

Research Bulletin

Food for thought: the relationship between diet and outcomes for depression and anxiety

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The question of whether what someone eats can affect their mental health has increasingly become a focus of research over the last decade. It has attracted such interest because of changes to the western diet (and lifestyle) that have seen a move away from traditional food intake to a diet high in sugar, fat and nutrient-poor and processed foods. The focus on whether an improved diet can improve mental health is also part of a wider effort to increase the availability of low-cost, low-risk interventions that can target modifiable risk factors for mental illnesses (e.g. exercise interventions). Diet is in theory an easily modified factor, and as an intervention, changing to a healthier diet is unlikely to be harmful. It may also have the added benefit of counteracting the adverse physical health effects associated with many mental health disorders and medical treatments for them.

The evidence for a causal link between diet quality and mental health is still emerging, but it does suggest that poor diet is a risk factor for depression and anxiety, although most studies have been carried out in community populations. The literature is also beginning to investigate whether diet modification is an effective adjunct to treatment in people with anxiety or depression. This research bulletin summarises the findings of some of the latest key studies in this area and discusses what these might mean for clinical practice.

Diet and mental health: a complex relationship

The mechanism by which diet interacts with mental health is likely complex and bidirectional, meaning not only might, for example, a healthy diet protect against depression, but also that experiencing depression might lead to a person's changing their diet. Like any other organ, the brain has nutritional needs, so it is reasonable to assume that what we eat will affect its functioning and therefore our mental health (Sarris et al., 2015).

Much research has been carried out that examines relationships between specific nutrients and mental health. Data from these studies suggests that certain nutrients are associated with mental ill health and that supplementation with some nutrients may be effective adjunct treatments for mental health conditions as summarised in Table 1. However, a focus on single nutrients may miss the bigger picture of how whole diet affects mental health. Given that nutritional supplementation can be complicated and expensive, research is beginning to focus on the effects of whole-of-diet and evaluate whether interventions to change diet, which constitute a cheaper and low-risk approach, may affect outcomes.

Table 1. Nutrients that may affect mental health

Nutrient	Effect
Omega-3 fatty acids	May have a positive effect as either stand-alone and adjunct treatment for major depressive disorder, but evidence quality is poor Efficacy as adjunct treatment of bipolar disorder Limited evidence for improved outcomes in schizophrenia, borderline personality disorder
S-adenosyl methionine	Effective as antidepressant, and shows significant augmentative effects with antidepressant medication
N-acetylcysteine	Evidence for efficacy in treating: <ul style="list-style-type: none"> ▪ bipolar depression ▪ schizophrenia (as adjunctive treatment) ▪ trichotillomania ▪ other compulsive and addictive behaviours
Zinc	Deficiency linked to increased depressive symptoms Supplementation as adjunct to antidepressants may improve depressed mood
B vitamins	B9 deficiency associated with depression and poor response to antidepressant medication
Vitamin D	Low maternal vitamin D associated with increased risk of schizophrenia Deficiency linked to increased symptoms of depression

(Appleton, Sallis, Perry, Ness, & Churchill, 2015; Berk, Malhi, Gray, & Dean, 2013; Mischoulon & Freeman, 2013; Sarris et al., 2015)

A significant body of cross-sectional research shows a link between poor diet and mental ill-health. However, because cross-sectional studies do not follow changes in diet or mental health over time, what that association means is less certain (see Table 3). We are likely to face more barriers to eating well when we are experiencing a mental illness (e.g. low energy, amotivation or difficulties in concentration might all make it harder to cook and plan ahead for groceries) and we may be more likely to 'comfort eat' or increase sugar consumption in an attempt to improve our energy. As such, it is unclear from cross-sectional studies whether poor diet causes poor mental health, or if poor mental health causes reduced diet quality.

A number of recent studies have tried to further investigate whether diet affects mental health, addressing two questions: firstly, does a poor diet increase someone's risk of experiencing mental ill-health? and secondly, can eating a healthy diet protect against mental ill health?

This is a difficult area to research: to get adequate sample sizes, researchers often rely on self-report measures of diet,* rather than objectively recording what people eat. It is also hard to find reliable ways to categorise diets as 'healthy' or 'unhealthy'. Different researchers have used different methods of classifying diet (see Table 2) and assessing diet quality, which makes it difficult to compare results between studies.

Bearing these limitations in mind, the results of these recent studies do suggest that diet may affect mental health. Furthermore, evidence suggests that dietary interventions for mental health problems are feasible in terms of both affordability and adherence to diet modifications.

In this research bulletin, we present some of the key recent studies into the relationship between diet and mental health. As there is very limited research in this area, we have reviewed research relating to depression or anxiety only, carried out in child, adolescent and adult populations.

*Self-reported data in research is notoriously vulnerable to 'socially desirable responding', where subjects tend to present a more socially acceptable or favourable picture of themselves. When self-reporting diet, this may mean people are prone to underestimate consumption of unhealthy foods and overestimate consumption of healthy foods. See van de Mortel, (2008) for more.

Evidence suggests that dietary interventions for mental health problems are feasible in terms of both affordability and adherence to diet modifications.

