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AN UMBRELLA REVIEW OF ASSOCIATIONS BETWEEN HEALTH-RELATED BEHAVIOURS AND WELL-BEING

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ABSTRACT

Background: There have been many studies of health-related behaviours and the mental health of adolescents and young adults. The present article provides an umbrella review of previous systematic reviews. **Methods:** The search engines PsycINFO, Medline, Web of Science, and Scopus were used to search for articles published between 2010 and 2023. The final search strategy consisted of paired keywords for diet (diet* OR "healthy food*" OR "unhealthy food*" OR "junk food*" OR "junk snack*" OR "processed meat" OR cola OR soda OR "soft drink*" OR beverage* OR "energy drink*" OR coffee OR tea OR caffeine OR "fruit* and vegetable*") AND well-being ("well-being" OR well-being OR stress OR health OR anxiety OR depression) AND adolescence (adolescent* OR adolescence* OR "university student*" or "young adult*" or "early adulthood") AND "systematic review". **Results**: Eight systematic reviews of observational studies were found in this umbrella review to identify the most recent data on the relationship between diet, health and well-being outcomes. It was found that most systematic review results were consistent in terms of the influence of junk food, such as fast food, unhealthy snacks, and sweets, which were correlated with an increase in mental health problems and negative well-being and health outcomes. In contrast, healthy food or a good diet was associated with positive affect. At the same time, some studies found no association between diet and well-being, especially between healthy diets such as high fruit and vegetable consumption and positive well-being. **Conclusions:** The umbrella review suggests that diet may play a role in the mental health of emerging adults, but the evidence base is still limited. It has emphasised the need for further high-quality research to better understand the relationships between diet and mental health outcomes in this age group.

KEYWORDS: Umbrella review; Systematic review; Adolescence; University students; Mental health; Stress; Anxiety; Depression; Sleep; Well-being; Diet; Junk food; Caffeine; Fruit and Vegetables.

INTRODUCTION

Numerous studies have examined the associations between health-related behaviours, especially diet, and mental health outcomes in the adolescent population, but it is still not fully understood. This article provides an umbrella review of the topic.

Overview of the Umbrella Review

This umbrella review was conducted because there are a large number of literature reviews related to the association between dietary patterns and well-being in adolescents and young adults. Poole et al.[1] describe umbrella reviews as meticulously exploring, arranging, and assessing the available evidence from various systematic reviews and meta-analyses. Associations were examined between dietary variables existing in current research, such as breakfast consumption, fruits and vegetables, junk snacks, junk meals, energy drinks, cola, coffee, and tea, and well-being outcomes. These outcomes included positive well-being, negative well-being, anxiety, and depression. This umbrella review investigated the association between dietary consumption and well-being in adolescence and early adulthood.

Literature Search

The search engines PsycINFO, Medline, Web of Science, and Scopus were used to search for articles published between 2010 and 2023. The reference lists of relevant papers and reviews were searched as well. A scoping search strategy was conducted to identify appropriate and database-specific keywords to obtain relevant articles. The final search strategy consisted of paired keywords for diet (diet* OR "healthy food*" OR "unhealthy food*" OR "junk food*" OR "junk snack*" OR "processed meat" OR cola OR soda OR "soft drink*" OR beverage* OR "energy drink*" OR coffee OR tea

OR caffeine OR "fruit* and vegetable*") AND well-being ("well-being" OR well-being OR stress OR health OR anxiety OR depression) AND adolescence (adolescent* OR adolescence* OR "university student*" or "young adult*" or "early adulthood") AND "systematic review". English language and publication date filters (2010 to 2023) were used in all databases. The article type filter was used in Scopus to include article documents.

Inclusion and Exclusion Criteria

The review included observational studies (cohort, case-control, cross-sectional) investigating this association. Systematic reviews included both observational and intervention studies, with the observational studies analysed separately. The review excluded studies focusing on children and adolescents with chronic diseases, adults, individual nutrients or supplements, eating disorders, emotional eating, letters, comments, narrative reviews, animal studies, duplicate studies, randomised controlled trials, and intervention studies. The review aimed to assess the relationship between diet quality or dietary patterns and well-being outcomes rather than examining dietary intervention effects. It focused on studies involving adolescents, excluding those with adult participants or published in languages other than English.

