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RESEARCH ARTICLE

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Classifying excessive exercise: Examining the relationship between compulsive exercise with obsessive-compulsive disorder symptoms and disordered eating symptoms

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Abstract

Objective: There remains a lack of consensus around nosology for compulsive exercise (CE). Although widely observed in eating disorders (ED), CE shares theoretical overlap with obsessive-compulsive disorder (OCD), where exercise compulsions occur in response to obsessions. Yet, there is limited and mixed evidence of a relationship between CE with OCD. This study aims to explore the appropriate diagnostic classification of CE through examination of CE in relation to OCD, obsessional thinking, and ED symptoms.

Method: Two hundred and eighty one adults with mental health symptoms, dieting, and exercise behaviour completed measures of OCD, CE, and disordered eating symptoms. Regression and Receiver Operating Characteristic analyses examined relationships between dimensions of CE with OCD and ED symptoms, and the predictive ability of CE assessment for detecting threshold OCD and ED symptoms.

Results: CE assessment was poor at predicting threshold OCD symptoms, probable Anorexia Nervosa, and Binge Eating Disorder and moderate at detecting probable disordered eating and Bulimia Nervosa. Associations between CE and OCD symptoms were not significant after adjustment for ED symptoms. Obsessional thinking was associated only with lack of exercise enjoyment.

Conclusions: Results indicate that excessive exercise might represent a distinct disorder, with some shared traits across CE, OCD and ED symptoms. Findings question the utility of adaptation of OCD diagnostic criteria for CE. Assessment and treatment implications are considered.

KEYWORDS
compulsions, disordered eating, exercise addiction, mental health, psychological distress

Highlights

- Associations between compulsive exercise (CE) and obsessive-compulsive disorder (OCD) symptoms are no longer significant after adjustment for eating disorder (ED) symptoms, thus results do not support adaptation of OCD criteria for CE.
- CE appears to represent a distinct disorder rather than representing a feature of EDs or OCD symptoms.
- CE treatments might usefully target ordering, strict adherence to schedules and organisation, dysfunctional perfectionism, avoidant coping, and anhedonia.

1 | INTRODUCTION AND AIMS

Compulsive exercise is widely understood as an urge to engage in exercise, with the exercise being excessive in frequency, intensity and/or duration. However, while diagnostic criteria for CE have been proposed (Dittmer et al., 2018), CE has not yet been formalised as a disorder and there remains a lack of consensus around nosology. While CE has widely been observed within eating disorder (ED) populations (Meyer et al., 2011) and is related to both the aetiology and maintenance of EDs (e.g., Davis & Kaptein, 2006; Thien et al., 2000), CE has also been observed outside of ED populations (e.g., Edlund et al., 2022; Guidi et al., 2009; Rocks et al., 2017; Weinstein et al., 2015). This has led to suggestions that CE might represent a form of subclinical disordered eating (Limburg et al., 2021) or an alternative pattern of weight and shape control from dietary restriction (Johnston et al., 2011). Yet CE also shares commonalities and conceptual overlap with obsessive-compulsive disorder (OCD), specifically the compulsive nature of exercise behaviour occurring in response to exercise-related obsessions (e.g., Lichtenstein et al., 2017). Along these taxonomic lines, the currently proposed CE diagnostic criteria (Dittmer et al., 2018) largely align with OCD (Bratland-Sanda et al., 2019), without overlap with ED criteria. However, it has also been proposed that excessive exercise constitutes its own distinct disorder rather than representing a symptom type or component of existing disorders (Szabo et al., 2015). Thus, ongoing research to better understand the appropriate classification of CE remains needed.

While there is a body of evidence linking CE with ED pathology (e.g., Meyer et al., 2016; Plateau et al., 2014; Plateau et al., 2017; Turton et al., 2017), only limited research to date has explored the relationship between CE and OCD to support the conceptualisation of CE within the obsessive-compulsive spectrum. Of the extant research, results remain equivocal (Young et al., 2013). For example, OCD symptoms were not related to CE among adolescents with EDs (Fietz et al., 2014), and no longer predicted CE after adjustment for ED symptoms (Noetel et al., 2016). Conversely, OCD symptoms were related to CE in a sample with Anorexia Nervosa (AN) (Young et al., 2018) and in a non-clinical adolescent sample (Goodwin, Haycraft, Willis, et al., 2011). Obsessive-compulsive symptomatology has been found to be higher amongst those engaging in excessive exercise than those who did not (Gulker et al., 2001; Spano, 2001), whereas other studies have shown either no difference (Peñas-Lledó et al., 2002), or lower OCD symptoms amongst those engaging in excessive exercise (Bewell-Weiss & Carter, 2010). These mixed findings suggest that there remains more to understand about CE and OCD and the extent to which CE might represent OCD.

