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A longitudinal study of perfectionism and orthorexia in exercisers

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ABSTRACT

Research suggests that trait perfectionism and perfectionistic self-presentation are related to orthorexia – a pathological obsession with correct nutrition. However, no studies have examined these relationships over time or compared the influence of the two aspects of perfectionism on orthorexia. In the present study we sought to address these two issues. Gym members who engaged in high degrees of exercise were recruited via social media platforms. They completed an online questionnaire that included the Multidimensional Perfectionism Scale-Short Form, Perfectionistic Self-Presentation Scale, and the Eating Habits Questionnaire on two occasions: 177 participants (Mean age = 31.6 years) initially completed the questionnaire and 82 completed the questionnaire six weeks later. A series of multiple regression analyses revealed that (i) trait perfectionism predicted an increase in orthorexia symptomatology over time with socially prescribed perfectionism and other-oriented perfectionism unique predictors of orthorexia, (ii) perfectionistic self-presentation predicted orthorexia over time with non-display of imperfection a unique predictor of orthorexia, and (iii) when considered alongside each other, only trait dimensions of perfectionism were unique predictors of orthorexia. The present study provides further evidence that perfectionism is related to orthorexia. In addition, the study also provides preliminary evidence that more engrained trait aspects of perfectionism are more predictive of orthorexia over time than the self-presentational aspects of perfectionism.

1. Introduction

Diet is an important aspect of maintaining a healthy lifestyle. A healthy diet is associated with longevity and reduced risk of diseases, such as cancer, heart disease, and diabetes (McComb & Mills, 2019). However, because pressures to eat, exercise, and look a certain way pervade modern society (e.g., Braun, Park, & Gorin, 2016), there is evidence that an obsession with healthy eating – known as orthorexia – is on the rise (Plichta & Jezewska-Zychowicz, 2019). In the present study, we aimed to further understand the factors implicated in the development of orthorexia and do so by focusing on perfectionism. To build on previous research, we provide the first test of (i) whether trait perfectionism predicts orthorexia over time, (ii) whether perfectionistic self-presentation predicts orthorexia over time, and (iii) whether trait perfectionism or perfectionistic self-presentation is most important in predicting orthorexia over time.

1.1. Orthorexia

Orthorexia is a pathological obsession with correct nutrition that is characterised by restrictive dietary practices, ritualised patterns of eating, and rigid avoidance of foods believed to be unhealthy or impure (Koven & Abry, 2015). Orthorexia was first defined by physician Steven Bratman (1997) and is derived from a Greek neologism (ὀρθός, right and ὄρεξις, appetite) meaning "correct appetite." Orthorexia is not officially recognized as an eating disorder or obsessive-compulsive classification in either the DSM-5 or the ICD-11. However, diagnostic criteria have been proposed by Dunn and Bratman (2016) based on an extensive review of research, existing criteria, case studies, and available measures. The narrative description of orthorexia he provides is of an "Obsessive focus on 'healthy' eating, as defined by a dietary theory or set of beliefs whose specific details may vary; marked by exaggerated emotional distress in relationship to food choices perceived as unhealthy; weight loss may ensue as a result of dietary choices, but this is not the primary goal" (p. 16).

The exclusion of orthorexia from the DSM-5 and ICD-11 reflects uncertainty in whether orthorexia is an antecedent, a maintaining factor, or a consequence of eating disorders (Brytek-Matera, Plasonja, & Décamps, 2020). Some of the possibilities include that orthorexia is a subthreshold eating disorder or becomes evident in recovery from an

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eating disorder (Bartel, Sherry, Farthing, & Stewart, 2020). Alternatively, orthorexia may be a distinct eating disorder itself or be indictive of an existing eating disorder with particular and additional symptoms (e.g., claiming health reasons to camouflage restrictive eating behaviour; Bartel et al., 2020). Work is ongoing to resolve this uncertainty. At this point, it seems that ascribing orthorexia solely to anorexia nervosa would be a misnomer and that orthorexia is relevant in clinical domains.

There are a number of ways to measure orthorexia. In the current study we use Gleaves, Graham, and Ambwani (2013) multidimensional model of orthorexia. This captures orthorexia via three dimensions. The first is *problems associated with healthy eating* that measures behaviours linked with a pathological fixation with healthy eating. The second is *knowledge of healthy eating,* which assesses cognitions associated with an obsessive fixation of healthy eating. The third is *feeling positively about healthy eating* that measures feelings related to a morbid preoccupation with healthy eating. All orthorexia dimensions have been related to eating disorder symptomology (e.g., Brytek-Matera et al., 2020). The use of this particular measure is advantageous as there is strong evidence that orthorexia is multidimensional whereas most other measures are unidimensional or bidimensional (Hallit, Brytek-Matera, & Obeid, 2021).

