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The psychological characteristics of people consuming vegetarian, vegan, paleo, gluten free and weight loss dietary patterns

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Summary

Objective

Previous research has identified several psychological factors associated with dietary restriction but has focused almost exclusively on the subcategory of people following a weight loss diet. Little is known about the psychological factors associated with other kinds of restrictive dietary patterns. Furthermore, it remains unclear whether the identified psychological characteristics of dieters (e.g. elevated disordered eating behaviours, poor well-being) are a cause of dieting, follow from calorie restriction or are the result of cognitive restraint.

Methods

This study conducted the first direct comparison of people (N = 393) following five different restrictive dietary patterns (vegetarian, vegan, gluten free, paleo and weight loss) as well as a comparison group who were not following a specific dietary pattern.

Results

The weight loss group had more negative psychological characteristics than all other groups, reporting the highest levels of eating disorder symptoms (M = 1.50), food cravings (M = 69.39), emotional eating (M = 2.97) and negative affect (M = 19.72). By contrast, several of the other restrictive dietary groups showed a number of psychological strengths, relative to the comparison group. This was particularly apparent among the paleo group, who reported the lowest levels of eating disorder symptoms (M = 0.74), food cravings (M = 47.63), emotional eating (M = 2.30) and negative affect (M = 14.81). By contrast, people following vegetarian and gluten free diets were largely the same as the non-restricted comparison group in their psychological characteristics.

Conclusions

People adhering to different dietary patterns showed stark differences in their psychological characteristics. Indeed, some restrictive dietary patterns (paleo and vegan) were associated with more positive psychological characteristics than seen in an unrestricted comparison group. This suggests that the psychological risk factors seen in weight loss dieters are not attributable to a restrictive dietary regimen per se.

Keywords: Dietary restraint, disordered eating, food choice, weight loss.

Dieting for weight loss has attracted significant research attention because of the growing number of people around the world who are overweight or have obesity (1). Across the last 40 years, evidence has accumulated suggesting that unsupervised weight loss dieting contributes to increased weight gain, poorer psychological health and, in some cases, disordered eating (2–5).

However, there has been less research exploring psychological factors associated with other kinds of restrictive dietary patterns. This is despite the fact that a significant proportion of people worldwide engage in a restrictive dietary pattern of some kind. For example, an estimated 75 million people around the world follow a vegetarian diet (6), and over 4.5 million Americans are estimated to follow

a gluten free diet (approximately half with diagnosed coeliac disease; (7)). We know relatively little about the psychological characteristics of people following these other dietary patterns.

The high rates of obesity and overweight globally prompt millions of people every year to undertake a weight loss diet, which is by far the most common strategy that people use to combat dissatisfaction with their body shape or weight (1). Calorie restriction is also the most common weight-control strategy recommended by health practitioners (8). Unfortunately, weight loss is typically difficult to achieve and maintain. Even though there can be initial weight loss success (5–10% of body weight) among dieters, the commonly observed outcome is that people quickly return to a similar or heavier weight than they were originally (9). Furthermore, repeated and failed efforts to lose weight through restrictive dieting may contribute to increased disordered eating behaviours such as excessive food restriction, binge eating and purging, as well as associated weight regain (2–5). These consequences of dieting for psychological health may, in rare cases, culminate in clinical eating disorders such as bulimia nervosa (BN) and binge eating disorder (4,10). Early research suggested that the mechanism underlying this relationship was *cognitive restraint*, which is the mental effort applied to modify one's eating behaviours in order to maintain a restrictive dietary pattern (11,12). More recent research has shed doubt on the causal relationship between dieting, restraint and disordered eating (13–15); however, there remains a general consensus that *naturalistic* weight loss dieting (i.e. the diverse, but mostly unsupported and unsuccessful, efforts to restrict calorie intake that people most commonly attempt) is associated with poor psychological well-being (3,16–18).

Some of the specific psychological correlates that are associated with weight loss dieting include depression, eating disinhibition (loss of control over eating behaviours), binge eating and loss of control over eating behaviours (19–22). In addition, higher levels of emotional eating and negative affect and lower levels of self-esteem and self-efficacy predict increased food intake, higher rates of binge eating and poorer weight loss outcomes (23–26).

It is important, however, to distinguish naturalistic weight loss dieting from supervised weight loss in formalized lifestyle modification programmes. There is growing evidence that *effective, assisted* weight loss is associated with positive mental health improvements and reduced disordered eating in intervention trials (27). These improvements may not be substantial enough that dieters who experience successful weight loss have levels of well-being comparable with their non-dieting peers. Nevertheless, the evidence suggests that many of the harmful associations with weight loss dieting may be limited to the (mostly unsuccessful) weight loss efforts that people typically embark upon alone (28).

To date, research on the psychological characteristics of restrictive dietary patterns has focused primarily on weight loss dieters. This means that little is known about the psychological characteristics of people following other restrictive dietary patterns. However, another drawback of this paucity of evidence is that it is not possible to separate whether the psychological characteristics associated with weight loss might be attributable to (i) calorie restriction or weight-related distress *per se*, (ii) the challenges associated with cognitive restraint or (iii) a risk factor for beginning a weight loss diet in the first place. It might be posited, for instance, that all people on restrictive dietary patterns experience the same cognitive challenges of adherence, and indeed, some dietary patterns such as vegan and gluten free require quite extensive checking and monitoring behaviours. Therefore, an examination of psychological characteristics of these diet groups may shed light not only on these specific populations but also on the reasons for poor psychological outcomes among weight loss dieters.

A small number of mostly qualitative studies have explored the psychological factors associated with being vegetarian or vegan. These studies have found that personal values and beliefs are central to these dietary patterns (29). Being vegetarian is associated with positive personal qualities such as morality, integrity, empathy, being liberal minded and self-sacrifice for the greater good (30). However, one study found evidence that vegetarianism may be a strategy used to advance a goal of dietary restraint (31), and another found that the vegetarians had poorer mental health than the general population (32), which if confirmed would suggest that vegetarians may psychologically resemble weight loss dieters. Conversely, the vegan dietary pattern is often considered to be more than simply a dietary preference: it is a self-defining lifestyle that is composed of strongly held ethical and moral beliefs around the treatment of animals during the production of meat and other animal products (33).