Limitations of the existing body of research include that few studies have explored OCD and ED symptoms concurrently with respect to CE. Further, CE assessment has varied across studies, but has largely been treated as a unidimensional construct. However, CE is multidimensional (Meyer et al., 2011), with exploration of the dimensions of CE needed (Limburg et al., 2021). Varied relationships between dimensions of CE with disordered eating have previously been observed (Limburg et al., 2021; Taranis et al., 2011), whereas only scant research has explored dimensions of CE with OCD symptoms. One study to date showed that OCD was related only to avoidance, weight control exercise (WCE) and exercise rigidity (ER) aspects of CE, but not mood improvement (MI) or lack of exercise enjoyment (LEE), in an inpatient ED sample (Noetel et al., 2016). Examination of CE in relation to specific core features or symptoms of OCD also remains limited.

In sum, there remains a lack of clarity regarding diagnostic classification of CE and whether or not it (a) constitutes its own distinct disorder, (b) is part of or a subtype of OCD, (c) is part of ED symptomatology, or (d) spans both OCD and ED. The limited and inconsistent findings from the body of research examining CE in relation to OCD (Lichtenstein et al., 2017), has resulted in difficulty in classification for CE. As a result, there is a

lack of understanding, guidance, and consensus regarding treatment for CE (Hallward et al., 2022; Lichtenstein et al., 2017). Previous suggestions have included that OCD treatments might be sufficient for treating CE (Bratland-Sanda et al., 2019), or that a range of cognitive, behavioural, and educational strategies, as well as motivational interviewing may be appropriate (see Lichtenstein et al., 2017; Weinstein et al., 2015). However, there remains minimal evidence-base for interventions for CE and the lack of clarity regarding diagnostic classification limits guidance around what treatment approaches are indicated. Therefore, this study aims to inform understanding around the diagnostic classification of CE. Specifically, this study aims to examine:

a. the relationships between CE symptoms with both OCD and ED symptoms,
b. if CE can be classified as a part of ED or OCD or a distinct disorder, by investigating if measures of CE can adequality detect the presence/absence of threshold ED or OCD symptoms or not,
c. the relationship between different dimensions of CE with OCD symptoms.

2 | METHOD

2.1 | Participants

In total, 281 participants aged 18 and over who self-identified as either (a) engaging in dieting behaviours, (b) engaging in exercise, and/or (c) having experienced mental health symptoms completed the study. A total of 300 participants started the survey but 19 were removed due to non-completion of all relevant measures. Little's MCAR test indicated that these data were missing completely at random, $\chi^2(65) = 14.15$, $p > 0.05$ (Little, 1988).

2.2 | Measures

Demographic data including age, gender, and self-reported height (cms) and weight (kgs) were collected.

2.2.1 | Compulsive Exercise

The Compulsive Exercise Test (CET; Taranis et al., 2011) is a 24-item measure of engagement in CE behaviours. Responses are provided on a six-point Likert-type scale (never true to always true). The CET produces five subscales (avoidance and rule-driven behaviour (ARB), WCE, LEE, ER, and MI). A total scale score is also produced by summing the means of the subscale scores, with higher scores representing greater levels of CE. The CET has good internal consistency and construct validity in both non-clinical and ED samples (Mathisen et al., 2018; Meyer et al., 2016; Taranis et al., 2011) and a possible cut-off score of 15 has been proposed (Meyer et al., 2016). The five-factor structure of the CET has been questioned (Formby et al., 2014; Limburg et al., 2021; Plateau et al., 2014) and an 18-item version of the CET proposed (Limburg et al., 2021). Internal consistency in the present study was good; $\alpha = 0.86$ for both the 18- and 24-item versions.

2.2.2 | Exercise behaviour

The Godin Leisure Time Exercise Questionnaire examines exercise frequency and intensity (GLTEQ; Godin & Shephard, 1997). Participants indicate how often they engage in strenuous, moderate and mild exercise for more than 15 min within a 7-day period. An exercise score is calculated which provides an indication of frequency and intensity (see Godin & Shephard, 1997) with higher scores indicating more exercise.

2.2.3 | Disordered eating symptomology

The Eating Attitudes Test-26 (EAT-26; Garner & Garfinkel, 1979; Garner et al., 1982) is a 26-item measure of disordered eating symptoms. Responses are given on a six-point Likert-type scale, with higher scores indicating a greater degree of symptom severity. The EAT-26 has good reliability and predictive validity (Koslowsky et al., 1992). A cut-off score of 20 has been proposed as indicating clinical symptomatology (Garner et al., 1982). Internal consistency in the present study was good; $\alpha = 0.93$.