In regard to the development of orthorexia, a growing number of studies have identified factors that place people at risk to higher orthorexia scores. These include personal factors (e.g., depressive symptoms; Lasson & Raynal, 2021) and lifestyle factors (e.g., yoga practice; Zickgraf & Barrada, 2022). Of note for the current study, research suggests that personality is important with neuroticism and narcissism positively correlated with orthorexia (e.g., Martinovic, Tokic, Martinovic, Rakusic, et al., 2022; Strahler, 2020). Exercise engagement (participation and frequency), too, continues to be positively correlated with orthorexia in research (e.g., Martinovic, Tokic, Martinovic, Rakusic, et al., 2022). This includes exercise addiction or dependence which suggests that exercise is a salient context in which to study orthorexia and identify risk factors (Strahler, Wachten, & Mueller-Alcazar, 2021). In the present study we build on this research by focusing on aspects of perfectionism as risk factors to orthorexia in regular exercisers.

1.2. Trait perfectionism and orthorexia

Trait perfectionism is characterised by setting high standards of performance and overly critical self-evaluation (Frost, Marten, Lahart, & Rosenblate, 1990). As a trait, it represents a stable and engrained way of thinking, feeling, and behaving. One of the most prominent models of trait perfectionism is provided by Hewitt and Flett (1991). This model differentiates between three dimensions of trait perfectionism: self-oriented perfectionism (demanding perfection from oneself), socially prescribed perfectionism (believing others expect perfection from oneself), and other-oriented perfectionism (demanding perfection from others). The two former dimensions are intrapersonal aspects of perfectionism (i.e., focused on the self), while the latter is an interpersonal aspect of perfectionism (i.e., focused on others).

Trait perfectionism has long been recognized as a risk factor for eating disorders, with several models including it (e.g., Fairburn's transdiagnostic model of eating disorders; Fairburn, Cooper, & Shafran, 2003). Evidence of the relationship between trait perfectionism and eating disorders has been provided a meta-analysis by Limburg, Watson, Hagger, and Egan (2017) who found that perfectionistic strivings (inclusive of self-oriented perfectionism) had a positive, small-to-medium, relationship (based on Cohen's [1992] benchmarks of small, $r \geq .10$, medium, $r \geq 0.30$, and large, $r \geq 0.50$) with both anorexia nervosa and bulimia nervosa. They also found that perfectionistic concerns (inclusive of socially prescribed perfectionism) had a positive, large, relationship with anorexia nervosa and a positive, medium, relationship with bulimia nervosa. Self-oriented perfectionism and socially prescribed perfectionism have also been found to be positively related to eating disorders themselves (e.g., Stoeber, Madigan, Damian, Esposito, & Lombardo, 2017).

As unrealistically high standards and self-critical appraisals guide behaviour in trait perfectionism, it is possible that they play a role in orthorexia if their focus becomes a healthy diet (viz. orthorexia). Popular commentary has even characterised orthorexia as the pursuit of the "perfect diet" (Schwartz, 2015). In regard to empirical evidence, consistent with what has been found for eating disorders, there is an emerging body of research that links trait perfectionism with orthorexia. To date, two of these studies have used Hewitt and Flett's (1991) measures of trait perfectionism to examine the relationship between trait perfectionism and orthorexia (Barnes & Caltabiano, 2017; Myrissa, Jackson, & Kelaiditi, 2021). Both studies found evidence that these dimensions of trait perfectionism have positive, small-to-medium, relationships with orthorexia (for Barnes & Caltabiano, 2017, all dimensions, and for Myrissa et al. (2021), just other-oriented perfectionism).

1.3. Perfectionistic self-presentation and orthorexia

Perfectionism can also manifest as a self-presentational style. Perfectionistic self-presentation is conceptually distinct from trait perfectionism as it focuses on a need to *appear perfect* in the eyes of others rather than *be perfect* (Sherry, Hewitt, Flett, Lee-Baggley, & Hall, 2007). Hewitt et al. (2003) conceptualised perfectionistic self-presentation as three distinct dimensions of perfectionistic self-promotion (promoting a perfect image of oneself to others), nondisplay of imperfection (avoidance of behavioural displays of imperfection), and nondisclosure of imperfection (avoidance of verbal disclosure of imperfection; Sherry et al., 2007). All perfectionistic self-presentation dimensions are interpersonal in focus. In distinguishing between trait perfectionism and perfectionistic self-presentation, a further useful distinction is that trait perfectionism captures who people are, whereas perfectionistic self-presentation captures how people would like to be viewed.

Like trait perfectionism, perfectionistic self-presentation is associated with various adverse mental health outcomes (Hewitt et al., 2003). Relevant to the current study is work that evidences that perfectionistic self-presentation is positively related to eating disorder symptoms, body image, and exercise dependence (e.g., Ferreira, Duarte, Pinto-Gouveia, & Lopes, 2018; Paixão, Oliveira, & Ferreira, 2020; Hill, Robson, & Stamp, 2015). Importantly, there is also research that has shown all dimensions of perfectionistic self-presentation to predict eating disorder symptomatology (i.e., dieting, bulimia, and oral control) alongside trait perfectionism (Stoeber et al., 2017). As such, perfectionistic self-presentation may be an important risk factor for eating disorders, and possibly orthorexia, independent of trait perfectionism.

