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Trait Perfectionism and Orthorexia in Exercisers:

The Mediating Role of Perfectionistic Self-Presentation

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Abstract

Purpose: Research suggests that trait perfectionism can predict orthorexia – a pathological obsession with correct nutrition. However, no studies have examined the role of perfectionistic self-presentation in whether a desire to present oneself perfectly is an explanation for previously observed relationships. The present study therefore examined whether perfectionistic self-presentation mediates relations between trait perfectionism and orthorexia.

Methods: A sample of 177 gym members (Mean age = 31.6 years) were recruited via social media platforms. Participants completed an online questionnaire that included the Multidimensional Perfectionism Scale-Short Form, Perfectionistic Self-Presentation Scale, and the Eating Habits Questionnaire on two occasions (separated by 6-weeks).

Results: Using cross-sectional mediation analyses, perfectionistic self-promotion and nondisplay of imperfection mediated relations between self-oriented perfectionism and orthorexia, perfectionistic self-promotion mediated relations between other-oriented perfectionism and orthorexia, and perfectionistic self-promotion and nondisplay of imperfection mediated relations between socially prescribed perfectionism and orthorexia. Using longitudinal mediation analyses, nondisplay of imperfection mediated relations between self-oriented perfectionism and orthorexia and socially prescribed perfectionism and orthorexia over time.

Conclusion: The study provides evidence that nondisplay of imperfection and perfectionistic self-promotion are important in regards to predicting orthorexia and may mediate the trait perfectionism-orthorexia relationship.

Keywords: disordered eating, eating disorder, perfectionism, perfectionistic self-presentation, exercise, orthorexia

Contents

Introduction 8

Orthorexia 8

Measurement of Orthorexia 11

ORTO-15. 11

BOT. 13

TOS. 13

DOS. 14

ONI. 15

EHQ. 16

The Development of Orthorexia 23

Review of Antecedents 23

Trait Perfectionism 26

Trait Perfectionism and Orthorexia 28

Perfectionistic Self-Presentation 38

Perfectionistic Self-Presentation and Orthorexia 39

Trait Perfectionism, Perfectionistic Self-Presentation, and Orthorexia 40

The Present Study 41

Methods 43

Participants 43

Procedure 43

Measures 44

Trait perfectionism. 44

Perfectionistic Self-Presentation. 44

Orthorexia. 45

Data Analysis Strategy 46

Results 47

Preliminary analyses 47

Cross-Sectional Data ..... **Error! Bookmark not defined.**

Time 1 Descriptive Statistics and Bivariate Correlations 47

Direct Effects. 49

Indirect Effects. 50

Longitudinal Data ..... **Error! Bookmark not defined.**

Time 2 Descriptive Statistics and Bivariate Correlations 52

Path Model and Mediation 54

Direct Effects. 54

Indirect Effects. 54

Discussion 57

Trait Perfectionism and Orthorexia 57

Perfectionistic Self-Presentation 59

Mediating Role of Perfectionistic Self-Presentation 60

Longitudinal Data 64

Longitudinal Mediation ..... **Error! Bookmark not defined.**

Limitations and Future Research 66

Practical Implications 67

Future Directions 67

Conclusion 69

References 71

Appendices 89

Appendix 1 89

Eating Habits Questionnaire. 89

Appendix 2 91

Multidimensional Perfectionism Scale – Short Form 91

Appendix 3 92

Perfectionistic Self-presentation Scale. 92

Appendix 4 94

Ethical Approval Letter. 94

Tables

Table 1. Review of Orthorexia Measures 18

Table 2 – Review of Trait Perfectionism-Orthorexia Studies 33

Table 3 – Time 1 Descriptive Statistics, Bivariate Correlations, and McDonald's Omega 48

Table 4 - Time 2 Descriptive Statistics, Bivariate Correlations, and McDonald's Omega 53

Figures

Figure 1. *Cross Sectional Mediation Model of Perfectionistic Self-Presentation Mediating the Relationship between Trait Perfectionism and Orthorexia (Model 1).* N = *177. All path coefficients are standardized, and nonsignificant paths (*p ≥ *.05) are indicated by dashed lines.* 51

Figure 2. *Autoregressive Path Model of Time 1 Perfectionistic Self-Presentation Mediating the Relationship between Time 1 Trait Perfectionism and Time 2 Orthorexia (Model 2). N = 82. All path coefficients are standardized, and nonsignificant paths (p ≥ .05) are indicated by dashed lines. T1 = Time 1, T2 = Time 2 (6 weeks later).* 56

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 whether perfectionistic self-presentation mediates the relationship between trait perfectionism and orthorexia, both cross-sectionally and longitudinally.

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." It is thought to contribute to a range of clinically significant psychosocial impairment. This includes distress, emotional fatigue, and social isolation (Strahler et al., 2018). It also contributes to significant physical impairment including medical complication (e.g., metabolic acidosis, malnutrition, and weight loss; McComb & Mills 2019; Bratman & Knight 2016; Cena et al., 2018; Strahler et al., 2018).

While orthorexia is not officially recognized as an eating disorder or obsessive-compulsive classification in either the DSM-5 or the ICD-10, proposed diagnostic criteria have been published. Initial criteria for the diagnosis of orthorexia were published by Donini et al. (2004), were reviewed by Barthels, Meyer, and Pietrowsky (2015), and then later

refined by Dunn and Bratman (2016). Current criteria include (Dunn & Bratman, 2016, p. 16):

Criterion A: 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.

As evidenced by the following:

1. Compulsive behaviour and/or mental preoccupation regarding affirmative and restrictive dietary practices believed by the individual to promote optimum health.
2. Violation of self-imposed dietary rules causes exaggerated fear of disease, sense of personal impurity and/or negative physical sensations, accompanied by anxiety and shame.
3. Dietary restrictions escalate over time, and may come to include elimination of entire food groups and involve progressively more frequent and/or severe ‘‘cleanses’’ (partial fasts) regarded as purifying or detoxifying. This escalation commonly leads to weight loss, but the desire to lose weight is absent, hidden or subordinated to ideation about healthy eating.

Criterion B: The compulsive behaviour and mental preoccupation becomes clinically impairing by any of the following:

1. Malnutrition, severe weight loss or other medical complications from restricted diet.
2. Intrapersonal distress or impairment of social, academic or vocational functioning

secondary to beliefs or behaviours about healthy diet.

3. Positive body image, self-worth, identity and/or satisfaction excessively dependent on compliance with self-defined ‘‘healthy’’ eating behaviour.

Despite available criteria amongst researchers, it is still debated whether orthorexia is a distinct disorder. The debate revolves around if orthorexia is a unique eating disorder, a variant of an existing disorder, or a behavioural complex that is informed by culture (Carpita et al., 2021). A growing body of research supports the existence of orthorexia on the eating disorders spectrum and a possible continuum between orthorexia and anorexia nervosa (Carpita et al., 2021). That being said, unlike individuals with anorexia nervosa who restrict calories to maintain an unhealthily low body weight, orthorexic individuals do not fixate on the number of calories consumed. Instead they focus on the quality of food eaten and its preparation (McComb & Mills, 2019; Turner & Lefervre, 2017). There are some similarities between orthorexia and anorexia nervosa in regards to their psychological basis. For example, both are associated with perfectionism, depressed mood, and anxiety (Brytek-Matera et al., 2012, 2018). However, there are also notable differences in this regard too. For example, distinct from anorexia nervosa, orthorexic individuals can believe that their eating patterns symbolise moral superiority and cite ethical reasons that guide and inform their dietary behaviours (Nevin & Vartanian, 2017).

With these similarities and differences in mind, it remains unclear whether orthorexia is an antecedent or a consequence of clinical eating disorders (Dunn & Bratman, 2016). On one hand, orthorexia may manifest as a subthreshold eating disorder, whereby an individual begins with the focus on food quality but transgresses to a focus on food quantity (Bartel et al., 2020). In a similar way, an individual recovering from a clinical eating disorder may switch their focus onto food quality instead of food quantity (Bartel et al., 2020). On the other

hand, orthorexia may be a distinct eating disorder itself or be indictive of an existing eating disorder with particular and additional symptoms (Bartel et al., 2020). If so, an individual displaying orthorexia may claim that their restrictive eating habits are for health reasons as a means of camouflaging their eating disorder.

In support of the notion that orthorexia is a subthreshold eating disorder or antecedent of a clinical eating disorder, its prevalence is estimated to be much higher than clinical eating disordered. For instance, it is estimated that approximately 1 to 7% of the general population possess orthorexia (Strahler, 2018) whereas prevalence rates for clinical eating disorders like anorexia nervosa and bulimia nervosa are estimated to be much lower at 0.4 to 1.5% (Pryke, 2018). However, due to issues relating to the reliability and validity of instruments used (discussed below), it is difficult to ascertain whether these are accurate and are over- or under-estimates of this problem. Regardless, due to its close link with eating disorders, orthorexia is an important issue for those who want to promote healthy eating behaviours and mental health.

Measurement of Orthorexia

There are several measures that have been developed to measure and quantify levels of orthorexia. These are reviewed in Table 1 and summarised below.

ORTO-15. The most commonly used assessment measure of orthorexia is the ORTO-15 (Donini et al., 2005). The ORTO-15 has been translated into various languages, such as Turkish (Asil & Sürücüoğlu, 2015), Portuguese (Alvarenga et al., 2012), Polish (Gubiec et al., 2015), and Spanish (Jerez et al., 2015), without changes to scoring (Dunn & Bratman, 2016). The ORTO-15 is a 15-item self-report questionnaire that is used to assess preoccupation with buying, preparing, and consuming healthy food (e.g., “do you think your mood affects your eating behaviour”). Responses are scored on a 4-point Likert scale from 1 (always) to 4 (never), where lower scores reflecting more orthorexia symptomatology. The

ORTO-15 uses a cut-off point of <40 points to indicate orthorexia, however some authors use a cut-off point of <35 points. Both cut-off points are derived from threshold value analysis.

Despite its popularity, the instrument has a number of major weaknesses. For example, both cut-off points appear to detect questionably high prevalence rates of orthorexia within samples (i.e., due to false positives; McComb & Mills 2019). This is particularly true for the cut-off point of <40, which reaches satisfactory values (i.e., sensitivity = 100%, specificity = 73.6%, positive predicative value = 17.6%, and negative predicative value = 100%; Neidzeilski & Zmierczak-Wojta, 2021). However, even the cut-off of <35 points yields prevalence rates ranging from 13 - 49% (McComb & Mils, 2019). Further, the ORTO-15 does not measure clinical impairment caused by a rigid preoccupation with eating healthily (as stated in criterion B of the proposed diagnostic criteria). This too could explain the high and extremely variable prevalence rates in samples to date (McComb & Mills, 2019; Dunn et al., 2017; Dunn & Bratman; 2016).

There are also multiple versions of the ORTO-15. These include the OTRO-11 (Arusoğlu et al., 2008), the ORTO-11-Hu (Varga et al., 2014), the ORTO-9-GE (Missbach et al., 2015), the Portuguese ORTO-12 (Alvarenga et al., 2012), the ORTO-11-ES (Parra-Fernandez et al., 2018), the ORTO-12-FR (Babeau et al., 2019), the ORTO-6 (Kazmierczak-Wojta, 2019), and the ORTO-10 (Mohammed Halim et al., 2020). However, none of these factor structures are yet to be replicated in independent samples. Even for the ORTO-15 variations, there is evidence of one, two, and three underlying factors (e.g., Varga et al., 2014, Brytek et al., 2014, Alvarenga et al., 2012). The prevailing view is now for a one-factor structure of 6-items (ORTO-R; Rogoza & Donini, 2021). Overall, considering available evidence, the ORTO-15 appears to have poor psychometric properties and when adopting this approach the newest version is best used (ORTO-R).

BOT. The Bratman Orthorexia Test (BOT; Bratman & Knight, 2000) was the first orthorexia self-test to measure an obsession with healthy eating. These include spending more than 3 hours per day thinking, cooking, shopping, and reading about food; planning future meals; caring more about the healthiness of food than the pleasure of eating; diminished quality of life; getting stricter with diet; decreasing social experiences with food; feelings of superiority/increasing self-esteem; feeling of guilt; social isolation; and a sense of control (Valante, Syurina, & Donini, 2019; Bratman & Knight, 2000). The BOT is a 10-item self-reported questionnaire using a "yes/no" response format (e.g., "does your self-esteem get a boost from eating healthily"). If an individual answers "yes" to four of the questions they are thought to possess symptoms of orthorexia (Bratman & Knight, 2000).

Despite being adapted in German, Polish, Greek, and Swedish (Neidzeilski & Zmierczak-Wojta, 2021), the BOT has poor psychometric properties (Valante, Syurina, & Donini, 2019). First, the BOT was based on characteristics of orthorexia that Steve Bratman had highlighted in his daily practice, as opposed to specific diagnostic criteria. Because of this, the measure was based on no methodological construct. Second, the BOT has a dichotomous response format. It has been suggested that if an individual responds "yes" to two or three of the ten questions then he/she has at least a "touch" of orthorexia; if an individual answers "yes" to four questions out of the ten then he/she is in "trouble"; and if an individual answers "yes" to all ten questions then he/she needs help. These cut-off points have no clinical relevance. Finally, there has been no reported validation of the measure despite it being translated into other languages.