Procedure

The final search of the four databases and other resources yielded 1152 potentially relevant papers. A manual duplicate check of the combined citations resulted in 180 removed duplicates, leaving 972 available for screening. The screening process consisted of reviewing titles and abstracts, resulting in the exclusion of 870 papers. The final step was a full-text review of 102 articles, which resulted in 8 articles that met the inclusion criteria (see Figure 1). The articles only included systematic reviews (n=5), systematic reviews, and meta-analysis studies (n=3).

Data Extraction

The first author, publication year, population, and outcome examined were extracted. Then, the diet type, total participant number, number of total studies, and each included study design (cohort, case-control, cross-sectional) were obtained. Furthermore, effect sizes and 95% confidence intervals (CIs) were extracted when possible, and the type of effect model and publication. Any differences in the extracted data were resolved by discussion.
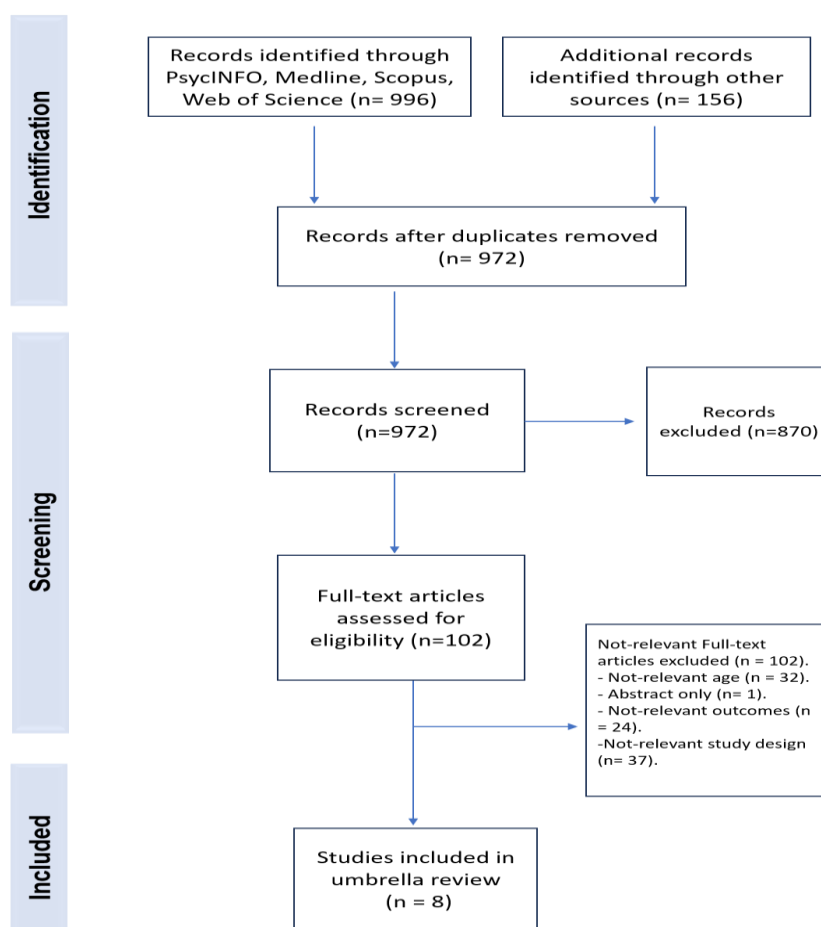

Figure 1: Flowchart of procedure for selecting studies to be included in the umbrella review (Source: Page et al.[2]).

RESULTS
The details of the reviews are shown in Tables 1 and 2 and summarised below.

3.7.1 Diet Quality
A systematic review conducted by O'Neil et al.[3] explored the relationship between diet quality, food consumption, and mental health in children and adolescents. The review included nine studies that examined the association between diet and mental health in this population. The studies included in the review used different instruments to measure mental health outcomes, such as the Child Behaviour Checklist, the Strengths and Difficulties Questionnaire, and the Short Mood and Feelings Questionnaire. These instruments assessed symptoms of depression, low mood, and anxiety. Although the results showed that there were consistent results of the association between unhealthy patterns and poor mental health, there were conflicting findings regarding the specific associations between healthy food and better mental health. They found that only three out of the six studies were significant. There was some evidence of a consistent trend between a good-quality diet and better mental health. However, the findings were inconsistent with lower diet quality and poor mental health. The studies also varied, in the confounding variables such as socioeconomic status and physical activity that were included. Interestingly, the systematic review confirmed that the associations between nutritional factors and mental health are likely to be bidirectional – while dietary factors may influence mental health, mental health may also affect diet and nutrition.