There are reasons to suspect that perfectionistic self-presentation may be particularly important in the development of orthorexia. This is because the potential for the need to appear perfect to others to include the body and dietary practices – looking the "right" way and appearing to make the "right" choices. To date, one study has examined the relationship between perfectionistic self-presentation and orthorexia. In this study, Pratt, Madigan, and Hill (2021) found that two dimensions of perfectionistic self-presentation – perfectionistic self-promotion and nondisplay of imperfection – were positively related to orthorexia in exercisers with perfectionistic self-promotion the strongest unique predictor. Accordingly, in the same way that wanting to be perfect (trait perfectionism) is linked to increased orthorexia, so is wanting to appear perfect (perfectionistic self-presentation).

1.4. Trait perfectionism, perfectionistic self-presentation, and orthorexia

The present study extends previous research in three ways. First, all previous studies examining trait perfectionism and orthorexia, and perfectionistic self-presentation and orthorexia, have been cross-

sectional in design. However, longitudinal designs are required in order to introduce temporal precedence, examine prediction over time, and provide stronger evidence for causation (Wang et al., 2017). Second, as yet, no studies examine whether trait perfectionism or perfectionistic presentational style is more important in predicting orthorexia. While the two aspects are distinct, they are positively related, which makes identifying their particular importance more difficult. In practical terms, this will help identify whether interventions should focus on addressing trait perfectionism, perfectionistic presentational styles, or both. Third, to date, research examining the aforementioned relationships has largely relied on unidimensional measures of orthorexia and has been unable to examine whether different symptoms have different predictors.

1.5. The present study

The aim of the present study was to provide the first test of (i) whether trait perfectionism predicts orthorexia over time, (ii) whether perfectionistic self-presentation predicts orthorexia over time, and (iii) whether trait perfectionism or perfectionistic self-presentation is most important at predicting orthorexia over time. It was hypothesised that both trait perfectionism dimensions and perfectionistic self-presentational dimensions would predict orthorexia over time but, with a focus on how one appears to others, perfectionistic self-presentation would be the most important predictor of orthorexia over time.

2. Methods

2.1. Participants and procedure

Approval was gained from an Institutional Ethics Review Board for the study and informed consent was obtained from all participants prior to taking part. The study was advertised via social media platforms over a period of two months (September to November 2021). After responding to the advertisement, a sample of 177 exercisers completed an online questionnaire at Time 1 (T1) and later 82 exercisers also completed an online questionnaire at Time 2 (T2). All participants were members of community and private gyms and had backgrounds in past/current gym-based sports (e.g., Strongman, CrossFit, Bodybuilding) (see Table 1 for participant information). Participants were administrated measures twice six weeks apart, once in February 2021 (T1) and then again in March 2021 (T2). A 6-week interval was chosen based on previous longitudinal research examining eating disorders over a similar time period (e.g., Puccio, Fuller-Tyszkiewicz, Buck, & Krug, 2019; Mackinnon et al., 2011; Smith et al., 2017). Note, during this time, all participants remained members of gyms but were training from home due to UK restrictions placed on these facilities as a consequence of COVID-19. No a priori power analysis was conducted. Sample size was determined by response rates during the recruitment period.

Table 1
Participant information.

	Time 1	Time 2
N	177	82
Mean Age (years)	31.6 (*SD* = 7.9)	31.2 (*SD* = 8.4)
Average Weight (kg)	82.5 (*SD* = 21.3)	82.9 (*SD* = 19.9)
Average Height (cm)	173.6 (*SD* = 10.0)	172.8 (*SD* = 21.4)
Average minutes of exercise (per day)	60 - 90	60 - 90
Average number of times attended the gym (per week)	5 - 6	5 - 6
Male (N)	109	52
Female (N)	68	29

Note. There was one missing response for gender at time 2.

2.2. Measures

2.2.1. Trait perfectionism

To measure trait perfectionism, we used the short form of the Multidimensional Perfectionism Scale (MPS; Hewitt & Flett, 1991; short form: Cox, Enns, & Clara, 2002). The MPS short form (Cox et al., 2002) is a 15-item self-reported questionnaire that captures self-oriented (SOP; 5 items; e.g., "I am perfectionistic in setting my goals"), other-oriented (OOP; 5 items; e.g., "I do not have very high standards for those around me," reverse-scored), and socially prescribed perfectionism (SPP; 5 Items; e.g., "People expect nothing less than perfection from me"). Responses are scored on a 7-point Likert scale from 1 (disagree) to 7 (agree). There is evidence for the validity and reliability of the short form MPS including better factorial validity than the original 45-item MSP and acceptable internal consistency (Stoeber, 2015).