TOS. The Teruel Orthorexia Scale (TOS; Barrada & Roncero, 2018) was developed in accordance with the original conceptualisation of orthorexia that was proposed by Bratman and Knight (2000) (Niedzielski & Zmierczak-Wojta, 2021). The TOS is a 17-item self-reported questionnaire used to assess orthorexia as two dimensions. The first dimension is

healthy orthorexia (HeOr; 9-items), which measures the tendency to engage in and interest in eating healthy food (e.g., “I mainly eat foods I consider to be healthy”). The second dimension is orthorexia nervosa (OrNe; 8-items) that measures a pathological preoccupation with a healthy diet (e.g., “I spend a lot of time buying, planning, and/or preparing food so my diet will be as healthy as possible”). Where HeOR represents a way of life that is independent of existing psychopathology, OrNe is associated with psychopathology including eating disorder symptoms and obsessive-compulsive disorder (Barrada & Roncero, 2018). Responses are scored on a 4-point Likert scale from 0 (completely disagree) to 3 (completely agree), where higher scores reflect higher orthorexic tendencies.

The TOS has a confirmed a two-factor structure with good internal consistency (Valante, Syurina, & Donini, 2019). HeOr showed a Cronbach’s α of 0.85 and 0.80 in the retest sample and OrNe showed Cronbach’s α of 0.81 and 0.90 in the retest sample (Valante, Syurina, & Donini, 2019). The TOS provides evidence for the multidimensional structure of orthorexia and the structure has been replicated in various countries and samples (Hallit et al., 2021). Despite sound psychometric properties, only OrNe represents eating disorder factors, such as drive for thinness and restrained eating behaviour; whereas HeOr is linked to positive affect (Barthels, Barrada & Roncero, 2019). Hence, the two factors assessed in the TOS provide two different theoretical perspectives of orthorexia.

DOS. The Dusseldorfer Orthorexie Skala (DOS; Barthels, Meyer, & Pietrowsky, 2015) was also developed in accordance with Bratman and Knight (2000) case studies on orthorexia. The DOS conceptualises orthorexia as a possible pathological fixation on eating healthily (Valante, Syurina, & Donini, 2019). The DOS is a 10-item questionnaire that assesses orthorexic eating behaviours (e.g., “I have certain nutrition rules that I adhere to”). Responses are scored on a 4-point Likert scale from 1 (this does not apply to me) to 4 (this applies to me), where higher scores reflect higher levels of orthorexia. The DOS uses a cut-

off point of <30 points to indicate orthorexia and scores between 25-29 indicate a risk of orthorexia.

The DOS has a confirmed one-factor structure with good internal consistency (e.g., Cronbach's $\alpha = 0.84$; Valante, Syurina, & Donini, 2019). The DOS has also been translated into English (Chard et al., 2018), Spanish (Parra-Fernandez et al., 2018), and Chinese (He et al., 2018; Valante, Syurina, & Donini, 2019). The main criticism of the DOS is that it does not differentiate between orthorexic and anorexic patients. For example, DOS scores and eating disorder symptoms have shown medium positive correlations in clinical and non-clinical samples (Meule & Voderholzer, 2021). It has therefore been suggested that the DOS measures orthorexia as an aspect of restrictive eating behaviour, as opposed to orthorexia as a separate disordered eating entity (Meule & Voderholzer, 2021).

ONI. The Orthorexia Nervosa Inventory (ONI; Oberle, De Nadai, & Madrid, 2020) is based on the Eating Habits Questionnaire and the DOS. The ONI conceptualises orthorexia as an overwhelming preoccupation with eating healthfully (Valante, Syurina, & Donini, 2019) and is a 24-item questionnaire. Responses are scored on a 4-point Likert scale from 1 (definitely not true) to 4 (definitely true), where higher scores reflect higher levels of orthorexia. The ONI has a three-factor structure that includes behaviour and absorptions (9-items; e.g., "preparing food in the most healthful way is very important in my diet"), emotional stress (5-items; e.g., "whenever I eat something unhealthy, I feel a great sense of impurity"), and physical and social impairment (10-items; e.g., "my healthy eating is a significant source of stress in my relationships") subscales.

The ONI is the first measure to assess physical impairment of orthorexia. It has been suggested that physical impairment is a key feature of orthorexia. The measure is currently available in English and Turkish (Kaya, Uzdil & Cakiroglu, 2021). Both versions of the measure showed good internal consistency (Cronbach's $\alpha = 0.94$ [Obele, De Nadai, &

Madrid, 2020] and Cronbach's $\alpha = 0.91$ [Kaya, Uzdil & Cakiroglu, 2021]), a good 3-factor structure (Kaya, Uzdil & Cakiroglu, 2021), and good validity (r = 0.86 to 0.87; Oberle, De Nadai, & Madrid, 2020). As the ONI is very new measure at this time, there currently are no documented criticisms.

EHQ. The Eating Habits Questionnaire (EHQ; Gleaves, Graham, & Ambwani, 2013) was also developed in accordance with Bratman and Knight (2000) case studies on orthorexia. It conceptualises orthorexia as an overwhelming preoccupation with eating healthfully (Valante, Syurina, & Donini, 2019). The EHQ is a 21-item questionnaire that assesses knowledge of healthy eating, problems associated with healthy eating, and feeling positively about healthy eating (e.g., "my diet is more healthy than most diets"). Responses are scored on a 4-point Likert scale from 1 (false) to 4 (very true), where higher scores reflect higher levels of orthorexia. The EHQ has a confirmed a three-factor structure with good internal consistency (e.g., Cronbach's $\alpha = 0.90$; Gleaves, Graham, & Ambwani, 2013).

The EHQ has been criticised for not adequately covering the compulsive behaviours associated with orthorexia, or the emotional distress caused by the disorder (Halim et al., 2020). Such criticisms could be understood as a failure to capture the significant impairment of orthorexia. It has been suggested that the properties of the EHQ are stronger as a total scale than as three subscales because weaker reliability estimates have been found for its subscales ($\alpha = 0.73$ to 0.87; Oberle et al., 2017). Similarly, Halim et al. (2020) have explained that the EHQ may be better conceptualised by four factors including thoughts about healthy eating, dietary restriction, diet superiority, and social impairment. However, this is yet to be replicated in samples. Despite some uncertainty, the EHQ is generally regarded as a sound measure of the disorder. This is exemplified through good test-retest reliability (r = 0.72 to 0.90) and a good factor structure (Gleaves, Graham, & Ambwani, 2013). For this reason, for

some researchers it is regarded as a strong alternative to other orthorexia measures (Meule & Voderholzer, 2021).

As part of reviewing measures for this study we recorded the number of studies that had used each of the measures. We also examined the psychometric properties of each of the measures including the number of items in the measure, the internal consistency (i.e., Cronbach's alpha), the test-retest reliability (i.e., Pearson's r), and the factor structure (i.e., AGFI—adjusted goodness of fit index; CFI—comparative fit index; df degree of freedom; GFI—goodness-of-fit index; PCLOSE—p (probability) of close fit; RMSEA— root mean square error of approximation; SRMR—standardized root mean square residual; TLI—Tucker–Lewis Index). These features are recorded in Table 1.

The ORTO-15 and its variations was the most frequently used measure (n = 61 studies). The ORTO-15 showed reasonable one and three factor model fit, but no test-retest reliability and low and inconsistent internal consistency. The BOT had been used 6 times (n = 6 studies) and showed no assessment of factor structure or test-retest reliability, but good internal consistency. The TOS had been used 6 times (n = 6 studies) and showed a good two-factor model fit, reasonable test-retest reliability, and good internal consistency. The DOS and its variations had been used 12 times (n = 12 studies) and showed a reasonable one- to three factor model fit, good test-retest reliability, and good internal consistency. The ONI had been used one time (n = 1 studies) and showed a good three-factor model-fit, good test-retest reliability, and good internal consistency. Finally, the EHQ had been used 6 times (n = 6 studies) and showed a good three-factor model fit, reasonable test-retest reliability and good internal consistency. Based on the preceding critique and the results of our review, we chose to use the EHQ as the most psychometrically sound assessment measure of orthorexia in the current study.

Table 1. Review of Orthorexia Measures

Measure	**Number of Studies**	**Number of Items**	**Internal Consistency (Cronbach's α)**	**Test-Retest Reliability (Pearson's r)**	**Factor Structure**
ORTO-15 (Donini et al., 2005)	42	15	.83 (Moller et al., 2018 version, no original reported)	no reported test-retest value	1-factor: χ^2= 4.9; GFI = .97; TLI = .94; CFI = .96; RMSEA = .06 (Moller et al., 2018 version, no original reported)
ORTO-11-Hu (Varga et al., 2014)	1	11	.82	no reported test-retest value	1-factor: χ^2= 230.8; p < .001; df = 5.63; CFI = .92; TLI = .90; RMSEA = .076; PCLOSE < .001.
ORTO-9-GE (Missbach et al., 2015)	1	9	.67	no reported test-retest value	1-factor: χ^2 = 83.865; p < .001; df = 3.355; CFI = .947; TLI = .92; RMSEA = .048; PCLOSE = .602

Polish ORTO-15 (Brytek et al., 2014)	4	15	.60 - .67	no reported test-retest value	2-factors: χ^2= 35,697 (df = 23, p < .044); CFI = .953; RMSEA = .053; PCLOSE = .412; AGFI = .927
ORTO-11 (Arusoglu et al., 2008)	6	11	.62	no reported test-retest value	1-factor
Portuguese ORTO-12 (Alvarenga et al., 2012)	1	12	.39 - .63	no reported test-retest value	3-factors
ORTO-11-ES (Parra-Fernandez et al., 2018)	2	11	.80	no reported test-retest value	3-factors: χ^2 = 64.13, df = 1.17; CFI = .99; p = .001, TLI = .98; RMSEA = .03, SRMR = .04
ORTO-12-FR (Babeau et al., 2019)	1	12	.73	no reported test-retest value	3-factors: χ^2= 144.54, df = 47, p = .000, CFI = .93, TLI = .90, RMSEA = .05, SRMR = .04.

ORTO-6 (Kazmierczak-Wojta, 2019)	1	6	.76	no reported test-retest value	no factor structure reported
ORTO-R (Rogoza & Donini, 2021)	1	6	.68	no reported test-retest value	1-factor: $\chi^2 = 21.49$; $p = .006$; CFI = .976; RMSEA = .057[.028, .086], WRMR = .68
ORTO-10 (Mohamed Halim et al., 2020)	1	10	.70	no reported test-retest value	no factor structure reported
Bratman Orthorexia Test (Bratman & Knight, 2000)	6	10	.79 (Meule et al., 2020, no original reported)	no reported test-retest value	no factor structure reported
Teruel Orthorexia Scale (Barrada & Roncero, 2018)	6	17	.81 - .85 (HeOr and ON)	.46	2-factors: CFI = .965, TLI = .954, RMSEA = .06

Dusseldorfer Orthorexie Skala (Barthels, Meyer, & Pietrowsky, 2015) *plus variations	12 10		.84	.79	1-factor
E-DOS (Chard et al., 2019),		10	.88	no reported test-retest value	1-factor: χ^2 (35) = 216.71, p < .001; RMSEA = .116; GFI = .863; AGFI = .785; CFI = .572
C-DOS (He et al., 2019),		10	.84		3-factors: χ^2= 105.16 (df = 32, p < .01), RMSEA = .06 (90% CI .05–.08), CFI = .93, TLI = .89, SRMR = .05
DOS-ES (Parra-Fernandez *et al*., 2019)		10	.84		no factor structure reported
Orthorexia Nervosa Inventory (Oberle, De	1	24	.88 - .90	.86 - .87	3-factors: χ^2= 1188.33, p < .001

Nadai, & Madrid, 2020)					
Eating Habits Questionnaire (Gleaves, Graham, & Ambwani, 2013)	7	21	.90	.72 - .81	3-factors: GFI = .85; TLI = .90; CFI = .91; RMSEA = .07

*Note. *AGFI—adjusted goodness of fit index; CFI—comparative fit index; df degree of freedom; GFI—goodness-of-fit index; PCLOSE—p (probability) of close fit; RMSEA— root mean square error of approximation; SRMR—standardized root mean square residual; TLI—Tucker–Lewis Index.*

The Development of Orthorexia

Despite issues regarding the measurement of orthorexia (Dunn & Bratman, 2016), the concept has gained increasing attention in academic literature. Some of this research has focused on the psychological factors associated with orthorexia. Understanding the psychopathology of orthorexia would better allow for orthorexia to be prevented and treated, and to determine what population groups are vulnerable to developing the disorder (Dunn & Bratman, 2016; McComb & Mills, 2019). McComb and Mills (2019) reviewed psychological risk factors of orthorexia and proposed a psycho-social model of orthorexia. The model posits social factors (e.g., weight bias, obesity stigma, positive reinforcement from others, higher income, availability of clean food, food knowledge, and time for food planning/preparation) and psychological factors (e.g., perfectionism, neuroticism, OCD tendencies, past/current ED, drive for thinness, and dieting/restrictive eating) as risk factors or antecedents in the development of orthorexia. The research underpinning this model is now reviewed.