Table 2. Features of healthy and unhealthy diets identified in the review articles presented in this bulletin

Article	Healthy diet features	Unhealthy diet features
Opie et al. 2014	Common themes of dietary interventions among reviewed studies include: <ul style="list-style-type: none"> ▪ increase fruit, vegetable, fibre and fish intake ▪ focus on weight loss 	NA
Lai et al. 2014	High intake of fruit, vegetables, fish and whole grains	Refined grains, processed meats, products high in sugar and fat
O'Neil et al. 2014	High intake of vegetables, fruit, fish and 'other food known to be healthful'	High in saturated fat, refined carbohydrates, processed food
Jacka et al. 2013	Healthy diet score was assigned based on frequency of breakfast and fruit and vegetable intake per day	Unhealthy diet score was based on consumption of savoury snacks, sweets or chocolate, biscuits, fried food and soft drink
Jacka et al. 2015	High in fresh vegetables, salads, fruit, grilled fish	High in roast meat, sausages, hamburgers, steak, chips, soft drink
Opie et al. 2015	High vegetable, fruit and whole grain intake, increased consumption of oily fish, olive oil, legumes and raw unsalted nuts. Moderate consumption of lean red meat and reduced-fat dairy*	Low in dietary fibre, lean protein, fruit and vegetables. High in sweets, processed meat and salty snacks

*Information about diet taken from the previously published protocol for this study (O'Neil et al., 2013).

Table 3. Definitions of study designs used in this review

Study design	Definition
Cross-sectional	A study that compares subjects with existing differences (e.g. people with or without depression) at a single point in time. These studies measure existing differences between subjects rather than a process of change
Prospective or longitudinal	Follows the same sample over time, examining subjects again at intervals. They can help establish causal relationships between variables
Cohort	A study conducted over a period of time involving members of a population who share a common quality, such as age, condition, gender, or shared exposure to a variable of interest. Can be prospective or retrospective
Meta-analysis	Carries out a new evaluation of existing individual studies by pooling their results. This increases the overall sample size to gain better insight into effects of interest
Experimental or intervention	Used to determine whether there is a causal relationship between one variable and another. The independent variable (e.g. a dietary intervention) is applied to one group of subjects but not another (the control), and both groups are assessed for the dependent variable (e.g. change in mental state)

Diet, depression and anxiety in adults

Lai J, Hiles S, Bisquera A et al. **A systematic review and meta-analysis of dietary patterns and depression in community-dwelling adults.** *Am J Clin Nutr* 2014; 99: 181-97.

This systematic review and meta-analysis explored the links between dietary habits and depressive symptoms among community-dwelling adults (aged 20-94 years). The sample sizes varied widely between studies, ranging from 52 to 50 605 participants. Data was collected from 20 observational studies (n = 13 cross-sectional, n = 6 prospective, n = 1 case control). Studies were conducted in European countries (n = 6), USA (n = 6), Australia (n = 4), Japan (n = 2), Taiwan and the UK.

Results The authors carried out two separate meta-analyses on pooled data from the included studies whose definitions of healthy and unhealthy diets were similar enough that their results could be meaningfully compared (13 in total: four cohort and nine cross-sectional). Two dietary patterns were identified across these studies: a 'healthy'

diet, characterised by a high intake of fruit, vegetables, fish and whole grains; and a 'western' diet, characterised by refined grains, processed meat or snacks, high-sugar foods and high-fat foods.

The first analysis (n = 13) looked at differences in high and low consumption of the healthy diet and odds for depression; the second (n = 4) compared high and low consumption of the western diet with odds for depression. It is important to note that the two diet patterns were examined as separate variables, meaning people who scored low on the healthy diet score in the first analysis did not necessarily have a high 'western' diet score.

Results of the first meta-analysis showed that a higher healthy diet score was associated with reduced odds of having depressive symptoms; however, there was significant variation in the studies' results. The authors could not explain this variation by accounting for the factors of age, sex, country, study design, methods used to identify dietary methods, dietary intake assessment, depression measure, percentage of depression cases at baseline or methodological quality. They suggest that the variation in results may be a result of other factors that they weren't able to measure,

such as associations between other protective factors (e.g. healthy behaviours such as exercise and not smoking) and healthy diet.

In the second analysis, there was a trend toward a positive relationship between higher scores on the western diet and increased odds of depression, but it was not significant.

Of the studies that were not included in the meta-analyses, one showed a link between low fruit and vegetable intake and depression, and three showed a relationship between diets high in fruit and vegetable intake and lower odds of depression, supporting the findings that the healthy diet was associated with reduced odds of depression (all four studies were cross-sectional).

Take home messages As nearly all of the data was cross-sectional (13 out of 20 studies), it isn't possible to determine a causal link between diet and depression: that is, whether the healthy diet protects against depression, whether the western diet causes depression, or whether in fact depression causes someone to have a poor diet (known as the 'reverse causality' hypothesis). However, the few studies that were prospective (i.e. measured diet and depressive symptoms at baseline and followed up over time) found no support for reverse causality. They tested this either by excluding subjects with depressive symptoms at baseline from their analysis, or by statistical means.