Eating-related questions from the Primary Care Evaluation of Mental Disorders Patient Health Questionnaire (PHQ) (Spitzer et al., 1999) were also used to examine presence of probable Bulimia Nervosa (BN) or probable Binge Eating Disorder (BED). The PHQ is a diagnostically valid self-report measure, with good agreement between PHQ and mental health professional diagnoses (Spitzer et al., 1999). The eating items of the PHQ have been shown to have acceptable sensitivity and specificity for use in ED screening (Graham et al., 2019; Striegel-Moore et al., 2010).

2.2.4 | Obsessive-compulsive disorder symptoms

The 18-item Revised Obsessive-Compulsive Inventory (OCI-R) was used to assesses OCD symptoms (Foa et al., 2002). Frequency of experiencing symptoms are reported on a five-point Likert scale with higher scores indicating greater symptom severity. To reflect that hoarding is now classified as a distinct disorder rather than part of OCD in the DSM-5 (APA, 2013), a 15-item version (OCI-OCD) that removes items pertaining to hoarding has been validated and shown to have good convergent and discriminant validity (Wootton et al., 2015). A cut-score of 12 has been proposed with acceptable sensitivity and specificity for detecting OCD (Wootton et al., 2015). In addition, the measure provides subscales that reflect different core OCD symptoms—obsessions, washing, ordering, checking and neutralising (assessed by three items each)—which are valid in clinical and non-clinical samples (Foa et al., 2002; Huppert et al., 2007). The scale has excellent internal consistency in the present study; $\alpha = 0.93$.

2.3 | Procedure

Ethics approval was granted by the University of New England Human Research Ethics Committee. Participants were recruited through social media sites of mental health foundations, ED groups, OCD-support groups, dieting groups, and eating and mental health related support groups. Interested participants were directed to an online survey hosted by Qualtrics, which took approximately 20 min. Measures were presented in random order to minimise order effects.

2.4 | Data analysis

Analysis was performed in SPSS version 28. Scores on the EAT-26 and OCI-OCD had a positive skew, therefore, relationships between key variables (CE, OCD and ED symptoms) were examined using Spearman's Rho. Regression analyses were performed to further understand the relationships of CE symptoms with ED and OCD symptoms. In the first instance, regression was performed using the total OCI-OCD score (predictor) and total CET score (outcome). Additional models were conducted to explore the relationship of subscales of the OCI-OCD with CET total as the outcome. Due to questions over the psychometric properties of the CET, all analyses examining total CET score were conducted using both the 24-item (Taranis et al., 2011) and 18-item (Limburg et al., 2021) versions. Further analyses were also conducted to examine the relationship of the OCI-OCD subscales with dimensions of CE. Regression analyses were performed for each dimension of CE (outcome) that was significantly related to OCD symptoms in the correlation analyses, with all OCI-OCD subscales entered as predictors. For all regression analyses, two models were conducted. The first adjusted for age and gender, while the second added EAT-26 score as an additional predictor variable. All regression model assumptions were checked and multicollinearity between predictors satisfied according to tolerance and variance inflation factors. A p value of ≤ 0.05 was considered statistically significant.

To examine the diagnostic classification of CE, analysis examined the extent to which the CET could predict the presence/absence of threshold ED and OCD symptoms using Receiver Operating Characteristics (ROC) curve analyses. The Area Under the Curve (AUC) was used to ascertain the predictive ability of the CET for predicting presence of clinically significant ED symptoms (as assessed by EAT-26 cut-off) and clinically significant OCD symptoms (as assessed by the OCI-OCD cut-off). Secondary analyses were performed examining the predictive ability of the CET for detecting probable AN, BN and BED (see Supporting Information S1). An AUC of 1.0 indicates perfect prediction with 0.5 indicating that predication is not better than chance (Hanley & Mcneil, 1982). AUC values were characterised as AUC <0.50–0.7 poor, 0.7–0.8 moderate, 0.8–0.9 excellent and above 0.9 as outstanding (Hosmer & Lemeshow, 2000). Power for conducting ROC analyses is typically determined by at least 10 participants with a diagnosis, 10 without a diagnosis, 10 false positives and 10 false negatives (Kraemer, 1992). Due to a lack of formal diagnosis and definitively agreed upon diagnostic criteria or validated diagnostic interview for CE, a final determination of false positives and negatives for CE was not possible and therefore positive- and negative-predictive values could not be calculated. However, given that there were over 10 probable cases for presence and absence of each potential diagnosis (see Table 1), it was considered appropriate to conduct the ROC analyses.