Review of Antecedents

Personality describes the characteristic manner in which in individual feels, behaves, thinks, and relates to others and is therefore an important vulnerability factor to psychopathology. In this regard personality explains how an individual with orthorexic tendencies may previously, currently, or prospectively think, feel, and behave in dysfunctional manners. Personality factors associated with orthorexia are: narcissism (Oberle et al., 2017); neuroticism (Gleaves et al., 2013); perfectionism including concern over mistakes and perfectionistic self-presentation (Oberle et al., 2017, Hayles et al., 2017; Barrada & Roncero, 2018; Parra-Fernandez et al., 2018; Pratt, Madigan & Hill, in press); and obsessive-compulsive traits in individuals with disordered eating behaviours (Segura-Garcia et al., 2015). Such obsessive-compulsive traits in individuals with disordered eating behaviours include a particular focus on food related rituals and rules (Oberle et al., 2018;

Roncero et al., 2017). These rituals and rules are heightened when coupled with generalised anxiety disorder and/or panic disorder (Poyraz et al., 2015).

Past or current psychopathology also increases the risk of developing orthorexia. This includes overall negative affect, depressive symptoms, suicidal thoughts (Oberle et al., 2017), major depressive disorder (Luck-Sikorski et al., 2018), and anxiety (Strahler et al., 2018). Past or current eating disorders (Segura-Garcia et al., 2015) are a further important vulnerability factor in the development of orthorexia. This extends to body dysmorphic symptoms (Bundros et al., 2016) and muscle dysmorphia (Cerea et al., 2018). In regards body and muscle dysmorphia, weight-related risk factors have been documented as orthorexia risk factors. These include social physique anxiety, appearance anxiety, (Hayles et al., 2017), muscularity, perceived fatness (Oberle & Lipschuetz, 2018), investment in appearance, overweight concern (Barnes & Caltabiano, 2017), drive for thinness (Parra-Fernandez et al., 2018), and thin idealisation (Eriksson et al., 2008).

When considering past or current eating disorders, research has associated disordered eating habits, such as dieting, bulimia, oral control, and food preoccupation (Barrada & Roncero, 2018; Roncero et al., 2017) with an increased risk of orthorexia. This risk has been demonstrated in predominately female samples. However, authors have documented that males high in orthorexia may experience different disordered eating habits to females, for example, higher oral control (Brytek-Matera et al., 2017; McComb & Mills, 2019). Notably, past eating disorders (Barnes & Caltabiano, 2017; Brytek-Matera et al., 2015; Gramaglia et al., 2017; Segura-Garcia et al., 2015) coupled with past dieting experience appear to be the most reliable cross-cultural predictors of orthorexia (Barthels et al., 2018; Missbach et al., 2015; Varga et al., 2014).

It has been suggested that individuals with experience of anorexia nervosa have much higher prevalence rates of comorbid orthorexia (e.g., prevalence rates in eating disorder

samples are between 28 and 87%; Gramaglia et al., 2017; Segura-Garcia et al., 2015; Brytek-Matera et al., 2015). This relationship is emulated in eating-related risk factors associated with orthorexia. Such risks include a desire to avoid particular food types and/or food groups (Segura-Garcia et al., 2012), substituting meals for fruit or salads (Bagci Bosi et al., 2007), and choosing to eat less saturated fat and/or animal fats (Grammatikopoulou et al., 2018). Food substitution and restriction are key features of anorexia nervosa (Barthels et al., 2017). Authors have proposed that orthorexic eating behaviour (i.e., food restriction based on health food selection) may act as a coping strategy in anorexic patients as it implies a sense of autonomy (Barthels et al., 2017).

Research on orthorexia has also recently shown commonalities with autism spectrum disorder (ASD). These commonalities include rigid and restricted patterns of behaviours, inflexible adherence to routine, and fixed interests regarding food preparation (Dell'Osso et al., 2016; Carpita et al., 2020). Dell'Osso et al. (2016) have highlighted that deficits in social interaction in orthorexia in terms of moral superiority dietary beliefs may result from the inability to respond to social interactions with others. This inability inevitably leads to social and occupational impairment, as in ASD (Carpita et al., 2020; McComb & Mills, 2019). The commonalities between orthorexia and ASD provide further evidence for the placement of orthorexia on a continuum of eating disorders due to previously established relations with ASD and anorexia nervosa (Dell'Osso et al., 2016).

Considering the above, research suggests that the orthorexic personality is characterised by anxiety and a need for control, which is informed by a desire to be perfect (Gramaglia et al., 2017). The pathoplasticity of personality means that expression of orthorexic tendencies and related psychopathology would likely occur as a result of the orthorexic personality (Cain & Sasso, 2017). For example, the manner in which an orthorexic individual thinks, feels, and behaves would be a response to psychological and social stressors. Here, the relationship

between personality and psychopathology would be mutually influential (Cain & Sasso, 2017). In line with McComb and Mills' (2019) model, in the present study, we focus on trait perfectionism and the interpersonal expression of perfectionism as key factors in the predisposition of, as a predictor of, and as a maintaining factor of orthorexia.

Although perfectionism is a unique factor in McComb and Mills (2019) psycho-social model of orthorexia, perfectionism is integral to the other psychological factors in the model. For example, trait perfectionism predicts dieting (Stoeber et al., 2017), OCD (Sametoglu et al., 2021), neuroticism (Enns, Cox & Clara, 2005), drive for thinness (McGee et al., 2005), and past or current eating pathology (Sherry et al., 2004). Perfectionism is also associated with other factors explored in McComb and Mills (2019) review of literature including narcissism (Smith et al., 2016), self-esteem (Goldner, Cockell, & Srikameswaran), and body dissatisfaction (Boone et al., 2014). We pair trait perfectionism with perfectionistic self-presentation as a means of encapsulating interpersonal and behavioural outcomes that are not captured in trait dimensions. Doing so will help to understand and explain unique vulnerabilities associated with orthorexia.

Trait Perfectionism

Trait perfectionism is characterized by striving for flawlessness and setting excessively high standards for performance while being overly critical evaluations of one's behaviour (Stoeber & Childs, 2010). There are two widely used multidimensional measures of trait perfectionism: the Frost Multidimensional Perfectionism Scale (F-MPS; Frost et al., 1990) and the Hewitt Multidimensional Perfectionism Scale (HMPS; Hewitt & Flett, 1991). The F-MPS (Frost et al., 1990) comprises or six subscales that combine previous measures of perfectionism. The subscales include Personal Standards (i.e., setting high standards for oneself), Concern over Mistakes (i.e., perceiving mistakes as failures), Doubts about Actions (i.e., doubting one's own performance), Parental Expectations (i.e., parents setting high

standards for oneself), Parental Criticism (i.e., parents criticising for mistakes made by oneself), and Organisation (i.e., one's own neatness [not included in the total score]). However, there has been criticism over the overlap of certain subscales in the F-MPS and OCD symptoms, as most of its items were originally taken from a measure of OCD – the Maudsley Obsessive-Compulsive Inventory (Hodgson & Rachman, 1977; Limburg et al., 2017).

The second of the most widely researched and applied measures of trait perfectionism is Hewitt and Flett's (1991) model (i.e., HF-MPS). Hewitt and Flett (1991) conceptualise multidimensional trait perfectionism as three separate and stable dimensions. The dimensions include self-oriented perfectionism or SOP (i.e., demanding perfection of oneself), other-oriented perfectionism or OOP (i.e., demanding perfection of others), and socially prescribed perfectionism or SPP (i.e., perceiving that others are demanding perfection of oneself). SOP comprises an individual's internal motivation for oneself; OOP reflects the imposition of one's own perfectionism onto others; and SPP comprises of an individual's perceptions of the imposition of others perfectionism onto them (Enns & Cox, 2002). Thus, trait perfectionism differentiates between the source and the direction of perfectionistic expectations.

The transdiagnostic nature of trait perfectionism means that is a significant vulnerability to a range of mental ill-health issues and psychopathologies (i.e., it is a risk and maintenance factor in various psychopathologies [Egan, Wade, & Shafran, 2012]). In this regard, perfectionism has been consistently linked to four forms of psychopathology, including affective disorders, obsessive compulsive disorder, anxiety disorders, and eating disorders (Limburg et al., 2017). Such psychopathology embodies depressive symptoms, suicide idealisation, OCD symptoms, obsessive beliefs, anxiety, social phobia, anorexic symptoms, and bulimia. All of which can be the cause of significant psychological distress and physical ill-health (see Limburg et al., 2017). Therefore, despite some ambiguity

regarding the benefits of perfectionism, research is clear in this area and provides compelling evidence in regards to its role as a risk factor for mental health.

Trait perfectionism has long been recognised as a risk and maintaining factor in eating disorders (Egan, Wade & Shafran, 2012). Individuals suffering from eating disorders, such as anorexia nervosa and bulimia nervosa typically drive to attain perfection regarding their eating, weight, shape, and size, and strive for control in these areas. Several eating disorder models have included trait perfectionism as a core variable in explaining its mechanisms in eating pathology (i.e., global eating pathology, binge eating, drive for thinness, thin idealisation, body dissatisfaction, dietary restraint, compensatory behaviours, suicide idealisation, and deliberate self-harm). These models include Fairburn's transdiagnostic model of eating disorders (Fairburn, Cooper & Shafran, 2003), Bardone-Cone et al. (2006) three-factor model of bulimia nervosa, and Schmidt and Treasure (2006) cognitive-interpersonal model of anorexia nervosa (Limburg et al., 2017). Extensive evidence of the role that trait perfectionism plays in predicting and maintaining eating disorders has been confirmed in a meta-analysis by Limburg et al. (2017).

Trait Perfectionism and Orthorexia

Understandably, as unrealistic standards and critical appraisals inform behaviour in trait perfectionism, it stands to reason that such engrained ways of thinking, feeing, and behaving would predict orthorexic symptomology. Ultimately, orthorexia conceptualises striving for a perfectly pure diet. Consistent with eating pathology, there is an emerging body of research that has linked trait perfectionism with orthorexia across a range of demographic factors (i.e., country of origin [McComb & Mills, 2019]). To date, five studies have used different measures of trait perfectionism to examine the relationship between trait perfectionism and orthorexia. All of these studies have found trait perfectionism to perhaps

correlate with the development of orthorexia (McComb & Mills, 2019). We have summarised these studies in Table 2 and discuss them in detail below.

Barnes and Caltabiano (2017) investigated whether perfectionism, body image, attachment style, and self-esteem predicted orthorexia in a sample of 400 students. The participants completed a series of online self-reported questionnaires including the ORTO-15 (Donini et al., 2005) as a measure of orthorexia and the Multidimensional Perfectionism Scale (HF-MPS; Hewitt & Flett, 1991). The overall results of the study suggested that orthorexia shares similarities with anorexia nervosa and bulimia nervosa. This is because high orthorexia scores showed significant correlations with high scores of appearance orientation, overweight preoccupation, self-classified weight, and fearful and dismissing attachment styles, and low scores for body areas satisfaction and secure attachment style (Barnes & Caltabiano, 2017). Specifically, Barnes and Caltabiano (2017) found that orthorexic tendencies showed significant and small to medium negative correlations with self-oriented perfectionism ($r = 0.36$), other-oriented perfectionism ($r = 0.25$), and socially prescribed perfectionism ($r = 0.23$). In addition, overweight preoccupation, appearance orientation, and the presence of an eating disorder history were significant predictors of orthorexia (Barnes & Caltabiano, 2017). Therefore, the results of the study suggest that perfectionism may be a risk factor for the development and maintenance of orthorexia but not a predictor.

A similar study by Hayles et al. (2017) assessed clinical correlates of orthorexia and the extent to which obsessive-compulsive symptoms, perfectionism, anxiety and depressive symptoms, eating disorder symptoms, and body image concerns were associated with orthorexic tendencies. The study was carried out on a sample of 404 American students (83% female). Again, Hayles et al. (2017) used a combination of online self-reported questionnaires, including the ORTO-15 (Donini et al., 2005) as a measure or orthorexia, the

Eating Disorder Examination Questionnaire (EDEQ; Fairburn & Beglin, 2008) to measure eating disorder symptoms, the Appearance Anxiety Inventory (AAI; Veale et al., 2014) to assess body image concerns, and the Frost Multidimensional Perfectionism Scale (F-MPS; Frost et al., 1990) to examine perfectionistic tendencies. Notably, it has been argued that the doubts about actions subscale of the F-MPS mainly reflects obsessive-compulsive symptomatology instead of perfectionism per se and that the parental subscales affect the aetiological factors of perfectionism (Limburg et al., 2017). Therefore, the F-MPS may have been better replaced with the HF-MPS. Nevertheless, Hayles et al. (2017) reported that 34.4% of the sample showed orthorexic symptomatology when using a cut-off point of <40 to indicate orthorexia. The results showed that orthorexia symptoms exhibited significant small to medium negative relations with the AAI (r = 0.27), OCI-r (r = 0.12), EDEQ (r = 0.34), and the F-MPS (r = 0.10) total scores. Notably, the ORTO-15 has significant limitations (as previously discussed) as a valid and reliable measure of orthorexia, which may have impaired results from both Barnes and Caltabiano (2017) and Hayles et al. (2017) studies.

