Helpful or Harmful? Differences in Exercise Experiences Between those With and Without Recent Disordered Eating

by

Nicole Legg

Hons B.Sc., University of British Columbia Okanagan, 2016

M.Sc., University of Victoria, 2019

A Dissertation Submitted in Partial Fulfillment
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We acknowledge and respect the Lək̓ʷəŋən (Songhees and Esquimalt) Peoples on whose territory the university stands, and the Lək̓ʷəŋən and W̱SÁNEĆ Peoples whose historical relationships with the land continue to this day.

Supervisory Committee

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Abstract

Results remain mixed around if exercise is helpful or harmful among those with eating pathology. As such, healthcare providers often recommend abstinence from exercise for this subpopulation. The current dissertation aimed to illuminate the benefits and consequences of exercise among those with recent, recent disordered eating (DE). Specifically, the study examined 1) if motivations for exercise engagement differ between those with and without recent DE, and between different DE-related concerns; 2) if changes in mood and body satisfaction from pre- to post-exercise differ between those with and without recent DE; 3) if associations between different intensities of exercise and body checking behaviours differ between those with and without recent DE. Participants were Canadian adults and students from UVic (n = 384; $Mean_{age}$ = 26.85, SD = 8.72; 62% female). Participants completed an online baseline survey assessing their demographics, depression and anxiety symptoms, and history of DE. Next, participants completed a 14-day daily monitoring protocol via a smartphone app: participants completed mobile surveys pre- and post-exercise that assessed mood, body satisfaction, duration and intensity of exercise, as well as surveys every evening that assessed engagement in body checking behaviours. Linear and generalized hierarchical linear models were used and all models controlled for relevant demographic and mental health variables. Results revealed that engaging in exercise to avoid negative affect, control weight, improve mood, change how one feels about their body, or follow rules/training expectations, were more strongly endorsed by those with DE relative to without, and by those with greater DE-related concerns relative to those with fewer. Mood and body satisfaction increased for both those with and without DE from pre- to post-exercise, however, those with recent DE experienced smaller mood benefits whereas there was no moderating effect for body satisfaction. Finally, level of exercise was not related to same-day body checking behaviours. Assessing motivations for exercise appears to be clinically relevant for those with DE as exercising to change perceptions of one's body, avoid distress, and follow rigid expectations may confer risk for exercise to intensify to become disordered. Exercise may be a helpful adjunct treatment to support mood and body satisfaction among those with recent DE, however, the benefits to mood appear to be small. Finally, exercise engagement (no/minimal, light or moderate/vigorous) does not appear to confer risks for increasing same-day body checking behaviours among those with recent DE. Results from the current study inform theoretical understandings of exercise experiences among those with recent DE, along with clinical considerations. Future research would benefit from using more clinically extreme DE groups to substantiate the current results and examining the impacts of different types and formats of exercise on such outcomes.

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Dedication

This dissertation project is dedicated to anyone who has struggled with their mental health in any way. Our mental health system is fraught with barriers in terms of access, navigation, and efficiency. It is my hope that this dissertation, along with the research component of my career, will help to inform best practices for those with mental health challenges and/or who engage in disordered eating. Furthermore, it is my aim that the results from my dissertation will be used to help care providers consider appropriate recommendations around exercise for those with experiences of disordered eating. The recovery from disordered eating is often a lifelong journey and knowing how exercise may be used as a safe tool for those striving for recovery, is critical.

Chapter 1 - Background and Context

Disordered eating is a phrase that refers to maladaptive eating behaviours such as restricted eating (i.e., severely limiting the number of calories consumed to change one's shape), extreme compensatory behaviours (e.g., vomiting, excessive exercise, laxative/diuretic use to counteract caloric consumption), and binge eating (i.e., eating an objectively large amount of food in a manner that feels out of control), at a frequency or severity that does not meet full diagnostic criteria for a clinical Eating Disorder (Pereira & Alvarenga, 2007; Perryman et al., 2018). Estimates suggest that between 10-44% of young adults have engaged in one or more disordered eating (DE) behaviours in their lifetime, and that the prevalence of DE is increasing (Eisenberg et al., 2011; Galmiche et al., 2019; Luce et al., 2008; Prouty et al., 2002; Tavolacci et al., 2015). Engagement in DE is associated with a range of mental health concerns including depression, anxiety, Obsessive Compulsive Disorder, suicide, and substance abuse difficulties, as well as severe physical health problems including cardiovascular, gastrointestinal, and endocrine complications (Ball & Lee, 2000; Rome & Ammerman, 2003; Touchette et al., 2011; Wolff et al., 2000). Additionally, engaging in DE is a robust risk factor for the escalation of such behaviours to meet criteria for a clinical Eating Disorder, which carry the highest mortality and morbidity rates, and the lowest recovery rate, of any other mental health disorder (American Psychological Association [APA], 2022; Hilbert et al., 2014). Many people with Eating Disorders continue to struggle with their mental health and psychosocial wellbeing, and frequently re-access healthcare, for years after their diagnosis (Brunet et al., 2021). As such, identifying interventions that address DE before it escalates to clinical levels is a critical research priority.