3 | RESULTS

Participants age ranged from 18 to 65 ($M = 32.3$, $SD = 10.3$) and the majority (79%) were female. Over one-third of the sample were above threshold for OCD and approximately one-third for disordered eating (see Table 1).

3.1 | Relationships between CE with OCD symptoms

Across all analyses, results were comparable for both the 18- and 24-item versions of the CET and patterns of association did not differ. Results in text are thus reported for the 24-item version only (see Supporting Information S1 for 18-item results). Total CE score was associated with ED symptoms, total OCD score and all OCD subscales (range ρ 0.164–0.473). All dimensions of CE were related to outcomes, with the exception of MI (Table 2).

Regression analyses which further explored the relationship between CE symptoms with OCD symptoms showed that, while total OCD symptoms predicted a small increase in CE symptoms in the first model, OCD symptoms were outside of significance after adjustment for ED symptoms (Table 3). Examination of the OCI-OCD subscales showed that only ordering was associated with CE symptoms in the final model. Collectively, OCD symptoms, accounted for a small amount of variance in regression models.

3.2 | Predictive ability of the CET

Further analyses examined the predictive ability of the CET for determining clinically significant OCD and ED symptoms. The CET showed a poor ability to detect threshold OCD symptoms (Hosmer & Lemeshow, 2000) with an AUC of 0.683 (95% CIs 0.620, 0.747) (see Figure 1). For detecting clinically significant ED symptoms, the CET showed moderate predictive ability;

TABLE 1 Sample characteristics.

	M (*SD*)	Range	*N* (%)[a]
Age	32.28 (10.29)	18–65	
Gender			
Female			220 (78.6%)
Male			55 (19.6%)
Other/prefer not to say			5 (1.8%)
Disordered eating symptoms	15.21 (15.19)	0–75	90 (32.0%)
Probable BN			22 (7.8%)
Probable BED			22 (7.8%)
Probable AN			17 (6.0%)
OCD symptoms	13.10 (12.23)	0–60	119 (42.3%)
Compulsive exercise symptoms	12.42 (3.46)	3–22	49 (23.0%)
Exercise behaviour	41.4 (27.4)	0–182	

Abbreviations: AN, Anorexia Nervosa; BED, binge eating disorder; BN, Bulimia Nervosa; CE, compulsive exercise; OCD, obsessive-compulsive disorder.

[a]*N* (%) above cut-off scores for Disordered Eating (EAT-26), OCD symptoms (OCRI), CE (CET).

TABLE 2 Relationships between CE symptoms and dimensions of CE with OCD symptoms and ED symptoms.

	OCD symptoms	Obsessing	Washing	Ordering	Checking	Neutralising	ED symptoms
ARB	0.333**	0.275**	0.196**	0.319**	0.285**	0.260**	0.410**
WCE	0.329**	0.319**	0.136*	0.266**	0.280**	0.251**	0.629**
MI	−0.043	−0.089	−0.020	0.012	−0.003	−0.039	0.008
LEE	0.106	0.232**	−0.009	0.020	0.036	0.083	0.151**
ER	0.147*	0.068	0.133*	0.171**	0.117*	0.084	0.143**
Total CE	0.286**	0.302**	0.164**	0.290**	0.275**	0.246**	0.473**

Abbreviations: ARB, avoidance and rule-driven behaviour; CE, compulsive exercise; ED, eating disorder; ER, exercise rigidity; MI, mood improvement; LEE, lack of exercise enjoyment; OCD, obsessive-compulsive disorder; WCE, weight control exercise.

**$p < 0.01$, *$p < 0.05$.

TABLE 3 OCD and ED symptoms as predictors of CE symptoms.

	Model 1			Model 2		
	B	SE	*p*	*B*	SE	*p*
Total OCD score						
OCD symptoms	0.081	0.017	<0.001	0.031	0.108	0.051
Gender	−0.249	0.385	0.519	−0.704	−0.108	0.037
Age	−0.004	0.020	0.858	0.032	0.098	0.068
ED symptoms				0.126	0.551	<0.001
OCD subscales						
Obsessing	0.239	0.238	0.002	0.077	0.077	0.259
Washing	−0.246	−0.186	0.024	−0.127	−0.096	0.188
Ordering	0.235	0.229	0.011	0.164	0.159	0.043
Checking	−0.101	−0.082	0.354	0.002	0.001	0.985
Neutralising	0.194	0.148	0.096	−0.012	−0.009	0.911
Gender	−0.297	−0.046	0.440	−0.719	−0.110	0.036
Age	0.000	0.001	0.987	0.031	0.094	0.082
ED symptoms				0.121	0.532	<0.001