A systematic review found that a healthy diet was associated with lower levels of depression in children and adolescents, while an unhealthy diet was linked to higher levels of depression. Seventeen studies were included in the systematic review conducted by Wu et al.[4], consisting of twelve cross-sectional and five longitudinal studies. The total sample size of these articles was 47,932. The review aimed to investigate the relationships between diet quality, such as healthy food, unhealthy food, and breakfast habits, and health-related quality of life in children and adolescents. It was discovered that children's and teenagers' health-related quality of life correlated with diet quality and dietary habits. It has been shown that eating a nutritious diet has a good impact on the physical, emotional, and psychosocial aspects of life quality. The effect size of the meta-analysis to identify the relationship between diet quality and health-related quality of life was measured using mean differences and odds ratios. The results showed that children and adolescents with healthy diets had significantly higher total health-related quality of life scores (mean difference = 3.45) and higher physical and psychosocial health summary scores (mean difference = 2.77 and 3.12, respectively) than those with unhealthy diets. The odds of having a poor health-related quality of life were higher for those who ate breakfast "sometimes"

(OR = 1.33) or "never" (OR = 1.56) compared to those who ate breakfast "every day". These effect sizes indicate that a healthy diet led to better health-related quality of life outcomes. However, it is essential to note that the review focused on the general population of children and adolescents and not specific diseases or conditions.

A systematic review[5] was conducted to determine the relationship between diet and depression among adolescents. The review included 20 studies after screening 3014 articles. Only articles in English published from 1970 to April 2016 were considered. The selected articles involved healthy foods like fruits and vegetables, whole grains, fish, dairy, and cereal. Unhealthy foods such as fast or takeaway foods, sweetened beverages, snacks, and high-fat processed foods such as hamburgers, pizza, meat pies, pastries, fried food, chips, and soft drinks were also included. The results showed that there was no association between fruit and vegetable consumption and mood in the majority of the studies. However, a correlation was observed between healthy food consumption in general and a reduction in depression. Notably, the effect size was small in most of the studies, and one study specifically identified this link among females alone. In addition, no significant associations were found between a healthy diet and anxiety. In contrast, the relationship between unhealthy diets and increased depression and anxiety was significant in most of the cross-sectional studies. While no long-term association was observed in the longitudinal study, unhealthy diets did not predict increased depression three years later. Seven studies examined the relationship between fast food and mental health, with only four reporting a significant correlation. However, the effect sizes of these relationships were small—a longitudinal study aimed to identify a correlation between fast food and emotional problems. The results revealed that fast food did not predict emotional problems seven years later. Moreover, two research studies have demonstrated that eating breakfast reduces depression. In addition, the association between beverages and depression was investigated, and three studies found that high consumption of soft drinks was associated with increased depression with a small effect size. Similar results were found between caffeine and depression.

Another systematic review examined the associations between diet quality and mental disorders, including depression and anxiety, in young adults aged 18–29 years. The findings suggested that emerging adulthood is critical for diet quality and mental health. The review included quantitative articles published between 2009 and 2019, with 16 studies meeting the inclusion criteria. The studies used various methods to assess diet quality, such as food frequency questionnaires, 24-hour recalls, and diet quality indices. Mental health outcomes were measured using scales for depression, anxiety, and general psychological health. The findings of this

systematic review were associations between higher diet quality and lower levels of depression, anxiety, stress, negative affect, and suicidal ideation, as well as better psychological health. Although the results were inconsistent, some studies did not find an association between unhealthy diets, depression, stress, and anxiety. What was of interest to the current review is that there was an association between sweets and increased positive effects. However, they noted that the methodological quality of the included studies was generally weak.[6]