The popularity of gluten free diets has grown in recent years. The literature has particularly focused on the physiological *effects* of adhering to a gluten free diet among people with coeliac disease (34). Although a gluten free diet is considered a medical necessity for people with coeliac disease, adherence is nevertheless highly variable and influenced by emotional well-being and internal motivation (35). There is growing evidence that coeliac disease is associated with an elevated risk of depression (36) and other psychiatric disorders (37) – however, these rates of psychiatric comorbidity are comparable with other chronic health conditions and so may not be attributable to the gluten free diet. On the other hand,

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there is some evidence that the hypervigilance required for strict adherence to a gluten free diet has negative consequences for emotional well-being (38). Many individuals experience psychological distress following a diagnosis of coeliac disease, and for some, acceptance of the gluten free dietary pattern is a transformation involving the letting go of the old dietary pattern 'identity' and going through a grief process (39,40). There is also ongoing debate in the literature concerning whether there are physical health benefits of a gluten free diet for people without coeliac disease who report symptoms of gluten sensitivity or allergy (e.g. bloating or discomfort; (41,42)). Nevertheless, people's motivation to adhere to a gluten free diet is typically health related, even among those without coeliac disease (43).

Paleo diets have burgeoned in popularity only in the last 10 years, with one survey indicating that as many as 3 million Americans follow this diet (44). The paleo dietary pattern promotes eating a diet purported to be closer to that of hunter-gatherer ancestral humans, emphasizing lean proteins, fruit and vegetables, and excluding processed foods, dairy and grains (45). There is some evidence for health benefits accruing to people on paleo diets, particularly for metabolic syndrome (e.g. reduced hypertension and triglycerides; (46,47)), although most of these studies have been underpowered. Importantly though, the popularity of paleo diets is attributable far more to the promotion of 'fad' versions of this diet by wellness bloggers and celebrity chefs, rather than to scientific research (48). No extant research has explored the psychological characteristics associated with paleo diets, although research on other fad diets has indicated that fad dieting is typically motivated by a desire for weight loss (49).

In sum, little research has investigated the psychological correlates of dietary patterns other than weight loss dieting, with the majority of extant work being qualitative and focused on the vegetarian community (30,33,39,50). Thus, it is unclear from the extant literature whether the psychological correlates of weight loss are *specific* to weight loss dieters or are general features associated with effortful restriction of one's eating pattern (11,13–15). No previous research has directly compared the psychological characteristics of people on different kinds of restrictive diets. This is an approach which arguably is likely to be fruitful in identifying both (i) features that are common to restrictive dieters in general, as well as (ii) features that are specific to particular dietary patterns.

This study aims to characterize the psychological factors associated with some of the most common restrictive dietary patterns: vegetarian, vegan, gluten free, paleolithic ('paleo') and weight loss, with the goal of understanding the psychological similarities and differences of people who follow them. Each of the psychological variables chosen for exploration in this study has been investigated extensively in previous weight loss research and/or in the limited research into the other dietary patterns. This study was necessarily exploratory in nature, examining a broad range of psychological correlates related to eating attitudes, behaviour and well-being.

Method

Participants and design

This study recruited a total of 408 participants, of which 272 were adult community members and 136 were students from a large Australian university. Participants self-categorized as belonging to a specific dietary group: vegetarian, vegan, gluten free, paleo, weight loss or an unrestricted dietary pattern. Recruitment continued until the sample included at least 35 in each dietary group. Of the 408 people recruited, 15 indicated that they were on another type of dietary pattern (e.g. low FODMAP, or gluten free plus vegan). These people were excluded from analysis because of their diversity and low numbers for each diet type. This left 393 participants in the final sample.

Procedure

Participants were recruited for a study titled 'Understanding your eating choices' via research participation pools, online advertisement on forums, social media, community webpages as well as through word of mouth. Recruitment aimed to systematically oversample people who were adhering to a restrictive dietary pattern of any kind. Participants were required to complete the survey in a single sitting (approximately 30 min). Students received course credit for their participation, and community members did not receive an incentive.

Measures

Demographic information

Demographic information collected from participants included self-reported age, gender and ethnicity. Participants were asked to record their height and weight, which was used to calculate their body mass index (BMI; $kg\, m^{-2}$).

Dietary pattern information

Participants were first asked a free-response text question about their dietary pattern. On the following page, participants were asked to self-categorize in terms of a

particular dietary group, with seven response options: 'vegetarian', 'vegan', 'paleo', 'gluten free', 'weight loss diet', 'unrestricted diet' and 'another specific restricted diet'. People who chose the latter group were asked to name their dietary pattern here. A small number of participants (<5%) were recategorized into a specific dietary group based on their free-response text (e.g. people who chose 'other' but named a specific weight loss diet, or who were gluten free and also tried to minimize junk food).

Length of time on the nominated dietary pattern was assessed by one item which asked, 'How long have you been eating this dietary pattern?', from which the following responses could be chosen: less than 1 month, 1–6 months, 6 months–1 year, 1–2 years, or longer than 2 years. The presence of a medical condition that may affect dietary pattern choices was assessed with the item: 'Do you have a medical condition that requires specific dietary restrictions?', and if answered yes, participants were asked to state in words which condition(s).

Eating attitudes and behaviours

Disordered eating behaviours. To screen for eating disorder symptoms, a 5-item version of the Eating Disorder Inventory (51) was included. Participants rated items such as 'I have the thought of trying to vomit in order to lose weight' on a scale ranging from 0 (Never) to 4 (Always). The scale screens for anorexia nervosa (AN; three items) and BN (two items) by calculating mean scores for each subscale. Friborg and colleagues (51) report adequate reliability for both the AN items ($\alpha = .71$) and the BN items ($\alpha = .79$). In this study, however, the two scales showed poor reliability ($\alpha_{AN} = .53$; $\alpha_{BN} = .66$). A factor analysis revealed the five items loaded onto one factor with factor weights of .46 to .77. Given that this study did not require clinical diagnosis of specific eating disorders, but rather an indicator of the severity of disordered eating behaviours, the five items were averaged to create a single scale for the purpose of this study with slightly improved reliability ($\alpha = .67$).

Emotional eating. Emotional eating was measured using the 13-item emotional eating subscale from the Dutch Eating Behavior Questionnaire (52). Participants were asked to rate items such as 'How often do you have the desire to eat when you are irritated' on a scale of 0 (Not applicable) to 5 (Very often). There is strong evidence for the scale's reliability ($\alpha = .94$ (52)), which was further supported by this study ($\alpha = .93$).