The authors concluded that while further research is needed, the data suggest that 'dietary interventions have the potential to be included as primary prevention strategies for depressive disorder'.

We note that a similar review, Quirk et al. (2013), was carried out a year earlier, and included a number of the papers reviewed in this article. However, as they did not include a meta-analysis, it was decided not to review it here. Of note, Quirk et al. (2013) reported that there was a conflicting level of evidence to support links between healthy diet and reduced likelihood of depression.

Opie R, O'Neil A, Itsiopoulos C et al. **The impact of whole-of-diet interventions on depression and anxiety: a systematic review of randomised controlled trials.** *Public Health Nutr* 2014; 18: 2074-93.

This review examined the evidence for the efficacy of whole-diet interventions on outcomes for depression and anxiety among adults (aged ≥ 18 years). Seventeen randomised controlled trials were included in the review. It is important to note that only one study targeted clinical depression with the dietary intervention and in fact five studies specifically *excluded* people with clinical depression, 'emotional or mood problems' or severe psychiatric disorders. This means that the overall results of the review cannot tell us how effective dietary interventions are for individuals with a *diagnosis* of depression or an anxiety disorder. Rather, they can tell us about whether dietary interventions can improve depressive and anxiety *symptoms* in people who may be at-risk of developing an anxiety or depressive disorder.

It is also important to note that the main aim of the dietary interventions across studies was not always to improve mental health (e.g. a number of studies aimed to study the effect of dietary intervention on a range of physical, social and psychological variables).

Results All seventeen studies measured symptoms of depression as either a primary or secondary outcome. Eight of these studies (47%) showed a significant improvement in depressive symptoms with the dietary intervention. Ten studies measured anxiety outcomes, of which only two showed a significant improvement following dietary intervention. The characteristics of the dietary interventions used in studies that measured depression outcomes are shown in Table 4. All interventions that improved depression scores had a single mode of delivery, and most (75%) used a dietitian or professional trained in nutritional science to deliver the intervention. Conversely, of the nine studies that had no effect on depression scores only 38% used a single mode of delivery, and 44% used a dietitian or nutritional science-trained professional.



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Commenting on the characteristics of the dietary interventions in the studies that reported on depressive outcomes, the authors note that the observation that all interventions that improved depressive symptoms involved a dietitian is consistent with findings in medical research that interventions delivered by dietitians are more effective (Homes et al. 2005). With regard to the observation that interventions that recommended less red meat or low cholesterol diets appeared less likely to have an effect on depression outcomes (see Table 4), they note that the ideal dietary plan that is recommended to reduce chronic physical

health conditions such as cardiovascular disease may not necessarily be the most appropriate diet for people with mental health conditions. For example, people with physical health conditions are often advised to reduce their red meat intake and/or to adopt a low cholesterol diet. However, some research has shown that inadequate intake of red meat is linked to an increased likelihood of depression (Jacka et al., 2012), while other research suggests low-cholesterol diets may have a negative impact on mental health (Engelberg, 1992).

Table 4. Characteristics of dietary interventions in studies that reported on depression outcomes in Opie et al. (2014).

Proportion of studies whose intervention included (n):					
	Single mode of delivery	Delivery by dietitian or professional trained in nutritional science	Recommended diet high in fibre and/or fruit and vegetables	Recommended diet with more fish	Recommended diet with less red meat/leaner meat, or low-cholesterol diet OR focused on weight loss
Studies with improvement in depressive symptoms	100% (8)	85%*	75% (6)	12.5% (1)	50% (4)
Studies with no effect	38% (5)	44% (4)	78% (7)	66.7% (6)	100% (9)

*We note that the figure of 85% reported by the authors does not appear to match the reported number of studies (n=6) that involved a dietitian or professional trained in nutritional science.

Take home messages In interpreting the results of this review, it is important to consider that the quality of included studies was limited. A significant limitation was that only four of the 17 studies reported being adequately powered to detect statistically significant results, meaning that most of the studies did not have enough data to detect whether changes in depressive and anxiety symptoms were associated with the interventions. There was also a great deal of variation in how the interventions were delivered and how intensively. A range of one to 62 sessions were offered to participants in the various studies, and modes of delivery ranged from group sessions to written advice only. Some interventions focused only on diet, while others included other interventions such as education about tobacco use. This means that we are still a long way from understanding what a 'good' dietary intervention should look like and how long it should last for. It also makes it difficult to compare the results of studies in a meaningful way.

This review shows there is potential for dietary interventions to improve depressive symptoms among people living in the community who are not help-seeking and do not have a depressive disorder, and also shows what characteristics of dietary interventions might be most effective. However, we still don't know if dietary interventions are effective for improving depressive symptoms in a help-seeking, clinical population, as only one study in this review specifically targeted clinical depression with the intervention.

Furthermore, in that study, change of diet was just one component of the intervention, along with exercise, sleep hygiene and sunlight exposure. This is in keeping with the recommendation of other reviews that a dietary intervention should never be considered as a stand-alone treatment for depression. Rather, it may be effective in improving treatment response as an adjunct to treatment-as-usual or as one component of treatment. The only way to test whether this is the case is to conduct adequately powered RCTs that compare the effects of treatments with and without a whole-of-diet intervention.