Moreover, a systematic review by Solomu et al.[7] examined the associations between diet quality and mental health outcomes among university students. The authors systematically searched four databases (PubMed, Scopus, PsycINFO, and CINAHL) for articles published up to December 2020. The quality of the included studies was assessed using the Newcastle–Ottawa Scale (NOS) for observational studies. A total of 44 studies met the inclusion criteria and were included in the review. Moreover, the studies were conducted in various countries, mainly from the United States, Australia, and Europe. Most studies used a cross-sectional design, with only a few longitudinal studies. Diet quality was assessed using various methods, including the Healthy Eating Index (HEI), the Mediterranean Diet Score (MDS), and factor-analysis-derived dietary patterns. Mental health outcomes were measured using validated questionnaires such as the Depression Anxiety Stress Scale (DASS), the Centre for Epidemiologic Studies Depression Scale (CES-D), and the Short Form-36 (SF-36). Most included studies found significant associations between higher diet quality and better mental health outcomes in university students. Students who adhered to healthier dietary patterns, characterised by higher intakes of fruits, vegetables, whole grains, and fish, tended to have lower levels of depression, anxiety, and stress, as well as better well-being and quality of life. Conversely, unhealthy dietary patterns, high in processed foods, sugar, and saturated fats, were associated with poorer mental health outcomes. However, some studies found no association between diet quality and mental health and well-being.[7]

Healthy Food
To investigate the relationship between mental health and fruit and vegetable consumption among adolescents, a systematic review of observational studies was conducted by Glabaska et al.[8] The systematic review included 17 studies covering 181,000 adolescents. The databases used to collect the article were PubMed, Web of Science, and reference lists. The results showed that most studies included in the review found an association between fruit and vegetable consumption and improved mental health among adolescents.[8] However, a study conducted among adolescents in sub-Saharan Africa showed that high fruit and vegetable consumption was associated with a high risk of depression, anxiety, and loneliness.[9]

Junk Food
Malmir et al.[10] used a systematic review method to investigate a broader range of junk food items among adolescents. The purpose of the systematic review and meta-analysis was to examine the relationship between junk food consumption and negative well-being outcomes such as depression, stress, anxiety, sleep dissatisfaction, and happiness in young people. The review included 17 studies involving more than 200,000 people. The findings revealed that junk food consumption, including sweet drinks, snacks, and junk food, was associated with an increased risk of depression and stress. The odds ratio for depression was 1.62 (95% CI: 1.35–1.95), and for stress was 1.34 (95% CI: 1.16–1.54). A similar relationship was discovered between junk food and anxiety and sleep dissatisfaction (odds ratio: 1.24; 95% CI: 1.03–1.50 for anxiety and 1.17; 95% CI: 1.05–1.30 for sleep dissatisfaction). Moreover, a negative relationship was discovered between junk food and happiness (odds ratio: 0.83; 95% CI: 0.75-0.92).[11]

Moreover, to assess the association between junk food consumption and symptoms of mental health problems, Hafizurrachman and Hartono[11] performed meta-analyses. The authors searched for relevant articles published between 2010 and 2020 in the PubMed and ScienceDirect databases. The inclusion criteria for selecting articles were the availability of full-text original articles and the use of keywords related to junk food and mental health. The initial search yielded 5,079 article titles, of which seven met the relevant requirements for meta-analysis. The correlation coefficient of meta-analyses between junk food consumption and mental health problems was 0.11 (95% CI = 0.09–0.14). It was noted that all seven research studies that were included in the systematic review consistently revealed an association between junk food and mental health. However, as shown in the results of the previous systematic review, the effect size was small.

Table 1: Key features of eligible systematic reviews and meta-analyses included in the study.

No.	Author, year	Aim of systematic review	Study design	Samples	Number of studies (Number of participants)	Country of study	Effect size
1	(O'Neil et al., 2014)	Systematic review	Cross-sectional and longitudinal studies	Children and adolescents	Nine studies (Approx. 35,000)	Australia (n=4) United States (n=1) United Kingdom (n=1) Canada (n=1) China (n=1) Germany (n=1)	N/A
2	(Khalid et al., 2016)	Systematic review	17 cross-sectional studies 3 longitudinal studies	Children and adolescents	20 studies (110,857)	United States (n=4) Australia (n=4) United Kingdom (n=2) Canada (n=2) Germany (n=1) Norway (n=2) Spain (n=1) China (n=1) Malaysia (n=1) Pakistan (n=1) Iran (n=1)	
3	(Solomou et al., 2023)	Systematic review	Cross-sectional studies Longitudinal studies	University students	44 studies	United States (n=9) Spain (n=5) Canada (n=4) United Kingdom (n=3) Japan (n=3) Iran (n=3) Various countries (n=3) Chile (n=2) Finland (n=2) Australia (n=1) China (n=1) France (n=1) Turkey (n=1) UAE (n=1) Saudi Arabia (n=1) Italy (n=1) Lebanon (n=1)	Most of the effect size was small to moderate