Note: OCD total analyses: Model 1 adjusted for age and gender; Adj. $R^2 = 0.072$, $F = 8.17$, $p < 0.001$; Model 2 adjusted for age, gender, eating disorder symptoms; Adj. $R^2 = 0.312$, $F = 32.32$, $p < 0.001$; OCD subscale analysis: Model 1 adjusted for age and gender; Adj. $R^2 = 0.108$, $F = 5.84$, $p < 0.001$; Model 2 adjusted for age, gender, eating disorder symptoms; Adj. $R^2 = 0.313$, $F = 16.90$, $p < 0.001$.

Abbreviations: CE, compulsive exercise; ED, eating disorder; OCD, obsessive-compulsive disorder.

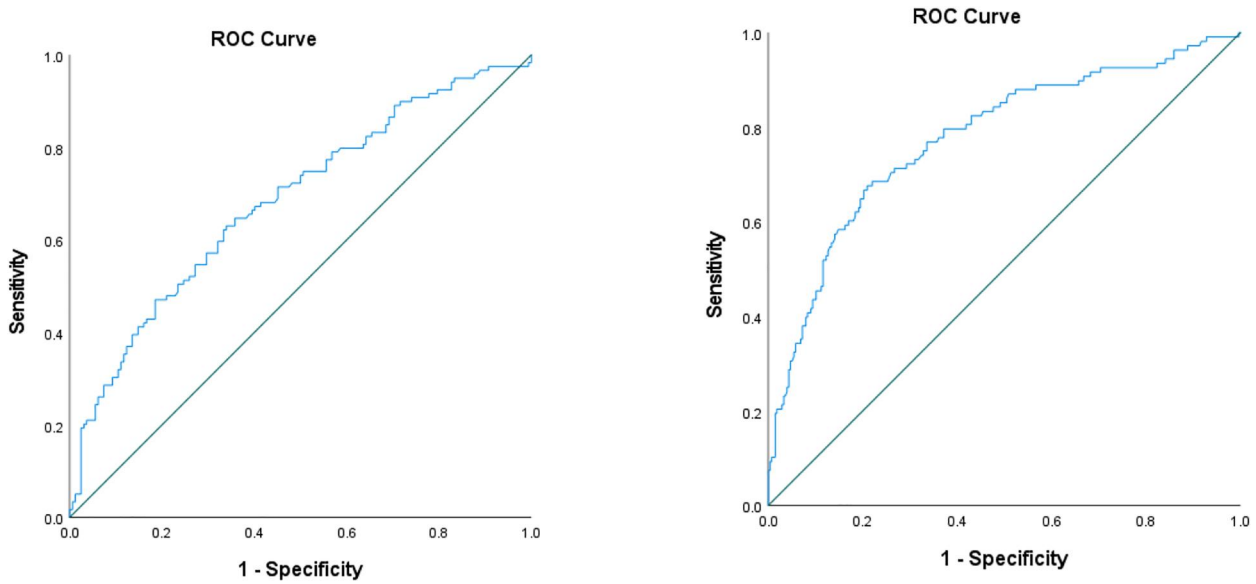

FIGURE 1 Compulsive exercise test predicting threshold obsessive-compulsive disorder and eating disorder symptoms. [Colour figure can be viewed at wileyonlinelibrary.com]

AUC = 0.777 (95% CIs 0.722, 0.831). Secondary analyses indicated poor predictive ability for detecting probable AN, the CET was worse than chance for detecting probable BED, and the CET had a moderate ability for detecting probable BN (see Supporting Information S1).

3.3 | Relationships between dimensions of CE with OCD symptoms

MI was not significantly related to any OCD symptom outcomes in the correlation analyses (Table 2), and was

thus not included in regression analyses. Results showed that, after adjustment for ED symptoms, three CE dimensions showed any association with OCD symptoms, while WCE was not related to any symptom dimensions of OCD (Table 4). In particular, ordering predicted an increase in ARB and ER, and obsessing predicted an increase in LEE. ED symptoms predicted all aspects of CE except for LEE.