Psychotherapy, and specifically Cognitive Behavioural Therapy, is considered the first-line treatment for most Eating Disorders (Costandache et al., 2023). While there are some publicly funded inpatient and outpatient Eating Disorder psychotherapy treatment programs in Canada, subclinical DE rarely qualifies for these programs: privately paid psychotherapy is often the primary treatment option for those who are struggling with DE (Fairburn et al., 2003; Kass et al., 2013; Stone et al., 2021). Unfortunately, private therapy is unaffordable and/or inaccessible to many Canadians (Moroz et al., 2020). Given the risks associated with DE engagement, and the barriers around accessing therapy for DE, accessible, adjunct treatments (i.e., a complementary treatment or strategy that aims to bolster the outcomes of the primary treatment) and therapeutic recommendations that address DE are needed (Brunet et al., 2021; Monteleone & Brambilla, 2015). One such recommendation may be exercise. Exercise is a commonly recommended adjunct intervention for various mental health challenges as engagement in exercise has well supported psychological benefits including reductions in anxiety, depression, and reactivity to stress, along with increases in positive mood, perceived self-efficacy and self-esteem (Carraça et al., 2021; Cekin, 2015; Rebar et al., 2015).

Although the presence eating pathology — defined as engagement in subclinical DE *or* having a diagnosed clinical Eating Disorder for the purposes of this dissertation) — often co-occurs with mood, anxiety, and self-esteem challenges (Ball & Lee, 2000; Monteleone & Brambilla, 2015; Touchette et al., 2011), which can improve via exercise engagement (Carraça et al., 2021; Cekin, 2015; Rebar et al., 2015), the helpfulness of exercise for those with eating pathology is mixed. Specifically, research suggests that people with clinical Eating Disorders often engage in excessive amounts of exercise and can experience distress, anxiety, guilt, intrusive thoughts, and/or obsessions and compulsions when engaging in exercise (Godier &

Park, 2015; Kolnes, 2016; Tobin et al., 1992). Further, research indicates that engaging in exercise can inhibit recovery among Eating Disorder patients as it may function to perpetuate, and in some cases even worsen, compulsive efforts at weight management (Godier & Park, 2015; Kolnes, 2016; Tobin et al., 1992). Conversely, a systematic review and a meta-analysis concluded that exercise can be physically and psychologically beneficial for people with Eating Disorders as long as their nutritional needs are being met, evidence-based exercise guidelines are followed, patients' engagement in exercise is closely monitored, a multidisciplinary team is involved in care, along with a number of other recommendations that may be difficult for clinicians and patients to attain or adhere to (see Cook et al., 2016; Ng et al., 2013). Unfortunately, limited research exists on the impacts of exercise on those with subclinical DE, precluding knowledge if exercise may be helpful or harmful among this subpopulation. Further, it is unknown if the exercise recommendations created for those with clinical Eating Disorders (i.e., Cook et al., 2016; Ng et al., 2013) are generalizable or necessary for those with DE.

The impact of exercise on those with eating pathology may also differ depending on the *type* of eating pathology symptoms that are present. Consequently, it may be that recommendations around exercise should differ across eating pathology symptom presentations and diagnoses. For example, research indicates that disordered exercise is most prevalent among those with Anorexia Nervosa - Restricting subtype (80%), followed by Binge/Purge subtype (43.3%) and Bulimia Nervosa (39.3%), indicating that vulnerability to disordered exercise, and thus its negative impacts, differs across diagnostic groups (Dalle Grave et al., 2008). These high prevalence rates may be because those with Anorexia Nervosa have an intense fear of weight gain and engage in behaviours to lose weight, such as disordered exercise (APA, 2022), while those with Bulimia Nervosa often engage in exercise to burn off the caloric surplus they accrue