						Puerto Rico (n=1) Poland (n=1)	
4	Collins et al. (2022)	Systematic review	N/A	Emerging adulthood (18–29 years)	16 studies (17,823)	United States (n=5) Australia/New Zealand (n=3) Canada (n=2) China (n=2) Japan (n=1) Mexico (n=1) Puerto Rico (n=1) Iran (n=1)	The effect size of diet on depression was small Diet and other mental health effect sizes were small Diet and anxiety effect sizes were moderate
5	(Wu et al., 2019)	Systematic review and meta-analyses	12 cross-sectional studies 5 longitudinal studies	8 studies for adolescents 9 studies for children	17 studies (47,932)	Australia (n=4) Japan (n=3) United States (n=2) Canada (n=2) Greece (n=2) United Kingdom (n=1) Spain (n=1) Switzerland (n=1) Various countries (n=1)	Healthy food had a significantly higher total HRQoL score measured using PedsQL and EQ-5D-Y VAS (pooled mean difference = 3.45, 95% CI 2.40, 4.50, $P < 0.0001$) (total mean difference of the healthy diet group versus the unhealthy diet group 3.12, 95% CI 1.32, 4.92, $P < 0.001$ for psychosocial health; total mean difference = 2.77, 95% CI 1.10, 4.44, $P < 0.01$ for physical health Children who ate breakfast 'sometimes' or 'never' had higher odds of having poor HRQoL than children who ate breakfast 'every day' (OR =

							1.33, 95% CI 1.05, 1.68, $P < 0.05$ for the 'sometimes' group; OR = 1.56, 95% CI 1.19, 2.04, $P < 0.01$ for the 'never' group)
6	(Głąbska et al., 2020)	Systematic review	N/A	Adolescents (11–18) years	17 studies (181,954)	United Kingdom (n=3) South Korea (n=3) Spain (n=1) China (n=1) Japan (n=1) Western Australia (n=2) Australia (n=2) Iceland (n=1) Iran (n=1) Ghana (n=1) Botswana, Kenya, the Seychelles, Uganda, the United Republic of Tanzania, Zambia (n=1)	N/A
7	(Malmir et al., 2023)	Systematic review and meta-analyses	14 cross-sectional studies 2 cohort studies 1 case-control study	16 studies of adolescents 1 study of children	17 studies (263,303)	United States (n=3) Korea (n=2) Iran (n=2) South Korea (n=2) United Kingdom (n=1) India (n=1) Spain (n=1) Pakistan (n=1) Lithuania (n=1) Karnataka (n=1) Indonesia (n=1) Australia (n=1)	According to meta-analysis: The impact of junk food on depression overall pooled OR (1.62 CI (1.35–1.95). Junk food on stress overall pooled OR 1.34(1.16–1.54) Junk food on anxiety overall pooled OR 1.24(1.03–1.50) Junk food on happiness overall pooled OR 0.83(0.75–0.92)
8	(Hafizurra chman & Hartono,	Systematic review and meta-analyses	7 cross-sectional studies	Adolescents	7 studies (213,394)	United Kingdom (n=2) Norway (n=1) Korea (n=1)	According to the meta-analysis, the correlation

						China (n=1) Iran (n=1) Various countries (n=1)	coefficient demonstrated a slight relationship between junk food consumption and symptoms of mental health problems (0.11, 95% CI = 0.09-0.14)
2021)							

Table 1: The main findings, assessment used, variables of interest, and outcomes of the included systematic reviews and meta-analyses were as follows.

No.	Author, year	Aim of the systematic review	Diet variables of interest	Dietary tools (survey/questionnaire)	Outcomes/ variables	Well-being assessments	Results
1	(O'Neil et al., 2014)	To determine the effect of diet patterns on mental health among children and adolescents	**Healthy food** (higher intake of nutrient-dense foods, including vegetables, salads, fruits, fish, and other food groups known to be healthful) **Unhealthy patterns** (higher intake of foods with increased saturated fat, refined carbohydrates, and processed food products)	FFQ Harvard Youth/Adolescent Questionnaire (YAQ-FFQ) CSIRO FFQ Dietary questionnaire The question "Do you eat a healthy diet?"	**Internalising disorders** (depression, low mood, depressive symptoms, emotional problems, and anxiety)	Strengths and Difficulties Questionnaire (SDQ) Emotional Functioning subscale (PedsQL) Health records of physician-diagnosed internalising disorders (ICD-9) Frequency of feeling depressed or distressed in the past 30 d The internalising subscale of CBCL SMFQ DSRS (Chinese version)	The results illustrated a consistency between unhealthy food consumption and poor mental health outcomes, while there was no consistency between healthy food consumption and better mental health outcomes.
2	Khalid et al. (2016)	To focus on the relationships between food patterns and depression	Healthy diets Unhealthy diets Fast food Snacks Soft drinks	FFQ YAQ, FFQ CSIRO FFQ Dietary questionnaires Dichotomised question: "Do	**Internalising disorders** Depression Anxiety Mood	CBCL SDQ SMFQ DSRS CES-DC	The results showed a consistency between unhealthy food consumption