A more in-depth study by Barrada and Roncero (2018) assessed relations between psychological disorders that are theoretically associated with orthorexia, including eating disorder symptoms, obsessive-compulsive disorder symptoms, negative affect, and perfectionism. Barrada and Roncero (2018) did so as a means of developing and validating the Teruel Orthorexia Scale. The Teruel Orthorexia Scale is a 17-item bidirectional test of orthorexia that includes measures of Healthy Orthorexia and Orthorexia Nervosa (Barrada & Roncero, 2018). A sample of 942 Spanish students (76% female) completed a battery of online self-reported questionnaires including the F-MPS (Frost et al., 1990) as a measure of perfectionism. The results of the study showed that Healthy Orthorexia showed no significant correlations with the above-mentioned measures of psychological distress or psychopathology. However, Orthorexia Nervosa showed medium to high significant

correlations the overall EAT-26 scores (r = 0.35 - 0.67), PANAS negative effect (r = 0.27), and F-MPS-CM (r = 0.41) scores (Barrada & Roncero, 2018). The results suggest that when reliably measured, orthorexia is particularly related to concerns about preoccupation with perfect eating behaviours and food control.

In line with trait perfectionism-eating disorder research, Bartel et al. (2020) sought to provide evidence of orthorexia in eating disorder classification and examined the motives behind food choice in orthorexia. A sample of 512 Canadian (83% female) students carried out a series of online self-reported questionnaires, which included the Revised Bratman's Orthorexia Test (rBOT; Haeberle-Savard, 2015) to examine motives behind food choice. Bartel et al. (2020) results overall suggested that orthorexia was more highly correlated with eating disorder symptoms (β = 0 .63) than obsessive-compulsive symptoms (β = 0.23), and that both orthorexia and eating disorder symptoms were moderately related to perfectionism. Specifically, high scores on the revised BOT showed small to medium significant correlations with total F-MPS perfectionism scores (r = 0.24), personal standards (r = 0.22), concerns over mistakes (r = 0.25), and doubts about actions (r = 0.26). Respectively, high scores on the EDE-Q showed significant medium correlations with total perfectionism scores (r = 0.35), personal standards (r = 0.30), concern over mistakes (r = 0.42), and doubts about actions (r = 0.33). Here, it is important to note the aforementioned criticisms of the doubts about actions subscale of the F-MPS. Nonetheless, Bartel et al. (2020) highlighted that eating disorder symptoms explained significant variance in orthorexia when controlling for BMI (β = 0.65). Such results suggest that orthorexia may be associated with shape and weight dissatisfaction as well as weight manipulation via perfect food control.

Finally, a study by Oberle et al. (2017) examined possible predictors of orthorexia, such as demographic variables (gender and BMI) and personality variables (perfectionism, self-esteem, and narcissism) in a sample of 459 American undergraduate psychology students

(81% female). The participants completed a series of online questionnaires including the Eating Habits Questionnaire (EHQ; Gleaves, Graham, &, Ambwani, 2013) as a measure of orthorexia, the Frost Multidimensional Perfectionism Scale (F-MPS; Frost et al., 1990) to assess perfectionism. Again, the F-MPS has been criticised in terms of its specific subscales, as noted above. Nevertheless, the demographic results of the study indicated that high BMI was a greater predictor of orthorexia than low BMI and that men showed greater orthorexic behaviours and lower positive feelings upon healthy eating than women. Importantly, results from partial correlation analyses showed that when controlling for gender and BMI, self-esteem was only significantly related to orthorexic behaviours (r = 0.15), and narcissism showed small significant relations with total orthorexia scores (r = 0.17). Oberle et al. (2017) findings suggest that there may be significant differences in gendered experiences of orthorexia and that BMI could be a predictor of orthorexia symptoms. Notably though, the results further confirm that individuals that are high in orthorexic tendencies are likely to exert self-control, resist temptation, and eat a near perfect diet that they believe is superior to other people's diets (Oberle et al., 2017).

In summarising the findings of these studies, the literature assessing the relationship between trait perfectionism and orthorexia has shown that perfectionism may be a risk factor for the development and maintenance of orthorexia. Trait perfectionism has consistently shown significant small-to-medium correlations with orthorexia. The below review of current trait perfectionism-orthorexia includes studies prior to October 31st 2020. All studies had been peer-reviewed. The review details the study authors, study sample, measures used, risk factors and epidemiological/demographic factors assessed, and correlations coefficients.

Table 2 – Review of Trait Perfectionism-Orthorexia Studies

Authors	**Sample**	**Measures**	**Risk Factors**	**Epidemiological Demographic Factors**	**Correlations**
Barnes & Caltabiano, (2017)	220 Australian university students (174 women, 46 men)	ORTO-15 (only used 9 items), Hewitt & Flett Multidimensional Perfectionism Scale (HF-MPS), Multidimensional Body-Self Relations Questionnaire-Appearance Scale (MBSRQ-AS), Relationship Scales Questionnaire (RSQ), Rosenberg Self-Esteem Scale (SES)	Gender, Education level, Eating disorder history, Food intolerance, Food allergy, Medically prescribed diet, Perfectionism Self-oriented, Other oriented, Socially prescribed, Overweight preoccupation, Appearance Orientation, History of eating disorders	-	HF-MPS Total Score: .40* Self-oriented Perfectionism: .36** Other-oriented Perfectionism: .25** Socially-prescribed Perfectionism: .23**

Barrada & Roncero, (2018)	942 Spanish university students (716 women, 226 men)	Teruel Orthorexia Scale (TOS), Obsessive Compulsive Inventory-Revised (OCI-r), Eating Attitudes Test-26 (EAT-26), Negative Affect Scale of the Positive and Negative Affect Scale (PANAS), Appearance Evaluation Scale of the Multidimensional Body-Self Relations Questionnaire (MBSRQ-AE), Concern over Mistakes Scale Frost-Multidimensional Perfectionism Scale (F-MPS)	BMI, Obsessive-compulsive tendencies, EAT-26, Diet, Oral control, Bulimia, Negative affect, Appearance evaluation, Concern over mistakes perfectionism	Sex, Age, Education level, Weight (to the nearest kilogram), Height (to the nearest centimetre)	Concern over Mistakes Perfectionism: .40* ORTO-15: .19 TOS: .41
Bartel et al. (2020)	512 (423 female, 89 male) American	Revised Bratman Orthorexia Test (rBOT), ORTO-15, Obsessive-Compulsive Inventory Revised	Eating disorder symptomology, Body weight and shape concern,	Age, sex, BMI	rBOT F-MPS Total Score: .24**

undergraduate psychology participants	(OCI-r), Eating Disorder Examination Questionnaire (EDE-Q), Frost Multidimensional Perfectionism Scale (F-MPS), Food Choice Questionnaire (FCQ)	perfectionism, Obsessions and compulsions	Personal Standards: .22** Concern over mistakes: .25** Doubts about Actions: .26** EDE-Q F-MPS Total Score: .35** Personal Standards: .30** Concern over Mistakes: .42**

					Doubts about Actions: .33** OCI-r F-MPS Total Score: .45** Personal Standards: .27** Concern over Mistakes .39** Doubts about Actions: .46**
Hayles et al. (2017)	404 American	ORTO-15 (cut-off < 40), Eating Disorder Examination Questionnaire	Gender, Perfectionism, Obsessive-compulsive	-	ORTO-15

	university students (334 women, 70 men)	(EDEQ), Appearance Anxiety Inventory (AAI), Frost Multidimensional Perfectionism Scale (F-MPS), Obsessive Compulsive Inventory Revised (OCI-r)	symptoms, Disordered eating, Appearance anxiety		F-MPS Total Score: .10*
Oberle et al. (2017)	459 American undergraduate psychology students (371 women, 88 men)	Eating Habits Questionnaire (EHQ), Rosenberg Self-Esteem Scale (SES), Narcissistic Personality Inventory, Frost Multidimensional Perfectionism Scale (F-MPS)	Gender, BMI, Self-esteem, Narcissism, Perfectionism	Ethnicity, Age, Sex, Weight, Height	F-MPS Total Score: .23*** Personal Standards: .29***

Note. Including peer-reviewed articles as primary sources that are published in English prior to Oct 31st 2020 and review some psychosocial risk factor for orthorexia.

Perfectionistic Self-Presentation

In addition to measuring perfectionism as a trait, it can also be measured as a self-presentational style. Perfectionistic self-presentation is conceptually distinct from trait perfectionism as it focuses on an excessive need to appear perfect in the eyes of others or to seem perfect (Sherry et al., 2007). Hewitt et al. (2003) conceptualised perfectionistic self-presentation as three distinct and stable dimensions including perfectionistic self-promotion (i.e., promoting a perfect image of oneself to others), non-display of imperfection or (i.e., avoidance of behavioural displays of imperfection), and non-disclosure of imperfection (i.e., avoidance of verbal disclosure of imperfection; Sherry et al., 2007). All perfectionistic self-presentation dimensions characterise interpersonal perfectionism. Therefore, the impression management associated with perfectionistic self-presentation represents what perfectionism *does* (Hewitt et al., 2003; Sherry et al., 2007).

Perfectionistic self-presentation is associated with various mental and physical health outcomes in children, adolescents, and adults that are not typically captured in trait perfectionism dimensions. Such mental and physical health outcomes include anxiety, personality disorders, narcissism, distress, disorder, dysfunction, dissociality, personality disorders, and dysregulation (Casale et al., 2019; Hewitt et al., 2008; Sherry et al., 2007). Perfectionistic self-presentation is also linked to eating pathology (Ferreria et al., 2018; Paixao et al., 2020), exercise dependence (Hill, Robson, & Stamp, 2015), and body image (McGee et al., 2005) in various clinical and non-clinical samples. Importantly, research has shown that all dimensions of perfectionistic self-presentation predict eat disorder symptomatology (i.e., dieting, bulimia and oral control) independent of trait perfectionism (Stoeber et al., 2017). This highlights the significance of the interpersonal expression of perfectionism in eating pathology.

Perfectionistic Self-Presentation and Orthorexia

It is possible that perfectionistic self-presentation is particularly important in the development and maintenance of orthorexia. This is because cognitions and behaviours surrounding the need to appear perfect to others may be transferred to eating habits. In this sense, an individual suffering from orthorexia would experience rigid and perfectionistic thoughts about their diet and adjust their dietary practises accordingly (Pratt, Madigan & Hill, in press). Research has well-documented that orthorexic individuals believe that their eating habits are superior to others and strive to obtain a perfectly pure diet (Nevin & Vartanian, 2017). Such cognitions and behaviour would reflect the assumed ego-syntonic and interpersonal nature of orthorexia.

It has been already established that orthorexia is associated with exercise addiction or compulsive exercise (Rudolph, 2018). However, the relationship between perfectionistic self-presentation in exercisers may be particularly important. This is because a strong commitment to "healthy" behaviours is often associated to unhealthy and extreme behaviours such as exercise dependence (Hill, Robson & Stamp, 2015). For example, Hill, Robson and Stamp (2015) suggest that exercise may be used as a coping and impression management strategy in individuals high is perfectionistic self-presentation. Therefore, rigid eating behaviours, which go hand-in-hand with exercise behaviours (Mond & Gorrell, 2021), may also be used for the same purpose (Pratt, Madigan & Hill, in press).

There is recent evidence to suggest that perfectionistic self-presentation dimensions may be associated with orthorexia. A study by Pratt, Madigan, and Hill (in press) provided a first cross-sectional examination of the perfectionistic self-presentation-orthorexia relationship in a sample of 150 exercisers. Correlation analysis showed that two dimensions of perfectionistic self-presentation - perfectionistic self-promotion and nondisplay of imperfection – were positively associated orthorexia. In addition, multiple regression

analyses showed that perfectionistic self-promotion was the strongest unique predictor of orthorexia (Pratt, Madigan, & Hill, in press). Therefore, as surmised, perfectionistic self-presentation may be a risk factor for orthorexia, with the need to promote a perfect image of oneself to others being an especially important component of this relationship.

Trait Perfectionism, Perfectionistic Self-Presentation, and Orthorexia

Given the above, it is possible that perfectionistic self-presentation may mediate the relationship between trait perfectionism and orthorexia. This is because research has previously shown that perfectionistic self-presentation mediates relations between trait perfectionism and disordered eating (Stoeber et al., 2017). Research has also explained why perfectionistic female students possess higher levels of pathological dieting particularly (Stoeber et al., 2017). Similarly, perfectionistic self-presentation has been shown to partially mediate relations between trait perfectionism and diet (i.e., eating pathology) and fully mediate relations between trait perfectionism and bulimic behaviours in mixed gender university students (Rodrigues et al., 2020). As more evidence is gathered for the categorisation of orthorexia on the eating disorder spectrum (Bartel et al., 2020), it is likely that similar patterns of mediation in context of perfectionistic self-presentation will occur.

All previous studies examining perfectionism and orthorexia have been cross-sectional in design. However, cross-sectional studies provide limited evidence for causality due to a lack of temporality (Spector, 2019). That is, all variables (presumed causes and effects) are measured at the same time. Longitudinal designs on the other hand are useful for examining potential temporal relations between variables and provide stronger evidence in regards to causation. This is because variables can be ordered in time based on the presumed causal chain and previous scores (or autoregressive effects) can be controlled for. As such, it would be beneficial to build on existing cross-sectional studies (as previously mentioned), which have assessed relations between trait perfectionism and orthorexia and perfectionistic

self-presentation and orthorexia. Doing so would also be necessary to begin to examine whether the proposed mediational model holds when examining changes in orthorexia over time.