during binge episodes, and report associated anxiety (Davis et al., 1997; Tobin et al., 1992). However, Binge Eating Disorder is not typically characterized by an overvaluation of weight and shape (APA, 2022). As such, those who have a fear of weight gain or overvalue weight/shape (e.g., those with Anorexia or Bulimia Nervosa) may be at the highest risk for experiencing maladaptive engagement and experiences around exercise, while those who place less value on weight (e.g., those with Binge Eating Disorder) may be at lower risk. Additional research is needed to investigate the exercise experiences across eating pathology diagnoses and symptoms presentations to understand if, and how, exercise recommendations should differ depending on the core features of the eating pathology.

Given the mixed evidence regarding the helpfulness of exercise for those with eating pathology, potential difficulties for patients in meeting clinical guidelines that may help ensure exercise is engaged in in a safe manner, and lack of research investigating exercise experiences across eating pathology presentations, many clinicians recommend abstinence from exercise for those experiencing or recovering from an Eating Disorder out of concern for the impacts it may have on such individuals (Brunet et al., 2021). Moreover, there is very little research examining the impacts and experiences of exercise among those with subclinical DE. Given the growing prevalence of DE globally (Galmiche et al., 2019), and the barriers to relevant treatment (Moroz et al., 2020), research is urgently needed to clarify if exercise may be used as a helpful mental health promotion strategy and adjunct treatment for those with DE. Thus, the overarching objective of this study is to better understand the experiences of exercise engagement for those who engage in DE, inform the ways in which exercise may be helpful or harmful among this subpopulation, and in turn, illuminate relevant considerations for exercise among this subpopulation.

1.1 Disordered Exercise and Construct Limitations

While some research suggests that exercise may be appropriate and helpful for those with Eating Disorders for increasing physical strength, quality of life, and cardiovascular health, and decreasing body dissatisfaction, other research suggests that exercise can escalate to excessive or disordered levels and interfere with recovery (Cook et al., 2016; Godier & Park, 2015; Kolnes, 2016; Ng et al., 2013). Construct validity issues around what is considered excessive/disordered exercise appears to be a significant contributor to these mixed results. Specifically, although there is consensus that excessive or disordered exercise is maladaptive and should be avoided (American Psychological Association [APA], 2021), definitions and cut-offs of what is considered 'excessive/disordered' vary widely. Therefore, recommendations around monitoring and targeting exercise that becomes excessive/disordered exercise is often ambiguous and unhelpful, as clinicians and patients are unsure of what constitutes excessive/disordered exercise and in what amounts or circumstances exercise is safe for those with eating pathology.

While some studies have used quantitative benchmarks to operationalize disordered exercise (e.g., frequency, intensity, or duration of exercise), other studies have used qualitative features (e.g., distress, compulsiveness), or a mix of both quantitative and qualitative features (e.g., frequency of exercise and the associated emotional experience; Szabo et al., 2015; Trott et al., 2021). For example, a number of terms are used in the literature when investigating excessive/disordered exercise[1,2] including excessive exercise, exercise addiction/dependence, compulsive exercise, obligatory exercise, exercise abuse, and problematic exercise; these terms

[1] At this time, there is no agreed upon definition of disordered exercise. For the purposes of this study, disordered exercise will hereby be used as a catch-all term to describe exercise that may be considered maladaptive, which includes both quantitative components (i.e., duration, intensity and/or frequency) and/or qualitative components (i.e., emotions, psychological experiences) of exercise.

[2] Please note that disordered exercise will be typed out in full, while the acronym 'DE' will continue to be used to denote subclinical 'disordered eating', throughout the current study.

encompass several operationalizations of disordered exercise including quantitative aspects, qualitative aspects, or a mix of both (see Szabo et al., 2015; Trott et al., 2021 for reviews). The current and previous versions of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; APA, 2013; DSM-5-TR; APA, 2022) refer to "excessive exercise" as exercise that is engaged in as an inappropriate compensatory behaviour "… in an attempt to prevent weight gain" in the context of a clinical Eating Disorder, including Anorexia Nervosa (restricting subtype) and Bulimia Nervosa (APA, 2022), however, it remains unclear what constitutes "excessive." While the DSM-5 (APA, 2013) did not provide a definition of what is considered "excessive" for exercise, the DSM-5-TR (APA, 2022) defined exercise as "excessive*"* when it "…significantly interferes with important activities, when it occurs at inappropriate times or in inappropriate settings, or when the individual continues to exercise despite injury or other medical complications". However, there continues to be confusion among researchers about this operationalization, as the interpretations of these factors can vary greatly depending on the age, gender, physical ability, and health status of a given individual, as well as their involvement in competitive athletics (Bardone-cone et al., 2017; Martenstyn et al., 2022). In sum, variability in the operationalization of disordered exercise has made it difficult for researchers to reach consensus around the impacts of exercise engagement for those with eating pathology, as the distinction between healthy versus disordered exercise remains ambiguous.