Dieting intentions. Dieting intentions were measured using the 7-item Dieting Intentions Scale (DIS (13)). The DIS has been found to predict immediate future efforts to alter eating behaviours and measures naturalistic weight loss dieting, which involves both healthy and unhealthy eating behaviours and is typically unsuccessful in achieving sustained weight loss. The DIS rates responses on a 7-point Likert scale to items such as 'I intend to go on a diet'. There is strong evidence for the scale's internal consistency ($\alpha = .91$ (13)), which was further supported by this study ($\alpha = .94$).

Food cravings. Food cravings were measured using the 21-item Trait General Food Cravings Questionnaire (53), which asks participants to rate items such as 'I find myself preoccupied with food' on a scale ranging from 1 (Never or not applicable) to 6 (Always). There is strong evidence for the scale's reliability ($\alpha = .94$ (53)), which was further supported by this study ($\alpha = .94$).

Dietary motivation. Motivation for food choices was measured using the 36-item Food Choice Questionnaire (54). The Food Choice Questionnaire asks participants to rate the importance of factors related to their food choices on a scale of 1 (Not important at all) to 7 (Extremely important). Mean scores are calculated for nine factors: *health* (e.g. 'Is nutritious'), *mood* (e.g. 'Cheers me up'), *convenience* (e.g. 'Takes no time'), *sensory appeal* (e.g. 'Smells nice'), *natural content* (e.g. 'Contain no additives'), *price* (e.g. 'Is cheap'), *weight control* (e.g. 'Is low in fat'), *familiarity* (e.g. 'Is what I usually eat') and *ethical concern* (e.g. 'Is approved politically'). There is good evidence for the scale's internal reliability for all nine factors ($\alpha = .68$–.88 (54)), which was further supported by this study ($\alpha = .80$–.93; with the exception of the ethical concern factor $\alpha = .63$).

Self-efficacy. Dietary pattern self-efficacy was measured using a single-item scale (55), which is considered to have comparable psychometrics properties to the full scale and asked 'How confident are you that you will be able to stick to your dietary pattern for the next 90 days, or three months?' Participants rated responses on a scale ranging from 1 (Not at all confident) to 10 (Very confident). This single-item scale has been widely used in varying contexts, including in the context of restrictive dietary patterns (56).

Self-control. Self-control was measured using the 13-item Brief Self-Control Scale (57), which asks participants to rate their responses from 1 (Not at all) to 5 (Very much) to items such as 'I am good at resisting temptation'. There is strong evidence for the scale's internal reliability

(α = .83–.85 (57)), which was consistent with this study (α = .85).

Well-being

Self-esteem. Self-esteem was measured using the validated single-item 'I have high self-esteem' and asks participants to rate responses on a scale ranging from 1 (Not Very True of Me) to 5 (Very True of Me). The single-item has comparable psychometric properties with the 10-item scale (58) and it has been utilized previously in weight loss research (59).

Depression, anxiety and stress. Symptoms of depression, anxiety and stress were measured using the 21-item Depression, Anxiety and Stress Scale (60), which asks participants to rate items on a scale ranging from 0 (Never) to 3 (Almost always). Example items are 'I felt that life was meaningless' (*depression*), 'I felt I was close to panic' (*anxiety*) and 'I found it difficult to relax' (*stress*). Summing the 7-item scores for each subscale and multiplying by 2 derives the total subscale score (60). There is strong evidence for the scales' internal reliability (α = .82–.97) in both clinical and non-clinical populations (60,61), which was further supported by this study (α = .83–.90).

Negative affect. Negative affect was measured using the 10 negative affect items from the Positive and Negative Affect Scale (62). Participants rate responses on a scale ranging from 1 (Very slightly or Not at all) to 5 (Extremely) based on the extent they experienced each emotion over the last week (e.g. 'guilty'). There is strong evidence for the scale's internal reliability (α = .84–.87 (62)), which was further supported by this study (α = .90).

Results

Of the 393 participants, 331 completed all measures and the remaining 62 had enough usable data to be included in some of the statistical analyses. Analyses used all of the available data and so vary slightly in their sample size as reported in the succeeding text. Participants were 83% female and 17% male (with one participant indicating 'other' gender). The mean age of participants was 29.38 years ranging from 17 to 74 years (SD = 13.12). Participants were 79% Caucasian, 11% Asian and 10% were from other ethnic groups (such as mixed, Indigenous Australian or Middle Eastern). Inspection of boxplots indicated the presence of possible outliers on a number of the variables, although on comparison of the variable means with the 5% trimmed means, only small differences between the two were found indicating that no score/s at the extremes was greatly influencing the mean, and therefore, no cases were removed.

Frequency analyses, one-way analysis of variance and chi-square analyses were conducted to identify the characteristics of each dietary pattern group, with pairwise comparisons only conducted where the omnibus test was significant. Multiple comparisons were further adjusted for using the Tukey honest significant difference test for continuous variables and Bonferroni *p*-value

Table 1 Descriptive information by dietary group

	Vegetarian	Vegan	Paleo	Gluten free	Weight loss	Unrestricted diet (comparison group)
N	48	128	42	38	36	101
Female (%)	88	83	94	91	78	76
Age (*M*) (years)	27.38[ad]	32.51[b]	41.56[c]	33.91[ab]	21.81[d]	24.11[d]
BMI (*M*) (kg m^{-2})	23.73[ac]	23.48[a]	26.73[b]	25.38[ab]	24.50[ab]	21.74[c]
BMI categories						
Underweight (%)	5	6	3	6	8	19
Healthy weight (%)	65	63	52	56	53	69
Overweight (%)	20	21	26	16	25	9
Obesity (%)	10[ab]	10[ab]	19[b]	22[b]	14[ab]	3[a]
Time on diet (modal category)	63% > 2 years[ab]	58% > 2 years[b]	36% 1–2 years[b]	68% > 2 years[ab]	44% 1–6 months[c]	84% > 2 years[a]
Diet-related medical condition (%)	8[a]	7[a]	36[b]	79[c]	11[ab]	4[a]
Ethnicity						
Caucasian (%)	80[abc]	84[bc]	91[abc]	100[c]	69[ab]	65[a]
Asian (%)	3[ab]	1[b]	6[abc]	0[ab]	19[ac]	29[c]
Other (%)	17	15	3	0	12	6

Scores with different superscripts are significantly different in Bonferroni or Tukey HSD adjusted comparisons. BMI, body mass index; HSD, honest significant difference.

corrections for categorical variables (63). Table 1 displays descriptive statistics of the sample. Participant numbers varied across groups; vegan was the largest group ($N = 128$) and weight loss dieters the smallest group ($N = 36$). Chi-square analysis indicated that there was no significant difference in the number of men versus women that were recorded for each of the diet groups $\chi^2(5, N = 334) = 9.58$, $p = .088$, with the majority of participants being female in all diet groups. Chi-square analysis indicated that there was a difference in ethnicity between the diet groups $\chi^2(10, N = 336) = 59.51$, $p < .001$. This difference was such that Caucasian participants were least likely to be in the unrestricted comparison group and most likely to be in the gluten free group (which was 100% Caucasian). Asian participants were overrepresented in the unrestricted and weight loss groups.