		among young people	Caffeine	you eat a healthy diet?" Three-day food diary Frequency of consumption of junk food, sweets, beverages, fast foods and salty snacks Frequency of consumption of sweet food and drinks Energy (kcal) consumed after an overnight fast Eating Behaviour Questionnaire Frequency of fruit and vegetable consumption Frequency of carbonated drinks and fast food consumption	Emotional problems	PedsQL ICD-9/10 DASS-21 EAS EuroQoL for youth Beck Depression Inventory (II) Frequency of depression or 'stress' in the past 30 days Kandel and Davies' 6-item scale Anxiety and suicidal ideation were measured using 1 item each Questions on depression, insomnia, confusion, anxiety, and aggression	and poor mental health outcomes, while there was no consistency between healthy food consumption and better mental health outcomes.
3	(Solomou et al., 2023)	To investigate the effect of diet quality on mental health among university students	Diet quality Diet pattern	FFQ DII DASH E-DII HEI DQS EMA REAP-S DSQ PREDIMED SWFL KIDMED MEDAS 3-day food record 24-hour dietary recall Diet history questionnaire Customary intake frequency Three items from the Family Transitions Project survey One-item dietary preference Posteriori self-reported diet General estimating equations of dietary quality Dietary questionnaire Dietary guideline adherence	Depression Anxiety Stress General mental well-being Academic stress	DASS-21 PANAS ZSRDS BDI CES-D PHQ-9 Clinical screening Centres for Disease Control and Prevention's Healthy Days Measure Anxiety tool GAD-7 Centers for Disease Control and Prevention Healthy Days Measure Stress tool 27-item stress questionnaire (stress) PSS PSS-10 5-item emotional distress scale Assessment of self-reported health complaints (22 items) SWEMWBS WEMEBS Oxford Happiness Questionnaire GHQ-12 K-6	Most of the studies that were included to identify an association between a healthy diet and mental health outcomes revealed a positive correlation between students' healthy diets and improved mental health, including reduced levels of stress, anxiety, and depression.

				index Questionnaire about dietary behaviour Dietary assessment Anonymous 7-day record of foods		SHS QoL single-item tool SWLS Academic stress tool Validated Scale of Academic Stress Self-concept tool AF-5 CDRS PTSD tool B7ISQ PCL-S	
4	Collins et al. (2022)	To identify the relationship between diet quality and mental health	Diet quality Healthy food Unhealthy food	FFQ DHQ Dietary questionnaires Food diary Diet Quality Index Healthy Eating Index (HEI) HPLP-II Nutrition Scale Self-report item/s	Depression Anxiety Stress Psychological health Positive affect Negative affect	CES-D GHQ-12 SHMS Depressed Mood Scale Self-report item/s (stress) Cohen Perceived Stress Scale STAI Self-report diary CDC Healthy Days Measure SDS and SAS DASS-42 Stress Scale	The majority of the results found associations between a higher healthy diet and decreased depression, anxiety, and stress symptoms, as well as increased psychological health. However, some of the results did not find an association between an unhealthy diet and mental health problems.
5	(Wu et al., 2019)	To investigate the relationships that exist between a healthy diet and health-related quality of life in children and adolescents	**Healthy food** (fruits, vegetables, dairy food) **Unhealthy food** (fat, fast foods) **Eating breakfast** (never, sometimes, every day)	MD FFQ DQI-I Frequency of breakfast and snack consumption Household Food Security	**Health-related quality of life** Physical health Psychological health	Paediatric Quality of Life Inventory (PedsQL 4.0) KIDSCREEN-27 KIDSCREEN-10 EQ-5D-Y Japanese COOP Charts Child Health Utility 9D (CHU9D) EQ-5D index Assessment of Quality of	The meta-analyses' results showed an association between healthy food and quality of life among children and adolescents.

