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Compulsive Exercise and Physical Activity in Eating Disorders

by

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Abstract

Compulsive exercise and extensive physical activity are significant symptoms of Eating Disorders (EDs). Compulsive exercise is one of the most persistent symptoms associated with a higher risk of relapse, chronicity, and prolonged hospitalization. However, a deeper understanding of the progression of compulsive exercise symptoms during sickness and recovery is lacking. This research aimed to investigate the role of compulsive exercise and physical activity in EDs before and after day-care treatment. A longitudinal mixed design was employed to assess symptoms at admission, discharge, and follow-up. Eight women diagnosed with EDs undergoing day-care treatment were assessed by Exercise and Eating Disorders questionnaire and interviews. A significant reduction in compulsive exercise attitudes and behavior was found following treatment and discharge. Anorectic individuals showed significantly higher symptoms of compulsive exercise at admission and discharge compared to bulimic clients. Thematic analysis revealed five broad themes that defined physical activity in EDs throughout sickness and recovery: (1) eating pathology, (2) compulsivity and obsessiveness, (3) exercise commitment, (4) affect regulation and (5) perfectionism. These findings provided substantial evidence for the progression and multidimensionality of compulsive exercise symptoms and highlight the importance of this factor in EDs treatment.

Keywords: exercise psychology, clinical disorders, anorexia nervosa, bulimia nervosa, daycare treatment, longitudinal study, sport, mixed methods

Introduction

Theoretical background

Physical Activity (PA) and exercise are crucial components of the everyday life of the general population. Although there is an increasing awareness of the benefits of exercise in times of an obesity epidemic, the medical stances on PA in population with Eating Disorders (EDs) differ. PA has been shown to promote physical and mental health, including body satisfaction, enhanced mood, and well-being in patients with EDs (Moola et al., 2015). On the other hand, the exercise routines of individuals with EDs can quickly become extensive, rigid, and addictive, which promotes weight loss and therefore makes exercise a triggering factor in the onset and maintenance of EDs (Hechler et al., 2005).

EDs are the most commonly diagnosed psychiatric disorders in the female population (Pritts & Susman, 2003), with one of the highest mortality rates among mental illnesses (Edakubo & Fushimi, 2020). The relationship between EDs and compulsive exercise has received growing attention due to the potentially compromising effects of exercise on EDs treatment. No consensus has yet emerged on the definition of compulsive exercise, which has led previous research to disagree on the diagnosis and prevalence of this phenomenon (Noetel et al., 2017). However, Dittmer et al. (2018) proposed a clinical evaluation defining compulsive exercise as extensive PA that a person feels obliged to perform as a consequence of obsession. The exercise aims to prevent or reduce distress and counteract adverse mood states. Compulsive exercise is time-demanding (1 hour or more a day), structured, and prioritized, resulting in withdrawal from social relationships and other work/life responsibilities. It often continues despite exhaustion, injury, illness, or lack of enjoyment (Dittmer et al., 2018).

Between 30 and 80 % of people with EDs engage in excessive exercise behavior (Grave et al., 2008), leading to longer hospitalization periods (Carter et al., 2004), higher risk

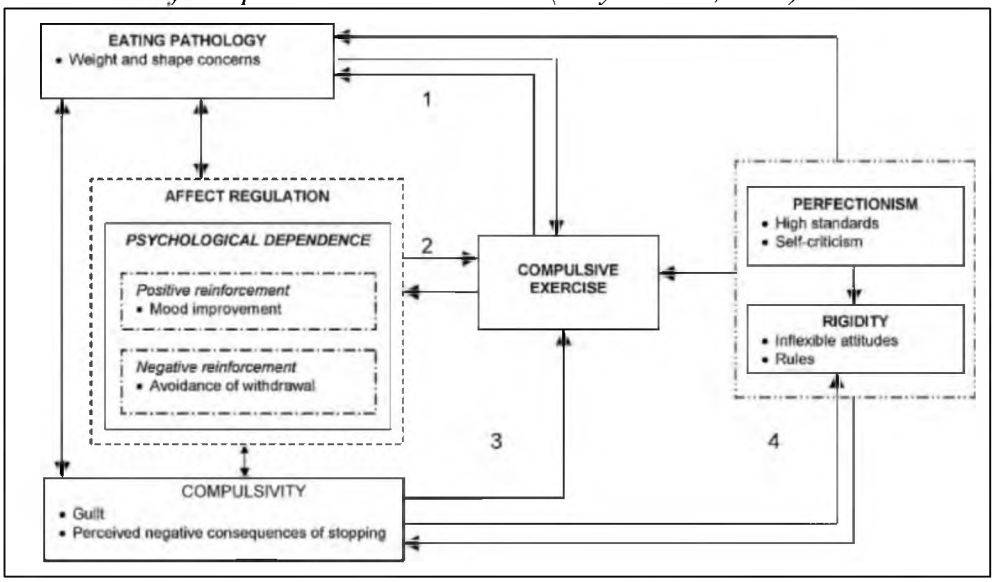
of dropout from treatment, relapse rate, and progression into chronic illness (Stiles-Shields et al., 2015). In addition, compulsive exercise has been identified as one of the last symptoms of EDs to subside (Davis et al., 1994). It is crucial to account for this symptom in treatment considering the strong association of compulsive exercise beliefs and behavior with greater eating pathology, specifically with dietary restraint (Grave et al., 2008). The prevalence of compulsive exercise is the highest in the population of restrictive anorexia nervosa (AN) reaching 81 %, followed by the 43 % prevalence in the purging and binge-eating subtype of AN, and 39 % in bulimia nervosa (BN) (Grave et al., 2008). For anorectic patients exercise serves mainly as a method for weight loss whereas for bulimic patients it substitutes a compensatory behavior (Danielsen et al., 2016). Past literature has primarily focused on the link between eating pathology and compulsive exercise, suggesting that starving promotes compulsivity, which results in an involuntary ritualized, and rigid PA (Crisp, 1967). Furthermore, exercise in the EDs not only serves as compensatory behavior for food already consumed but also as a "reserve" in case one eats something later. This mindset, defined as "debting", forces a person to exercise in advance to "earn the calories" (Beumont et al., 1994).