4 | DISCUSSION

This study has added to understanding the nosology of CE through examining the overlap of CE symptoms with ED and OCD symptoms. While associations between OCD symptoms with CE symptoms were observed, these were largely non-significant after adjustment for ED symptoms, suggesting that these relationships are better explained by ED pathology. Of the mixed CE and OCD research to date (e.g., Fietz et al., 2014; Young et al., 2013), few studies have controlled for ED symptoms and our results are consistent with previous reports of no relationship between CE and OCD symptoms after adjustment for ED symptoms (Noetel et al., 2016). Further, only two symptom areas of OCD, obsessing and ordering, were associated with CE symptoms, which might partially explain the mixed results in the literature to date, with variability in the symptoms assessed by the different OCD measures used. In addition to findings of no significance with total OCD scores after adjustment for ED symptoms, the finding that only obsessing and ordering symptoms had any association with CE symptoms also indicates that, while CE symptoms may have some overlap with OCD symptoms, CE does not represent OCD symptoms in their entirety. Results from the ROC analyses also showed that the CET had a poor ability to detect threshold OCD symptoms. Taken together, the relationships observed with OCD symptoms in the current study and reported in the literature previously (e.g., Goodwin, Haycraft & Meyer, 2011; Young et al., 2018) might reflect or be better explained by the comorbidity of EDs with OCD and the obsessive-compulsive features often observed in EDs (Swinbourne & Touyz, 2007) including in relation to exercise beliefs (Naylor et al., 2011). Given the finding that CE symptoms have only limited overlap with OCD symptoms, current results do not support adaptation of OCD criteria as sufficient for detecting CE (Bratland-Sanda et al., 2019), and thus further review of criteria may be required.

While ED symptoms were associated with CE symptoms, regression models including ED symptoms only accounted for a small to moderate amount of variance in CE symptoms and, as found previously (Limburg et al., 2021; Taranis et al., 2011), not all dimensions of CE were associated with ED symptoms. Results also showed that the CET had moderate predictive ability for detecting ED symptoms and probable BN, but was poor at detecting probable AN and worse than chance for detecting probable BED. The better ability to detect probable BN, and inability to detect probable BED reflects that excessive exercise likely represents a purging behaviour. Further, the current results together suggest that CE symptoms have some overlap with ED symptoms, but that there are also differences between CE and ED symptoms. Accordingly, these findings support the understanding of CE as distinct from a component of EDs (Meyer et al., 2011) or subclinical disordered eating (Limburg et al., 2021). This suggestion is consistent with findings that, while CE is observed in EDs (e.g., Fietz et al., 2014; Shroff et al., 2006), it is not a core feature observed across all individuals with an ED (Taranis et al., 2011) and it is also widely observed outside of ED samples (e.g., Goodwin, Haycraft, Willis, et al., 2011; Guidi et al., 2009; Rocks et al., 2017). Thus, as previously argued (Szabo et al., 2015), excessive exercise might represent a distinct disorder. The regression models including ED symptomatology accounted for a larger amount of variance in CE outcomes than models with OCD symptoms only and the ability of the CET to detect threshold ED symptoms was better than for detecting threshold OCD symptoms. These results might reflect that CE is better classified as a disorder within the feeding and eating spectrum rather than the OCD spectrum; but may also reflect the overlap of excessive exercise behaviour in both CE and EDs.

The results suggest that while CE symptoms appear to be distinct from OCD and ED symptoms, there may be some common or shared traits across presentations. Specifically, LEE, where exercise is viewed as a chore from which pleasure is not derived (Taranis et al., 2011), was associated with obsessions, characterised by uncontrollable thoughts (Foa et al., 2002). This relationship may reflect the links between rumination with anhedonia (e.g., Andrews & Thomson, 2009; Dygdon & Dienes, 2013). This relationship might also reflect the role of exercise engagement as a means of avoidant coping in CE, rather than exercise performed due to intrinsic motivation or enjoyment (Meyer et al., 2011), with such exercise behaviours potentially then reinforcing and maintaining the obsessional thinking (Salkovskis, 1985). Exercise as means of modulating emotion intolerance has also been reported within EDs (Fairburn et al., 2003; Meyer et al., 2011). LEE was not related to ED symptoms here, but ARB was associated with ED symptoms and some symptoms of OCD, indicating possible overlaps with avoidant coping across symptoms of these disorders.

TABLE 4 OCD and ED symptoms as predictors of CE dimensions.