Diet, depression and anxiety in young people

O'Neil A, Quirk S, Housden S et al. **Relationship between diet and mental health in children and adolescents: a systematic review.** *Am J Public Health* 2014; 104: e31-e42.

Although much research has focused on adult populations and the role of diet in developing depressive disorders, less has been done into the role of diet in depression during early development. This study sought to evaluate the evidence for a relationship between diet quality and symptoms of depression and anxiety in young people aged 19 years and under. Studies of dietary interventions were excluded, as were studies that used clinical population samples.

Twelve studies were included in the review, from Australia, UK, USA, China, Germany, Canada and Norway. Nine studies were cross-sectional and only three were prospective studies, with participants followed up 2-4 years later. The age range of study participants was 4.5-18 years, and mental health outcomes were measured by either self- or informant report, medical records or diagnostic tools. The authors defined a healthy diet as one with a high intake of vegetables, fruit, fish and other food known to be healthful. An unhealthy diet was defined as a high intake of saturated fat, refined carbohydrates and processed food.

Results The study looked at the association between mental health and diet 'quality' and diet 'patterns'. It is unclear how or why they distinguished diet in this way, but it appears that dietary 'patterns' refers to how people tend to eat over the long-term, while diet 'quality' is measured by a snapshot of particular food consumption over a defined period. There was a significant association between unhealthy diet *patterns* and poor mental health, but there was less evidence for a positive association between healthy diet *patterns* and mental health. Those studies that examined diet *quality* found that children and young people who reported a healthier diet were more likely to report better mental health. Two out of three studies looking at poor mental health and poor diet quality found a link between them.

Three studies examined the impact of mental health on diet (rather than diet on mental health). Two of them found that children and adolescents with poor mental health also reported significantly poorer dietary habits.

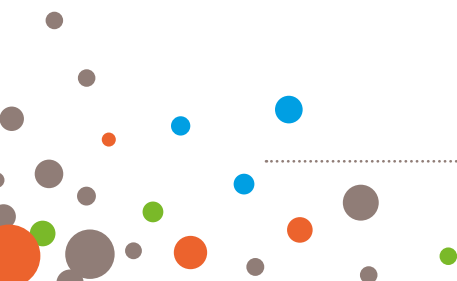
Three prospective studies were identified. These studies are important, as they can provide evidence to answer the question of causality (i.e. whether poor diet is actually responsible for the poor mental health observed or only associated with it). The results of these studies were conflicting, which limits the conclusions that can be drawn regarding causality. One found a prospective association between higher baseline healthy diet score and higher emotional wellbeing at follow-up, but not between higher baseline unhealthy diet and lower emotional wellbeing at follow-up. Another found an association between lower rates of internalising disorders at follow-up and consumption of a greater variety of foods at baseline, although no such association was found with overall diet quality scores. The third study found no association between a 'junk food dietary pattern' at age 4.5 years and emotional problems at age 7.

Take home messages Although the results show an association between poor diet patterns and poor mental health, the evidence is complicated by a number of issues. There was considerable variation between studies in the tools that were used to measure dietary pattern and quality, making it

difficult to compare results. It also not clear how the authors distinguished between diet 'quality' and dietary 'patterns', and how this distinction is relevant to the results. Inconsistency among the studies in controlling for important factors that are also associated with diet and mental health (e.g. a person's socioeconomic status or level of physical activity) means that it is unclear how much of the reported impact of diet is due to these other factors. And as noted in the introduction to this bulletin, the reliance on self-report or parent-report data subjects data to reporting bias - in this population, children or adolescents may not recall their dietary patterns very well, and parents may be particularly susceptible to socially desirable responding.

Noting the above limitations, this review highlights the association and possible importance of diet and mental health in children and young people. On the basis of the reviewed studies, we cannot say whether a poor diet increases a child or adolescent's vulnerability to mental ill-health, as very few high-quality studies have been conducted that can explore this question. There is a clear need for further research, in the form of high-quality prospective and intervention studies, to provide a stronger evidence base, and to further investigate whether there is a causal relationship between diet and mental health in young people and whether dietary interventions can be effective in improving mental health.

There is a clear need for further research, in the form of high-quality prospective and intervention studies.



Jacka F, Rethon C, Taylor S et al. **Diet quality and mental health problems in adolescents from East London: a prospective study.** *Soc Psych Psych Epid* 2013; 48: 1297-1306.

This study builds on previous Australian research (including one study carried out by the same authors) that has shown an association between diet and mental health problems in young people, including a prospective study that showed diet was an independent risk factor for developing mental health problems. However, because participants in the previous studies were predominantly from the same cultural and ethnic backgrounds, the authors sought to examine the association between diet and mental health in adolescents in a more culturally and ethnically diverse population. The study used data from an existing study of a cohort from East London, which was designed to measure relationships between social disadvantage, ethnicity and mental health problems. Data was measured in 2001 and was followed up in 2003.

The participants in the study were aged 11-14 years at baseline. Over 10 ethnicities were represented, including white (21%), Bangladeshi (26%), Black African (10.1) and Asian Indian (9%). Nearly 40% of participants were from families where both parents were unemployed.