Although eating pathology has been recognized as an essential component of compulsive exercise (Grave, 2009; Mond et al., 2004), subsequent research suggests that this explanation is overly simplistic and one-sided. The necessity to account for cognitions related to compulsive exercise in EDs is highlighted in the cognitive behavioral model proposed by Meyer et al. (2011). Unlike older models, this model incorporates cognitions that explain the mechanisms behind the onset and maintenance of compulsive exercise, including eating pathology, affect regulation, perfectionism, rigidity, and compulsivity (Meyer et al., 2011). Based on this theory, exercise serves as a compensatory behavior to alleviate states of anxiety and tension, particularly in anorectic individuals who lack other countervailing mood

regulation behavior, compared to bulimic patients (bingeing and purging serving as compensation) (McManus & Waller, 1995). Although exercise usually begins as a temporary mood regulation strategy, it remains the only persistent coping strategy over time, as others are not developed (Adams & Kirkby, 2002; Geller et al., 2000). This theory is compatible with the exercise dependence model, which suggests that PA is maintained to relieve withdrawal symptoms and fear of guilt when unable to exercise (Hausenblas & Downs, 2002).

Figure 1

Maintenance model of compulsive exercise in EDs (Meyer et al., 2011).



Current state of research

Past research accentuates the significance of both qualitative and quantitative methods for the measurement of compulsive exercise in EDs while establishing qualitative methods as the most clinically valuable (Meyer et al., 2011). Despite the interest in this topic, there is an absence of qualitative studies conducted within clinically disordered population. In previous research, compulsive exercise has generally been assessed quantitatively in an inpatient setting. Danielsen et al. (2016) conducted a quantitative longitudinal study investigating inpatients' attitudes to compulsive exercise at discharge from treatment and follow-up. They

found a significant improvement in compulsive exercise during treatment and follow-up. Furthermore, the decrease in compulsive exercise attitudes was responsible for an increase in Body Mass Index (BMI) and a reduction in eating pathology.

However, qualitative evaluation has been attempted only in a sample of self-reported ED patients (Moola et al., 2015; Brunet et al., 2021). Brunet et al. (2021) accentuated the need to help patients establish a healthy approach towards exercise during treatment by encouraging medical staff to address this topic and provide support for PA engagement during recovery. Furthermore, the results of this study highlighted the benefits of exercise for women with EDs, particularly its involvement in coping with adverse mood states, managing ED behaviors, and reducing the risk of relapse (Brunet et al., 2021). Similarly, the study by Moola et al. (2015) conducted with Canadian women living with AN has shed more light on the change in motivation for exercise during recovery. PA during sickness was driven by pragmatic motives, particularly weight loss, which shifted to more healthful motives after exercise restriction during treatment (Moola et al., 2015). Nonetheless, previous studies have neglected the cognitive predictors and correlates of compulsive exercise in EDs resulting in little understanding of what beliefs and behavior related to compulsive exercise change during recovery.

In older treatment settings a total restraint from PA in malnourished patients was perceived to be crucial for weight gain and progress in treatment (Kolnes, 2016). This could be explained by the compulsive and obsessive nature of the disorder that is encouraged in case a patient does not abstain from exercise before achieving substantial progress in treatment (Brunet et al., 2021). Nevertheless, evidence from previous literature proved a positive relationship between PA participation and treatment progress (Moola et al., 2013; (Ng et al., 2013). In addition, tailored exercise intervention programs showed greater weight restoration in anorectic patients compared to patients without PA participation during

treatment (Szabo & Green, 2002). For women who are physically active during treatment, exercise remains a part of their life after discharge and mainly serves as a coping behavior for adverse mood states (Kolnes, 2016).

Aims and hypotheses

The present study aimed to target the yet understudied treatment settings (outpatient day-care) and population (clinically diagnosed EDs), with the advantage of combining quantitative and qualitative methods in a longitudinal design. Furthermore, this study sought to cover the absence of qualitative research comparing the accounts of bulimic and anorectic individuals and their relationship to exercise. It focused on exploring the role of compulsive exercise and PA in women with EDs before and after day-care treatment as there is little knowledge on how women integrate exercise into their lives during sickness and recovery. For quantitative evaluation, the objective was to investigate the course of compulsive exercise symptoms during and after day-care treatment. In addition, the effect of diagnosis and BMI on compulsive exercise was examined.

Starvation has been identified as a facilitator of compulsive behavior (Lloyd et al., 2017), suggesting a link between low BMI and increased compulsive tendencies. Thus, with the progress of treatment and the expected weight gain, compulsive exercise should be reduced. Hence, it was hypothesized (H1) that the symptoms of compulsive exercise will improve significantly from admission to discharge and from discharge to follow-up (Lloyd et al., 2017; Danielsen et al., 2016). The second hypothesis (H2) expected significantly higher symptoms of compulsive exercise among women diagnosed with AN compared to BN (Grave et al., 2008; McManus & Waller, 1995). Lastly (H3), an increased BMI was expected to predict lower symptoms of compulsive exercise (Davis, 1997; Danielsen et al., 2016)

Methods

A mixed-method design was used to obtain comprehensive accounts of participants' attitudes toward exercise. The quantitative component allowed for accurate measurement of the phenomenon from a longitudinal perspective. On the other hand, the inclusion of a qualitative assessment facilitated a deeper understanding of the underlying mechanisms and cognitions that impacted the progression of compulsive exercise symptoms that could not be captured by quantitative methods. Furthermore, it built on an ongoing study entitled *Evaluation of the EED 19 Questionnaire on Excessive Exercise in EDs* (Minařík et al., n.d.). The original study aims to validate the questionnaire for the Czech clinical population to individualize treatment plans and facilitate diagnostics and prognosis in ED patients. A critical realist research paradigm was adopted. This paradigm assumes a relativist ontology (realist and subjectivist stance) that has been established as an adequate framework for integrating qualitative and quantitative methods (Mukumbang, 2023).

Participants

Participants were recruited from an EDs day-care unit of a psychiatric clinic in the Czech Republic. The total sample consisted of ten female participants; however, two respondents were excluded due to dropping out of the research during the follow-up. Therefore, the final sample included eight women aged 18 to 50 years (M = 31.1, SD = 13.3), of which five women were diagnosed with AN (M = 27.8, SD = 11.5) and three with BN (M = 36.7, SD = 16.7). The size of the sample conforms to the sample size recommendations for qualitative research (Willig & Stainton-Rogers, 2017). A purposive sampling was chosen with the inclusion criteria as follows: (i) women aged 18 to 65 years, (ii) clinically diagnosed with ED according to ICD-10 criteria, and (iii) undergoing full-time treatment in the day-care unit (min. duration of 4 weeks). Any clients having the status of professional athletes were excluded. Table 1 describes the individual characteristics of the respondents.