2.2.2. Perfectionistic self-presentation

To measure perfectionistic self-presentation, we used the Perfectionistic Self-Presentation Scale (PSPS; Hewitt et al., 2003). The PSPS is a 27-items self-reported questionnaire that measures the three facets of perfectionistic self-presentation. These include perfectionistic self-promotion (PSP; 10 items; "I strive to look perfect to others"), nondisplay of imperfection (ND; 10 items; "I hate to make errors in public"), and nondisclosure of imperfection (NDCI; 7 items; "Admitting failure to others is the worst possible thing"). Responses are scored on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). There is evidence for the validity and reliability of the PSPS including factor structure, test-retest reliability, and internal consistency (Hewitt et al., 2003).

2.2.3. Orthorexia

To measure orthorexia, we used the Eating Habits Questionnaire (EHQ; Gleaves et al., 2013). The EHQ is a 21-item self-reported questionnaire and combines three different factors: Knowledge of healthy eating (5 items, e.g., "I am more informed about healthy eating than others"), Problems associated with healthy eating (12 items, e.g., "I am distracted by thought about healthy eating"), and Positive feelings about healthy eating (4 items, e.g., "I feel great when I eat healthily"). Responses are scored on a 4-point Likert-type scale from 1 (false) to 4 (very true). There is evidence for the validity and reliability of the EHQ including factor structure, test-retest reliability, and internal consistency (Brytek-Matera et al., 2020).

2.3. Data analysis strategy

Following preliminary analyses, descriptive statistics, internal consistency (McDonald's Omega), and bivariate correlations were calculated. We ran three series of multiple regressions. First, we ran a series of multiple regressions to examine whether Time 2 orthorexia dimensions were predicted by Time 1 trait perfectionism dimensions. Second, we then tested to see whether Time 2 orthorexia dimensions were predicted by Time 1 perfectionistic self-presentation dimensions using a second series of multiple regressions. Third, we entered all perfectionism dimensions simultaneously in a final series of multiple regressions to assess whether Time 2 orthorexia dimensions were better predicted by Time 1 trait perfectionism dimensions or Time 1 perfectionistic self-presentation dimensions. These analyses allow us to examine whether aspects of perfectionism predict variability in later orthorexia scores once initial scores have been controlled for. The statistical analyses were not pre-registered.

3. Results

3.1. Preliminary analyses

We inspected the data for missing values. Because there were few

missing responses ($i = 2$), the missing values were replaced with the average of the remaining items. Then, the data were screened for univariate and multivariate outliers. No participant showed a Z score $> \pm 3.29$ or Mahalanobis distance larger than the critical value of χ^2 (9) = 27.88, $p < .001$ (Tabachnick & Fidell, 2007). Next, we computed McDonald's Omega for our variables (see Table 3) which were all satisfactory.

3.2. Descriptive statistics and bivariate correlations

Descriptive statistics and bivariate correlations are reported in Tables 2 and 3. In regards to descriptive statistics, note there are currently no clear cut-offs or thresholds that are diagnostically meaningful for orthorexia. However, levels of orthorexia for the current sample would be considered in the low-to-moderate range based on the response format, and depending on the particular aspect. The levels reported here are similar to those reported by others in similar samples (e.g., Domingues & Carmo, 2021). Comparing Time 1 and Time 2 means and 95% CI, there were no statistically significant differences in reported orthorexia between the time points (at overall group level). Note, this does not preclude examination of residual variation between individuals' later orthorexia (once we have controlled for initial scores). In regards to bivariate correlations, at Time 1, knowledge was positively related to SOP and OOP; problems were positively related to all dimensions of trait perfectionism and perfectionistic self-presentation; and positive feelings was positively related to SOP, SPP, and OOP. At Time 2, knowledge was positively related to SOP, OOP, PSP and NDCI. Problems was positively related to SOP, OOP, PSP and NDCI, and positive feelings was positively related to SOP, OOP, PSP and NDCI.

3.2.1. Longitudinal multiple regressions

A series of multiple regressions were carried out to examine whether perfectionism predicts orthorexia over time (see Tables 4 – 6).

In the first series of multiple regressions, we entered Time 1 trait perfectionism dimensions (self-oriented perfectionism, other-oriented perfectionism, and socially prescribed perfectionism) to examine whether they predict Time 2 orthorexia dimensions, while controlling for Time 1 orthorexia (knowledge, problems, and positive feelings). All three models were statistically significant and accounted for 39.9%–69.1% of variance in orthorexia dimensions. Problems and positive feelings at Time 2 were significantly predicted by orthorexia and other-oriented perfectionism at Time 1. Knowledge at Time 2 was significantly predicted by orthorexia and socially prescribed perfectionism at Time 1.

In the second series of multiple regressions, we simultaneously entered Time 1 perfectionistic self-presentation dimensions (perfectionistic self-promotion, nondisplay of imperfection and nondisclosure of imperfection) to examine whether they predict separate Time 2 orthorexia dimensions, while controlling for Time 1 levels (knowledge, problems, and positive feelings). All three models were statistically significant and accounted for 35.1%–67.4% of variance in orthorexia. Knowledge, and positive feelings at Time 2 were significantly predicted by orthorexia at Time 1. Problems at Time 2 was significantly predicted by orthorexia at Time 1 and nondisplay of imperfection at Time 1.