While directly examining the impacts of disordered exercise would be an ideal method of distinguishing and defining harmful exercise experiences for those with DE, the construct limitations associated with disordered exercise make this difficult. One way that researchers have attempted to investigate exercise experience among those with eating pathology while circumventing this challenge, is by examining differences in aspects of exercise *between* those

with and without eating pathology, rather than investigating aspects of exercise *among* those who purportedly engage in excessive/disordered exercise. Comparing exercise experiences between those with and without eating pathology illuminates how experiences may differ for those with eating pathology. A meta-analysis found that those with eating pathology are at a 3.5 times greater risk for engaging in disordered exercise (define as scoring above the original authors' cut off of any compulsive exercise, disordered compulsive exercise, disordered exercise, or exercise addiction questionnaire) relative to those without eating pathology (Trott et al., 2021), supporting that differences in exercise experiences like differ between those with and without eating pathology. Additional studies further substantiate that disordered exercise is more prevalent among those with eating pathology relative to those without (Bratland et al., 2011; Dalle Grave et al., 2008; Trott et al., 2020). Taken together, the results indicate that those with eating pathology are more prone to engaging in maladaptive exercise and thus, that this subpopulation likely has different exercise experiences on average, relative to those without eating pathology. Research is needed to better understand the circumstances that may lead to exercise becoming a maladaptive experience for those with eating pathology.

1.2 Characteristics of Disordered Exercise

Researchers have also compared exercise experiences between those with and without eating pathology to further understand, quantify, and define what constitutes disordered exercise. For example, researchers have aimed to uncover the quantitative benchmarks of excessive exercise (i.e., duration, frequency, intensity) by comparing exercise patterns between these two groups. While some studies found that those with Eating Disorders engage in a higher average weekly duration of engagement in moderate-to-vigorous exercise relative to healthy controls (Bratland-Sanda et al., 2011; El Ghoch et al., 2013), other studies did not replicate this finding

nor find a difference in number of minutes spent exercising each day between the two groups (Boyd et al., 2007; Zipfel et al., 2013). Another study examined differences in exercise intensity between those with and without Eating Disorders (Bratland-Sanda et al., 2011). The researchers found that number of minutes spent on vigorous (but not moderate) exercise shared a positive association with DE symptom scores and exercise dependence scores among those with Eating Disorders, but shared a negative association with DE symptom scores, and no association with exercise dependence scores, among those without Eating Disorders (Bratland-Sanda et al., 2011). The study also found that weekly amount of vigorous exercise explained 78% of the variance in exercise dependence scores among those with an Eating Disorder. The researchers concluded that intensity of exercise, more so than duration, is important to capture in the context of examining disordered exercise, as vigorous exercise may be feature of disordered exercise (Bratland-Sanda et al., 2011). While comparing quantitative differences in exercise between those with and without eating pathology has illuminated behavioural aspects that may be relevant to disordered exercise, there are no established quantitative criteria to distinguish disordered and harmful amounts from healthy amounts of exercise. This line of research remains limited as appropriate versus inappropriate durations, intensities, or frequencies of exercise is largely dependent on the demographic characteristics of the individual (Bardone-cone et al., 2017; Martenstyn et al., 2022).