Procedure

The present study combined the quantitative assessment of compulsive exercise at admission (T1), discharge (T2), and follow-up (T3) with qualitative interviews conducted at follow-up (T3). A parallel convergent mixed methods design was used with quantitative and qualitative data collected and analyzed separately and later combined to provide a detailed understanding of the topic (Creswell & Clark, 2018). Due to a sample size more suited for qualitative inferences, the research design employed the typology QUALITATIVE + quantitative to prioritize the qualitative section while quantitative data had a complementary role (Creswell & Clark, 2018). Data were collected from September 2022 to March 2023. The study received approval from the Ethics Committee of the Department of Physical Education and Sport Sciences of the University of Thessaly. No compensation was provided for participation.

After providing informed consent at admission, participants completed the Exercise and Eating Disorders Questionnaire, including personal information on age, diagnosis, height, and weight (for BMI calculation). The same procedure was repeated at discharge. The follow-up evaluation was scheduled two months after discharge and included questionnaire administration and a semi-structured interview. At admission and discharge, the participants were weighed by medical personnel, while at follow-up weight was self-reported. The follow-up data collection was conducted online or in person according to the respondent's preference.

All participants were voluntarily admitted to the day-care program upon being clinically diagnosed with ED at admission according to ICD-10 criteria (World Health Organization, 1993). The day-care treatment is offered for one to three months, depending on the client's individual needs and the treatment progress. The duration of treatment ranged from 8 to 12 weeks (M = 11, SD = 1.4). A BMI greater than 16.0 is a requirement for admission; otherwise, inpatient treatment is recommended instead. This form of care offers a

regimented treatment program without removing the client from their natural environment and hence facilitating a smoother transition from treatment discharge. The client attends the program every working day from 8 AM to 3 PM. The aim is to adjust eating behavior and attitude while achieving a biologically healthy body weight. The dietary regime in the day-care includes breakfast, snack and lunch, while afternoon snack and dinner are served at home, without direct supervision. However, clients are required to keep a therapeutic journal and food log, both are turned in to the therapists in the morning for regular check-ups and the contents are discussed at communions. An important part of the program is psychoeducation on appropriate eating provided by a specialized nurse present at all meals. The treatment is grounded in the biopsychosocial concept of the disease. The therapeutic program is based on group and community activities and consists of psychodynamic therapy, cognitive-behavioral therapy, expressive techniques, relaxation, and ergotherapy (Chudobová et al., 2005).

Measures

The Exercise and Eating Disorders (EED) questionnaire developed by Danielsen et al. (2015) was chosen for the quantitative assessment of compulsive exercise symptoms. It is a suitable scale as it measures attitudes toward compulsive exercise while taking into account the severity of symptoms. Furthermore, the EED is the first clinically oriented questionnaire designed for use in the ED population. It contains 18 items with a six-point Likert response scale (from *never* to *always*). The questionnaire factor structure consists of four subscales that thoroughly cover exercise-related issues in EDs: (1) compulsive exercise, (2) positive and healthy exercise, (3) awareness of bodily signals, (4) and exercise for weight and shape reasons. The global and subscales scores are based on mean values, with higher scores indicating greater compulsive behavior and unhealthy exercise. The global score allows for the classification of symptoms severity into the following categories: (1) score <1.80 (no symptoms of compulsive exercise), (2) score 1.80 - 2.39 (low severity), (3) score 2.40 – 3.19

(moderate severity) and (4) score >3.20 (high severity) (Danielsen et al., 2015). Although the method has been validated abroad, it is currently undergoing validation in the Czech population. The author has consented to use the translated Czech version and validate the questionnaire in a clinical setting. The reliability of the questionnaire is not reported, as research suggests that reliability analysis should not be attempted for sample sizes < 30 (Yurdugül, 2008). The original questionnaire shows good and acceptable psychometric properties, with Cronbach's alpha coefficient of .90 for the global EED and subscale coefficients ranging from .81 to .85 (Danielsen et al., 2015).

In terms of the qualitative assessment, eight semi-structured interviews were conducted at T3. The interview structure was flexible and designed to shed light on the cognitions and attitudes associated with exercise during the period from admission to day-care to two months after discharge (T1-T3). Given the inspiration of Meyer's model, the focus of the interview was specifically on the thoughts and emotions associated with exercise at each stage of recovery, to validate whether the same cognitions concluded by Meyer et al. (2011) were present in the day-care clients. The qualitative approach aimed to explore the potential changes in the relationship with exercise by covering the following domains: (1) initial relationship with exercise, (2) day-care treatment effects, (3) current relationship with exercise and (4) risk and protective factors and post-care. The interview guide is presented in Appendix. The interview durations ranged from 16 to 44 min ($M = 26$). Interviews were audiotaped and transcribed verbatim for data analysis. Pseudonyms were used to protect the anonymity of participants.

Table 1

Participants' characteristics

Pseudonym	Age (years)	ICD-10 Dg	BMI T1	BMI T2	BMI T3	EED T1	EED T2	EED T3
Anna	44	AN	16.09	17.26	17.60	2.95	3.05	2.37

Pseudonym	Age (years)	ICD-10 Dg	BMI T1	BMI T2	BMI T3	EED T1	EED T2	EED T3
Alex	42	BN	17.34	18.29	18.00	1.32	0.53	0.53
Marta	36	AN	18.48	19.35	17.60	2.32	3.42	2.79
Sandra	20	AN	16.09	18.28	18.40	3.21	2.79	3.16
Nina	50	BN	19.58	20.34	19.90	1.79	1.42	0.47
Ester	21	AN	17.35	18.82	19.20	1.95	1.21	1.11
Laura	18	AN	19.60	20.80	23.70	2.58	2.16	0.84
Nela	18	BN	22.19	20.70	22.90	1.26	1.53	1.89

Note. ICD-10 Dg: Diagnosis according to International Classification of Diseases, BMI: Body Mass Index, EED: Exercise and Eating Disorders score.

Analytic approach

Statistical analyses of the quantitative data were performed using JASP software, version 17.2. The Shapiro-Wilk test confirmed that the assumption of sphericity for the EED data was not violated. Due to the small sample size (n = 8), non-parametric tests were chosen to test the hypotheses. Friedman's test was used to examine the change in EED scores over time (H1), followed by the Conover post hoc test for significant main effects. The Mann-Whitney test was chosen to examine the effect of diagnosis on compulsive exercise symptoms (H2). Lastly, the determination of Spearman correlation coefficients was performed to test the association between BMI and compulsive exercise (H3) at each measurement point. The level of significance was set to 5 %. In regards to qualitative data, transcripts were analyzed using thematic analysis, a method suitable for identifying and categorizing patterns in qualitative data (Braun et al., 2016). No software was used for analysis. Transcripts were read several times, and initial patterns were observed. Subsequently, these notes were transcribed into codes, and similar codes were grouped into themes and subthemes. Theoretical coding was applied. This approach is based on a specific

research question, in contrast to inductive coding (Braun et al., 2016). The themes were grounded in Meyer's model of compulsive exercise in EDs: eating pathology, affect regulation, perfectionism, rigidity, and compulsivity (Meyer et al., 2011). Achieving a satisfactory quality of codes, themes, and representative quotes required a rigorous process of going back and forth during the coding phase. Given the design of mixed methods, qualitative data were used to clarify and deepen the results of quantitative analyses.