In the third series of multiple regressions, we entered Time 1 trait perfectionism dimensions (self-oriented perfectionism, other-oriented perfectionism, and socially prescribed perfectionism) and Time 1 perfectionistic self-presentation dimensions (perfectionistic self-promotion, nondisplay of imperfection and nondisclosure of imperfection) to examine whether they predict separate Time 2 orthorexia dimensions, while controlling for Time 1 orthorexia (knowledge, problems, and positive feelings). All three models were statistically significant and accounted for 39.5%–69.2% of variance in orthorexia. Problems and positive feelings at Time 2 were significantly predicted by orthorexia at Time 1 and other-oriented perfectionism at Time 1. Knowledge at Time 2 was significantly predicted by orthorexia and socially prescribed perfectionism at Time 1.

4. Discussion

The aim of the present study was to provide the first test of (i) whether trait perfectionism predicts orthorexia over time, (ii) whether perfectionistic self-presentation predicts orthorexia over time, and (iii) whether trait perfectionism or perfectionistic self-presentation is most important at predicting orthorexia over time. We found that some dimensions of trait perfectionism (other-oriented perfectionism and socially prescribed perfectionism) and perfectionistic self-presentation (nondisplay of imperfection) predicted orthorexia symptomatology over time. In addition, we found that trait perfectionism (other-oriented perfectionism and socially prescribed perfectionism), and not perfectionistic self-presentation, was the most important predictor of orthorexia over time.

4.1. Trait perfectionism and orthorexia

The results support previous research on the relationship between trait perfectionism and orthorexia, as well as extend our understanding of this relationship. In the first study to examine the relationship between these dimensions of perfectionism and orthorexia, Barnes and Caltabiano (2017) found all three dimensions of perfectionism to be related to higher orthorexia. In keeping with this study, we also found that trait dimensions of perfectionism are generally related to higher orthorexia. However, in extending previous research, we show that these relationships vary depending on the dimensions of orthorexia measured. Here, self-oriented perfectionism and other-oriented perfectionism were typically related to higher orthorexia across all its dimensions (problems associated with healthy eating, knowledge of healthy eating, and feeling positively about healthy eating) whereas socially prescribed perfectionism tended to be related only to problems

Table 2
Means, 95% confidence intervals, and standard deviations.

		Time 1 (all)				*Time 1 (completers)*				*Time 2*			
Variable	Response Format	N	Mean	95% CI	SD	N	Mean	95% CI	SD	N	Mean	95% CI	SD
Knowledge	1 to 4	177	2.75	[2.65, 2.85]	0.67	82	2.70	[2.55, 2.86]	0.70	82	2.62	[2.48, 2.77]	0.65
Problems	1 to 4	177	1.80	[1.72, 1.87]	0.52	82	1.73	[1.64, 1.83]	0.43	82	1.67	[1.58, 1.76]	0.43
Positive feel.	1 to 4	177	3.14	[3.06, 3.23]	0.60	82	3.11	[2.98, 3.24]	0.60	82	3.08	[2.96, 3.20]	0.55
SOP	1 to 7	177	4.44	[4.23, 4.65]	1.40	82	4.34	[4.01, 4.66]	7.43	82	4.39	[4.27, 4.70]	1.43
OOP	1 to 7	177	3.64	[3.45, 3.82]	1.23	82	3.51	[3.23, 3.79]	6.36	82	3.62	[3.35, 3.89]	1.23
SPP	1 to 7	177	3.15	[3.34, 3.87]	1.18	82	3.33	[3.09, 3.56]	5.34	82	3.58	[3.33, 3.83]	1.13
PSP	1 to 7	177	3.63	[3.44, 3.82]	1.29	82	3.57	[3.27, 3.87]	1.37	82	3.71	[3.43, 4.00]	1.30
ND	1 to 7	177	3.80	[3.59, 4.01]	1.41	82	3.68	[3.36.4.00]	1.47	82	3.76	[3.45, 4.07]	1.40
NDCI	1 to 7	177	3.02	[2.85, 3.19]	1.16	82	2.95	[2.69, 3.20]	1.17	82	3.15	[2.89, 3.41]	1.17

Note. Time 1 N = 177, Time 2 N = 82. Knowledge = knowledge of healthy eating, Problems = Problems associated with healthy eating, Positive Feel. = Positive feelings about healthy eating, SOP = self-oriented perfectionism, OOP = other-oriented perfectionism, SPP = socially prescribed perfectionism, PSP = perfectionistic self-promotion, ND = nondisplay of imperfection, NDCI = nondisclosure of imperfection.

