOQOL)	Country Specific - Standardized Fruit and Vegetable list. Self-Reported Number of Servings of Fruits and Vegetables as Indicators for General Fruit Consumption and Vegetable Consumption.	No	No	No	No	Multilevel Regression Analyses	Fruit and Vegetable Consumption Predicted an Increased Cognitive Performance in Older Adults Including Improved Verbal Recall, Improved Delayed Verbal Recall, Improved Digit Span Test Performance and Improved Verbal Fluency; the Effect of Fruit Consumption was Much Stronger than the Effect of Vegetable Consumption. Regarding Mental Health, Fruit Consumption was Significantly Associated with Better Subjective Quality of Life and Less Depressive Symptoms; Vegetable Consumption, However, did not Significantly Relate to Mental Health.
26	Deborah Gibson-Smith et al, 2020	At each Assessment the Presence of a DSM-IV Depressive [Major Depressive Disorder(MDD), Dysthymia] or Anxiety Disorder (Social Phobia, Agoraphobia, General Anxiety Disorder and Panic) was Established using the Composite International	238-Item, Semi-Quantitative FFQ which was Based on a Validated Ethnic Dutch FFQ.	No	No	No	Yes	Linear Regression Analysis, Multivariable Regression	MDS Score Shows the Strongest Relationships with Depression/Anxiety . Greater Consumption of Non-Refined Grains and Vegetables was Associated with Lower Depression and Anxiety Severity, whilst Being a Non-Drinker was Associated with Higher Symptom Severity. Higher Fruit and Vegetable Intake was Associated with Lower Fear Severity. Non-Refined Grain Consumption was Associated with Lower Odds and Being a Non-Drinker with Greater Odds of Current Depression/Anxiety Disorders Compared to Healthy Controls, these Associations Persisted after Adjustment for Other Food Groups.

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
		Diagnostic Interview (CIDI)Version 2.1. At the 9-Year Follow-Up Assessment, Participants were Classified as Controls (no Lifetime History of Depressive or Anxiety Disorder), Current Disorder (6-Month Recency of Depressive or Anxiety Disorders), or Remitted Disorder (Lifetime Diagnosis of Depressive or Anxiety Disorder but no Current Disorder). Additionally, the Severity of Symptoms was Measured. Depressive Symptoms were Measured with the 30-Item Inventory of Depressive Symptomatology—Self Report. The Severity of Anxiety Arousal Symptoms was Measured Using the 21-Item Beck Anxiety Inventory and the Severity of Agoraphobia and Social Phobia with the 15-Item Fear. Questionnaire.							

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometri Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Mein Finding
27	Ryo Okubo et al, 2019	Patient Health Questionnaire -9 (PHQ-9)and the Center for Epidemiolo-gical Scale-Depression (CES-D)	Food Frequency Questionnaire; Diet Quality was Assessed Based on Japanese Food Guide Spinning Top.	No	No	No	No	Logistic Regression Analyses	Mean Age of the Participants was 73 years and 59% were Women. Total Diet Quality Score was not Significantly Associated with Risk of Depression 20 Years after the Baseline Assessment. Among the Eight Components on the Diet Quality Score, there was a Significantly Reduced Risk for the Highest Quartile of the White to Red Meat Ratio Score. In Conclusion, Our Results do not Indicate that Higher Adherence to the Japanese Food Guide Prevents Depression.
28.	Shakya et al 2019	Center for Epidemiolo-gical Studies-Depression (CES-D) Scale	Food Frequency Questionnaire - Eicosapentaenoic Acid (EPA)/Docosahexaenoic Acid (DHA), Folate, Magnesium (Mg) and Zinc (Zn) Densities were Chosen as the Response Variables for RRR and PLS Analyses.	No	No	No	No	Principal Component Analysis (PCA), Reduced-Rank Regressions (RRR) and Partial Least-Squares (PLS)	The ‘Prudent’ Pattern Determined by PCA [ORQ4VsQ1 ¼ 0.57; 95% CI: 0.35, 0.92] and PLS [ORQ4VsQ1 ¼ 0.66; 95% CI: 0.43,1.00] Together with the 'Typical Australian' Pattern Determined by RRR [ORQ4VsQ1 ¼ 0.60; 95% CI: 0.40,0.90] were Inversely Associated with DepS whereas the 'Western' Pattern Derived by PCA [ORQ4VsQ1 ¼ 2.04; 95% CI: 1.12, 3.68] and PLS [ORQ4VsQ1 ¼ 1.62; 95% CI: 1.05, 2.50] was Positively Associated. with DepS. In the