Dietary information was taken at baseline only. The participants were asked about breakfast, fruit and vegetable consumption and consumption of unhealthy food. Participants were followed up after 2 years and 75% were assessed at the second timepoint.

The Short Moods and Feelings Questionnaire (SMFQ) was used to measure depressive symptoms (18.9% of boys and 29.8% of girls had a significant score). Self-report Strengths and Difficulties Questionnaire (SDQ) was used to measure emotional and behavioural problems (9.2% of boys and 11.3 % girls had a significant score).

Results At baseline, cross-sectional data showed that the healthier participants' diets were, the less likely they were to report both symptoms of depression and emotional or behavioural problems. However, further analyses indicated that these results were mostly accounted for by other associated factors that influence mental health. Once the impact of other health behaviours was controlled for, the relationship between healthy diet and emotional or behavioural problems was no longer significant; the relationship between healthy

diet and depressive symptoms was fully accounted for by a combination of gender and family factors.

Unhealthy diet scores correlated positively with emotional and behavioural problems (measured by SDQ) both before and after adjusting for other factors that might influence mental health. Participants in the highest range for unhealthy diet scores were twice as likely to qualify as a 'case' on the SDQ than those in the lowest range. There was a significant correlation between depressive symptoms (measured by SMFQ) and unhealthy diet after adjusting for family factors and dieting behaviour. This suggests that there was a positive relationship between unhealthy diet and depression, but this effect was outweighed by the effects that family factors and dieting behaviour have on mental health.

Other factors associated with increased mental health problems were tobacco, alcohol or other drug use, family conflict, low family support, and 'dieting behaviour'.

Prospective analyses were conducted to investigate whether unhealthy dietary habits at baseline predicted 'caseness' (i.e. having clinically significant depressive symptoms or emotional or behavioural problems) at follow-up 2 years later. Prospectively, the only significant association found was between healthier diet scores and higher SDQ scores; however, after adjusting for the effects of other factors, this relationship was not significant (although it still trended in the same direction). This means that unhealthy dietary habits did not act as a unique risk factor for future development of poor mental health.

There were a number of limitations to this study. The healthy diet measure was limited in that it only asked about fruit and vegetable intake and breakfast consumption. There was no data to inform as to the quality of the breakfast consumed, and no items to capture other elements of a healthy diet (e.g. fish intake). It may also have been difficult for participants to accurately estimate their vegetable intake if their meals usually consisted of chopped vegetables (e.g. stir-fries and curries). Statistical power may have been limited, especially considering the number of confounding variables included in the analyses. There were differences in those participants who completed follow-up and those who did not (e.g. those who didn't complete follow-up were more likely to be depressed at baseline, to be white, and to be eligible for school meals), which may have affected the results. Again, social desirability bias is a potential limitation,

as the study relied on self-report data. A major limitation of the study is that reverse causality could not be tested, as no dietary data was collected at follow-up.

Take home messages Despite the described limitations, the results of this study add to a growing body of literature that indicates there is an association between diet quality and mental health. Importantly, the study reports on this association in a highly disadvantaged and ethnically diverse population of young people. When looking at the relationship between diet

and mental health, it is likely that socioeconomic background is a significant confounder – that is, it is potentially very difficult to separate out the effects of socioeconomic status from diet. Because the population in this study was relatively homogenous in this regard, coming from the same area of London, the study was able to control well for the effects of socioeconomic status. Although some potential confounders may not have been measured (e.g. parental mental health), this study improved on previous research by including a wide range of confounding variables, including family functioning.

Importantly, the study reports on the association between diet quality and mental health in a highly disadvantaged and ethnically diverse population of young people.

Although the results do not demonstrate a prospective relationship between poor diet and mental health problems, this does not mean one does not exist, and a number of other studies have seemed to show there is one (Akbaraly et al., 2009; Sanchez-Villegas et al., 2009). Given the many socioeconomic factors in this cohort that may have a much stronger influence on mental health, isolating the effect of diet is likely to have been difficult.

These results suggest that a poor diet is likely to be one of many risk factors for mental health difficulties among adolescents, but to detect a significant effect of diet on mental health, while controlling for other important risk factors, very large sample sizes may be needed. This may explain why many studies in this area report trends towards relationships between diet and mental health, but fail to report significant results. It demonstrates an association between diet and mental health, but also shows that the effect of diet

is likely to get lost among all the other confounding factors that may also play a role in mental ill health. Diet modification alone is therefore unlikely to be the answer to reducing risk of developing a mental health problem; however, it has the advantage of being a modifiable risk factor, and one that a young person may find easier to change than other modifiable risk factors (e.g. family functioning). This indicates the need for further research investigating the impact of dietary interventions as an adjunct to treatment among young people with mental health problems.

Encouraging change: is it realistic to ask people to change their diets?

Opie R, Segal L, Jacka F et al. **Assessing diet affordability in a cohort with major depressive disorders.** *J Public Health Epidemiol* 2015; 7: 159-69.