Note on reflexivity

To ensure the validity of the qualitative section of the research, trustworthiness criteria have been considered, namely credibility, dependability, transferability, and confirmability (Lincoln et al., 1985). To comply with the following recommendations, the author used several techniques. One such activity involved a prolonged engagement with participants during treatment in the EDs unit, where the author worked for four months. By observing and interacting with the clients at the day-care centre, the author was better equipped to prepare an appropriate interview structure that effectively addressed the role of exercise for participants. Despite the possibility of confounding due to familiarity between the author and respondents influencing the interview atmosphere, it rather seemed to facilitate a safer environment for the respondents to open up to someone experienced from the day-care unit. In addition, all data were clearly and logically documented by keeping records of raw data (audio files), transcripts, and field notes to report personal reflections and provide options for data checks to other researchers. Lastly, considering the nature of the mixed-method design, it was feasible to ensure the triangulation of the methods, resulting in a broader understanding of the phenomenon.

Results

Quantitative Results

As shown in Table 2, the mean values of the global EED scores and the compulsive exercise subscale scores decreased consistently from admission to discharge and from discharge to follow-up. However, only compulsive exercise scores improved significantly ($\chi^2 = 6.645$, $df = 2$, $p < .05$). The effect size of .42, as determined by Kendall's W, suggests a moderate agreement. Conover's post hoc pairwise comparisons indicated a significant change between compulsive exercise symptoms at T1 and T3 ($p < .05$). Similarly, significant changes were observed for BMI ($\chi^2 = 9.25$, $df = 2$, $p < .05$) with an increase from admission to discharge and discharge to follow-up. The effect size indicated a moderate agreement (.58). Conover's post hoc pairwise comparisons revealed significant increases from T1 and T2, and T1 and T3. The scores of the other subscales are summarised in Table 2, although not demonstrating significant changes. However, the subscale of positive and healthy exercise subscale indicates an improvement from admission to discharge and follow-up. Interestingly, exercise for weight and shape reasons was reinforced during treatment but discontinued after discharge.

Table 2

EED scores (global score and subscales) and BMI at admission (T1), discharge (T2) and follow-up (T3) and differences from admission to follow-up

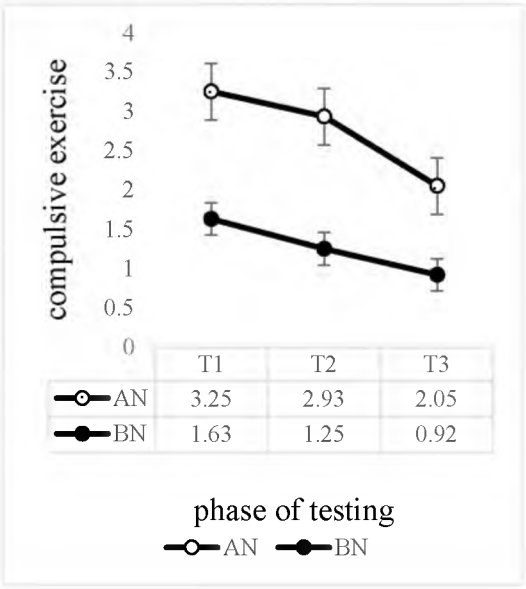
	Mean (SD) T1	Mean (SD) T2	Mean (SD) T3	x^2	Effect size Kendall's W	Conover post hoc p values
EED Global score	2.2 (0.7)	2.0 (1.0)	1.6 (1.1)	2.77	.17	
Compulsive exercise	2.6 (1.0)	2.3 (1.1)	1.6 (1.2)	6.65*	.42	T1 and T3
Positive and healthy exercise	1.1 (0.4)	1.3 (0.7)	1.9 (1.2)	3.07	.20	
Awareness of bodily signals	1.5 (0.9)	1.4 (1.3)	1.2 (1.1)	1.87	.12	
Exercise for weight and shape reasons	2.3 (0.7)	2.8 (1.1)	2.1 (1.2)	3.16	.20	
BMI	18.3 (2.1)	19.5 (1.7)	19.7 (2.4)	9.25*	.58	T1 and T2, T1 and T3

Note. x^2: Friedman test. *p < .05. Kendall's W: Small agreement = .10, moderate = .30, and strong = .60. In Conover post hoc test, only significant relationships are reported (p < .05).

In terms of H2, the Mann-Whitney test was performed to compare the levels of compulsive exercise at T1, T2, and T3 between anorectic (n = 5) and bulimic (n = 3) individuals. As shown in Figure 2, the results indicated significantly higher levels of compulsive exercise for individuals with AN compared to BN at T1 (W = 15.0, p = .02, r = 1.0) and at T2 (W = 14.5, p = 0.03, r = .93). No significant changes were found at T3.

Figure 2

Mean compulsive exercise subscale scores at admission (T1), discharge (T2), and follow-up (T3) for AN and BN individuals



Regarding the relationship between BMI and compulsive exercise (H3), Spearman's correlation analyses revealed a significantly strong and negative correlation at T1 (r = -.68, p = .03) that suggests the association between higher BMI and reduction in compulsive exercise symptoms. However, weak and strong negative correlations were observed at T2 (r = -.34, p = .21) and T3 (r = -.59, p = .06) lacking statistical significance.

Qualitative Results

Participants gave detailed accounts of the development of their relationship with exercise and PA. The role of compulsive exercise and PA was outlined through five interrelated themes that represent common constructs of compulsive exercise across all phases of the research. By breaking down the phenomenon into several components, it was possible to discover what aspects and attitudes related to compulsive exercise improved and which remained unchanged. The following broad themes emerged: (1) eating pathology, (2) compulsivity and obsessiveness, (3) exercise commitment, (4) affect regulation and (5) perfectionism. The themes and representative quotes are presented in Figure 3.