As can be seen in Table 1, there was a statistically significant difference between the diet groups in age, $F(5, 328) = 15.99$, $p < .001$, and in BMI, $F(5, 327) = 5.12$, $p < .001$. The paleo group was significantly older ($M = 41.56$) than all the other groups and also reported the highest average BMI ($M = 26.73$), which fell in the overweight range. The weight loss group reported the lowest average age ($M = 21.81$) and an average BMI that fell in the healthy range ($M = 24.50$). The comparison group reported the lowest average BMI ($M = 21.74$). In keeping with this, people with obesity were underrepresented among the comparison group and overrepresented in the paleo and gluten free groups.

Chi-square analyses indicated a significant difference between diet groups in the length of time following the diet, $\chi^2(20, N = 393) = 187.20$, $p < .001$, as well as presence of a medical condition, $\chi^2(5, N = 393) = 139.74$, $p < .001$. The weight loss group reported following their diet for the shortest average period of time (29% for 1 month or less; 72% for 6 months or less), while the comparison group reported consuming their diet for the longest average period of time (84% more than 2 years). The gluten free group was most likely to report a diet-related medical condition (79%). Of these, 57% stated they had diagnosed coeliac disease and 40% stated they had a gluten intolerance or allergy, or suspected (but undiagnosed) coeliac disease. One participant stated infertility problems. The paleo group was also more likely to report a diet-related medical condition than other diet groups (37%), and these included diverse conditions such as irritable bowel syndrome, dairy or other intolerances, arthritis and hypertension.

Psychological characteristics of the diet groups

The psychological characteristics for each diet group, along with significant pairwise comparisons, are displayed in Table 2 (eating attitudes and behaviour variables) and Table 3 (well-being variables). Only significant differences are described in the succeeding text.

In the domain of eating attitudes and behaviour (Table 2), there was a statistically significant difference between the diet groups in disordered eating symptoms $F(5, 364) = 6.13$, $p < .001$, emotional eating $F(5, 334) = 2.46$, $p = .012$, dieting intentions $F(5, 367) = 12.67$, $p < .001$ and food cravings $F(5, 329) = 6.33$, $p < .001$. All four of these variables were highest in the weight loss

Table 2 Mean scores of eating behaviour and attitudes variables by diet group

	Vegetarian	Vegan	Paleo	Gluten free	Weight loss	Unrestricted diet (comparison group)
Eating disorders	1.04[a]	0.85[a]	0.74[a]	0.96[a]	1.50[b]	1.10[a]
Emotional eating	2.64[ab]	2.43[a]	2.30[a]	2.70[ab]	2.97[b]	2.69[ab]
Dieting intentions	3.96[a]	3.57[a]	3.30[a]	4.04[a]	5.77[b]	4.15[a]
Food craving	56.95[ab]	53.48[ab]	47.63[a]	52.00[ab]	69.39[c]	58.27[b]
Self-control	3.24[a]	3.24[a]	3.77[b]	3.36[ab]	2.94[a]	3.07[a]
Self-efficacy	8.36[ab]	9.17[a]	8.21[ab]	8.11[abc]	6.67[c]	7.65[bc]
Mood motivation	4.71	4.60	5.15	4.76	5.12	4.63
Convenience motivation	4.98	4.56	4.51	4.70	4.74	5.05
Sensory appeal motivation	5.30	5.04	5.06	4.92	5.21	5.42
Health motivation	5.15[a]	5.23[a]	5.85[b]	5.26[ab]	5.14[a]	5.05[a]
Natural content motivation	4.87[a]	4.76[a]	6.50[b]	5.15[a]	4.97[a]	4.63[a]
Price motivation	4.85	4.69	4.48	5.01	4.97	5.22
Weight control motivation	3.82[ac]	3.26[a]	3.04[a]	3.62[ac]	5.70[b]	4.03[c]
Ethical concern motivation	3.72	3.80	4.01	3.53	3.49	3.58
Familiarity motivation	3.53[abc]	3.10[a]	3.71[ab]	3.41[ab]	3.96[b]	4.09[b]

Mean scores with different superscripts are significantly different in Tukey HSD adjusted comparisons. HSD, honest significant difference.

Table 3 Mean scores of emotional well-being variables by diet group

	Vegetarian	Vegan	Paleo	Gluten free	Weight loss	Unrestricted diet (comparison group)
Self-esteem	3.58[a]	3.34[a]	3.66[a]	3.20[ab]	2.72[b]	3.42[a]
Depression	6.38	8.66	4.70	8.19	9.94	9.01
Anxiety	5.33	6.00	4.86	7.71	8.17	7.73
Stress	10.19	10.78	8.54	13.47	13.28	12.48
Negative affect	17.17[ab]	17.75[a]	14.81[b]	18.50[a]	19.72[a]	19.52[a]

Mean scores with different superscripts are significantly different in Tukey HSD adjusted comparisons. HSD, honest significant difference.

group ($M_{ED\ symptoms}$ = 1.50; $M_{emotional\ eating}$ = 2.97; $M_{dieting\ intentions}$ = 5.77; $M_{food\ craving}$ = 69.39) and lowest in the paleo group ($M_{ED\ symptoms}$ = 0.74; $M_{emotional\ eating}$ = 2.30; $M_{dieting\ intentions}$ = 3.30; $M_{food\ craving}$ = 47.63, respectively). Self-control similarly differed between groups, $F(5, 360)$ = 7.67, p = .001, and was highest in the paleo group (M = 3.77) and lowest in the weight loss group (M = 2.94). Diet self-efficacy also differed significantly between groups, $F(5, 364)$ = 9.78, $p < .001$, and was highest in the vegan group (M = 9.17) and lowest in the weight loss group (M = 6.67).