Table 3
Bivariate correlations and McDonald's Omegas.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Time 1																		
1. Knowledge																		
2. Problems	.44**																	
3. Positive feel.	.39**	.47**																
4. SOP	.20**	.35**	.34**															
5. OOP	.29**	.34**	.21**	.63**														
6. SPP	.09	.28**	.16*	.59**	.52**													
7. PSP	.08	.39**	.14	.68**	.62**	.61**												
8. ND	−.02	.31**	.02	.52**	.45**	.53**	.82**											
9. NDCI	.07	.34**	.03	.46**	.47**	.49**	.72**	.74**										
Time 2																		
10. Knowledge	.80**	.45**	.30**	.25*	.41*	.17	.29*	.08	.25*									
11. Problems	.46**	.75**	.44**	.23*	.43*	.15	.29**	.09	.28*	.62**								
12. Positive feel.	.30**	.43**	.60**	.14	.28*	−.01	.12	−.05	.01	.37**	.57*							
13. SOP	.17	.29**	.21	.86**	.62**	.52**	.77**	.66**	.57**	.23**	.29*	.16						
14. OOP	.23*	.22*	.11	.52**	.76**	.47**	.48**	.37**	.41**	.35**	.35*	.23*	.61*					
15. SPP	−.03	.22	−.07	.47**	.43**	.77**	.56**	.51**	.51**	.12	.15	−.07	.57*	.53**				
16. PSP	.12	.28*	.11	.73**	.65**	.54**	.90**	.78**	.69**	.25**	.29*	.15	.84*	.52**	.56*			
17. ND	−.04	.17	−.03	.55**	.47**	.46**	.74**	.91**	.69**	.06	.12	.05	.69*	.42**	.55*	.81**		
18. NDCI	.15	.30**	.03	.46**	.48**	.44**	.66**	.70**	.83**	.29**	.28*	−.16	.58**	.40**	.53**	.73**	.74**	
McDonald's ω	.73	.79	.62	.90	.82	.77	.86	.90	.71	.73	.79	.62	.90	.82	.77	.86	.90	.71

Note. Time 1 N = 177, Time 2 N = 82. T2 = Time 2. ** Correlations are significant at the 0.01 level (two-tailed). * Correlations are significant at the 0.05 level (two-tailed). Knowledge = knowledge of healthy eating, Problems = Problems associated with healthy eating, Positive Feel. = Positive feelings about healthy eating, SOP = self-oriented perfectionism, OOP = other-oriented perfectionism, SPP = socially prescribed perfectionism, PSP = perfectionistic self-promotion, ND = nondisplay of imperfection, NDCI = nondisclosure of imperfection.

Table 4
Multiple regression analysis of trait perfectionism and orthorexia.

Model	B	SE	β	*p*
Knowledge T2				
F (4, 77) = 46.207, p = <.001, R^2 = .71, R^2_{adj} = .69				
Knowledge T1	.74	.06	.79	<.001
Self-oriented perfectionism T1	- .01	.01	−.12	.172
Other-oriented perfectionism T1	.02	.01	.16	.052
Socially prescribed perfectionism T1	.03	.01	.21	.008
Problems T2				
F (4, 77) = 31.226, p = <.001, R^2 = .62, R^2_{adj} = .60				
Problems T1	.68	.07	.68	<.001
Self-oriented perfectionism T1	−.01	.01	−.08	.401
Other-oriented perfectionism T1	.02	.01	.30	.002
Socially prescribed perfectionism T1	−.003	.01	−.04	.670
Positive feel. T2				
F (4, 77) = 14.472, p = <.001, R^2 = .43, R^2_{adj} = .40				
Positive feelings T1	.54	.08	.60	<.001
Self-oriented perfectionism T1	−.01	.01	−.18	.128
Other-oriented perfectionism T1	.03	.01	.34	.003
Socially prescribed perfectionism T1	−.01	.01	−.08	.432

Note. Knowledge = knowledge of healthy eating, Problems = Problems associated with healthy eating, Positive Feel. = Positive feelings about healthy eating, T1 = time 1, T2 = time 2. N = 82. All *p* values two-tailed.

Table 5
Multiple regression analysis of perfectionistic self-presentation and orthorexia.

Model	B	SE	β	*p*
Knowledge T2				
F (4, 77) = 42.804, p = <.001, R^2 = .69, R^2_{adj} = .67				
Knowledge T1	.71	.06	.76	<.001
Perfectionistic self-presentation T1	.08	.06	−.17	.151
Nondisplay of imperfection T1	−.05	.05	−.11	.363
Nondisclosure of imperfection T1	.10	.05	.17	.079
Problems T2				
F (4, 77) = 28.662, p = <.001, (R^2 = .60, R^2_{adj} = .58				
Problems T1	.68	.07	.69	<.001
Perfectionistic self-presentation T1	.07	.04	.24	.073
Nondisplay of imperfection T1	−.08	.04	−.29	.033
Nondisclosure of imperfection T1	.05	.04	.15	.186
Positive feel. T2				
F (4, 77) = 11.942, p = <.001, R^2 = .38, R^2_{adj} = .35				
Positive feelings T1	.52	.08	.57	<.001
Perfectionistic self-promotion T1	.11	.06	.27	.102
Nondisplay of imperfection T1	−.08	.06	−.02	.220
Nondisclosure of imperfection T1	−.01	.06	−.02	.904

Note. Knowledge = knowledge of healthy eating, Problems = Problems associated with healthy eating, Positive Feel. = Positive feelings about healthy eating, T1 = time 1, T2 = time 2. N = 82. All *p* values two-tailed.

associated with healthy eating. These findings illustrate the importance of distinguishing between different dimensions of perfectionism and different dimensions of orthorexia when examining their relationship and, in turn, when considering who may be most at risk to orthorexia.