Eating pathology

One of the most discussed themes associated with exercise was eating pathology. Before day-care treatment, there was a pressing motivation for exercise as a means to lose weight and compensate for food. Meals were only ”deserved and earned” after engaging in excessive exercise, thereby burning all calories consumed or planned to be consumed. After mealtime, there was often an urge to exercise. For instance, Ester (AN) expressed her need for compensation by the following thinking process after a meal: “Now I've spoilt it and I have to go on again to make up for it”. Therefore, women tended to give up food to avoid the craving to exercise again. Exercise often served as an excuse to avoid dining in a social setting. Overall, participants admitted that dietary restraint reinforced toxic and excessive PA and labelled PA as a primary tool to control appearance and weight. Moreover, respondents described a constant struggle with distorted body image, poor self-worth, and a desire for thinness. During treatment, women had to abandon their dietary and fasting practices which were replaced by flexible but regimented eating. Taking into account the sudden increase in food intake and gradual weight gain, recalled heightened shape and weight concerns with constant observations of body changes were recalled. The eating pathology related to exercise in the day-care was characterized by fighting the urges to compensate for food to not

jeopardize the treatment outcomes. Nevertheless, following discharge, women reported a change in perspective on food and exercise with a major positive impact of the day-care. The main factor contributing to this realization was the experience of gradual, rather than sudden, weight gain with increased food intake in the day-care. Increasing their food intake while restricting PA helped them experience a regimen they would not have been committed to without supervision. Dietary restraint has disappeared from eating habits along with the urge to compensate for food or the mindset of earning calories. Although respondents reported general improvements in attitudes toward eating and body image regardless of exercise, shape and weight concerns remain present considering the ongoing process of adjustment to weight gain. This can be illustrated by the following quote from Sandra (AN): "I know that somehow I'm not going to become obese overnight (...). But I'm a little worried that if it goes up, I'll do something else to kind of compensate for everything. But it's not that I want to burn everything I've eaten, it's not like that again".

Compulsivity and obsessiveness

The second theme reflects obsessive and compulsive behavior related to exercise. Prior to the admission to treatment, respondents exhibited strong patterns of rigid and inflexible exercise behavior. All activities were constantly measured using a fitness watch with the "urge to finally check off the achieved goal" (Ester, AN). In terms of exercise structure, routines were stereotypical and ritualized, indicating an inflexible mindset. Participants found it unthinkable to skip a workout, as in such cases intense feelings of guilt would creep in. To avoid intrusive thoughts of perceived negative consequences, women often engaged in secretive exercise. This devotion often took a toll on neglecting other duties, illustrated by a comment from Laura (AN) who would "rather walk to school for one hour and a half than take a subway like a normal person and have time to study".

During treatment, this pattern manifested in difficulties in adjusting to the regimen, in terms of abandoning rigid routines and encoded movement patterns. Most respondents reported intensified creeping thoughts and urges to walk off the calories consumed. By confronting inflexible habits during treatment and readjusting daily routines, participants learned a liberating approach to exercise. Rigidity and urgency disappeared from routines, and guilt is no longer experienced when skipping exercise. Additionally, in most cases, exercise is not obsessively tracked and counted anymore as more meaningful activities are practised instead. However, given the absence of supervision and freedom to exercise, women struggle to resist the urge to overexercise, and they fear finding joy in past toxic routines. Some of them mentioned being aware of the chronicity of the disorder by confessing to having a "sick brain". For example, Sandra (AN) admits persistent difficulties with numbers obsession: "Well, I still have it with me [fitness watch], I gave it away at one point, but I just couldn't do it. If I don't know it [the numbers], it's like it didn´t happen, like I didn't do anything". Although toxic thoughts surface occasionally, respondents learned not to act on them and rather implement safety measures, such as not planning exercise in advance.

Exercise commitment

On the topic of PA routine and its importance, exercise commitment emerged as a frequent theme. Prior to treatment, exercise used to be the centerpiece of daily life and commitment to exercise was perceived as an onerous obligation and devotion. Although the approach to PA was consistent and disciplined, it was driven by unhealthy motivation and personal goals related to the illness. Routines consisted of high-intensity extensive PA (2 hours a day), usually involving a strict workout plan combined with active transportation or jogging on top of working out. The relationship to exercise was characterized by dependence and lack of insight into the problematic behavior, demonstrated by the mindset of "knowing it is not normal to exercise so much, but feeling like it is normal in my life" (Sandra, AN).

Participants would engage in exercise despite fatigue or sickness, resisting body signals and often using exercise as self-torture. PA had a top priority which resulted in interference with other program and social isolation. Respondents reported feeling "consumed by exercise".

When entering the day-care, underweight clients were instructed to reduce the exercise hours to three times per week, until they reached a healthy body weight. With the restriction of PA, most respondents reported compensating for the lack of exercise by excessive walking to and from the day-care, as this activity was not supervised. Two respondents also engaged in secretive exercise at home, however, gradually accepted the rules and decided to abstain from exercise. Although women returned to exercise after discharge, the commitment to exercise is defined by positive motivation unrelated to the sickness, such as spending time with friends and family. PA is practiced at a healthy and leisurely pace. Sports are no longer viewed based on the amount of calories burned during a particular exercise. Thus, exercise is still present in their life, but without any significant priority or pressure. It was predominantly mentioned that the effort goes into seeking a balance between the exercise regime before and during day-care. Interestingly, bulimic respondents considered exercise as a protective factor in recovery from the disorder as a tool to prevent them from binging and purging as it offers a new coping strategy for mental relief.

Affect regulation

Furthermore, exercise among respondents was strongly associated with affect regulation. Before attending day-care, PA served as a primary coping mechanism for adverse mood states. Participants reported using exercise as a way to escape "everyday problems", "constant tension", "feelings of loneliness", and "not being good enough". After admission to treatment, where exercise abstinence was necessary, women had to abandon this learned pattern of stress management. Consequently, anorectic clients experienced extreme withdrawal symptoms, characterized by emotional sensitivity, distress, and depression. The

constant tension gradually encouraged participants to pursue more adaptive coping strategies, such as journaling or relaxation. Interestingly, there were no signs of withdrawal in bulimic clients. All of their focus was devoted to adhering to the eating regime and effort not to binge or purge, leaving no space for thoughts on exercise. After discharge from treatment, exercise remained a primary coping mechanism, specifically to improve mood and mental relief. However, no withdrawal symptoms manifest when PA is not performed.