Given the limitations of exclusively focusing on behavioural aspects of disordered exercise, there has been a call in the literature to examine the qualitative features of disordered exercise engagement such as attitudes towards exercise (e.g., preoccupation, obsessions), motivations for engaging in exercise, perceived control over exercise (e.g., loss of control, rigidity), the consequences of engaging in exercise (e.g., changes in mood, exhaustion), and the

emotional consequences of *not* engaging in exercise (e.g., guilt, distress; Adkins & Keel, 2005; Godoy-Izquierdo et al., 2021; Taranis et al., 2011). Research aiming to identify qualitative features of disordered exercise have purported that such exercise is characterized by rigidity, compulsiveness, distress, and guilt, and that the exercise is motivated by a desire to change one's weight or shape (Martenstyn et al., 2022; Mond et al., 2008; Mond et al., 2006). This line of research helps identify qualitative experiences of exercise that may be more prevalent among those with eating pathology, and may have negative consequences. For example, a systematic review concluded that those with eating pathology are at higher risk for disordered exercise given the high value on weight and shape among this subpopulation, which in turn, can be reinforced by the desired weight changes and affect regulation that are often incurred through exercise (Meyer et al., 2011). The review hypothesized that compulsivity, perfectionism, and rigidity may function to maintain ongoing engagement of disordered exercise, as these characteristics contribute to rigid expectations for one's exercise engagement and a low tolerance for perceived failure in meeting exercise goals. The review also suggests that overvaluation of weight and shape, affect regulation, motivation to change one's weight, compulsivity, and rigidity may be qualitative experiences that surround exercise for those with eating pathology. Another qualitative feature of exercise that may be more prevalent for those with eating pathology is distress. Distress in the context of body or weight preoccupation is listed as a diagnostic criterion for Anorexia and Bulimia Nervosa, while distress in the context of a binge episode is listed as a criterion for Binge Eating Disorder (APA, 2022). Thus, distress in the context of exercise engagement may be more prevalent among those with eating pathology relative to those without, as disordered exercise often occurs within these disorders. Indeed, research indicates that women with Eating Disorders often report that exercise elicits negative

affective experiences and compulsivity, indicating that negative affect and distress may be a feature of disordered exercise (Cook et al., 2016; Godier & Park, 2015; Meyer et al., 2011).

Although considering the qualitative experience of exercise is an important advancement in the field, the lack of a consistent quantitative or qualitative operationalizations of disordered exercise has impeded a clear theoretical understanding of this behaviour and has made it difficult to investigate its consequences and make appropriate recommendations. While quantitative experiences of exercise (i.e., duration and intensity) can vary based on demographic characteristics of the individual, further examination of qualitative experiences of exercise for those with eating pathology appears to be a promising avenue to better understand the impacts of exercise among this subpopulation. Specifically, comparing the psychological and behavioural consequences of exercise between those with and without eating pathology can illuminate how exercise may be helpful or harmful to this subpopulation while circumventing the construct limitations associated with trying to directly examine the consequences of disordered exercise itself.

1.3 Motivations for Disordered Exercise

While research has identified correlates of disordered exercise and aimed to explain how and why those with eating pathology are more susceptible to engagement in disordered exercise (e.g., Meyer et al., 2011), links between the presence of eating pathology and disordered exercise are still not well understood. For example, while research suggests that disordered exercise is more prevalent among those with eating pathology relative to those without (Bratland et al., 2011; Dalle Grave et al., 2008; Trott et al., 2020), research also suggests that engaging in exercise may be a negative experience in those with eating pathology (Godoy-Izquierdo et al., 2021), and therefore, may be avoided. Those with eating pathology often experience

overvaluation and distorted perceptions of one's weight and shape, maladaptive cognitions and preoccupations about one's body, fear of weight gain, guilt about eating, and/or body dissatisfaction (APA, 2013; Brechan et al., 2015). Exercising often requires individuals to confront and increase their awareness of their bodies via mirrors in exercise facilities, form fitting athletic clothing, self-weighing or body measuring to check fitness progress, feedback from instructors on one's body position or movement technique, monitoring or comparing one's weight or shape to others, etc. Therefore, it seems likely that enhanced focus on one's body during exercise would exacerbate body preoccupation, maladaptive cognitions, and negative emotions for those with eating pathology. Thus, it follows that those with eating pathology may avoid or be disincentivized to engage in exercise, given the negative psychological experiences that it may elicit. However, given the higher prevalence of disordered exercise among those with eating pathology (relative to those without), it does not appear that those with eating pathology avoid exercise despite the negative impacts it may incur. One explanation for the greater prevalence of disordered exercise among those with eating pathology (Bratland et al., 2011; Dalle Grave et al., 2008; Trott et al., 2020), may be related to the reasons or motivations for engaging in exercise.