Table 4..... *Continued*

S.No.	Author and	Mental Health Year	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Assessment	Intervention Biophysical	Control Group Comparison	Statistical Analysis	Main Finding
									Longitudinal Analysis, the Prudent' Pattern Determined by PCA [ORQ4VsQ1 ¼0.52; 95% CI: 0.25, 1.09] Tended to be Inversely Associated with DepS whereas 'Western' Patterns Determined by PCA [ORQ4VsQ1 ¼ 3.47; 95% CI: 1.37, 8.78] and PLS [ORQ4VsQ1 ¼ 2.47; 95% CI: 1.24, 4.91] were Positively Associated with DepS. We Found that a Dietary Pattern Characterized by High Intakes of Fruits, Vegetables, Medium Fat Dairy, Nuts, Legumes, and Fish was Inversely Associated with DepS in this Population-Based Study. Contrary to this, a Dietary Pattern Characterized by High Intakes of Processed and Red Meat, Fast Foods (Snacks and Takeaway Foods), Soft Drinks, White Bread and High-Fat Dairy Products were Significantly Associated with DepS. Multiple Imputation and Sensitivity Analysis Identified Similar Patterns of Association between Dietary Pattern and DepS.

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
29.	Choda et al, 2020	12 Item General Health Questionnaire (GHQ)	Food Frequency Questionnaire.	No	No	No	No	Cross Sectional Logistic Regression Analysis	The Cross-Sectional Logistic Regression Analysis Showed Vegetables, Protein, Calcium, Vitamin D, Carotene and n-3 Highly-Polyunsaturated Fatty Acids were Inversely Associated with a GHQ Score ⩾ 4. On the Other Hand, Mono-Unsaturated Fatty Acids Showed a Positive Association with Higher GHQ Score. The Prospective Logistic Regression Analysis Found Dairy Products, Calcium, Vitamin B_2, and Saturated Fatty Acids were Inversely Correlated with a GHQ Score ⩾ 4. Calcium was Associated with GHQ Scores in Both the Cross-Sectional and Follow-Up Studies. In the follow-up Study, the Multivariable adjusted Odds Ratio for a GHQ Score ⩾ 4 was 0.71 (95% Confidence Interval, 0.55–0.92) for the Highest Versus Lowest Quartiles of Calorie-Adjusted Dietary Calcium Intake.
30.	Nanri et al, 2020	Center for Epidemiological Studies Depression (CES-D)	Self-Administered Diet History Questionnaire. Adherence to the Japanese Food Guide Spinning Top was	No	No	No	No	Multiple Logistic Reguession	At the Time of the 3-year Follow-Up Survey, 153 (16.8%) Workers were Newly Identified as Having Depressive Symptoms (CES-D Score of 16). The Adherence Score was not

Table 4..... *Continued*

S.No.	Author and Year	Mental Health Assessment	Dietary Pattern Assessment	Anthropometric Assessment	Biochemical/ Biophysical Assessment	Intervention	Control Group Comparison	Statistical Analysis	Main Finding
.			Measured based on Consumption of the Recommended Number of Servings of Grains, Vegetables, Fish and Meat, Milk, and Fruits, as well as Total Energy Intake and Energy from Snacks and Alcoholic Beverages.						Associated with Depressive Symptoms after 3 Years. The Multivariable-Adjusted Odds Ratios (95% Confidence Interval) for the Lowest Through Highest Tertiles of Dietary Score were 1.00 (Reference), 0.91 (0.57e1.45), and 1.23 (0.76e1.99) (P for Trend ¼ 0.41). The Odds Ratios for Severe Depressive Symptoms (CES-D Score of 23) Tended to Decrease with Increasing Adherence Score.
31.	Saeidlou et al, 2021	Beck Depression Inventory	168-Item Validated Semi-Quantitative Food Frequency Questionnaire; Household Food Insecurity Access Scale.	BMI	No	No	Yes	Logistic Regression	The Mean ±SD Ages of the Participants were 36.97 ±11.28 and 36.07 ±10.58 Years in the Case and Control Groups, Respectively (P=0.374), and Five Major Dietary Patterns were Extracted in this Study. The Odds Ratio (OR) in the Last Adjusted Model was (OR: 0.61; 95% CI: 0.46, 0.81); Therefore, the "Healthy Pattern" was Significantly Inversely Associated with the Odds of Depression. Adherence to the "Western Pattern" Significantly Increased Depression by 29% (OR: 1.29; 95% CI: 1.06, 1.59). Furthermore, the "Traditional Pattern" was Positively Associated with Depression (OR: 1.16; 95% CI: 0.94, 1.43). There was no Significant Association Between "Sugar and Fast Food" and "Red Meat and Oils" Dietary Pattern and Depression.

Principal Investigator

Dr. Bani Tamber Aeri*
Assistant Professor
Department of Food and Nutrition
Institute of Home Economics, Delhi University
New Delhi, India

Co- Principal Investigator

Dr. Preeti Khanna*
Department of Food and Nutrition
Institute of Home Economics, Delhi University
New Delhi, India

Email: preetikhanna.k@gmail.com

*The Principal Investigator and Co- Principal Investigator have declared no conflict of interest.

International Life Sciences Institute India

Email: info@ilsi-india.org Website : http//www.ilsi-india.org