Research Protocol
Diet and Psychological Distress in NZ Adults

Introduction

There is emerging evidence that diet has an influence on depression, but our understanding of it is not yet well defined (Bear et al., 2020), and data in the New Zealand population is lacking. Around 1 in 5 New Zealand adults experience symptoms of anxiety or depression in their lifetime, with higher numbers in women (Ministry of Health, 2020). Psychological distress measured over the last four weeks was reported as having higher prevalence in women and in Māori adults (Ministry of Health, 2020). The high impact on individual quality of life, as well as increasing pressure on the public health system, means that preventing and treating anxiety and depression are priorities. There has been a call for a broader research approach with more interdisciplinary efforts (Marquez & Saxena, 2016).

Dietary factors linked with an increased risk of depression include lower intake of fruit and vegetables, omega-3 fatty acids, and micronutrients zinc, magnesium, selenium, iron, and vitamins D, B12, B6, E, and folate (Alpert & Fava, 1997; Anglin et al., 2013; Gougeon et al., 2016; Jacka et al., 2012; Vulser et al., 2016; Wang et al., 2018). New Zealand adults have been found to have an inadequate intake of vitamin A, calcium, zinc, and selenium, iodine and folate in ~10-70% of the adult population (similar numbers in Māori), and around 44% of the population was found to be eating less than 3 servings of vegetables and 40% ate less than two servings of fruit per day (University of Otago and Ministry of Health, 2011). Proposed mechanisms in which diet could influence depression include micronutrient status, inflammatory effects, or changes in the gut microbiota (Bear et al., 2021). Inflammation is likely to be a strong mediator of any effect of diet on depression; an inflammatory dietary pattern has been found to increase the risk of developing depression in women (Beurel et al., 2020; Dantzer, 2012; Lucas et al., 2014; Sahin et al., 2016; Shivappa et al., 2018). It is possible that the relationships between diet and depression are due to reverse causality, with depression causing an alteration in dietary habits (Jacka et al., 2015). However, there are several studies showing a positive effect of dietary interventions on depressive symptoms (Agarwal et al., 2015; Ciarambino et al., 2011; Jacka et al., 2017; Perez-Cornago et al., 2014; Stahl et al., 2014). This study will assess whether diet (diet patterns, dietary quality, food type and macro/micronutrient intake) is associated with levels of psychological distress in healthy NZ adults.

Stress is a variable which is rarely taken into account in research into diet and depression, and yet environmental stressors are a strong predictor of the development of episodes of major depressive disorder (Heim et al., 2008; Park et al., 2019). Stress also affects food choices (Oliver et al., 2000; Zellner et al., 2006). There is a large amount of heterogeneity in the research exploring whether there is a relationship between diet and depression. Conceivably, the heterogeneity could be due to stress acting as a moderator: a poor-quality diet could increase depression when the individual is under stress (and/or a higher quality diet is protective under stress). This study will assess whether life stressors moderate the relationship between diet and psychological distress by assessing whether diet quality is more strongly related to psychological distress when an individual is experiencing high levels of stressful life events, than when their level of life stress is low. It is also plausible that resilience to developing anxiety and depression symptoms following stress may be influenced by diet. This could be due to a change in diet under stress, or a healthy diet could be protective against stress-induced changes in gut microbiota or systemic inflammation (Bear et al., 2021). This study will assess whether

people who are resilient to developing psychological distress with high levels of life stress have a healthier diet than those who experience higher levels of psychological distress under life stress.

Depression is more common in women (Piccinelli & Wilkinson, 2000), and diet differs by gender in New Zealand. Men had a higher fibre intake, but fewer men than women ate the recommended servings of 3+ vegetables and 2+ fruit servings per day. Macronutrient intake also varied with more men than women having inadequate Vitamin A and Zinc, whereas more women than men had inadequate iron and selenium intake (Thomson et al., 2008; University of Otago and Ministry of Health, 2011). There is not a clear indication of whether these specific differences in dietary intake between men and woman would increase or decrease the risk of depression. It is possible that that the higher rates of depression in women could be partially explained by diet. This study will assess whether gender moderates any relationship between diet and psychological distress.

Other factors that increase the risk of developing depression and reduced stress resilience are avoidant coping style (Thompson et al., 2016), low socioeconomic status (Lorant et al., 2003), reduced social support (Ozbay et al., 2007), poor sleep quality (Fang et al., 2019), and inadequate exercise (Paolucci et al., 2018). Body mass index is associated with low grade systemic inflammation, and therefore could be a mediator of a diet-psychological distress relationship (Oddy et al., 2018). Data on these variables will also be collected in the current study, both to obtain data on the New Zealand population, and to be able to control for these as confounding/mediating variables.