In regard to the notion of differing risk, other-oriented perfectionism emerged as the only unique predictor of two of the dimensions of orthorexia over time – higher problems associated with healthy eating and feeling positively about healthy eating. At first glance, this may not be an intuitive finding – the tendency to impose the need for perfection on others predicting increases in a personal focus on healthy eating. However, we note that in one of the two previous studies to examine the relationship between trait perfectionism and orthorexia, Myrissa et al. (2021) also found only other-oriented perfectionism to predict dimensions of orthorexia. We offer two speculative explanations for their and our finding. The first explanation is that because both other-oriented perfectionism and orthorexia share a relationship with narcissism, it is possible that this finding reflects underlying self-interest and narcissistic qualities of this dimension of perfectionism (e.g., Miley, Egan, Wallis, & Mantzios, 2022; Smith et al., 2016; Stoeber, 2015). The second explanation is that the findings may reflect general dysregulation, or a lack of

Table 6
Multiple regression analysis of trait perfectionism, perfectionistic self-presentation and orthorexia.

Model	B	SE	β	*p*
Knowledge T2				
F (7, 74) = 26.953, p = <.001, R^2 = .72, R^2_{adj} = .69				
Knowledge T1	.73	.07	.77	<.001
Self-oriented perfectionism T1	−.01	.01	−.15	.106
Other-oriented perfectionism T1	.01	.01	.11	.206
Socially prescribed perfectionism T1	.02	.01	.17	.043
Perfectionistic self-promotion T1	.04	.07	.09	.534
Nondisplay of perfection T1	−.03	.05	−.07	.565
Nondisclosure of imperfection T1	.07	.05	.13	.165
Problems T2				
F (7, 77) = 18.492, p = <.001, R^2 = .64, R^2_{adj} = .60				
Problems T1	.65	.08	.66	<.001
Self-oriented perfectionism T1	−.004	.01	−.07	.490
Other-oriented perfectionism T1	.02	.01	.28	.007
Socially prescribed perfectionism T1	−.003	.01	−.04	.647
Perfectionistic self-promotion T1	.04	.05	.13	.432
Nondisplay of imperfection T1	−.07	.04	−.24	.068
Nondisclosure of imperfection T1	.04	.04	.12	.290
Positive feeling T2				
F (7, 74) = 8.541, p = <.001, R^2 = .45, R^2_{adj} = .40				
Positive feelings T1	.54	.09	.56	<.001
Self-oriented perfectionism T1	−.12	.01	−.24	.084
Other-oriented perfectionism T1	.03	.01	.29	.019
Socially prescribed perfectionism T1	−.01	.01	−.12	.306
Perfectionistic self-promotion T1	.12	.08	.30	.135
Nondisplay of imperfection T1	−.06	.06	−.15	.343
Nondisclosure of imperfection T1	−.02	.06	−.05	.704

Note. Knowledge = knowledge of healthy eating, Problems = Problems associated with healthy eating, Positive Feel. = Positive feelings about healthy eating, T1 = time 1, T2 = time 2. N = 82. All *p* values two-tailed.

self-control, that is common to people being overzealous and forthright in their demands of others and in those with difficulties maintaining healthy eating habits (see Obeid, Hallit, Akel, & Brytek-Matera, 2021; Stoeber, 2015). Future research is required to test both of these interesting possibilities.

Socially prescribed perfectionism also emerged as the only unique predictor of one of the dimensions of orthorexia over time – higher knowledge of healthy eating. This finding is much more in keeping with perfectionism research that has illustrated that this dimension of perfectionism carries significant risks of personal difficulties that includes eating disorders (e.g., Smith et al., 2016). Individuals higher in socially prescribed perfectionism are thought to adopt various self-protective and self-corrective behaviours in response to perceived demands from others and obsessive healthy eating may be a further such behaviour. In support of this explanation, others have argued that the avoidance of social shame is central to the behaviours associated with this dimension of perfectionism (e.g., Stoeber, Sherry, & Nealis, 2015) and recent research has found that higher levels of internal and external shame are related to orthorexia (Ferreira & Coimbra, 2021). In this sense, seeking a diet that is "more informed", "healthier" and "superior" to others (as captured by this dimension of orthorexia) may be part of an effort to compensate for social fears of rejection for those higher in this dimension of perfectionism.