Perfectionism

The final theme that resonated among respondents in the context of exercise was perfectionism. The pre-treatment mindset toward exercise and other domains of life was characterized by striving for high standards, performance orientation, and a sense of obligation to pursue PA. Nina (BN) described her motivation for exercise as “I was just trying to run, put in some sort of performance because I needed to be fit and I needed to be okay”. What particularly stood out was the most recurring thought related to exercise, “I have to”, which forced women to exercise regardless of the circumstances. When exercising, women were strongly disciplined and strict, always requiring themselves to complete the workout despite exhaustion. It was typical to compete with oneself and the idea of not meeting the goals was usually followed by a pronounced surge of self-criticism. Throughout the treatment, clients were no longer able to maintain their perfectionist goals in terms of PA and body image due to modification of eating and exercise habits, thus gaining weight. Overcoming the initial stress and resignation was followed by a gradual change in mindset and a progressive surrender of the sorely needed control. This shift has translated into the current attitude toward exercise. The idea of “I have to” has changed to “I want to”, altering exercise from a duty to a hobby. Sandra (AN) mentioned, “I don't have to put so much pressure on myself that everything has to be done right away, all the steps walked and all the calories burned.” Exercise is no longer performance oriented and by lowering personal

standards the clients are now capable of accepting imperfections and experiencing self-compassion and self-acceptance. Seven out of eight participants reported establishing and maintaining a healthy relationship with exercise while accounting for the impact of day-care treatment as the most significant factor in this improvement.

Convergence of Quantitative and Qualitative Data

Qualitative data unveiled overarching themes related to participants' experience of exercise and PA. Consequently, quantitative data provided insight into the manifestation of compulsive exercise symptoms from a longitudinal perspective. Results revealed an improvement in compulsive exercise symptoms during treatment and post-discharge, consistent with the participants' interview statements regarding compulsivity and obsessiveness. In regards to observed differences between compulsive exercise in AN and BN from the quantitative data, qualitative results correspond with these findings as they highlight the lack of withdrawal symptoms in BN during treatment compared to AN. Furthermore, an increase in BMI was indicated that correlates with the improvement in eating pathology and the shift from dietary restriction to flexible eating. Interestingly, a peak in the subscale of exercise for weight and shape reasons was observed during treatment suggesting an amplification of body image concerns that corresponded with participants' qualitative accounts. Overall, both analyses revealed an improved relationship with exercise from admission to treatment to discharge and follow-up.

Figure 3

Representative themes and quotes from qualitative analysis

THEMES	T1: BEFORE TREATMENT	T2: DURING TREATMENT	T3: AFTER TREATMENT
Eating pathology	When I exercised I would **see myself better** in the mirror afterward, and when **I didn't exercise** I would just **see myself a lot bigger** in the morning, although I looked the same. (...) And then when I exercised I felt like I **deserved to eat** because it was affecting a lot how I was eating and **how I felt about myself**. (Laura, AN) I would maybe eat something, and then I would **compensate** for it by exercising. And I would exercise so that I would either **work out what I had eaten** or exercise **on top of that**, in case I ate something else afterward so that I would have a **reserve**. (Sandra, AN)	The whole time I was in the day-care I felt like I was going to be a **hundred-pound girl**. But yet every Monday on the scale it was completely different, but my head was always thinking in a **sick, crazy, just weird way**. (Marta, AN) It was all **distorted, a distorted view of myself.** And I still had this tendency to maybe **observe myself more**. (Anna, AN)	**I don't have that regret** anymore in that if I randomly really don't go for a walk some days, I'm not allowed to eat. I'll have a **meal anyway** and I try to kind of **take it easy, enjoy the day**. (Anna, AN) I know that somehow I'm **not going to become obese overnight** (...). But I'm a little bit **worried** that just if it goes up, I'll just do something else to kind of **compensate** for everything. But it's not that I want to burn everything I've eaten, **it's not like that again**. ([redacted])
Compulsivity and obsessiveness	I was really trying to **every single time** or every single day **just don't stand around and do nothing**. (...) I was always watching my **smartwatch**... All the time I had that tendency to **keep track** of how many steps I walked, just **to feel at ease**. I had to go around this many blocks just to **reach that promised limit**. And basically, I always had that **urge** to exercise. ([redacted]) **I had to do something all the time**. (Sandra, AN)	In the beginning, it was **hard for me**, because I had this **encoded pattern of movement** and some sort of **daily ritual** that had been going on for a very long time. So getting out of that pattern was really **hard for me**. (Anna, AN) In the day-care, it was really **tough**. Because **I was used to something**, and as we could only exercise three times a week, **it didn't suit me at all**. I had a terrible **tension** inside me (Marta, AN)	I would say it's much **more freeing**. (...) [Before] I was just walking like a **robot**, like **programmed**. Whereas now I'm having more **fun**. (Anna, AN) It's more like I don't have any **purposeful plan**. If I don't exercise, the **world doesn't fall apart**. It's more of a **nice feeling** to keep in a routine. (Alex, BN) There are still sometimes those **tendencies to do more and more**, but then I always tell myself that **I've done enough**, that I don't need to exercise anymore, that **my body needs rest again**. ([redacted])
Exercise commitment	I always **structured my whole day around it**. (...) And most of the time I would do it in **secret**, so I would just pack a bag, pretend like I was going out with my friends, and instead I would **head to the gym and spend hours there**. (Laura, AN) I had a set goal of **30k steps a day** that I wanted to hit. (...) So over time, I was **addicted** to it and I had to kind of balance that with being so **exhausted** from even school, but at the same time **I knew I had to do it**. (...) I was really struggling to sort of **fit it in with the other program**. That I often just put the exercise in the **very first place** compared to other responsibilities. (Sandra, AN)	**I walked to the day-care, I walked from the day-care**, I just tried to do **as many steps as I could...** I was still sometimes doing **stupid 10 mins workouts at home** and stuff like that in my room, **secretly**. Which sounds really embarrassing to me now, but it's true. (Laura, AN) When I was commuting to the day-care, I was trying to move around by **walking or faster jogging** so I was walking between stops. ([redacted])	I don't require myself to go for 2-3 hours anymore, but I cut it down to an **hour**, sometimes an hour and a half when the weather's nice. (...) And **I don't have those regrets** when I cut it short. (Anna, AN) I used to be a little bit **obsessed** with exercise, so the treatment kind of helped me to look at it in a different way than just **controlling my appearance**. (...) I definitely would **prefer to go out with my friends** now rather than shut myself in the gym for a few hours. (Laura, AN) But the **climbing**, that's what kept me trying to eat healthily, more, mainly to **make sure I didn't purge**, because if I threw up and went climbing I wouldn't be able to climb anything. So it was like, **the more sports I did, the less I overate**. ([redacted])
Affect regulation	I didn't have a lot of friends, so I went to work out instead and **I didn't have to think about just not doing well in school or feeling lonely** or whatever. (Laura, AN) I used to be so tired that sometimes I didn't even feel like doing it. But anyway, **my head was just pressuring me so much** that I went anyway. And then once I was on the trail, in the woods, **I felt fine there**. And then I was aware that **the tension was drifting away**, there was **silence, peace**. **Nobody was asking me to do anything.** (Anna, AN)	It was a great **anguish**, a lot of times some kind of **depression** that if I just **won´t be moving** and will just eat and be here in this program, I felt like **it couldn't be like this**. That my body would just keep **gaining, gaining, gaining**. (Anna, AN) All the energy was going into the **eating**, and the exercise was only with the dog, or occasionally outside. But I was definitely more **focused on not overeating**. ([redacted])	I find that sometimes now I end up using exercise instead if maybe I had a **bad mechanism to use when I'm stressed.** Like, if I started **purging** again, I'd **go to the gym instead** to get out of the house. (Laura, AN) A lot of times when I've had **bad moods** the **physical activity was definitely elevated**... when I'm in a worse mood, **I feel worse about myself too**, it's linked a lot, just the **trying to change myself**... if I can't change a situation that's happening, then I try to **change how I feel about myself**. ([redacted])
Perfectionism	Especially when I finished my workout, I always **felt so good about myself** that I had done it, and that **I hadn't slacked off**, and that I had **pushed myself**. (Sandra, AN) Most of the time those thoughts were just about some kind of **self-torture**. Well, **not being good enough at work, not being good enough at school, not being good enough in this society**. (Anna, AN) Sometimes there were these thoughts of **"I just have to"**. That really I was **forcing myself** to do it, to just have it **checked off in my head** and just have it done. ([redacted])	When I **accepted** that I had to gain weight in the day-care, I was like, I'm gonna do it, I'm gonna gain weight, but I'm gonna **gain in a good sense**, and I'm gonna exercise at the same time, and I'm gonna **gain muscle**, not fat. And I just couldn't make it work. (...) And then I fell into a state where I felt like **it didn't matter anymore**. ([redacted])	I used to make myself go because otherwise, I'd feel like I'm the **worst person in the world to ever exist**. And that I just **don't deserve to eat or talk to anybody**... So really working out made me feel like I'm **finally gonna be able to talk to people because I'm gonna look better and be liked more.** And now I'm just like, people should like me anyway... (Laura, AN) There's really been this **big shift** in that I don't put that emphasis on the **performance** anymore. And that it should be the **focus of my whole day and my whole year and my whole life**. (Anna, AN)