Recommending that people with depression who have unhealthy dietary habits improve their diets seems to make sense, but how easy is this for people to achieve? In areas of health such as cardiovascular disease and stroke, adherence to dietary advice is typically poor (Ball et al., 2003). The perception that high-quality diets are expensive has been identified as a possible cause of poor adherence; however, the evidence regarding whether a healthy diet is actually more expensive than a poor quality one has been mixed. The aim of this study was to establish whether a healthy diet was affordable to a sample population of adults with moderate to severe major depressive disorder and a current unhealthy diet

The first twenty participants enrolled in a large clinical trial (Supporting the Modification of Lifestyle in Lowered Emotional States, or SMILES) in Victoria (Australia) completed this study. The majority of participants (65%) were female, 35% were overweight and 45% were obese. Their diet at baseline was characterised by low intake of dietary fibre, fruit, vegetables and lean proteins and a high intake of sweets, processed meats or salty snacks.

The study aimed to calculate the average cost of participants' current unhealthy diet and compare it with an estimated cost for the modified version of the Mediterranean diet that was recommended to all participants in the SMILES trial. This diet included a recommended daily intake of non-refined cereals, vegetables, pulses, nuts, fruit, red meat, chicken, eggs, fish, dairy, olive oil, wine and sweets.

Depression was diagnosed according to the DSM-IV-TR criteria. Severity was determined by scores on the Montgomery-Asberg Depression Rating Scale (MADRS). Diet was assessed by a self-reported 7-day food diary, which was checked by a research assistant for missing data and likely errors. Portion size was also taken into account.

Participants' BMI was measured and used to calculate estimated energy requirements, which were in turn compared to actual energy intake from the food diaries to determine the likely validity of the food diary data. This meant that under- and over-reporting could be accounted for in the analysis.

Results The cost of the modified Mediterranean diet and participants' current diet (per person, per week) were estimated based on prices on the Woolworths supermarket online store. The estimated cost of the modified Mediterranean diet was actually lower than the mean cost of the participants' diets prior to commencing the trial (\$112 versus \$138 per week, including beverages). This effect was consistent regardless of whether low, medium, or high-cost brands of products were selected. The Mediterranean diet was considerably cheaper than the poor quality diet, when costs were calculated on low- (\$75 versus \$92) and high- (\$150 versus \$183) cost foods (rather than medium-cost products).

There was a considerable range in how much money participants currently spent on food, from \$53 to \$239 per week; however, the Mediterranean diet was as cheap as, or cheaper than, their current diet for 60% of the participants.

Take home messages The results of this study suggest that a high-quality diet can actually be cheaper than poor-quality diets among individuals with major depressive disorder. It is encouraging to note that a healthy diet could be obtained at a cost of \$75 per week if people choose low-cost products (e.g. home brand products). Other strategies, such as choosing products that are in season, or canned or frozen rather than fresh goods (e.g. pulses, fish), could reduce costs even further. However, further research is needed to replicate these findings with other populations. For example, the costs of different foods may vary widely across geographic locations.

Clinicians and the general population alike need to be educated that a healthy diet may actually be more affordable than a current poor diet.

This was a well-designed study, and these are important findings, as although not accurate, even just the perception (by both clinicians and their clients) that healthy diets are expensive may act as a barrier to their uptake. As the authors highlight, the results suggest that efforts to improve dietary quality among people with depression should address other barriers to healthy eating. Other factors that may contribute to a low-quality diet include low mood, fatigue, and lack of motivation to eat well. Depressed individuals may eat unhealthy foods to improve their mood or increase their energy levels in the short-term. They may have less motivation and energy to cook and, clean-up after cooking, and be less enthusiastic about experimenting with new recipes. As a result, they may be more likely to eat out or purchase convenience and highly processed foods.

Although cost may not be a real barrier to eating more healthily, clinicians and the general population alike need to be educated that a healthy diet may actually be more affordable than a current poor diet. In addition, they need to be educated about emerging evidence regarding the association of poor diet quality and poor mental health. Young people may also need practical support from clinicians in figuring out how to adjust to a healthy diet that is affordable.

Clinicians can refer to the dietary guidelines for the prevention of depression (see page 14) to educate themselves and provide information to their clients regarding emerging evidence in this area.

Jacka F, Cherbuin N, Anstey K & Butterworth P. Does reverse causality explain the relationship between diet and depression? *J Affect Disorders* 2015; 248-50.

The reverse causality hypothesis for an association between depression and diet proposes that depression causes people to eat a poor diet, rather than the other way round. This has not been supported by prospective studies of the association between depression and diet (Akbaraly

et al., 2009; Jacka et al., 2011), but given that there is some reason to believe that depression would affect someone's eating habits, the authors of this study sought to explicitly examine the reverse causality hypothesis. They used an existing cohort study (of adults in the general population aged in their 20s, 40s and 60s) that had shown that low healthy diet scores and high unhealthy diet scores were both predictors of increasing depressive symptoms over time. If the reverse causality hypothesis were true, they expected that people with a history of depression would have a worse current diet than those without a history of depression.