	Model 1			Model 2		
	B	**SE**	***p***	***B***	**SE**	***p***
Avoidance and rule-driven behaviour						
Obsessing	0.065	0.188	0.012	0.022	0.063	0.373
Washing	−0.050	−0.110	0.176	−0.018	−0.040	0.596
Ordering	0.098	0.278	0.002	0.080	0.225	0.006
Checking	−0.041	−0.097	0.266	−0.014	−0.033	0.686
Neutralising	0.058	0.129	0.141	0.004	0.008	0.920
Gender	−0.339	−0.151	0.010	−0.451	−0.201	<0.001
Age	−0.006	−0.049	0.412	0.003	0.023	0.684
ED symptoms				0.032	0.410	<0.001
Weight control exercise						
Obsessing	0.079	0.215	0.004	0.008	0.022	0.719
Washing	−0.102	−0.210	0.010	−0.050	−0.102	0.125
Ordering	0.040	0.106	0.227	0.009	0.023	0.745
Checking	0.011	0.025	0.775	0.056	0.124	0.083
Neutralising	0.083	0.174	0.049	−0.007	−0.014	0.848
Gender	0.237	0.099	0.090	0.053	0.022	0.646
Age	−0.010	−0.083	0.166	0.003	0.028	0.565
ED symptoms				0.053	0.635	<0.001
Lack of exercise enjoyment						
Obsessing	0.116	0.303	<0.001	0.103	0.269	<0.001
Washing	−0.063	−0.125	0.130	−0.053	−0.106	0.203
Ordering	−0.058	−0.147	0.102	−0.063	−0.162	0.072
Checking	−0.052	−0.109	0.220	−0.043	−0.091	0.306
Neutralising	0.096	0.192	0.033	0.079	0.158	0.085
Gender	0.453	0.182	0.002	0.418	0.168	0.005
Age	0.006	0.048	0.434	0.009	0.067	0.274
ED symptoms				0.010	0.114	0.091
Exercise rigidity						
Obsessing	0.018	0.047	0.547	−0.008	−0.021	0.795
Washing	0.010	0.020	0.815	0.030	0.057	0.495
Ordering	0.099	0.248	0.007	0.088	0.219	0.016
Checking	−0.049	−0.102	0.266	−0.032	−0.067	0.458
Neutralising	−0.004	−0.009	0.925	−0.038	−0.074	0.424
Gender	−0.464	−0.183	0.003	−0.533	−0.209	<0.001
Age	0.001	0.009	0.886	0.006	0.048	0.445
ED symptoms				0.020	0.221	0.001

Note: ARB analyses: Model 1 adjusted for age and gender; Adj. $R^2 = 0.134$, $F = 7.17$, $p < 0.001$; Model 2 adjusted for age, gender, and eating disorder symptoms; Adj. $R^2 = 0.254$, $F = 12.87$, $p < 0.001$; WCE analyses: Model 1 Adj. $R^2 = 0.131$, $F = 7.08$, $p < 0.001$; Model 2 Adj. $R^2 = 0.424$, $F = 26.66$, $p < 0.001$; LEE analyses: Model 1 Adj. $R^2 = 0.096$, $F = 5.22$, $p < 0.001$; Model 2 Adj. $R^2 = 0.102$, $F = 4.96$, $p < 0.001$; ER analyses: Model 1 Adj. $R^2 = 0.047$, $F = 2.975$, $p < 0.005$; Model 2 Adj. $R^2 = 0.080$, $F = 4.021$, $p < 0.001$.

Abbreviations: CE, compulsive exercise; ED, eating disorder; OCD, obsessive-compulsive disorder.

Further, ordering symptoms were associated with total CE score, as well as with ARB and ER. Results thus suggest a link between compulsions related to repetitive organising and aspects of CE that relate to strictly adhering to exercise rules and inflexible schedules (Taranis et al., 2011), indicating a shared pattern around compulsive and rigid organising in CE and OCD symptoms. This shared pattern around rigidity may relate to the role of dysfunctional perfectionism across the disorders; that is, rigidity is argued to be an aspect of perfectionism that maintains CE (Meyer et al., 2011), with perfectionism also linked with OCD (Frost et al., 2002). Given that perfectionism is also widely observed in EDs (Fairburn et al., 2003) and these dimensions of CE were also associated with ED symptoms in the present study, these relationships might also reflect a common trait across all disorders.

To date, there remains limited treatment evidence for CE, and little understanding to guide treatment focus (Lichtenstein et al., 2017). Results call into question the use of OCD treatment such as Exposure-Response Prevention for treatment of CE (Bratland-Sanda et al., 2019). However, treatments targeting ordering, strict adherence to schedules and organisation, dysfunctional perfectionism, avoidant coping as well as anhedonia, might be indicated, especially for those with OCD comorbidity or traits. Further, results suggest that treatment for CE might best be informed by ED-related treatments, with some evidence guiding treatment of CE in those with EDs (Hallward et al., 2022), which might be applicable more broadly for those with CE. Ongoing research to further build the treatment evidence base for CE remains needed.