The Present Study

Against this background, the aim of the present study was to examine whether perfectionistic self-presentation mediates the relationship between trait perfectionism and orthorexia in exercisers. Because self-oriented perfectionism is related to compulsivity and compulsively striving to achieve (Sherry et al., 2007), its relationship with orthorexia is likely to be mediated by all perfectionistic self-presentation facets (i.e., perfectionistic self-promotion, nondisplay of imperfection and nondisclosure of imperfection). This would emulate the intrapersonal or self-regulation of orthorexic behaviours. In other words, the unrealistic expectation of perfection in an individual high in orthorexia is likely to be explained by the need to avoid showing personal inadequacies that may be representative of failure. This would be reflected in actively engaging in self-promotion and avoiding revealing imperfections in their dietary and lifestyle practices.

The interpersonal facets of trait perfectionism (i.e., other-oriented perfectionism and socially prescribed perfectionism) may relate slightly differently to orthorexia. The relationship for other-oriented perfectionism will likely be mediated by only perfectionistic self-promotion to explain the ego-syntonicity associated with orthorexia and the projection of perfectly pure eating habits onto others as a means of impression management. This is because the an orthorexic individual high in other-oriented perfectionism will likely engage in self-promotion in an attempt to elicit self-verification from others (Sherry et al., 2007). By contrast, the relationship for socially prescribed perfectionism is likely to be mediated by the defensive elements of perfectionistic self-presentation (i.e., nondisplay of imperfection and nodisclosure of imperfection). This is because if an orthorexic individual is able to guard

themselves against public admission of any personal deficiencies and avoid behavioural displays of imperfections, they can minimise exposure to criticism and maintain a desirable self-image.

To address our aim, we tested two models. First, we tested a model based on cross-sectional data in which the relationship between trait perfectionism and orthorexia was mediated by facets of perfectionistic self-presentation. Second, we tested a model based on longitudinal data in which the relationship between Time 1 trait perfectionism and Time 2 orthorexia was mediated by Time 1 perfectionistic self-presentation while we controlled for Time 1 orthorexia. As described above, we hypothesised that perfectionistic self-presentation would mediate the relations between trait perfectionism and orthorexia cross-sectionally. We also predicted that perfectionism would explain change in orthorexia over time and that perfectionistic self-presentation would also mediate the relations between trait perfectionism and orthorexia longitudinally.

Methods

Participants

At Time 1, a sample of 177 exercisers (109 males, 68 females) was recruited via social media platforms. The participants were all members of community and private gyms and all had a background in past/current gym-based sports (e.g., Strongman, CrossFit, Bodybuilding). The participants' mean age was 31.6 years (*SD* = 7.85, range = 18 - 57 years). The participants had an average height of 173.61cm (*SD* = 9.95) and an average weight of 82.45kg (*SD* = 21.33). Participants exercised on average for 60 - 90 minutes per day and attended the gym on average 5 - 6 times per week.

At Time 2, 81 (52 males, 29 females) of the original participants completed the second wave of questionnaires. The participants' mean age was 31.24 years (*SD* = 8.36, range = 18 - 52 years). The participants had an average height of 172.82 cm (*SD* = 21.37) and an average weight of 82.90kg (*SD* = 19.92). These participants showed a similar pattern of gym attendance as those from Time 1.

Procedure

The study adopted a non-experimental two-wave longitudinal design using self-report questionnaires. Sample size requirements were based on those provided by Fritz and MacKinnon (2007). Specifically, based on the estimated *a* and *b* paths of $\alpha = 0.40$ and $\beta = 0.36$, and bias-corrected bootstrap tests of indirect effects, the estimated sample size was 148 participants (Fritz & MacKinnon, 2007). The recruitment of the sample was purposive and convenient. Informed consent was obtained from all participants. All participants were above the age of 18 years. The study was approved by a university ethics committee. A unique participant code was used for identification of second wave data and an email address was required for re-contact of the second data collection.

Questionnaires were distributed online via social media platforms. Participants were administrated all measures twice separated by 6 weeks, once in February 2021 (Time 1 [T1]) and then again in March 2021 (Time 2 [T2]). 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. Because the present study was the first study to examine the longitudinal relationship between perfectionism and orthorexia, a 6-week interval was chosen based on previous research in a similar area (McGrath et al., 2012).

Measures

The questionnaire was 71-items long and included a brief demographics questionnaire (i.e., sex, age, height, weight, level of physical activity, and frequency of training) alongside standardised self-report measures of trait perfectionism, perfectionistic self-presentation, and orthorexia.

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, Enns, & Clara, 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, 2016).

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 (NOP; 10 items; “I hate to make errors in public”), and nondisclosure of imperfection (NOI; 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 high internal validity (Hewitt et al.,2003).

Orthorexia. To measure orthorexia, we used the Eating Habits Questionnaire (EHQ; Gleaves, Graham, & Ambwani, 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 feeling positively about healthy eating (4 items, e.g., “I feel great when I eat healthily”). The three factors can be combined to an overall orthorexia score. 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 good internal consistency (Brytek-Matera, Plasonja, & Decamps, 2020).

Data Analysis Strategy

Following preliminary analyses, descriptive statistics, internal consistency (McDonald's Omega), and bivariate correlations were calculated. To test our hypotheses, we tested two models. First, we tested a model based on the cross-sectional data in which the relationship between trait perfectionism and orthorexia was mediated by perfectionistic self-presentation. Second, we tested a model based on the longitudinal data in which the relationship between Time 1 trait perfectionism and Time 2 orthorexia was mediated by Time 1 perfectionistic self-presentation while we controlled for Time 1 orthorexia. To do so, we ran path models in Mplus 8.1 (Muthén & Muthén, 1998–2017). We chose to evaluate goodness of model fit using the following indices; comparative fit index (CFI), Tucker–Lewis index (TLI [also known as *nonnormed fit index*, NNFI]), the root mean square error of approximation (RMSEA; see Marsh, Hau, & Wen, 2004). Because it is recommended to examine a range of incremental and absolute fit indices, we additionally included the and standardised root mean square residual (SRMR; Hu & Bentler, 1999). The following cut-off values were used as benchmarks for acceptable (CFI > .90, TLI > .90, RMSEA < 10, SRMR< .10) and good model fit (CFI > .95, TLI > .95, RMSEA < .08, SRMR< .08; Marsh et al., 2004). To test both cross-sectional and longitudinal mediation, we used bias-corrected bootstrapping (5,000 samples) to estimate indirect effects (Rucker, 2011). The indirect effects were deemed significant at the $p < .05$ level if the 95% confidence interval (CI) does not contain zero (Rucker et al., 2011).

Results

Preliminary analyses

First, we inspected the data for missing values. In total, 2 missing responses at Time 1. Because there were so few missing responses, we based our analyses on the average of the remaining items. Then, the data were screened for univariate and multivariate outliers. No participant showed a *Z* score > 3.29 or Mahalanobis distance larger than the critical value of $\chi^2(4) = 18.467$, $p < .001$ (Tabachnick & Fidell, 2007). Next, we computed McDonald's Omega for our variables (see Tables 3 and 4) which were all satisfactory.

Descriptive Statistics and Bivariate Correlations (Time 1)

Means and standard deviations for all variables for Time 1 can be found in Table 3. We next calculated correlations between all variables. Perfectionism variables showed significant medium-large positive correlations with one another within and across both time points. Self-oriented perfectionism, other-oriented perfectionism, and socially prescribed perfectionism at Time 1 all showed significant medium correlations with orthorexia at Time 1. Self-oriented perfectionism at Time 1 showed significant small-medium correlations with orthorexia at Time 2, other-oriented perfectionism at Time 1 showed a significant medium-large correlation with orthorexia at Time 2, and socially prescribed perfectionism at Time 1 showed a nonsignificant small correlation with orthorexia at Time 2. Further, self-oriented and other oriented perfectionism at Time 2 showed significant medium correlations with orthorexia at Time 2, where socially prescribed perfectionism at Time 2 showed a nonsignificant small correlation with orthorexia at Time 2.

Table 3 – Time 1 Descriptive Statistics, Bivariate Correlations, and McDonald's Omega

Variable	1	2	3	4	5	6	7
Time 1							
1. Self-oriented Perfectionism							
2. Other-oriented Perfectionism	.63**						
3. Socially Prescribed Perfectionism	.59**	.54**					
4. Perfectionistic Self-presentation	.68**	.62**	.61**				
5. Nondisplay of Imperfection	.52**	.45**	.53**	.82**			
6. Nondisclosure of imperfection	.46**	.47**	.49**	.72**	.74**		
7. Orthorexia	.38**	.37**	.26**	.33**	.21**	.25**	
Mean	22.19	18.12	17.55	3.63	3.80	3.02	2.25
SD	7.01	6.15	5.9	1.29	1.41	1.06	.46
McDonald's ω	.88	.80	.76	.86	.90	.75	.86

Note. Time 1 N = 177. *SOP = Self-oriented Perfectionism, OOP = Other-oriented Perfectionism, SPP = Socially Prescribed Perfectionism, PSP = Perfectionistic Self-promotion, NOP = Nondisplay of Imperfection, NOI = Nondisclosure of Imperfection, ORTHO = Orthorexia. ** Correlations are significant at the 0.01 level (2 tailed). * Correlations are significant at the 0.05 level (2 tailed).*

Mediation Model (Cross-Sectional)

Direct Effects. For Time 1, we ran a cross-sectional mediation model (see Figure 1) to test direct and specific indirect effects of perfectionism and perfectionistic self-presentation on orthorexia. The goodness of fit statistics suggested a good fitting model ($\chi 2$ [3] = 11.91, p > .007, CFI (.98), TLI (.90), RMSEA (.013, p = .035), and SRMR (.04). The model explained 13% of the variance in orthorexia.

Self-oriented perfectionism had a significant direct effect on orthorexia (β = .12, *SE* = .04, 95% CI [.04, .21], p = .004). Other-oriented perfectionism had a significant direct effect on orthorexia (β = .11, SE = .04, 95% CI [.04, .19], p = .004). Socially prescribed perfectionism had a significant direct effect on orthorexia (β = .07, SE = .04, 95% CI [.01, .14, p = .036).

Self-oriented perfectionism had a significant direct effect on perfectionistic self-promotion (β = .37, *SE* = .07, 95% CI [.22, .50], p = .000) and nondisplay of imperfection (β = .26, *SE* = .08, 95% CI [.08, .54], p = .003). Other-oriented perfectionism had a significant direct effect on perfectionistic self-promotion (β = .24, SE = .07, 95% CI [.11, .38], p = .001) and nondisclosure of imperfection (β = .22, SE = .09, 95% CI [.05, .40], p = .013). Socially prescribed perfectionism had a significant direct effect on perfectionistic self-promotion (β = .27, SE = .07, 95% CI [.13, .40, p = .000), nondisplay of imperfection (β = .31, SE = .08, 95% CI [.16, .47, p = .000), and nondisclosure of imperfection (β = .27, SE = .08, 95% CI [.12, .42, p = .000).

Perfectionistic self-promotion had significant direct effects on orthorexia (β = .46, SE = .12, 95% CI [.22, .69, p = .000). Finally, nondisplay of imperfection had significant direct effect on orthorexia (β = -.25, SE = .12, 95% CI [-.46, -.00, p = .035).

Indirect Effects. Based on bias-corrected bootstrapped indirect effects at Time 1, relations between self-oriented perfectionism and orthorexia were significantly mediated by perfectionistic self-promotion (indirect effect = .17, SE = .06, 95% CI [.07, .30]) and nondisplay of imperfection (indirect effect = -.64, SE = .04, 95% CI [-.17, -.01]). Relations between other-oriented perfectionism and orthorexia were significantly mediated by perfectionistic self-promotion (indirect effect β = .11, SE = .05, 95% CI [.04, .22]). Finally, relations between socially prescribed perfectionism and orthorexia were mediated by perfectionistic self-promotion (indirect effect β = .01, SE = .04, 95% CI [.05, .22]) and nondisplay of imperfection (indirect effect β = -.08, SE = .04, 95%CI [-.17, -.01]).