At baseline, participants were asked fill out a food frequency questionnaire, which as in other studies was used to identify two dietary patterns: 'prudent' (or healthy) and 'western' (or unhealthy). Participants were also asked to report whether they had had depression before and whether they had received professional treatment for it. Current depressive symptoms were measured using the Goldberg Depression Scale (GDS).

Results Of the participants, 9.4% were deemed likely to have current depression based on their GDS scores and 43.1% reported having had depression in the past. Of the latter, 17.4% were likely to have current depression. After accounting for age, gender, socioeconomic status, cardiovascular disease risk factors and health behaviours, the authors found that lower prudent diet scores were associated with current depression. However, neither lower nor higher prudent diet score was associated with past depression. Interestingly, a history of depression was associated with *lower* western diet scores, but no link was found between current depression and western diet score.

When the authors separated out those people who had received professional treatment in the past for depression, they found that people who had not received help for their past depression did not differ in their prudent diet scores from people with no history of depression. However, people who had sought professional help for depression in the past had higher prudent diet scores than people with no history of depression. When they looked at western diet scores, there was no difference between people with past depression who had sought help or not – both groups scored lower (i.e. were less likely to eat unhealthy foods) than people without a history of depression.

Take home messages An obvious limitation of the study was the reliance on self-report of past depressive episodes. However, the authors highlight that the validity of the measures of prior depression used in the study is supported by the fact that ‘88% of respondents who reported current use of antidepressant medications also reported a prior history of depression while only 1% of those not reporting prior depression reported current use of antidepressant medication.’

This study did show evidence of reverse causality – but not in the way expected. Rather than a history of depression predicting a poorer diet later on, it

seems that people who reported past depression were *less* likely to eat an unhealthy ‘western’ diet than those who did not. Furthermore, those who had sought help for past depression were more likely to eat a ‘prudent’, or healthy, diet than those who had not (although those with current depression were less likely to eat a prudent diet). The authors suggest that a past depressive episode may in fact motivate people to change their diet for the better, although it is not known if this change might occur at the advice of health professionals or because of a belief that improvements in physical health will help improve mental health. Regardless of where the motivation comes from, this seeming willingness among people with depression to change their diet for the better is encouraging, particularly given the association between diet and depressive outcomes. Further research is needed to generalise these results to other samples. However, the results of this study suggest that clinicians should encourage improved diet in their clients with depression, and be optimistic about the likelihood of clients adhering to dietary recommendations. This can be assisted by providing extra support to address any barriers (real or perceived) to change.

Rather than a history of depression predicting a poorer diet later on, it seems that people who reported past depression were **less** likely to eat an unhealthy ‘western’ diet than those who did not.

Dietary recommendations for depression

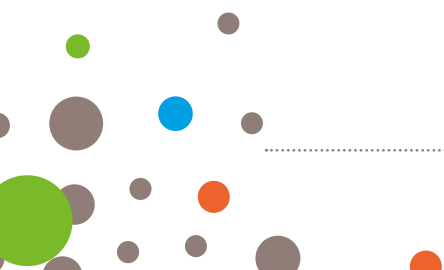
Opie R, Itsiopoulos C, Parletta N et al. **Dietary recommendations for the prevention of depression.** *Nutr Neurosci* 2015; DOI: 10.1179/1476830515Y.0000000043.

The authors of these recommendations examined the evidence concerning dietary patterns and specific nutrients or components (such as those presented in Table 1) that might affect the risk of developing depression. From this they aimed to create a set of dietary recommendations for the prevention of depression.

They note that the evidence base that the recommendations draw on can only be considered 'emerging', rather than 'established', due to gaps in the literature: a major limitation is that most studies have been either observational or animal studies, and there have been few randomised controlled trials. In addition to available evidence, the recommendations were also influenced by discussions with the authors, who all have substantial research experience in the area of diet and mental health. The recommendations are intended to be modified as more research becomes available. In addition, it is important that individuals with dietary restrictions or comorbidities that prevent them following the general recommendations tailor them to their needs to ensure that their dietary choices are safe.

The authors make five key recommendations, summarised below.

1. Follow 'traditional' dietary patterns, such as Mediterranean, Norwegian, or Japanese diets, that have a high intake of fish and whole-plant-based food. The available evidence suggests that traditional dietary habits may be beneficial for positive mental health.
 2. Increase your consumption of fruits, vegetables, legumes, wholegrain cereals, nuts, and seeds. These foods should form the bulk of the diet, as they are nutrient-dense, high in fibre, and low in saturated and trans-fatty acids.
 3. Include a high consumption of food rich in omega-3 polyunsaturated fatty acids (PUFAs). Fish is one of the main sources of omega-3 PUFAs, and higher fish consumption is associated with reduced depression risk.
 4. Limit your intake of processed food, 'fast' food, commercially baked food, and confectionary. These foods are high in trans-fatty acids, saturated fat, refined carbohydrates and added sugars, and are low in nutrients and fibre. Consumption of these foods has been associated with an increased risk or probability of depression in observational studies.
 5. Replace unhealthy foods with wholesome nutritious foods. Healthy dietary patterns (e.g. high consumption of fruits, vegetables, wholegrain cereals, and fish) and unhealthy dietary patterns (e.g. high consumption of confectionary, soft drink, fried food, refined cereals, and processed meats) are *independent* predictors of lower and higher depressive symptoms, respectively.
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Other recommendations made by the authors are:

- Consume lean red meat in moderation.
- Ensure vitamin D levels are optimal.
- Include olive oil as the main source of added fat.
- Avoid alcohol abuse.
- Given the link between depression and cardiovascular disease, type 2 diabetes and metabolic syndrome, these dietary guidelines may be particularly important for people with those conditions.