Ongoing research into the diagnosis and assessment of CE may also be valuable in order to detect those in need of support. Currently, the CET remains the most commonly used tool for assessing CE. While the 24-item version of the CET and its factor structure have been questioned (Limburg et al., 2021), results were comparable across both the 24- and 18-item versions, suggesting that both might be amendable for use in assessing CE. Minimal research has examined the subscales of the CET in relation to psychopathology to date (Limburg et al., 2021), and our results suggest different associations for each dimension. MI was not related to any outcomes, consistent with earlier findings that MI is not associated with wellbeing (Noetel et al., 2016) or ED symptoms (Taranis et al., 2011). This is also in line with suggestions that it is the avoidance of negative affect that maintains CE behaviours and underlies resultant distress (Meyer et al., 2011; Scharmer et al., 2020; Taranis et al., 2011). After adjustment for ED symptoms, WCE was not associated with OCD symptoms. This finding is consistent with evidence suggesting that this dimension most closely reflects the focus on weight and shape observed in disordered eating and has the strongest relationship with EDs (Lampe et al., 2021; Limburg et al., 2021; Taranis et al., 2011). ARB has previously been shown to relate to various aspects of psychopathology, including symptoms of ED, anxiety disorders, and depression (Limburg et al., 2021; Noetel et al., 2016). Our results suggest that this dimension may be a key aspect that reflects distress and dysfunction in CE as we found it was associated with both ED and OCD symptoms. Therefore, identification of this symptom type may be especially helpful in determining those who may require support. Notably, the two subscales excluded in the 18-item version of the CET, ER and LEE, had relationships with OCD symptoms after adjustment for ED symptoms. ER was also related to ED symptoms. LEE was the only dimension related to obsessional thinking symptoms, suggesting that this dimension better reflects the obsessive nature of CE than the other dimensions. These results indicate that there may be benefit in retaining these two subscales as they appear to capture broader aspects of distress or impairment related to CE beyond disordered eating symptoms. Our results thus suggest some value in retention of all subscales for assessment of at-risk individuals.

4.1 | Limitations

There are a number of limitations that need to be considered in interpreting the results. Data are cross-sectional; thus, directionality of associations cannot be ascertained. All measures were self-report and may be subject to reporting bias or limited by insight. The use of self-report measures rather than verified diagnosis also limits the conclusions that can be drawn from the ROC analyses, although it should be noted that CE lacks a gold-standard diagnostic assessment, thereby necessitating use of self-report measures of CE. While the EAT-26 has good predictive value for EDs, this assessment is not disorder specific, and ROC analyses for detecting probable AN, BN and BED may have been underpowered due to the small numbers and may warrant replication. Associations and diagnostic prediction are also limited to the assessment of CE using the CET and the conceptualisation of CE used in developing the measure, which might not reflect or capture current thinking around the definition of CE (e.g., Dittmer et al., 2018).

OCD symptoms were assessed using a well-established measure; however, this measure assesses OCD symptoms more broadly and was not designed to detect exercise-related obsessions and compulsions. Therefore, the limited relationship with OCD symptoms might reflect

the lack of assessment of exercise-specific aspects of OCD. The OCRI also has a stronger assessment of compulsions over obsessions (Foa et al., 2002), although analyses were also performed with the obsessional thinking subscale to specifically examine this aspect of OCD symptomatology. Further, the sample was predominantly female, which may reflect that women may be more likely to self-report disordered eating and dieting behaviours, but which may limit generalisability to males. However, a recent meta-analysis indicated only small gender differences in problematic exercise behaviour (Alcaraz-Ibáñez et al., 2022) and analyses adjusted for gender.

5 | CONCLUSIONS

Our results provide minimal support for the association of CE symptoms with OCD symptoms, especially after adjustment for ED symptoms. This study suggests that the links between CE and OCD symptoms might better be understood as reflecting comorbidity between EDs and OCD, and shared traits and obsessive-compulsive features observed within EDs (Naylor et al., 2011; Swinbourne & Touyz, 2007). Our results thus question the conceptualisation of CE within the obsessive-compulsive and related disorder spectrum. Results showed multiple relationships between aspects of CE symptoms with ED symptoms, although not all dimensions of CE were related to ED symptoms. The CET also had poor to moderate predictive ability for detecting clinically significant ED symptoms and probable ED diagnoses. Results, therefore, suggest that rather than representing a feature of ED symptoms or being an aspect of OCD symptoms, CE might represent a distinct disorder, warranting its own diagnosis and treatment.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

Data are available from the corresponding author upon reasonable request.

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