Discussion

The objective of this project was to explore the role of compulsive exercise and PA in women with EDs following a day-care treatment. It aimed to provide a deeper understanding of cognitive attributes and motives related to compulsive exercise and its evolution over the course of treatment and discharge. The results revealed a significant reduction in compulsive exercise symptoms and a positive change in attitudes towards PA from admission to discharge and follow-up, an observation consistent with previous observations (Danielsen et al., 2016; Calogero & Pedrotty, 2004; Bratland-Sanda et al., 2009a). Further quantitative results confirmed a higher prevalence of compulsive exercise among anorectic clients compared to individuals with BN, as also documented previously (Grave et al., 2008). In addition, anorectic respondents reported considerably more withdrawal symptoms when abstaining from exercise during treatment. This observation was previously explained by McManus and Waller (1995) suggesting that exercise embodies the only learned coping strategy in anorectic patients who do not possess other maladaptive strategies for stress relief present in bulimic patients, such as binging and purging. Additionally, negative correlations were found between compulsive exercise and BMI, supporting the link between starvation and compulsivity from prior findings (Davis, 1997; Lloyd et al., 2017). Previous literature explains the relationship between compulsivity and malnutrition through serotonin dysregulation that frequently follows chronic starvation and was found to be responsible for the facilitation of compulsive behavior (Kaye et al., 1993).

Qualitative findings emphasized the complex multiple dimensions of PA in EDs, as previously outlined by the cognitive-behavioral model of compulsive exercise (Meyer et al., 2011). The results highlight the fact that compulsive exercise in EDs entails multiple attributes, indicating that some cognitions improve effectively during treatment (perfectionism, compulsivity and rigidity), while others remain unchanged (affect regulation,

body preoccupation). Overall, most participants considered a day-care treatment to be a pivotal factor in establishing a healthy relationship with PA. In agreement with past qualitative findings (Brunet et al., 2021), exercise attitudes and behaviors improved and became less disordered as a consequence of treatment. Participants disclosed that following discharge, exercise routines became less intense and extensive. Exercise lost priority in their lives and no longer served as a means of controlling weight. Respondents described a lengthy progression towards this realization, defined by the experience of abstinence from exercise during treatment and overcoming withdrawal symptoms. Nevertheless, it is crucial to acknowledge the change in both PA behaviors and attitudes as it contradicts the notion that ED patients score high in compulsive exercise scales while engaging in low levels of PA, which is explained by the maintenance of obsessive beliefs about exercise (Bratland-Sanda et al., 2019).

In terms of the specific attributes of compulsive exercise, the greatest improvement was observed in perfectionist tendencies and exercise commitment. Pre-treatment attitudes toward exercise were characterized by strong exercise dependence and performance orientation. Over time, participants learnt to relinquish control of all aspects of their lives, including exercise and body appearance, and managed to set realistic standards for the future. It is important to account for the significant progress in perfectionist behavior as perfectionism has been found to be independent of eating pathology in EDs (Kaye, 1997). Compulsive and obsessive behavior, such as repetitive exercise routines, steps tracking, and exercise cravings, disappeared, however, intrusive thoughts and the temptation to overexercise remain present. Although participants report signs of disordered thinking, they have learned to manage toxic thoughts and not act on them.

Eating pathology was found to be a fundamental attribute in compulsive exercise prior to treatment, consistent with past findings indicating a mutually reinforcing relationship

between EDs and compulsive exercise (Meyer et al., 2011). Dietary restriction and compensation for food with exercise shifted to flexible eating routines independent of PA levels during the day. Thus, a major improvement was observed in breaking the co-dependency of eating and calorie burning with exercise. One aspect of eating pathology that intensified during treatment and remained present after treatment was shape and weight concern. This could be explained by gradual weight gain throughout treatment and after discharge, which could have triggered disturbed body perception and reinforced concerns related to shape and weight.