Take home messages These recommendations are based on the best current evidence, but remain open to modification as more work is done in this emerging area of research. The recommendations are meant to be practical, and focus on broad dietary behaviour rather than particular foods or nutrients, as any protective effects of diet are probably a result of the whole diet. Critically, as the authors note, 'there is currently no data to suggest that dietary interventions can replace other forms of treatment for depression, including pharmacology and psychotherapy.' However, as these dietary guidelines are essentially harmless, they should be considered a part of treatment, with the aim of improving people's overall health.

Where to from here?

Summary of the evidence

In children, adolescents and adults there is evidence to suggest that unhealthy dietary patterns are a risk factor for depression and anxiety. Although there is currently insufficient evidence to establish a causal relationship between poor dietary patterns or quality and poor mental health across all age groups, this does not mean that a causal relationship does not exist. The mixed results gained from prospective studies appear to relate to the complexity of conducting research in this area. Methodological issues include variability in definitions of diet quality and diet measures between studies, reliance on self-report data and variation in how studies controlled for confounding variables. This last reflects the difficulty of controlling for confounding factors while still maintaining an adequate sample size to detect a significant effect of diet on mental health outcomes.

The evidence regarding whether whole-of-diet interventions can reduce risk of depression and anxiety in community-based (non-clinical) samples has been inconclusive. About half of the studies that have been conducted found a positive effect, while half found no difference between the diet intervention and a control condition. More high-quality research is needed to establish whether certain types of interventions are more promising than others.

Likewise, it is not yet known if whole-of-diet interventions can improve symptoms in individuals with a diagnosed depressive or anxiety disorder.

Prospective studies with adults have failed to find support for the reverse causality hypothesis. Jacka et al. (2015) found that poor diet quality in adults was associated with a current diagnosis of depression, but was not associated with a history of depression. A history of depression was in fact associated with *healthier* dietary behaviours, rather than less healthy.

A common problem highlighted by most of the studies reviewed here is the difficulty of getting adequately powered prospective and intervention studies to detect the influence of diet. With all the factors in play in determining mental health, a huge study sample is needed to control for likely confounders, such as socioeconomic background and the influence of family. More well-powered, high-quality prospective studies and RCTs are urgently needed. Clinical trials examining the impact of using whole-of-diet interventions as an adjunct to standard treatment for mental health disorders are also warranted. One such trial, SMILES, is currently underway (O'Neil et al., 2013).

What does this mean for clinical practice?

Most critically, there is no evidence that dietary interventions alone can treat or prevent depression or anxiety in young people or adults. Improvement in diet should only be considered as an adjunct to standard treatment – never as a stand-alone treatment.

While there is insufficient research to establish whether poor diet causes mental health problems, there is substantial research to suggest poor diet is a modifiable risk factor for depression and anxiety. It is also very unlikely that encouraging people with a mental health problem to improve their diet quality can cause harm. Indeed, given that young people with serious mental illnesses such as clinical depression and psychosis are extremely likely to experience poor physical health (including being overweight [National Mental Health Commission, 2012], and cardiometabolic problems [Curtis et al., 2011]), it seems beneficial for clinicians to discuss diet quality with all young people and support them to make positive changes. This could fit in well with other lifestyle interventions (e.g. increasing physical activity) that are included in the current treatment guidelines for depression.

One barrier to improving diet quality among young people with mental health problems is the perception that eating well is expensive. However, as Opie et al. (2013) showed, for adults with depression, there is evidence that this is not necessarily the case. For most participants, changing from their existing poor diet to a high-quality Mediterranean diet would have saved them money. While further research is needed to replicate these results, these results suggest that a high-quality diet can be

affordable to individuals with a poor diet and a moderate to severe mental illness. Moreover, they highlight that clinicians can support clients to adopt a healthier diet by exploring perceptions of comparative costs of healthy and unhealthy diets, providing evidence that a good diet can be affordable, and helping them to plan practical ways to eat well on a budget.

As Jacka et al. (2015) found, is likely that young people with depression will be motivated to change their diet. However, it is important for conversations about changing diet to be done tactfully and with consideration of the young person's situation. For example, someone with low self-esteem may not respond well to being told they have a 'poor' diet, and many young people may not have the resources or skills needed to eat more healthily. Clinicians therefore need to help young people develop these skills and explore any other barriers to healthy eating. A problem-solving approach could be helpful in detailing what is most problematic about their current diet, what changes they would like to make, what barriers are most relevant to them, and how can these be best addressed.

It is likely that research in this area will evolve rapidly. To stay up to date, clinicians can refer to the dietary recommendations for depression, which will be updated as more evidence becomes available. Dietary guidelines for other disorders (e.g. psychosis) may also emerge.

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