					Life-6D		
6	(Głąbska et al., 2020)	To analyse various observational studies to determine whether there is a positive relationship between fruit and vegetable consumption and mental health outcomes in adolescents	Fruit and vegetable intake	MDS FFQ KIDMED Self-administered food frequency questionnaire Question about the number of portions Questions about the frequency of engaging in dietary behaviours Question about the frequency of consumption 14-item dietary questionnaire to assess the healthy and unhealthy diet scores	Mental health		The review found a positive association between the intake of fruit and vegetable products and mental health in adolescents. Specifically, green vegetables, yellow vegetables, and fresh fruit were particularly beneficial for general mental health.
7	(Malmir et al., 2023)	To investigate the relationship between eating unhealthy food and psychological distress among children and adolescents	**Junk food** **Sweet drinks** (fruit-flavoured drinks, sweetened coffee, fruit drinks, sugared coffee and tea, energy drinks, Coca-Cola, beverages, soft drinks, lemonade, and soda) **Sweet snacks** (sweetened desserts, fatty/sweet products, ice cream, chocolate, artificial sweeteners, dessert, candy, biscuits and pastries, cakes, pie/cookies, bakery	FFQ Junk food questionnaire Food labels	Depression Anxiety Stress Sleep dissatisfaction Happiness	Questionnaire (GSHS) Self-made questionnaire IES-R Cohen's PSS (0–40) PROMIS sleep disturbance measure and sleep impairment measure (0–40) MDS (5–25) Children's Depression Inventory (0–54) Beck Depression Inventory (0–63) Depression anxiety stress scales 21 GASC SMFQ SDQ Kandel scores Self-administered questionnaire	The result of meta-analyses revealed that there was a positive association between junk food consumption and depression, anxiety, stress, and sleep problems. On the other hand, there was a negative association between junk food consumption and positive well-being.

			wares, etc.) **Junk food and snacks** (fast food, fried foods, fried potato, crisps, salty snacks, hamburgers)				
8	(Hafizurrachman & Hartono, 2021)	To determine the effects of eating junk food on mental health outcomes	Junk food	N/A	Mental health	N/A	Junk food consumption led to an increase in mental health problems, although the effect size of the meta-analysis was small.

FFQ: Food Frequency Questionnaire, **DII**: Diet Inflammatory Score, **DASH:** Dietary Approaches to Stop Hypertension Score, **E-DII:** Energy-Adjusted Dietary Inflammatory Index, **HEI:** Healthy Eating Index, **DQS:** Diet Quality Score, **DSQ:** Dietary Screener Questionnaire, **EMA:** Ecological Momentary Assessment, **REAP-S:** Rapid Eating and Activity Assessment for Patients—Short Version, **SWFL:** Satisfaction with Food-Related Life Scale, **KIDMED:** Mediterranean Diet Quality Index for Children and Teenagers, **MD:** Mediterranean Diet, **PREDIMED:** PREvención con DIeta Mediterranean Questionnaire, **CBCL:** Child Behaviour Checklist, **SDQ:** Strengths and Difficulties Questionnaire, **SMFQ:** Short Mood & Feelings Questionnaire, **DSRS:** Depression Self-Rating Scale for Children, **CES-DC:** Centre for Epidemiologic Studies Depression Scale for Children, **CES-D:** Centre for Epidemiological Studies—Depression Scale, **PedsQL:** Paediatric Quality of Life, **ICD-9/10:** International Classification of Disease, **DASS:** Depression Anxiety & Stress Scale, **DQI-I:** Diet Quality Index—International, **MDS:** Mediterranean Diet Score, **GSHS:** Global School-Based Health Survey, **IES-R;** Impact of Event Scale—Revised, **PSS:** Perceived Stress Scale, **PROMIS:** Patient-Reported Outcomes Measurement Information System, **MDS:** Modified Depression Scale, **GASC:** General Anxiety Scale for Children, **EAS:** Emotionality Activity and Sociability Questionnaire, **CSIRO:** Commonwealth Scientific and Research Organisation, **YAQ:** Youth and Adolescent Questionnaire, **HPLP-II:** Health-Promoting Lifestyle Profile, **DHQ:** Diet History Questionnaire, **SAS:** Self-Rating Anxiety Scale, **SDS:** Self-Rating Depression Scale, **CDC:** Centres for Disease Control and Prevention, **GHQ-12:** 12-Item General Health Questionnaire, **STAI:** State–Trait Anxiety Inventory, **SHMS:** Sub-Health Measurement Scale, **CSIRO**: Commonwealth Scientific and Industrial Research Organization, **ZSRDS:** Zung Self-Rating Depression Scale, **PANAS:** Positive and Negative Affect Scale, **BDI:** Beck Depression Inventory, **PHQ-9:** Patient Health Questionnaire, **SWEMWBS:** Warwick–Edinburgh Mental Well-being Scale—Short Version, **K-6:** Kessler-6 Psychological Distress Scale, **SHS:** Subjective Happiness Scale, **SWLS:** Satisfaction with Life Scale, **AF-5:** Five-Factor Self-Concept Questionnaire, **CDRS:** Connor–Davidson Resilience Scale, **B7ISQ:** Breslau's 7-Item Screening Questionnaire, **PCL-5:** Post-Traumatic Stress Checklist, **SMFQ:** Short Mood and Feelings Questionnaire, **CBCL:** Child Behavior Checklist, **DSRS:** Depression Self-Rating Scale for Children.