There was a significant difference between the diet groups on four of the diet motivation subscales. The paleo group was most likely to be motivated in their food choices by health, $F(5, 369)$ = 3.61, p = .003, and natural content, $F(5, 369)$ = 10.49, $p < .001$, and least likely to be motivated by weight control, $F(5, 369)$ = 18.50, $p < .001$ ($M_{health\ motivation}$ = 5.85; $M_{natural\ content\ motivation}$ = 6.50; $M_{weight\ control\ motivation}$ = 3.04). By contrast, the weight loss group was the most motivated by weight control (M = 5.70). The comparison group was most likely to motivated by familiarity, $F(5, 369)$ = 6.71, $p < .001$, and least likely to be motivated by health or natural content ($M_{familiarity\ motivation}$ = 4.09; $M_{health\ motivation}$ = 5.05; $M_{natural\ content\ motivation}$ = 4.63). The vegan group was least likely to be motivated by familiarity (M = 3.10).

In the domain of well-being (Table 3), the differences between groups tended to be smaller, although they followed the same overall pattern as seen for the eating attitudes and behaviours. There was a significant difference between the diet groups in self-esteem, $F(5, 363)$ = 3.66, p = .003, which was highest in the paleo group (M = 3.66) and lowest in the weight loss group (M = 2.72). There was also a significant difference between the groups in negative affect, $F(5, 350)$ = 2.97, p = .012, stress, $F(5, 356)$ = 2.51, p = .030, and depression, $F(5, 356)$ = 2.34, p = .042. In each case, well-being was highest in the paleo group ($M_{negative\ affect}$ = 14.81; M_{stress} = 8.54; $M_{depression}$ = 4.70). Comparably poor well-being was reported by the weight loss group ($M_{negative\ affect}$ = 19.72; $M_{depression}$ = 9.94) and to a lesser degree the gluten free group (M_{stress} = 13.47).

Discussion

This study investigated the psychological characteristics of five restrictive dietary patterns: vegetarian, vegan, gluten free, paleo and weight loss, as well as a comparison group following no restrictive dietary pattern. Overall, the weight loss diet group tended to be the most 'extreme' in its psychological characteristics, showing poorer psychological well-being and less healthy eating attitudes and behaviours, as well as lower self-control and self-efficacy. By contrast, the vegetarian, vegan and especially the paleo groups showed characteristics of relative psychological strength, including more helpful and health-motivated eating behaviours. The gluten free and comparison groups tended to fall in between the other restrictive dietary groups and the weight loss group in terms of their psychological characteristics.

The paleo group was the oldest of the groups with a mean age of 41.56 years and had the highest average BMI (26.70) and highest rate of obesity – this is consistent with the one extant survey of people following a paleo diet (44). Among the paleo group, 37% reported having a diet-related medical condition, and these participants reported the highest levels of health-related motivation for consuming their diet, as well as the highest motivation to consume natural foods. However, in stark contrast to the weight loss group, people following a paleo diet had an overall pattern of psychological health and healthy eating attitudes and behaviours. They reported significantly higher self-control and self-esteem and less negative affect and depression than the other groups. Interestingly, the paleo group was least likely to report a weight-control motivation for their dietary choices, which is in stark contrast to research on other fad diets (49).

Similar to people following a paleo diet, vegetarians showed a number of significant differences from the weight loss group, although these scores tended to be less extreme. In general, vegetarians had a low presence of medical conditions as well as characteristics of psychological health compared with the weight loss group. Their eating attitudes and behaviours were generally healthy, particularly in the areas of dieting intentions,

eating disorders, food cravings, self-esteem and self-efficacy. However, a striking feature of the vegetarian group was their overall remarkable similarity to the comparison group, differing significantly from this group *only* in their ethnic composition (fewer Asians). This suggests that it is not the specific act of restricting one's dietary pattern that is responsible for the psychological characteristics of weight loss dieters.

The vegan group recorded the highest number of participants of all the groups with 128 responses, despite receiving the same level of recruitment effort as other dietary patterns. This higher level of engagement may be because of the passionately held views on food choice in this community, with vegans viewing the survey as an opportunity to voice these views (33). The main variable that separated the vegan group from all others was high levels of diet self-efficacy. Having higher self-efficacy is indicative of increased confidence in being able to adhere to a diet and has been linked to better outcomes among weight loss dieters specifically (26). Vegan respondents also tended to have somewhat better psychological health than other groups, in terms of fewer eating disorder symptoms, lower levels of emotional eating and dieting intentions, less stress and reduced weight-control motivations. Vegans were also less motivated in their food choices by the familiarity of foods than other dietary groups.

People following a gluten free diet tended to fall in between weight loss dieters and the comparison group in their psychological characteristics. They were the second oldest and second heaviest of the groups (after paleo) and as expected had the highest level of diet-related medical conditions. Indeed, although some previous research has suggested that the gluten free diet is something of a 'fad' that many people follow for non-medical reasons (64), among this sample, the vast majority of people on a gluten free diet indicated they were motivated either by diagnosed coeliac disease, suspected but undiagnosed coeliac disease or gluten allergy or intolerance. The gluten free group was also 100% Caucasian, which may reflect ethnic differences in coeliac disease prevalence (65). As with the vegetarian group, there were almost no variables on which the gluten free group differed from the comparison group, although they had lower dieting intentions, eating disorder symptoms and food cravings than the weight loss dieters. The gluten free group did report the highest levels of stress, although this was not significantly different from the comparison group. Therefore, this study found little evidence of higher psychological distress among people following a gluten free diet, in contrast to some previous research (36).

Finally, the psychological characteristics of the weight loss group showed the greatest number of extreme and negative values compared with the other dietary groups. Generally, the weight loss group reported significantly lower psychological well-being and a greater presence of unhelpful eating attitudes and behaviours. In particular, the weight loss diet group had lower diet self-efficacy and higher dieting intentions, disordered eating behaviours, weight control motivation and food cravings compared with all the remaining diet groups and the comparison group. In comparison to some, although not all, of the other diet groups, the weight loss group also reported lower self-esteem, self-control and higher levels of stress, depression and emotional eating. The weight loss group were predominantly of healthy weight, and indeed their weight profile was comparable with the other dietary groups. These psychological characteristics are similar to previous findings in the literature (17,23–26), which has exclusively compared weight loss dieters to non-dieting comparison groups.