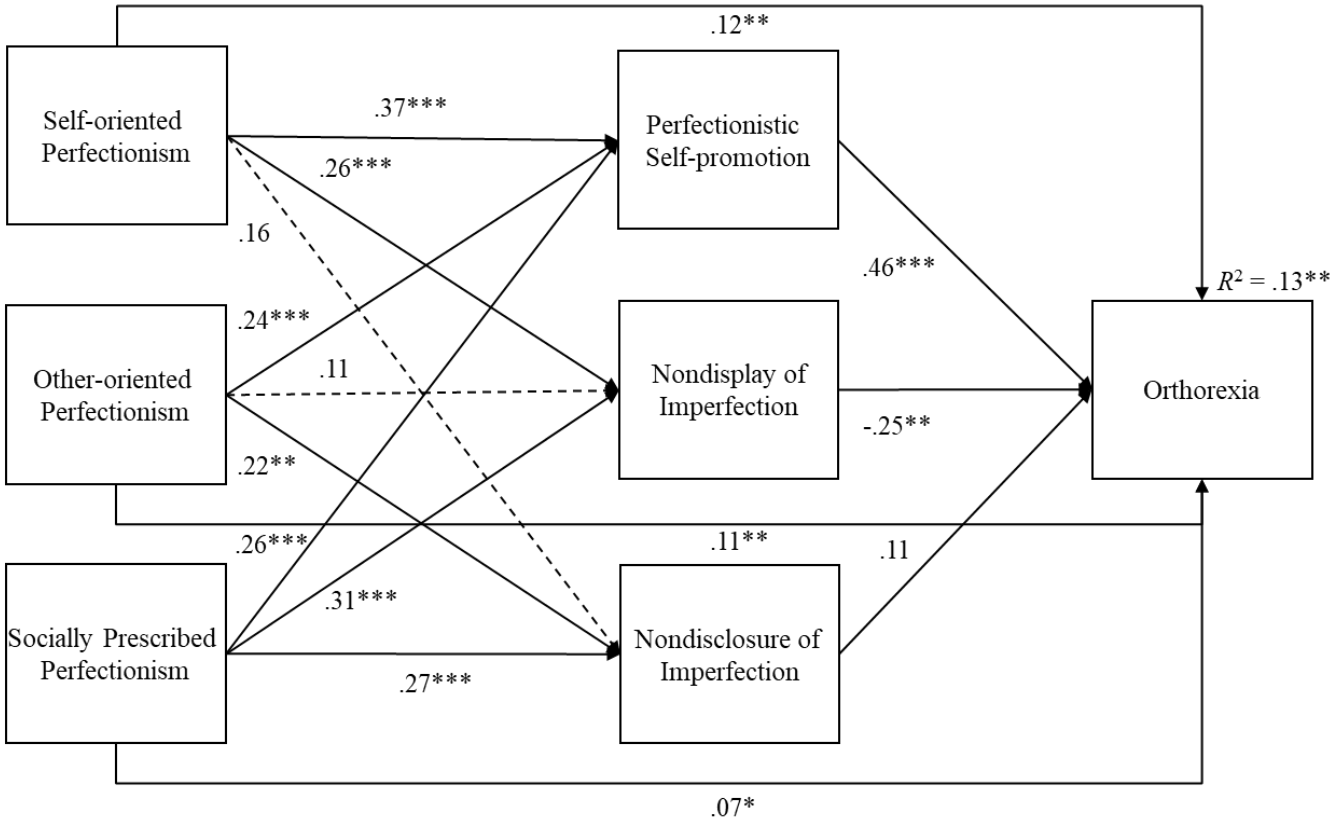

Figure 1. *Cross Sectional Mediation Model of Perfectionistic Self-Presentation Mediating the Relationship between Trait Perfectionism and Orthorexia (Model 1).* N = *177. All path coefficients are standardized, and nonsignificant paths (*p ≥ *.05) are indicated by dashed lines.*

Descriptive Statistics and Bivariate Correlations (Time 2)

Means and standard deviations for all variables for Time 2 can be found in Table 4. We then calculated correlations between all variables. Perfectionistic self-presentation at Time 1 showed a significant medium correlation with orthorexia at Time 1. Nondisplay of imperfection and nondisclosure of imperfection at Time 1 both showed significant small-medium correlations with orthorexia at Time 1. Perfectionistic self-presentation at Time 1 showed a significant positive correlation with orthorexia at Time 2. Nondisplay of imperfection at Time 1 showed a nonsignificant correlation with orthorexia at Time 2. Nondisclosure of imperfection at Time 1 showed a significant small-medium correlation with orthorexia at Time 2. Finally, Perfectionistic self-presentation and nondisclosure of imperfection at Time 2 showed significant small-medium correlations with orthorexia at Time 2. Non-display of imperfection at Time 2 showed a nonsignificant small correlation with orthorexia at Time 2.

Table 4 - Time 2 Descriptive Statistics, Bivariate Correlations, and McDonald's Omega

Variable	1	2	3	4	5	6	7
Time 2							
1. Self-oriented Perfectionism							
2. Other-oriented Perfectionism	.61**						
3. Socially Prescribed Perfectionism	.57**	.53**					
4. Perfectionistic Self-presentation	.84**	.52**	.56**				
5. Nondisplay of Imperfection	.70**	.42**	.52**	.81**			
6. Nondisclosure of imperfection	.58**	.40**	.53**	.73**	.74**		
7. Orthorexia	.29**	.38**	.11	.29**	.11	.25*	
Mean	21.91	18.12	17.98	3.71	3.76	3.15	2.14
SD	7.13	6.15	5.65	1.30	1.40	1.17	.42
McDonald's ω	.90	.82	.77	.86	.90	.70	.86

*Note. Time 2 N = 81. SOP = Self-oriented Perfectionism, OOP = Other-oriented Perfectionism, SPP = Socially Prescribed Perfectionism, PSP = Perfectionistic Self-promotion, NOP = Nondisplay of Imperfection, NOI = Nondisclosure of Imperfection, ORTHO = Orthorexia. ** Correlations are significant at the 0.01 level (2 tailed). * Correlations are significant at the 0.05 level (2 tailed).*

Path Model and Mediation (Longitudinal)

Direct Effects. An autoregressive path model (see Figure 2) was tested to investigate the longitudinal effects of perfectionistic self-promotion, non-display of imperfection, and non-disclosure of imperfection on orthorexia over a six-week period (i.e. autoregressive paths from perfectionism Time 1 → perfectionistic self-presentation Time 1 → orthorexia Time 2). The goodness of fit statistics was (CFI (.94), TLI (.86), RMSEA (.134, p =.001), and SRMR (.15), which all suggested a good fitting model. The model explained 66.3% variance in orthorexia.

Orthorexia at Time 1 had a significant direct effect on orthorexia at Time 2 (β = .79, *SE* = .06, p = .000).

Self-oriented perfectionism at Time 1 had a significant direct effect on perfectionistic self-promotion at Time 1 (β = .12, *SE* = .04, p = .004) and nondisplay of imperfection at Time 1 (β = .26, SE = .09, p = .003). Other-oriented perfectionism at Time 1 had a significant direct effect on perfectionistic self-promotion at Time 1 (β = .24, SE = .07, p = .003) and nondisclosure of imperfection at Time 1 (β = .22, SE = .09, p = .012). Socially prescribed perfectionism at Time 1 had a significant direct effect on perfectionistic self-promotion at Time 1 (β = .27, SE = .07, p = .000), nondisplay of imperfection at Time 1 (β = .31, SE = .08, p = .000), and nondisclosure of imperfection at Time 1 (β = .27, SE = .08, p = .000).

Perfectionistic self-promotion at Time 1 had a significant direct effect on orthorexia at Time 2 (β = .21, SE = .09, p = .022). Finally, nondisplay of imperfection at Time 1 had a significant direct effect on orthorexia at Time 2 (β = -.21, SE = .09, p = .023).

Indirect Effects. Based on bias-corrected bootstrapped indirect effects, relations between self-oriented perfectionism at Time 1 and orthorexia at Time 2 were significantly mediated by nondisplay of imperfection at Time 1 (indirect effect β = -.047, SE = .034, 95%

CI [-.140, -.001]). Relations between socially prescribed perfectionism at Time 1 and orthorexia at Time 2 were significantly mediated by nondisplay of imperfection at Time 1 (indirect effect β = -.056, SE = .034, 95%CI [-.141, -.003]).

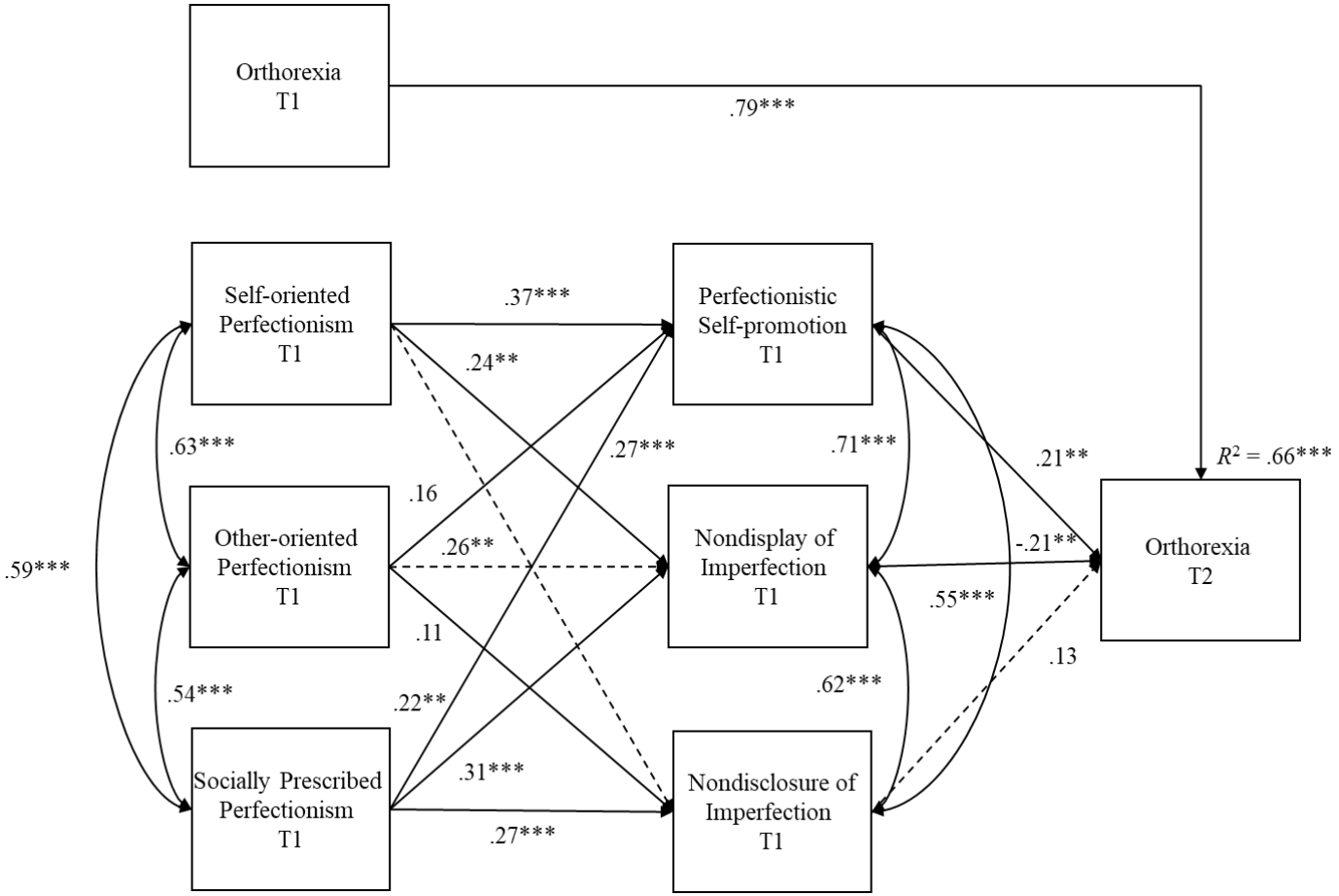

Figure 2. *Autoregressive Path Model of Time 1 Perfectionistic Self-Presentation Mediating the Relationship between Time 1 Trait Perfectionism and Time 2 Orthorexia (Model 2). N = 82. All path coefficients are standardized, and nonsignificant paths (p ≥ .05) are indicated by dashed lines. T1 = Time 1, T2 = Time 2 (6 weeks later).*

Discussion

The aim of the present study was to examine whether perfectionistic self-presentation mediates the relationship between trait perfectionism and orthorexia. To address this aim, we first tested a model based on cross-sectional data to examine whether the relationship between trait perfectionism and orthorexia was mediated by perfectionistic self-presentation. Second, we tested a model based on longitudinal data to examine whether the relationship between Time 1 trait perfectionism and Time 2 orthorexia was mediated by Time 1 perfectionistic self-presentation when controlling for Time 1 orthorexia. As a first longitudinal study of orthorexia, data were based on a sample of gym-members. Doing so further highlights the role of exercise in the disorder.

Trait Perfectionism and Orthorexia

The study provides first evidence that the interpersonal expression of perfectionism – perfectionistic self-presentation – mediates the relationship between the need to be perfect – trait perfectionism – and orthorexia both cross-sectionally and over time. The present findings provide support for what has been presented by McComb and Mills' (2019) review of psychological risk factors of orthorexia. McComb and Mills (2019) highlighted that trait perfectionism is consistently associated with higher levels of orthorexia. In a sample of exercisers, we found that all three dimensions of trait perfectionism at Time 1 showed significant correlations with orthorexia at Time 1, as expected. We also found that two dimensions of trait perfectionism at Time 1 and Time 2 showed significant correlations with orthorexia at Time 2.

Self-oriented perfectionism at Time 1 showed significant positive relations with orthorexia at Time 1. Self-oriented perfectionism at Time 1 and Time 2 also showed positive relations with orthorexia and Time 2. Self-oriented perfectionism represents a self-directed form of perfectionism. Individuals high in self-oriented perfectionism are intrinsically

motivated to strive compulsively for perfection to improve oneself (Hewitt & Flett, 1991). This emulates an orthorexic's motivation to achieve a pure and perfect diet. An orthorexic individual high in self-oriented perfectionism is likely to persistently work towards obtaining the most perfectly impure diet by continuously evaluating and assessing flaws in their eating habits. Such self-directed behaviour may also be the likely cause of negative affect that is evident in orthorexia literature via self-blame (Hewitt & Flett, 1991; McComb & Mills, 2019).