Study aims and hypotheses

The aim of this study is to explore patterns in lifestyle, diet, and psychological distress in physically healthy adult New Zealanders aged between 18-45 years. The study will provide baseline information from which more targeted research can be developed. The proposed hypotheses are:

1. There is a relationship between diet and psychological distress in the NZ population, with poorer quality diet associated with higher levels of psychological distress.
2. Lower intakes of micronutrients will be associated with increased psychological distress
3. An inflammatory diet (lower anti-inflammatory diet index score) will be associated with increased psychological distress.
4. Environmental stressors will moderate the relationship between diet and psychological distress, with a poor-quality diet being more strongly related to psychological distress when an individual is experiencing high levels of stressful life events.
5. Gender will moderate the relationship between diet and psychological distress, with the relationship being stronger in females than in males.
6. Stress-resilience will be associated with a higher quality diet.
7. Relationships between diet and psychological distress will still be significant after controlling for confounding variables.

Method

Design

The cross-sectional study will use an online questionnaire to collect quantitative mood and stress measures, sleep, exercise, dietary intake, and demographic information. There will be one collection time point only per participant. The study is registered with the Australian New Zealand Clinical Trials Registry (ANZCTR registration number tbc), with Universal Trial number: U1111-1269-7112

Participants

180 medically healthy, community-based women and men between the ages of 18 and 45 will be recruited. Participants will be recruited using advertisements at the Massey University Palmerston North Campus, Palmerston North City Library, via email subscription groups, and social media. Recruitment will begin in October 2022 and continue until March 2023. The study will be put on hold during the Christmas holiday period from between 19 December 2022 and 31 January 2023, because lifestyle during the period typically is not representative of the rest of the year.

Sample size was estimated using G*Power software version 3.1.9.7. For multiple regression, with six covariates and assuming an identification of four dietary patterns, 172 participants are required for an effect size of 0.1, 80% power and an alpha of 5% for the f-test. For MANOVA, 180 participants are required for an effect size (f) of 0.25, 80% power, and an alpha of 5%.

Research Team

Principal Investigator:	Tracey Bear, Plant and Food Research, New Zealand
Co-Investigators:	Associate Professor Dianne Gardner, School of Psychology, Massey University Professor Nicole Roy, Department of Human Nutrition, University of Otago Katie Bear, Recent graduate school of Psychology, Waikato University
Trial Coordinators:	Tracey Bear, Nayer Ngametua, Hannah Dinnan and Sheridan Martell, Plant and Food Research, New Zealand.

The principal investigator has been assigned to the study and will be responsible for the overall conduct of the study and preparation of the final report.

Measurements

Assessment of dietary intake

Participants will record their dietary intake using a 70-item food frequency questionnaire. The FFQ has previously been validated in NZ adults (Sam et al., 2020). Individual dietary components will be quantified (see Table A2, Appendix A), and dietary patterns will be identified using multivariate analysis using the 70 food items measured in the FFQ. Diet quality will be assessed using the 2015 version of the Healthy Eating Index (HEI-2015). The HEI-205 scores diet on quality, independently from energy intake. It comprises two sub-scores, diet adequacy with nine components, and diet moderation, with four components. A total score out of 100 is obtained, with a higher score indicating a better quality diet (Guenther et al., 2008; Krebs-Smith et al., 2018).

Assessment of psychological distress

The short form 12-item version of the General Health Questionnaire (GHQ-12) will be used (Goldberg, 1972; Goldberg & Williams, 1988). The GHQ-12 contains two factors: Anxiety and Depression and Social Dysfunction (Kalliath et al., 2004). There are 12 statements to which participants indicate agreement based on the previous seven days on a four-point scale (0 = *Not at all*; 3 = *More than usual*). Scores are summed, and a lower overall score indicates less psychological distress.

Measurements of life stressors

Recent Life Changes Questionnaire (RLCQ), also known as the Holmes-Rahe stress inventory, is a questionnaire with a list of 74 life events (Miller & Rahe, 1997). Participants select all which they have experienced over the past 6 months. The occurrence of a high number of these life events was found to be associated with increased risk of the onset of mental distress (Holmes & Rahe, 1967). Each life

event is assigned a Life Change Unit (LCU) value and the LCUs are summed to provide a total score. A score of 300 LCU or higher is considered as high life stress (Miller & Rahe, 1997).

Stress resilience

Cluster analysis will be used to determine if groups categorised as stress-resilient and stress-sensitive can be determined. Possible groups are shown in Table 1. If cluster analysis does not adequately split the groups, participants will be grouped according to whether they have experienced a high number of life stressors, and whether they have high or low psychological distress scores. Those with high life stressors will be classed as stress-sensitive or stress-resilient depending on their distress scores. High and low scores will be determined using a median split.

Table 1 – Possible categories of stress resilience (life stress)

		Life Stress	
		Low/moderate	High
GHQ-12 score	Low	Low stress & low psych distress	Stress-sensitive
	High	Low stress, high psych distress	Stress-resilient

Physical Activity

The New Zealand Physical Activity Questionnaire - short form (NZPAQ-SF) will be used to collect physical activity data. This is a self-report questionnaire which asked participants to report the number of days and hours/minutes they have spent walking and undertaking moderate and/or vigorous physical activity over the previous week (Boon et al., 2010; Moy et al., 2008). Total physical activity will be quantified using the scoring protocol of the international physical activity questionnaire (Craig et al., 2003).Total physical activity will be expressed as metabolic equivalent minutes per week (METs/wk) (Boon et al., 2010; Moy et al., 2008).