The most significant strength of this study was its inclusion of participants following five different restrictive diets and a comparison group following an unrestricted dietary pattern. This allowed for direct comparisons between groups, thus providing evidence that speaks to unresolved questions in the weight loss dieting literature in particular. For instance, the influential theory of dietary restraint has argued that although naturalistic dieting does not necessarily lead to prolonged caloric restriction (15,66), the cognitive effort required to effortfully restrict one's intake is a causal risk factors for disordered eating behaviours and poor well-being in chronic weight loss dieters (4). The evidence presented here indicates that the cognitive challenges of restrictive eating may not be the critical factor after all, as people on other kinds of restrictive diets such as vegetarian, vegan, paleo and gluten free (which are arguably more complex diets and thus require substantial and sustained cognitive effort) do not show similar psychological characteristics to those on a weight loss diet. Indeed, people on these alternative dietary patterns show an overall pattern of good psychological well-being and healthy eating attitudes and behaviours. In some cases, particularly among the paleo and vegan groups, the general pattern of psychological health was superior to the comparison group, which was unexpected and warrants further investigation.

As with any research, this study had a number of limitations. Firstly, the data is cross-sectional and so no causation can be inferred from these results. Nevertheless, some of the correlations found here make particular causal relationships previously proposed in the literature less likely (e.g. cognitive restraint causing disordered eating; vegetarianism being motivated by a desire for weight loss) and provide insight into unique and universal factors that influence diet. A further limitation was the unequal

sample sizes across groups. Greater numbers in each group would increase statistical power and the strength of conclusions.

Anecdotally, in recruiting for this study, it was found that some people following gluten free diets felt uncomfortable with the framing of this study in terms of the psychology of food choices, stating things such as 'my diet is not a choice'. By contrast, people following vegan diets not only enthusiastically completed the survey but were keen to assist in circulating it among their community. Similarly, women and young people were overrepresented in this sample, presumably because they were, on average, more interested in the psychology of food choices. Recruitment on university campus and via social media may also have lowered the average age of the sample and limits its generalizability to older populations with more lifestyle-related illness (e.g. cardiovascular disease). Finally, this study focused on naturalistic dietary patterns and so did not seek to distinguish between the different forms of weight loss dieting, or people's degree of adherence to the dietary pattern they nominated. Despite these limitations, as the first study to compare people on a variety of restrictive dietary patterns, this study represents a significant advance of knowledge in this domain.

This study was the first to explore the psychological characteristics of people following one of five different restrictive dietary patterns: vegetarian, vegan, gluten free, paleo and weight loss dieters, as well as a comparison group with an unrestricted pattern. The primary finding was that the weight loss group had more negative psychological characteristics than all other groups, whereas several of the other restrictive dietary groups (specifically, paleo and vegan) showed a number of psychological strengths, relative to the comparison group. By contrast, people following vegetarian and gluten free diets were largely the same as the unrestricted comparison group in their psychological characteristics. This study not only provides a starting point for new investigation of these under-researched dietary groups but also offers insights into ongoing debates about the origins and generalizability of the psychological risk factors associated with weight loss dieting.

Conflict of interest statement

The authors declare that they have no conflict of interest.

Author contributions

R. N. led the data collection and wrote the first draft of the manuscript. T. C. led the data analysis and the preparation of the manuscript for publication. All authors contributed to developing the research question, designing the study and editing the manuscript.

References

1. World Health Organization. Obesity and overweight, 2018. Retrieved from http://www.who.int/mediacentre/factsheets/fs311/en/

2. Haynes A, Kersbergen I, Sutin A, Daly M, Robinson E. A systematic review of the relationship between weight status perceptions and weight loss attempts, strategies, behaviours and outcomes. *Obesity Reviews* 2017; **19**: 347–363. http://doi.org/10.1111/obr.12634.

3. Lowe MR, Timko CA. Dieting: really harmful, merely ineffective or actually helpful? *British Journal of Nutrition* 2004; **92**: S19–S22. https://doi.org/10.1079/BJN20041136.

4. Polivy J, Herman CP. Dieting and binging: a causal analysis. *American Psychologist* 1985; **40**: 193–201. https://doi.org/10.1037/0003-066x.40.2.193.

5. Racine SE, Burt SA, Iacono WG, McGue M, Klump KL. Dietary restraint moderates genetic risk for binge eating. *Journal of Abnormal Psychology* 2011; **120**: 119–128. https://doi.org/10.1037/a0020895.

6. Leahy E, Lyons S, Tol RSJ. An estimate of the number of vegetarians in the world, ESRI working paper, 2010, No. 340.

7. Hyun-seok K, Patel KG, Orosz E, et al. Time trends in the prevalence of celiac disease and gluten free diet in the US population: results from the National Health and Nutrition Examination Surveys 2009-2014. *JAMA Internal Medicine* 2016; **176**: 1716–1717. http://doi.org/10.1001/jamainternmed.2016.5254.

8. Campbell K, Engel H, Timperio A, Cooper C, Crawford D. Obesity management: Australian general practitioners' attitudes and practices. *Obesity* 2000; **8**: 459–466. Retrieved from https://doi.org/10.1038/oby.2000.57.

9. Wadden TA, Foster GD, Letizia KA. One-year behavioral treatment of obesity: comparison of moderate and severe caloric restriction and the effects of weight maintenance therapy. *Journal of Consulting and Clinical Psychology* 1994; **62**: 165–171. https://doi.org/10.1037/0022-006X.62.1.165.

10. Garfinkel PE, Moldofsky H, Garner DM. The heterogeneity of anorexia nervosa: bulimia as a distinct subgroup. *Archives of General Psychiatry* 1980; **37**: 1036–1040. https://doi.org/10.1001/archpsyc.1980.01780220074008.

11. Heatherton TF, Polivy J, Herman CP. Restraint, weight loss, and variability of body weight. *Journal of Abnormal Psychology* 1991; **100**: 78–83. https://doi.org/10.1037/0021-843x.100.1.78.

12. Polivy J, Heatherton TF, Herman CP. Self-esteem, restraint, and eating behavior. *Journal of Abnormal Psychology* 1988; **97**: 354–356. https://doi.org/10.1037//0021-843x.97.3.354.

13. Cruwys T, Platow MJ, Rieger E, Byrne DG. The development and validation of the Dieting Intentions Scale (DIS). *Psychological Assessment* 2013; **25**: 264–278. https://doi.org/10.1037/a0030547.

14. Lowe MR, Butryn ML. Hedonic hunger: a new dimension of appetite? *Physiology & Behavior* 2007; **91**: 432–439. https://doi.org/10.1016/j.physbeh.2007.04.006.

15. Stice E, Fisher M, Lowe MR. Are dietary restraint scales valid measures of acute dietary restriction? Unobtrusive observational data suggest not. *Psychological Assessment* 2004; **16**: 51–59. https://doi.org/10.1037//1040-3590.16.1.51.