DISCUSSION
Eight systematic reviews of observational studies were found in this umbrella review to identify the most recent data on the relationship between diet, health and well-being outcomes. It was found that most systematic review results were consistent in terms of the influence of junk food, such as fast food, unhealthy snacks, and sweets, which were correlated with an increase in mental health problems and negative well-being and health outcomes. For example, junk food increases the likelihood of experiencing depression and anxiety[5,6,7,9], stress[7,9], sleep dissatisfaction, and decreased happiness.[10] Other studies further supported this.[3,4,10] It was found that high consumption of unhealthy food might lead to poorer well-being, physical health, and mental health. In contrast, most results found that the relationship between healthy diets and well-being was inconsistent. For example, in six studies examining the relationship between healthy diets and increased mental health, only three found a significant relationship.[3] In another systematic review[5], the relationship between depression and healthy food consumption was investigated in eight studies, and a significant correlation between healthy food and reduced depression was reported in five studies. However, the effect sizes varied from minor to moderate. In addition, the results of studies that examined the influence between fruit and vegetables and mood were not significant, suggesting no relationship between fruit and vegetable consumption and well-being.[5,6] Although another systematic review[8] found a relationship between fruits and vegetables and mental health outcomes in most studies that were included in the review, they confirmed that the studies that found no significant relationship between fruit and vegetable consumption and mental health may have been due to indirect effects where fruits and vegetables affect BMI, which, in turn, affects mental health. Some studies emphasised the gender differences in the consumption of certain foods that had an impact on well-being and behavioural outcomes; for example, Głąbska et al.[8] found a relationship between healthy food consumption and reduced depression among females but not males, which confirmed the decision to consider gender and BMI as confounding factors in the multivariate analyses.

Contrastingly, the consumption of soft drinks or sugar-sweetened drinks was found to correlate with a high risk of depression[5,9], stress, sleep problems, and poor well-being.[10] In addition, of four studies examining the influence of sweet consumption on increased depression, three found a positive association.[5] Other reviews, however, have examined sweets and found that sweet consumption increases positive affect among people in emerging adulthood.[6]

Although the current umbrella review provides helpful information on the current evidence related to diet and mental health in adolescents and emerging adults, most of the studies were cross-sectional, an approach that does not provide proof of causality. Most of the studies used univariate analyses to assess the outcomes rather than a holistic approach to measure well-being and mental health (i.e., including the established predictors of well-being) to obtain a more accurate estimate of the effect of diet on health and well-being outcomes.

CONCLUSION

The umbrella literature review presented in this article provides a comprehensive review of existing research exploring the association between diet and psychological and physical well-being among adolescents and university students. It was observed that most unhealthy foods or low-quality diets were associated with increased negative well-being outcomes such as depression, anxiety, stress, and emotional problems. In contrast, healthy food or a good diet was associated with positive affect. At the same time, some studies found no association between diet and well-being, especially between healthy diets such as high fruit and vegetable consumption and positive well-being. The umbrella review suggests that diet may play a role in the mental health of emerging adults, but the evidence base is still limited. It has emphasised the need for further high-quality research to better understand the relationships between diet and mental health outcomes in this age group.

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