The formula for calculating the METs/wk is as follows:

- Walking MET-minutes/week at work = 3.3 * walking minutes * days walking.
- Moderate MET-minutes/week at work= 4.0 * moderate-intensity activity minutes * number moderate intensity days
- Vigorous MET-minutes/week at work = 8.0 * vigorous-intensity activity minutes * number vigorous intensity days

Total PA MET-minutes/week = sum of walking + moderate + vigorous MET-minutes/week scores.

Sleep

The single-item sleep quality scale (SQS) will be used. The SQS comprises one question which asks the participant to rate their sleep quality over the last 7 days on a scale from 0 (terrible) – 10 (Excellent) (Snyder et al., 2018).

Body Mass Index

Body Mass Index will be calculated using self-reported height and weight using the formula BMI = $kg/m^{2.}$

Social support

Perceived social support will be measured using the Multidimensional Scale of Perceived Social Support (Zimet et al., 1988). Lower social support measured using this scale has been found to be associated with higher depression scores (Trivedi et al., 2009). The scale has 12 items which are rated on a scale from 0 (very strongly disagree) to 7 (very strongly agree). Scores are summed for a total score, and there are three subscales, significant other, family, and friends.

Coping style

Approach (task-focussed or problem solving) coping is associated with better psychological outcomes compared with avoidance (escapism or emotion-focused) coping (Beasley et al., 2003). Due to limitations to the length of the survey only approach coping will be measured. The Brief Resilient Coping Scale (BRCS) will be used in this study. It is a 4-item measure which measures tendencies to cope with stress in an active problem-solving manner (Sinclair & Wallston, 2004). The scale asks participants to rate statements on a scale from 0 (does not describe me at all) – 5 (describes me very well). Scores are summed for a total BRCS score.

Socioeconomic status

To minimise the number of questions asked to the participants, the direct socioeconomic status of the participants will not be calculated, but the socioeconomic status of their neighbourhood will be recorded using the 2018 New Zealand Index of Multiple Deprivation (Exeter et al., 2017). Participants will enter the address of their usual residence which will be automatically converted to an IMD score. The address itself is not recorded.

Procedure

Questionnaires will be administered via the online survey program *Qualtrics*. To reduce participant bias, the study will be described in generic terms as collecting data on lifestyle factors and wellbeing.

The information sheet and consent form are included as part of the survey. The participants are able to access the survey via links in advertising emails and can begin the survey without needing contact with the researchers.

Anonymity of data collection will be done using the following protocol. The survey data does not collect any identifying information. The main researchers will only have access to this data, and the research assistants will not be able to access it. At the end of the survey, there is a link for participants to click to go to a different survey where they can put their name and address in, to receive their vouchers. Only the research assistants will have access to this data and will send out a koha (voucher) to the participants.

Statistical Analysis

Dietary patterns will be identified using principal component analysis combined with cluster analysis. This combination reduces the influence of minor foods or outliers, but still allows diet to be attributed to individuals (Ocké, 2013).

To investigate associations between diet quality and psychological distress (hypotheses 1 and 2), dietary patterns, diet quality, and individual dietary components will be (separately) assessed against psychological distress (GHQ-12 scores) along with the covariates BMI, sleep quality, physical activity, IMD, social support and coping style using multiple linear regression.

To assess if relationships between diet and psychological distress are stronger under higher environmental stressors (hypothesis 3), or differ by gender (hypothesis 4), moderator analysis using linear regression will be undertaken.

To determine any unique contribution of diet to psychological distress (hypothesis 6), these analyses will be repeated with stepwise multiple regression, controlling for the covariates.

To investigate whether stress resilience is associated with differences in diet quality (hypotheses 5), participants will be grouped according to stress-resilience (see Table 1), and diet quality and individual dietary components will be compared between groups using MANOVA.

Appendix A

Table A2. Food types and dietary components which will be identified using the FFQ data.

Food type	
Fruit & Vegetable intake	(serving)
Dairy intake	(serving)
Eggs, meat etc (animal derived protein)	(serving)
Breads, Cereals, Starches	(serving)
Fast Foods	(serving)
Sweets, baked goods, miscellaneous	(serving)

Dietary component	
Energy	(MJ)
Protein	(g)
Total fat	(g)
Saturated fat	(g)
Monounsaturated fat	(g)
Polyunsaturated fat	(g)
Cholesterol	(mg)
Carboyhdrate	(g)
Sucrose	(g)
Fructose	(g)
Fibre	(g)
Alcohol	(g)
Total vitamin A	(µg)
β-carotene	(µg)
Thiamin	(mg)
Riboflavin	(mg)
Niacin equivalents	(mg)
Vitamin B6	(mg)
Folate	(µg)
Vitamin B12	(µg)
Vitamin C	(mg)
Vitamin E	(mg)
Calcium	(mg)
Potassium	(mg)
Iron	(mg)
Selenium	(µg)
Sodium	(mg)
Magnesium	(mg)
Zinc	(mg)

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