16. Granberg EM. "Now my 'old self' is thin": stigma exists after weight loss. *Social Psychology Quarterly* 2011; **74**: 29–52. https://doi.org/10.1177/0190272511398020.

17. Neumark-Sztainer D, Wall M, Guo J, Story M, Haines J, Eisenberg M. Obesity, disordered eating, and eating disorders in a longitudinal study of adolescents: how do dieters fare 5 years later? *Journal of the American Dietetic Association* 2006; **106**: 559–568. http://doi.org/10.1016/j.jada.2006.01.003.

18. Stice E. A prospective test of the dual-pathway model of bulimic pathology: mediating effects of dieting and negative affect. *Journal of Abnormal Psychology* 2001; **110**: 124–135. https://doi.org/10.1037//0021-843X.110.1.124.

19. McGuire MT, Wing RR, Klem ML, Lang W, Hill JO. What predicts weight regain in a group of successful weight losers? *Journal of Consulting and Clinical Psychology* 1999; **67**: 177–185. https://doi.org/10.1037/0022-006X.67.2.177.

20. Brantley P, Stewart D, Myers V, et al. Psychosocial predictors of weight regain in the weight loss maintenance trial. *Journal of Behavioral Medicine* 2014; **37**: 1155–1168. https://doi.org/10.1007/s10865-014-9565-6.

21. Elfhag K, Rossner S. Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain. *Obesity Reviews* 2005; **6**: 67–85. https://doi.org/10.1111/j.1467-789X.2005.00170.x.

22. Klem ML, Wing RR, McGuire MT, Seagle HM, Hill JO. Psychological symptoms in individuals successful at long-term maintenance of weight loss. *Health Psychology* 1998; **14**: 336–345. https://doi.org/10.1037/0278-6133.17.4.336.

23. Canetti L, Berry EM, Elizur Y. Psychosocial predictors of weight loss and psychological adjustment following bariatric surgery and a weight loss program: the mediating role of emotional eating. *International Journal of Eating Disorders* 2009; **42**: 109–117. https://doi.org/10.1002/eat.20592.

24. Kemp E, Bui M, Grier S. When food is more than nutrition: understanding emotional eating and overconsumption. *Journal of Consumer Behaviour* 2013; **12**: 204–213. https://doi.org/10.1002/cb.1413.

25. Leehr EJ, Krohmer K, Schag K, Dresler T, Zipfel S, Giel KE. Emotion regulation model in binge eating disorder and obesity – a systematic review. *Neuroscience and Biobehavioural Reviews* 2015; **49**: 125–134. https://doi.org/10.1016/j.neubiorev.2014.12.008.

26. Shimpo M, Fukkoshi Y, Akamatsu R. Correlations between self-efficacy in resisting six temptations and dietary energy and macronutrient intake at each meal. *Eating Behaviours* 2014; **15**: 563–566. https://doi.org/10.1016/j.eatbeh.2014.08.012.

27. Stice E, Martinez EE, Presnell K, Groesz LM. Relation of successful dietary restriction to change in bulimic symptoms: a prospective study of adolescent girls. *Health Psychology* 2006; **25**: 274–281. https://doi.org/10.1037/0278-6133.25.3.274.

28. Schaumberg K, Anderson DA, Anderson LM, Reilly EE, Gorrell S. Dietary restraint: what's the harm? A review of the relationship between dietary restraint, weight trajectory and the development of eating pathology. *Clinical Obesity* 2016; **6**: 89–100. http://doi.org/10.1111/cob.12134.

29. Ruby MB. Vegetarianism. A blossoming field of study. *Appetite* 2012; **58**: 141–150. https://doi.org/10.1016/j.appet.2011.09.019.

30. Fox N, Ward KJ. You are what you eat? Vegetarianism, health and identity. *Social Science & Medicine* 2008; **66**: 2585–2595. https://doi.org/10.1016/j.socscimed.2008.02.011.

31. Martins Y, Pliner P, O'Connor R. Restrained eating among vegetarians: does a vegetarian eating style mask concerns about weight? *Appetite* 1999; **32**: 145–154. http://doi.org/10.1006/appe.1998.0185.

32. Baines S, Powers J, Brown W. How does the health and well-being of young Australian vegetarian and semi-vegetarian women compare with non-vegetarians? *Public Health Nutrition* 2007; **10**: 436–442. https://doi.org/10.1017/S1368980007217938.

33. Cherry E. I was a teenage vegan: motivation and maintenance of lifestyle movements. *Sociological Inquiry* 2015; **85**: 55–74. https://doi.org/10.1111/soin.12061.

34. Holmes GKT, Prior P, Lane MR, Pope D, Allan RN. Malignancy in coeliac disease – effect of a gluten free diet. *Gut* 1989; **30**: 333–338.

35. Hall NJ, Rubin G, Charnock A. Systematic review: adherence to a gluten free diet in adult patients with coeliac disease. *Alimentary Pharmacology and Therapeutics* 2009; **30**: 315–330. http://doi.org/10.1111/j.1365-2036.2009.04053.x.

36. Smith DF, Gerdes LU. Meta-analysis on anxiety and depression in adult celiac disease. *Acta Psychiatrica Scandinavica* 2012; **125**: 189–193. https://doi.org/10.1111/j.1600-0447.2011.01795.x.

37. Cossu G, Carta MG, Contu F, et al. Coeliac disease and psychiatric comorbidity: epidemiology, pathophysiological mechanisms, quality-of-life, and gluten free diet effects. *International Review Of Psychiatry (Abingdon, England)* 2017; **29**: 489–503. https://doi.org/10.1080/09540261.2017.1314952.

38. Wolf RL, Lebwohl B, Lee AR, et al. Hypervigilance to a gluten free diet and decreased quality of life in teenagers and adults with celiac disease. *Digestive Diseases and Sciences* 2018; **63**: 1438–1448. https://doi.org/10.1007/s10620-018-4936-4.

39. Rose C, Howard R. Living with coeliac disease: a grounded theory study. *Journal of Human Nutrition and Dietetics* 2013; **27**: 30–40. https://doi.org/10.1111/jhn.12062.

40. Ford S, Howard R, Oyebode J. Psychosocial aspects of coeliac disease: a cross-sectional survey of a UK population. *British Journal of Health Psychology* 2012; **17**: 743–757. https://doi.org/10.1111/j.2044-8287.2012.02069.x.