4.2. Perfectionistic self-presentation and orthorexia

We also examined the predictive ability of perfectionism via perfectionistic self-presentation. Notable in this regard is that only one dimension of orthorexia was related to dimensions of perfectionistic self-presentation across both time points - problems associated with healthy eating. With this in mind, problems associated with healthy eating is the dimension of orthorexia that is most central to the pathology associated with orthorexia as evidenced by its closer association with measures of eating disorders (Gleaves et al., 2013). It is also the dimension of orthorexia that most references others, interpersonal interactions, and interference with routine social situations (e.g., going out less, avoiding restaurants, affecting employment options). In this regard, the close link between dimensions of perfectionistic self-presentation, an impression management style, and this particular dimension of orthorexia is understandable. Research that has found problems associated with heathy eating to be related to interpersonal insecurity and interpersonal alienation support this explanation (Novara, Pardini, Maggio, Mattioli, & Piasentin, 2021).

When examining unique predictors of orthorexia over time, nondisplay of imperfection was the only dimension of perfectionistic self-presentation to predict any dimension of orthorexia (specifically problems associated with healthy eating). In addition, this dimension predicted lower, rather than higher, levels of orthorexia. It is possible that because obsessive eating behaviours could be viewed as unusual, odd, or extreme, those seeking to project an image of perfection by hiding imperfections may shun behaviours that could be viewed negatively by others (McComb & Mills, 2019). However, in comparing the bivariate correlations with the regression results there is evidence that this finding is the result of suppression (the direction the relationship differs in the two analyses). Similar cases of suppression when examining perfectionistic self-presentation have been observed by others (e.g., Stoeber et al., 2017). Consequently, this unexpected finding is more likely the result of the higher correlations between dimensions of perfectionistic self-presentation and the difficulty this creates when examining unique effects. We therefore encourage caution in interpreting this finding.

4.3. Trait perfectionism versus perfectionistic self-presentation

When we considered the predictive ability of trait perfectionism and perfectionistic self-presentation alongside each other, only trait perfectionism dimensions – other-oriented perfectionism and socially prescribed perfectionism – predicted dimensions of orthorexia. Other-oriented perfectionism predicted increases in all dimensions of orthorexia and socially prescribed perfectionism predicted increases in knowledge of healthy eating. These findings suggest that it is the more engrained aspects of perfectionism that is most important in regard to the development of orthorexia. In other words, wanting to *appear perfect* appears to be secondary to wanting to *be perfect* when it comes to obsessional healthy eating. On the distinction between the two, Hewitt, Flett, and Mikail (2017) have previously described how they consider the traits of perfectionism to capture content (who people are) whereas self-presentation reflects how this expressed (what people do). In this regard, it is understandable that trait perfectionism would be more relevant to predicting orthorexia which itself is likely to be, at least in part, an expression of deeper underlying traits and characteristics. The main implication is that the most effective interventions for orthorexia are likely to be those that target perfectionism traits as opposed self-presentation styles.

4.4. Limitations and future research

The present study has several limitations. First, our findings and their generalisability may have been affected by the high dropout rate. Notably, the main analyses are based only on participants who completed both questionnaires. Consequently, although our findings provide preliminary evidence for the relationship between trait perfectionism, perfectionistic self-presentation, and orthorexia over time, future research should re-examine these relations using longitudinal designs and utilise strategies to reduce dropout (e.g., incentives; Gustavson, von Soest, Karevold, & Roysamb, 2012). Second, we recruited a sample of adult exercisers. It is unclear whether the findings of the present study are generalisable beyond this population. The participants' exercise regimens were also altered by COVID-19 at the time of data collection so may also have influenced the results. Future research may wish to replicate the current work in different populations (and under more normal circumstances). This could include samples that

have been previously examined such as clinical populations, students, and other non-clinical populations. Third, we used Cox et al.'s (2002) short version of the HF-MPS (Hewitt & Flett, 1991). Although the measure has acceptable factorial structure, it has been criticised for its use of reversed items in the other-oriented subscale (Stoeber, 2018). Therefore, researchers may wish to use alternative versions of the scale to verify the findings (e.g., Hewitt & Flett, 1991). Fourth, in the statistical analyses we did not control for multiplicity, despite multiple analyses. Multiplicity refers to the increased possibility of type I error as a result of multiple testing. Exact *p* values are reported to aid interpretation. Finally, the measure used to assess orthorexia does not have norms, thresholds, or cut-off values. Therefore, the extent to which orthorexia is evident to any clinically or diagnostically meaningful level is unknown in this study (and other studies). Future studies are required to establish these features of the instrument so this issue can be revisited in this sample and other samples that have used the instrument.

5. Conclusion

The present study provides further evidence that perfectionism is related to orthorexia. This includes trait aspects of perfectionism and aspects that pertain to how people seek to present themselves to others. The study also provides preliminary evidence that more engrained trait aspects of perfectionism are more predictive of orthorexia over time than the self-presentational aspects of perfectionism.

Author contributions

All authors have approved the final article for publication.

Ethical approval

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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