Other-oriented perfectionism at Time 1 also showed significant positive relations with orthorexia at Time 1. Other-oriented perfectionism at Time 1 and Time 2 also showed positive relations with orthorexia and Time 2. Other-oriented perfectionism represents an interpersonal level of motivation. In this dimension of perfectionism, an individual's expectations of perfection are imposed on to others. Such behaviour is similar to self-oriented perfectionism but leads to other-directed blame as opposed to self-blame (Hewitt & Flett, 1991). Other-oriented behaviour mirrors beliefs of moral superiority in orthorexia and encapsulates the notion that others should share beliefs of attaining a perfectly healthy diet (Hewitt & Flett, 1991; McComb & Mills, 2019). These beliefs and behaviours are narcissistic in nature and constitute grandiosity (Smith et al., 2016).

Finally, socially prescribed perfectionism at Time 1 also showed significant positive relations with orthorexia at Time 1. In contrast to self-oriented perfectionism and other-oriented perfectionism, socially prescribed perfectionism is an externally motivated form of perfectionism. A socially prescribed perfectionist typically feels pressured to live up to others standards or perfection (Hewitt & Flett, 1991). Although seemingly dissimilar from orthorexia, socially prescribed perfectionism is associated with negative affect, like in orthorexia (McComb & Mills, 2019). An othorexic individual high in socially prescribed perfectionism would likely exhibit a fear of negative evaluation and act to avoid disapproval

from others (Hewitt & Flett, 1991). Such behaviour can be seen in the stringent endeavour of presenting correct nutrition.

Perfectionistic Self-Presentation

The study also provides further evidence of the role of perfectionistic self-presentation in disordered eating (see Stoeber et al., 2017). In support of previous research on the pertinent role of perfectionistic self-presentation in orthorexia (see Pratt, Madigan & Hill, in press), we found that all three dimensions of perfectionistic self-presentation at Time 1 showed significant correlations with orthorexia at Time 1. As a first examination of the role of perfectionistic self-presentation in orthorexia over time, we also found that two dimensions of perfectionistic self-presentation at Time 1 showed significant positive correlations with orthorexia at Time 2. The same two dimensions of perfectionistic self-presentation at Time 2 showed significant positive correlations with orthorexia at Time 2.

Perfectionistic self-promotion at Time 1 showed significant positive relations with orthorexia at Time 1. Perfectionistic self-promotion at Time 1 and Time 2 also showed significant positive correlations with orthorexia at Time 2. Perfectionistic self-promotion involves a pathological need to proclaim one's supposed perfection in a nonveridical manner (Hewitt et al., 2003). This interpersonal style of perfectionism may result in a need to flaunt one's eating and lifestyle choices in orthorexia. An orthorexia individual high in perfectionistic self-promotion would likely be pathologically driven to display their purportedly perfect eating behaviours despite limited insight into the consequences of their behaviours (Hewitt et al., 2003, Pratt, Madigan & Hill, in press; McComb & Mills, 2019).

Nondisplay of imperfection at Time 1 showed significant positive relations with orthorexia at Time 1. Nondisplay of imperfection is a self-protective form of interpersonal perfectionism that involves the desire to conceal behavioural/public displays of imperfections and is driven by feeling of inadequacy (Hewitt et al., 2003). Nondisplay of imperfection is

neurotic and defensive in nature and mirrors the neurotic impetus of orthorexic behaviour (McComb & Mills, 2019). An orthorexic individual high in nondisplay of imperfection may excessively avoid displaying imperfections in their diet to decrease the possibility of disapproval of others (Hewitt et al., 2003). They may even avoid public situations where their eating behaviours may be subject to scrutiny by others (Hewitt et al., 2003). This would reflect social withdrawal that is common in orthorexic behaviour (McComb & Mills, 2019).

Finally, nondisclosure of imperfection at Time 1 showed significant positive relations with orthorexia at Time 1. Nondisclosure of imperfection at Time 1 and Time 2 also showed significant positive correlations with orthorexia at Time 2. Like nondisplay of imperfection, nondisclosure of imperfection represents the need to avoid verbal disclosures of imperfection and is motivated by an interpersonal fear of rejection (Hewitt et al., 2003). Nondisclosure of imperfection is in line with the higher order dimension of perfectionism - perfectionistic concerns – that involves a fear of social evaluation. Nondisclosure of imperfection is in keeping with issues relating to stigma in orthorexia (Nevin & Vartanian, 2017). Othorexic individuals are known to avoid the stigma associated with clinical eating disorders by masking their disordered eating via a focus on health (Strahler et al., 2018). An orthorexic individual high in nondisclosure of imperfection would therefore likely avoid social situations that may involve them verbally revealing any shortcomings of their disorder as a form of impression management.

Mediating Role of Perfectionistic Self-Presentation

In terms of mediation analyses of the cross-sectional data, perfectionism self-presentation explained 13% of variance in orthorexia and all three dimensions of trait perfectionism (self-oriented perfectionism, other-oriented perfectionism, and socially prescribed perfectionism) had significant direct effects on orthorexia. In regards to perfectionistic self-presentation, only perfectionistic self-promotion and nondisplay of

imperfection had significant direct effects of orthorexia. The fact that nondisclosure of imperfection had no direct effect on orthorexia further suggests that at a day-to-day level, the need to avoid verbally expressing concerns, mistakes, and perceived imperfections may not be as important as concealing imperfections within one's dietary behaviour and projecting an image of perfection. As expected, all dimensions of trait perfectionism had significant direct effects on perfectionistic self-promotion because all have been associated with one another in terms of narcissism (grandiosity and vulnerability [Smith et al., 2016]) and generally (Hewitt et al., 2003). Here, we mention narcissism as clinical eating disorders and perfectionism are both consistently linked to narcissistic psychopathology. Orthorexia itself has also shown associations with narcissistic personality (Oberle et al., 2017; Lasson & Raymal, 2021).

Both other-oriented perfectionism and socially prescribed perfectionism also had significant direct effects on nondisclosure of imperfection. Nondisclosure of imperfection is considered to be an antisocial avoidant expressional style of perfectionism (Hewitt et al., 2021), which overlaps with narcissistic vulnerability and neuroticism (Smith et al., 2016). Although dissimilar in motivational direction, other-oriented perfectionism and socially prescribed perfectionists are concerned with others. Whether a perfectionist has expectations of perfection of others, or whether they believe others have expectations of perfectionism of them, other-oriented and socially prescribed perfectionism are both antisocial forms of perfectionism (Stoeber, 2015) that are associated with hostility and instability regarding their social status (Hewitt et al., 2021). Hence, the nondisclosure of imperfection, other-oriented, and socially prescribed perfectionism are similar in nature.

Finally, socially prescribed perfectionism also had significant direct effects of nondisplay of imperfection. This finding was expected, as both facets of perfectionism have been uniquely associated with social anxiety and social phobia (Hewitt et al., 2003). Nondisplay of imperfection has also predicted social anxiety when controlling for socially

prescribed perfectionism (Lee-Kehayes & MacKinnon, 2019). Where socially prescribed perfectionism reflects the belief that others expect perfection from oneself, nondisplay of imperfection involves avoiding situations where one's behaviour may become scrutinised by others, or where personal failures may be revealed (Hewitt et al., 2003). In this sense, both perfectionism dimensions are concerned with how the self is presented to and interpreted by others.

In accordance with a study by Stoeber, and colleagues (2017), which highlighted that perfectionistic self-presentation explained more variance in eating disorder symptoms (i.e., dieting and oral control) than trait perfectionism, the indirect effects of our cross-sectional mediation analyses revealed that the relationship between all three trait perfectionism dimensions (self-oriented perfectionism, other-oriented perfectionism, and socially prescribed perfectionism) and orthorexia were all significantly and specifically mediated by perfectionistic self-promotion. Perfectionistic self-promotion – promoting an image of perfection – is ubiquitous with all perfectionism facets in that regardless as to the direction, being perfect or attempting to look, demonstrate, or behave in a perfect manner to others can be seen across perfectionism facets. In regards perfectionistic self-promotion, although both perfectionistic self-promotion and nondisplay of imperfection mediated relations between trait perfectionism cross-sectionally, perfectionistic self-promotion was the strongest mediator of all trait perfectionism dimensions-orthorexia. These findings were expected and resemble to the findings of Pratt, Madigan and Hill (in press) who found that perfectionistic self-promotion was the strongest predictor of orthorexia out all perfectionistic self-presentation dimensions in a sample of exercisers.

In terms of the link between perfectionism and eating disorder symptoms, self-oriented perfectionism, socially prescribed perfectionism, and all dimensions of perfectionistic self-presentation have shown relations with dieting (Stoeber et al., 2017). Like

anorexic symptoms of dieting, orthorexia is also associated with dieting and a drive for thinness (McComb & Mills, 2019). This was reflected further in the present findings where the relationships between self-oriented perfectionism and orthorexia and socially prescribed perfectionism and orthorexia were both significantly and specifically mediated by nondisplay of imperfection. These results suggest that individuals high in self-oriented perfectionism and socially prescribed perfectionism may seek to evade publicly showing any imperfections in their orthorexic behaviours and demonstrate that they are in control of their eating behaviours. In this sense, individuals high in both self-oriented perfectionism and socially prescribed perfectionism are likely to attempt defend themselves against shame and humiliation by securing social connections. This explains why orthorexic individuals would want to falsely promote one's own perfection and avoid displaying any problematic eating behaviours to others (Hewitt et al., 2021).

It is worth noting that nondisclosure of imperfection played no mediating role between trait perfectionism dimensions and orthorexia. As trait perfectionism places high demands on oneself to be perfect causing perfectionistic stress, it may be that the stress attributed to the need to appear perfect and attain a flawless diet in orthorexic individuals is alleviated by actively seeking to portray a perfect image and avoiding displays of imperfection. That is that perfectionistic self-promotion and nondisplay of imperfection become a 'solution' by presenting a false perfect (McKinnon & Sherry, 2012). In this sense, nondisclosure of imperfection is irrelevant as an orthorexic individual is motivated by a commitment to an image of perfection to avoid the possibility the other may detect perfectionistic flaws within oneself by presenting one's diet as perfect and avoiding displaying that it is not (McKinnon et al., 2014; Sherry et al., 2007). Therefore, the need to display perfection takes precedence over the need to avoid disclosing issues that could reveal

the perfectionistic flaws in their presentation of a perfect dietary practice, and a fear of losing control over their eating behaviours (McComb & Mills, 2019; Sherry et al., 2007).

Longitudinal Data and Mediation

As regards the analyses of the longitudinal data, when controlling for orthorexia at time 1 in autoregressive path analyses, orthorexia at Time 1 positively predicted orthorexia at Time 2, as expected. Mirroring the findings in the bivariate correlations, self-oriented perfectionism at Time 1 positively predicted perfectionistic self-promotion and nondisplay of imperfection at Time 1. Other-oriented perfectionism at Time 1 predicted perfectionistic self-promotion and nondisclosure of imperfections at time 1. Again, research has linked other-oriented perfectionism to Machiavellianism and narcissism broadly (Stoeber, 2015), which may explain why it was associated with a need to portray in image of perfection as impression management and a desire to avoid interpersonal rejection (Sherry et al., 2007). Interestingly, socially prescribed perfectionism positively predicted all dimensions of perfectionistic self-presentation (perfectionistic self-promotion, nondisplay of imperfection and nondisclosure of imperfection). As socially prescribed perfectionism represents a social facet of trait perfectionism, the need to present of whole image of perfection and hide imperfections may mask the possibility that an individual does not meet the social expectations of others and act as serve as a self-protective strategy (McKinnon et al., 2012).

When controlling for orthorexia at Time 1, two dimensions of perfectionistic self-presentation (perfectionistic self-promotion and nondisplay of imperfection) predicted changes in orthorexia over time. Nondisplay of imperfection predicted positive changes in orthorexia and nondisplay of imperfection predicted negative changes in orthorexia. Perfectionistic self-promotion positively predicted changes in orthorexia, meaning that the need to promote an image of perfection may be the impetus of developing stronger orthorexic behaviours with time. As perfectionistic self-promotion is an approach-oriented aspect in the

portrayal of a perfect image (Hill et al., 2020), it suggests that the development of orthorexic behaviours may reflect a more ostentatious display of their eating habits. Similarly, it may be that these behaviours are a used to display moral superiority or virtue in regards to diet, or in tandem with other behaviours (e.g., exercise) to portray a broader image of perfection.

Nondisplay of imperfection showed a positive correlation with orthorexia in bivariate correlations but a negative effect in the autoregressive path model. This is indicative of a suppression effect (Tzelgov & Henrik, 1991). If so, there may be little practical relevance (i.e., we would not expect to see increases in nondisplay of imperfection decrease orthorexic symptoms). Rather it is due to the large shared variance between facets of perfectionistic self-presentation and the examination of residualised effects. However, this effect could also be interpreted as alluding to some protective or defensive strategy. If this was the case, it may be that obsessive eating behaviours are consider unusual, odd, or imperfect, those seeking to project an image of perfection may activity shun these behaviours. Although unlikely it is a possibility that also had support in the mediation analyses of the longitudinal data.