41. Di Sabatino A, Volta U, Salvatore C, et al. Small amounts of gluten in subjects with suspected nonceliac gluten sensitivity: a randomized, double-blind, placebo-controlled, cross-over trial. *Clinical Gastroenterology and Hepatology* 2015; **13**: 1604, e3–1612. http://doi.org/10.1016/j.cgh.2015.01.029.

42. Zanini B, Marullo M, Ricci C, Lanzarotto F, Lanzini A. Non celiac gluten sensitivity (NCGS) is outnumbered by FODMAPs sensitivity in patients spontaneously adhering to gluten free diet (GFD): a two stage double blind prospective study. *Gastroenterology* 2014; **146**: S-348.

43. Golley S, Corsini N, Topping D, Morell M, Mohr P. Motivations for avoiding wheat consumption in Australia: results from a population survey. *Public Health Nutrition* 2015; **18**: 490–499. https://doi.org/10.1017/S1368980014000652.

44. Schwartz DB, Stapell HM. Modern cavemen? Stereotypes and reality of the ancestral health movement. *Journal of Evolution and Health* 2013; **1**: 3.

45. Cordain L, Eaton SB, Sebastian A, et al. Origins and evolution of the Western diet: health implications for the 21st century. *American Journal of Clinical Nutrition* 2005; **81**: 341–354.

46. Mellberg C, Sandberg S, Ryberg M, Eriksson M, Brage S. Long-term effects of a Palaeolithic-type diet in obese postmenopausal women: a two-year randomized trial. *European Journal of Clinical Nutrition* 2014; **68**: 350–357. http://doi.org/10.1038/ejcn.2013.290.Long-term.

47. Tarantino G, Citro V, Finelli C. Hype or reality: should patients with metabolic syndrome-related NAFLD be on the hunter-gatherer (paleo) diet to decrease morbidity? *Journal of Gastrointestinal and Live Diseases* 2015; **24**: 359–368. http://doi.org/10.15403/jgld.2014.1121.243.gta.

48. Pitt CE. Cutting through the Paleo hype: the evidence for the Palaeolithic diet. *Australian Family Physician* 2016; **45**: 35–38.

49. Banjari I, Kenjeric D, Mandic M, Nedekjko M. Is fad diet a quick fix? An observational study in a Croatian student group. *Periodicum Biologorum* 2011; **113**: 377–381.

50. Epiphaniou E, Ogden J. Successful weight loss maintenance and a shift in identity: from restriction to a new liberated self. *Journal of Health Psychology* 2010; **15**: 887–896. https://doi.org/10.1177/1359105309358115.

51. Friborg O, Clausen L, Rosenvinge JH. A five-item screening version of the Eating Disorder Inventory (EDI-3). *Comprehensive Psychiatry* 2013; **54**: 1222–1228. https://doi.org/10.1016/j.comppsych.2013.05.004.

52. Van Strien T, Frijters JER, Bergers GPA, Defares PB. The Dutch Eating Behaviour Questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behaviour. *International Journal of Eating Disorders* 1986; **5**: 295–315. https://doi.org/10.1002/1098-108X(198602)5:2%3C295::AID-EAT2260050209%3E3.0.CO;2-T.

53. Nijs IMT, Franken IHA, Muris P. The modified Trait and State Food-Cravings Questionnaires: development and validation of a general index of food craving. *Appetite* 2007; **49**: 38–46. https://doi.org/10.1016/j.appet.2006.11.001.

54. Steptoe A, Pollard TM, Wardle J. Development of a measure of the motives underlying the selection of food: the food choice questionnaire. *Appetite* 1995; **25**: 267–284. https://doi.org/10.1006/appe.1995.0061.

55. Hoeppner BB, Kelly JF, Urbanoski KA, Slaymaker V. Comparative utility of a single-item vs. multiple-item measure of self-efficacy in predicting relapse among young adults. *Journal of Substance Use and Treatment* 2011; **41**: 305–312. https://doi.org/10.1016/j.jsat.2011.04.005.

56. Grenen E, Kent EE, Hennessy E, Hamilton JG, Ferrer RA. Association between nutrition resource stress and dietary consumption: results from a U.S. nationally representative survey. *Health Education and Behavior* 2018; **45**: 524–531. https://doi.org/10.1177/1090198117741940.

57. Tangney JP, Baumeister RF, Boone AL. High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality* 2004; **72**: 271–324. https://doi.org/10.1111/j.0022-3506.2004.00263.x.

58. Robins RW, Hendin HM, Trzesniewski KH. Measuring global self-esteem: construct validation of a single-item measure and the Rosenberg Self-Esteem Scale. *Personality and Social Psychology Bulletin* 2001; **27**: 151–161. https://doi.org/10.1177/0146167201272002.

59. O'Brien K, Venn BJ, Perry T, et al. Reasons for wanting to lose weight: different strokes for different folks. *Eating Behaviors* 2007; **8**: 132–135. https://doi.org/10.1016/j.eatbeh.2006.01.004.

60. Lovibond PF, Lovibond SH. The structure of negative emotional states: comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy* 1995; **33**: 335–343. https://doi.org/10.1016/0005-7967(94)00075-U.

61. Henry JD, Crawford JR. The short-form version of the Depression Anxiety Stress Scales (DASS-21): construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology* 2005; **44**: 227–239. https://doi.org/10.1348/014466505X29657.

62. Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology* 1988; **54**: 1063. https://doi.org/10.1037/0022-3514.54.6.1063–1070.

63. Jaccard J, Becker MA, Wood G. Pairwise multiple comparison procedures: a review. *Psychological Bulletin* 1984; **96**: 589–596. https://doi.org/10.1037/0033-2909.96.3.589.

64. Reilly NR. The gluten free diet: recognizing fact, fiction, and fad. *The Journal of Pediatrics* 2016; **175**: 206–210. http://doi.org/10.1016/j.jpeds.2016.04.014.

65. Rubio-Tapia A, Ludvigsson JF, Murray JA, Everhart JE. The prevalence of celiac disease in the United States. *American Journal of Gastroenterology* 2012; **107**: 1538–1544. https://doi.org/10.1038/ajg.2012.219.

66. Stice E, Cooper JA, Schoeller DA, Tappe K, Lowe MR. Are dietary restraint scales valid measures of moderate-to long-term dietary restriction? Objective biological and behavioral data suggest not. *Psychological Assessment* 2007; **19**: 449–458. https://doi.org/10.1037/1040-3590.19.4.449.