The last attribute associated with compulsive exercise in EDs was affect regulation. In line with previous research (Geller et al., 2000), this study's qualitative findings indicate that exercise serves as a crucial mood-regulatory behavior at both stages of sickness and recovery. These outcomes support the multidimensional nature of compulsive exercise, suggesting that exercise is intended not only for calorie burn but also to counteract adverse mood states (Meyer et al., 2011). Moreover, this aligns with models of exercise dependence that view exercise as a mechanism for affect regulation and relieving withdrawal symptoms when unable to exercise (Hausenblas & Downs, 2002). Although following treatment women no longer experience withdrawal when not being able to exercise, PA is still positively reinforced by providing a form of psychological escape and mental relief.

Strengths and limitations

There were several strengths and limitations associated with the methodology of this research. An essential strength lies within the mixed methods design, which allowed for a thorough evaluation of improvements in attitudes towards compulsive exercise while concurrently capturing the progress of symptoms at admission, discharge, and follow-up. To date, this is the first research that accounts for both quantitative and qualitative data in the evaluation of day-care treatment settings. The inclusion of follow-up measurement provides a

better understanding of long-term tendencies of compulsive exercise behavior following a discharge from treatment. Moreover, EDs research has been conventionally conducted on a younger adult sample, considering it the most affected population. This research covers a wide age range of participants, focusing on two major diagnoses, AN and BN.

Although this study provides valuable insights, several limitations should be acknowledged. Primarily, this research suffers from a small sample size for quantitative assessment which may have impacted the statistical analyses and generalizability of the findings. The results are encouraging, however, should be confirmed in studies with a larger sample size. Consequently, all participants were recruited from the same day-care unit, which may have increased sampling bias and potentially make it difficult to generalize to other treatment models. Therefore, the self-reported data should be interpreted with caution given the specific treatment and gender context of this study. Lastly, it is worth noting the impact of the two dropouts from the research. Dropping out could be explained by the potential relapse of these patients, to the detriment of the study lacking more negative accounts of respondents. Therefore, the missing accounts of these participants should be taken into account and given consideration when interpreting the results.

Practical implications

Despite the large body of evidence on the role of compulsive exercise in the onset and maintenance of EDs, there is still considerable ambiguity in how to address this symptom in the treatment (Hechler et al., 2005; Bratland-Sanda et al., 2009b). Although our work demonstrates that exercise in EDs can be beneficial in terms of emotion management and serve as a protective factor in BN, it is essential to recognize all the risks associated with excessive exercise routines and dysfunctional attitudes towards PA. Women reported consistent use of exercise for managing problematic emotions throughout the treatment and discharge. Hence, future treatment should give attention to teaching patients more adaptive

coping strategies for mood intolerance as a substitution for the overuse of exercise. The day-care treatment successfully introduced new mood modulatory behaviours, such as journaling or relaxation, that significantly helped with overcoming withdrawal symptoms.

Although outpatient treatment possesses several challenges in terms of adherence to a diet and exercise regimen while being out of the unit, the women expressed appreciation for this model of treatment. In particular, the mutual trust between clients and staff and the need to take ownership of their behaviour during unsupervised evenings at home made the transition from treatment to normal life smoother. This offers a major advantage over inpatient treatment where the client does not have the opportunity to experience a regime at home during treatment without supervision. That being said, outpatient treatment is only suitable for clients who do not have a critical BMI value and discharge from treatment does not put them at risk of harm. Due to the intensity and duration of day-care treatment, this model appears to be effective in less severe cases of EDs and/or as a follow-up treatment after hospitalization, to ease the transition from hospital discharge to normal life.

As indicated by the respondents, finding a healthy approach to exercise and disrupting inflexible routines is a long endeavor and extends beyond discharge from treatment. Furthermore, the treatment follow-up period appears crucial for establishing a healthier approach to PA and not returning to toxic pre-treatment routines. Although the compulsive-obsessive dimension of sickness substantially improved with treatment, many women remain worried about shifting back to their toxic exercise routines. Taking into account the primary focus on maintaining sustainable eating habits, problematic exercise behaviour can be overshadowed. Most respondents mentioned the importance of being involved in aftercare and having supervision to maintain eating and exercise habits.

Future attempts should be made to introduce uniform guidelines for the regulation of exercise in treatment. Healthcare professionals should openly address this topic to ensure that

patients understand its importance and the risks associated with EDs. Although most of the focus in treatment is devoted to readjusting eating habits, it is essential to manage withdrawal symptoms associated with exercise restriction. This issue should be anticipated in the future and additionally investigated in the male disordered population with the inclusion of all diagnoses from the EDs spectrum. Several interesting aspects could be explored by obtaining a healthcare specialist's perspective. The results obtained would provide a theoretical framework for establishing a clinical definition of compulsive exercise and its management in treatment.

Conclusion

Taken together, the current study provides a substantial foundation for understanding the role of PA and compulsive exercise in EDs during illness and recovery. Significant reductions in compulsive exercise behavior and attitudes were discovered, following a day-care treatment. These results uniquely contribute to the explanation of what attributes associated with compulsive exercise undergo improvement during day-care treatment and how are these attitudes replaced with more adaptive cognitions. The findings have implications for future research. A closer investigation of how compulsive exercise attitudes and behaviors progress in the long run after the treatment is essential to ensure a safe return to PA and maintenance of functional PA beliefs. This topic should be further addressed in clinical practice through psychological, psychiatric, or therapeutic follow-up care. Compulsive exercise remains an unresolved challenge within the context of EDs (Zipfel et al., 2015). Successful management of compulsive exercise and integration of PA into patients' lives will be a crucial step for comprehensive progress in ED treatment (Dittmer et al., 2018).

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Appendix

Interview guide

(1) Initial relationship with exercise

1. Describe your relationship with exercise when entering the day-care program.

- What were your exercise habits?

- What usually led you to exercise?

- How did exercise make you feel and what was running through your head?

(2) Day-care treatment effects

2. How did the relationship with exercise progress throughout the treatment?

- Was there any modification of physical activity? If so, what? If not, why?

- In case there was a change of physical activity routine, what did it make you think and feel?

3. What effect did the treatment have on the attitude towards PA?

- Did you find the treatment effective in adjustment of exercise habits or would you appreciate any different approach? Why is that?

(3) Current relationship with exercise

4. How physically active are you at the moment?

5. What usually motivates you to exercise now?

6. How important is exercise to you now compared to the time of the day-care admission?

- What thoughts and feelings do you experience when being physically active?

- Does exercise affect any other aspect of your life?

(4) Post-care

7. Do you feel like you have managed to build a positive relationship with exercise?

- If so, what has helped you with that?

- On the other hand, were there any triggers that made you engage in excessive physical activity? If so, what?

8. Did you attend any post-day-care treatment that would have impact on your exercise habits? If so, what?

9. Is there anything else we have not talked about related to this topic that you would like to mention?