As regards the mediation analyses of the longitudinal data, again when controlling for Time 1 orthorexia, the relationships between two facets of trait perfectionism (i.e., self-oriented perfectionism and socially prescribed perfectionism) and orthorexia were significantly and specifically mediated by nondisplay of imperfection. These findings were not expected and differ to the cross-sectional results, where perfectionistic self-promotion was the strongest mediator of all perfectionistic self-presentation dimensions. Building on the idea that this may represent a meaningful finding – and pathway to less orthorexia – it is plausible that those higher in these two dimensions of perfectionism experience lower orthorexia via need to display “normal” or acceptable behaviours to win acceptance from others (socially prescribed perfectionism) or themselves (self-oriented perfectionism). Again, despite this plausibility, we stress that we find the notion that perfectionistic self-presentation

will mediate an increase (rather than decrease) in orthorexia over time more likely (noting a similar sized path for perfectionistic self-promotion but no significant indirect effect).

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 (46.3%). 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 with larger sample sizes and offer incentives for research completion. Doing so may help to reduce attrition rates, improve generalisability, and increase the statistical power of the results (Gustavson et al., 2012).

Second, we recruited a sample of exercisers. Therefore, it is unclear whether the findings of the present study are generalisable beyond this population. Future studies may wish to replicate the current work in different populations. This may include repeating samples that have been previously examined, such as clinical populations, students, and non-clinical populations (e.g., Novara et al., 2021; McComb & Mills, 2019).

Third, we assessed mediation analyses using only two time points. As a result, we introduced a temporal lag. Three-wave designs are more appropriate for detecting causal chains (Cole & Maxwell, 2003). Therefore, although we used an autoregressive path model, we are still short of establishing mediation. Future studies will need three time points and allow a proper test of mediation and assessment of causal effects (Roth & MacKinnon, 2012).

Finally, 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 using exclusively reversed items in the other-oriented subscale (Stoeber, 2018). Therefore, researchers may wish to explore alternative measures, such as the full version of the HF-MPS

(Hewitt & Flett, 1991) to determine whether the present findings have been affected by the other-oriented perfectionism subscale (Stoeber, 2018).

Practical Implications

The findings from the study have a number of practical implications for the management of orthorexia. Cognitive behavioural therapy (CBT) interventions have been recommended for the treatment of both perfectionism and eating disorders (Lloyd et al., 2015). As perfectionism is important in orthorexia and orthorexia appears to be similar to clinical eating disorders, CBT may be a good way to reduce perfectionistic tendencies in orthorexia and to alleviate the progression of the disorder over time (Lloyd et al., 2015; Bartel et al., 2020). We therefore advocate for the use of CBT and its techniques in a pre-emptive manner to help manage the mental health of those who are perfectionistic and showing signs of orthorexia. A number of useful guides are available for those who are interested in doing so (e.g., Shafran, Ega & Wade, 2010; Anthony & Swinston, 2009).

As a non-clinical disorder, research and guidance on managing orthorexia is much sparser than for eating disorders. However, from existing work we highlight the practical utility of multidisciplinary teams that include dieticians and psychotherapists (Bartrina, 2007). In addition, the inclusion of pharmacology intervention - the use of selective serotonin reuptake inhibitors - may have some benefits (Mathieu, 2005). The use of relaxation techniques may also be beneficial for reducing post-meal eating anxiety (Shapiro et al., 2008; Niedzeilski & Kamzmierczack-Wojtas, 2021). However, more work on evaluating the efficacy and effectiveness of these and other similar interventions are required before strong recommendations can be made for orthorexia.

Future Directions

Future research may wish to repeat this study examining multidimensional orthorexia (i.e., using the EHQ subscales). This would enable the understanding of how orthorexia

cognitions, behaviours and feelings relate to trait perfectionism and perfectionistic self-presentation. Based on previous research, it would be expected that all EHQ subscales (e.g., Problems, Feelings, and Knowledge) would be positively correlated with trait perfectionism, particularly self-oriented perfectionism and socially prescribed perfectionism (Oberle et al., 2017; Novara et al., 2021). Given that perfectionistic self-presentation conceptualises what perfectionism does, it would be expected that the EHQ-Feelings subscale and the EHQ-Problems subscales would also be positively correlated with perfectionistic self-presentation (Ferreria, Pinto-Gouveia & Durate, 2014). Knowledge of healthy eating may have a less significant role in perfectionistic-self-presentation. Hence, the Problems and Feelings subscales are related to eating pathology, like all dimensions of perfectionistic self-presentation (Stoeber et al., 2017; Gleaves, Graham & Ambwani, 2013).

In addition to assessing multidimensional perfectionism, it may be useful to explore longitudinal gender differences in orthorexia. It has been suggested that men are more likely to report anxiety associated with orthorexia and problems associated with rigid eating behaviours (Strahler, 2020). Whereas, research shows that women are more likely to report positive feelings associated with their health eating or pathological healthful eating (Strahler, 2019, 2020). It may be that these differences become less significant over time, or that normative orthorexic behaviours intensify (Van Dyke, 2018). Assessing gender differences longitudinally would therefore give a more in-depth understanding and allow for comparison to previous studies assessing gender differences (e.g., Oberle et al., 2017).

It could also be beneficial to explore other facets of perfectionism and their association with orthorexia. This could include perfectionism cognitions, which are ruminative automatic thoughts that reflect the ideal self as a self-schema and facilitate the recall of perfectionism content (Flett et al., 2011). Longstanding evidence also highlights that perfectionism cognitions also play an important role in linking trait perfectionism and eating

disorders (Downey et al., 2014; Flett et al., 2011). For example, perfectionistic automatic thoughts are strongly associated with bulimic automatic thoughts (Flett et al., 2011). Perfectionism cognitions has also proven to fully mediate relations between self-oriented perfectionism, socially prescribed perfectionism and dieting behaviour in females and self-oriented perfectionism and bulimic behaviour in males (Downey et al., 2014). Given previous literature, it would be expected that individuals high in orthorexia would be high in perfectionism cognitions (Hill & Donachie, 2019).

Exploring orthorexia and perfectionism further could also include the role that narcissistic perfectionism plays in orthorexia. Narcissism and perfectionism are highly linked as narcissists often present themselves as being perfect to promote their self-image (Nealis et al., 2015). Narcissism is generally centred around two themes: grandiosity (i.e., self-entitlement and self-importance) and vulnerability (i.e., hypervigilance; Smith et al., 2016). Narcissistic grandiosity has been associated with self-oriented perfectionism, other-oriented perfectionism, and perfectionistic self-promotion whereas narcissistic vulnerability has been linked with socially prescribed perfectionism and nondisplay of imperfection. Both vulnerable narcissism and narcissistic grandiosity have shown consistent correlations with eating disorders symptomatology (e.g., body checking, drive for thinness, and excessive exercise; Bardone-cone, Thompson & Miller, 2018). Therefore, it is likely that narcissistic perfectionism may play a unique role in orthorexia.

Conclusion

As the first study to examine whether perfectionistic self-presentation can explain relations between trait perfectionism and orthorexia over time, the present study makes an important contribution to the orthorexia literature. It was found that the relationships between self-oriented perfectionism and socially prescribed perfectionism and orthorexia were mediated by nondisplay of imperfection over time. However, both other-oriented

perfectionism and perfectionistic self-promotion aspects of perfectionism were irrelevant in mediational analyses. The findings suggest that the desire to hide imperfections (i.e., not display them or disclose them) from others is a key factor in why individuals high in self-oriented perfectionism and socially prescribed perfectionism may develop and/or maintain orthorexia. In this sense, the motivation for orthorexia would shift from an externally motivated display of perfection (i.e., display of a perfect diet) to an internally motivated concealment of imperfection (i.e., hiding flaws in dietary practises) over time.

The present findings suggest that both trait perfectionism (i.e., self-oriented perfectionism, other-oriented perfectionism and socially prescribed perfectionism) and perfectionistic self-presentation (i.e., perfectionistic self-promotion, nondisplay of imperfection and nondisclosure of imperfection) are especially important in the development of orthorexia. These factors may also be relevant in the maintenance of the disorder. Expecting perfection from oneself (i.e., self-oriented perfectionism), believing that others expect perfection from oneself (i.e., socially prescribed perfectionism), and avoiding behavioural displays of imperfection (i.e., nondisplay of imperfection) may be particularly pertinent in the progression of orthorexia over time. The findings of the current study warrant further investigation. Notably, perfectionistic self-presentation deserves greater attention in orthorexia theory and research.

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Appendices

Appendix 1

Eating Habits Questionnaire.

Following are statements that reflect thoughts, feelings, and beliefs about your current eating habits. For these, think about your yourself. Please read each item carefully and select the appropriate response that most reflects you.

1	2	3	4
False, Not at All	**Slightly True**	**Mainly True**	**Very True**

1. My diet is better than other people's diets.
2. I am more informed than others about healthy eating.
3. My eating habits are superior to others.
4. I prepare food in the most healthful way.
5. I turn down social offers that involve eating unhealthy food.
6. My healthy eating is a significant source of stress in my relationships.
7. My diet affects the type of employment I would take.
8. I have difficulty finding restaurants that serve the foods I eat.
9. I follow a health-food diet rigidly.
10. I spend more than three hours a day thinking about healthy food.
11. Few foods are healthy for me to eat.
12. I follow a diet with many rules.
13. I only eat what my diet allows.
14. In the past year, friends or family members have told me that I'm overly concerned with eating healthily.

15. I am distracted by thoughts of eating healthily.

16. I go out less since I began eating healthily.

17. The way my food is prepared is important in my diet.

18. I have made efforts to eat more healthily over time.

19. I feel in control when I eat healthily.

20. Eating the way I do gives me a sense of satisfaction.

21. I feel great when I eat healthily.

Appendix 2

Multidimensional Perfectionism Scale – Short Form.

Listed below are a number of statements concerning personal characteristics and traits. Read each item and decide whether you agree or disagree and to what extent.

1	2	3	4	5	6	7
Disagree			**Neutral**			**Agree**

1. One of my goals is to be perfect in everything I do.
2. Everything that others do must be of top-notch quality.
3. The better I do, the better I am expected to do.
4. I strive to be as perfect as I can be.
5. It is very important that I am as perfect as I can be in everything that I attempt.
6. I have high expectations for people that are important to me.
7. I demand nothing less than perfection from myself.
8. I can’t be bothered with people who won’t strive to better themselves.
9. Success means that I must work even harder to please others.
10. If I ask someone to do something, I expect it to be done flawlessly.
11. I cannot stand to see people close to me make mistakes.
12. I must work to my full potential at all times.
13. My family expects me to be perfect.
14. People expect nothing less than perfection from me.
15. People expect more from me, than I am capable of giving

Appendix 3

Perfectionistic Self-presentation Scale.

Listed below are a group of statements. Please read each item carefully and use the rating scale to indicate your degree of agreement or disagreement with each of the statements.

1	2	3	4	5	6	7
Disagree Strongly			**Neutral**			**Agree Strongly**

1. It is okay to show others that I am not perfect
2. I judge myself based on the mistakes I make in front of other people
3. I will do almost anything to cover up a mistake
4. Errors are much worse if they are made in public rather than in private
5. I try always to present a picture of perfection
6. It would be awful if I made a fool of myself in front of others
7. If I seem perfect, others will see me more positively
8. I brood over mistakes that I have made in front of others
9. I never let others know how hard I work on things
10. I would like to appear more competent than I really am
11. It doesn't matter if there is a flaw in my looks
12. I do not want people to see me do something unless I am very good at it
13. I should always keep my problems to myself
14. I should solve my own problems rather than admit them to others
15. I must appear to be in control of my actions at all times
16. It is okay to admit mistakes to others
17. It is important to act perfectly in social situations

18. I don’t really care about being perfectly groomed

19. Admitting failure to others is the worst possible thing

20. I hate to make errors in public

21. I try to keep my faults to myself

22. I do not care about making mistakes in public

23. I need to be seen as perfectly capable in everything I do

24. Failing at something is awful if other people know about it

25. It is very important that I always appear to be “on top of things”

26. I must always appear to be perfect

27. I strive to look perfect to others

Appendix 4

Ethical Approval Letter.

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School of Education, Language and Psychology

8 January 2021

Dear Verity Pratt,

I am pleased to inform you that your project "Perfectionism and orthorexia: the mediating role of perfectionistic self- presentation" has now been approved by the Cross-School Research Ethics Committee for the School of Education, Language and Psychology and School of Science, Technology and Health.

Although the committee was generally satisfied that the project dealt wit the main ethical issues, there are several specific conditions that you will be required to change (which will need to be checked by your PhD supervisor, Daniel Madigan).

Please follow these specific recommendations before commencing data collection:

- Question 6d.1.: Interview notes data is included in this table, yet no mention of carrying out interviews as part of the study methodology. Please delete from ethics form.
- In the 'What is the purpose of this investigation?' section of the Gatekeeper's info sheet, please include a simple definition of perfectionism, to ensure full comprehension from the Gatekeeper.

Participant Information Sheet

- The information sheet is too vague in the 'what will you do in the project section' – include more information on the nature of the questions asked; i.e., perfectionism and questions around eating habits.
- In the 'What are the potential risks to you in taking part?' section, the reference to 'parents' is not needed as all participants will be aged over 18 years. Please remove.
- In the 'What are the potential risks to you in taking part?' the potential of the eating habits questions to trigger psychological issues should be acknowledged. Please include the support information you have in the debrief on the information sheet also.

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