Taranis and colleagues (2011) noted that although past research has assumed that the primary motivator for those with eating pathology to engage in exercise was for weight or shape control (e.g., Fairburn et al., 2003), there appear to be several motivators for exercise among this subpopulation, many of which may help to explain the high prevalence of disordered exercise among this group (e.g., Mond & Calogero, 2009; Naylor et al., 2011; Schlegl et al., 2018). For example, because exercise is an avenue for changing one's weight or shape, those who are preoccupied or dissatisfied with their weight or shape (e.g., those with eating pathology) may be

more incentivized to engage exercise to address their weight concerns, even if exercising becomes a distressing experience (Meyer et al., 2011; Mond & Calogero, 2009). As such, although exercising may elicit negative psychological experiences among those with eating pathology, this subpopulation may continue to engage in disordered exercise as it serves a highly valued function of weight management. Another explanation for the higher prevalence rate of disordered exercise among those with eating pathology may be related to the aversive consequences of *not* engaging in exercise. Research suggests that people with clinical Eating Disorders experience guilt when they miss a workout and a high level of preoccupation with burning off a certain number of calories to maintain their weight, while those without eating pathology do not report these negative psychological experiences (Bardone-cone et al., 2017; Mond & Calogero, 2009). Thus, while exercising may elicit a negative psychological experience among those with eating pathology, *not* exercising may carry even more salient negative emotional consequences. Therefore, those with eating pathology may be motivated to engage in exercise to avoid the intense emotional consequences related to missing an opportunity to burn calories.

Given the construct limitations associated with disordered exercise, researchers have compared exercise motivations between those with and without eating pathology, illuminating motivations for exercise motivations that are unique to those with eating pathology (Bratland-Sanda et al., 2011; Keyes et al., 2015; Mond & Calogero, 2009). Research found that exercising for health reasons was less important to those with an Eating Disorder relative to those who without (Bratland-Sanda et al., 2010; Keyes et al., 2015; Schlegl et al., 2018). Research also found that exercising for the purpose of avoiding guilt was more salient among those with an Eating Disorder relative to those without, suggesting that avoidance of distress and guilt, and

rigid expectations or rules for one's exercise engagement, may be primary motivators for exercise among those with Eating Disorders (Mond & Calogero, 2009). Contrary to what may be expected, one study found that exercising for weight loss or weight control is relevant to both those with and without an Eating Disorder (Mond & Calogero, 2009). However, other studies have not replicated this result and found that motivations for exercise related to weight loss were more relevant to those with eating pathology (Boyd et al., 2007; Furnham et al., 2002). Moreover, although the DSM-5-TR defines excessive exercise as exercise that interferes with important obligations or occurs despite injury or illness, researchers did *not* find differences in the prevalence of missing social obligations due to exercise, or continuing to exercise when sick or injured, between those with and without an Eating Disorder (Mond & Calogero, 2009). This suggests that motivations for exercise, more so than the context that surrounds rigid engagement in exercise, may be an important avenue in exploring and understanding the unique experiences of exercise for those with eating pathology.

The Compulsive Exercise Test (CET) is widely used tool that assesses different motivations for engaging in disordered exercise (Taranis et al., 2011). The scale is comprised of five motivations for disordered exercise including: an avoidance/rule-driven behaviour subscale which captures motives to engage in exercise to avoid the negative affect associated with missing a workout and to follow one's expectations for exercise; a weight control subscale which captures motives related to weight control practices and reasons; a mood improvement subscale which captures motives related to positive reinforcement of improving mood; a lack of exercise enjoyment subscale which captures how much one dislikes exercising and feels as if it's a chore; and an exercise rigidity subscale which captures the degree of rigidity of one's daily routine and how structured and/or repetitive one's exercise routine is. In contrast to past research (i.e., Boyd

et al., 2007; Furnham et al., 2002; Mond & Calogero, 2009), Taranis and colleagues (2011) found that the weight control items, followed by avoidance/rule-driven behaviours, shared the strongest associations with the presence of eating pathology, while the mood improvement, lack of exercise enjoyment, and exercise rigidity subscales did not share an association with eating pathology. The researchers noted that while those without eating pathology appeared to engage in exercise to improve their mood, those with eating pathology appeared to engage in exercise to avoid the negative affective experiences associated with not exercising, supporting this as a unique characteristic of exercise among those with eating pathology. In partial support of Taranis and colleagues' (2011) findings, another study using the CET found that those with an Eating Disorder had stronger endorsement of all of the CET subscales relative to those without, with the exception of the mood-improvement subscale which did not significantly differ between the two groups (Meyer et al., 2016). However, two other studies using the CET both found that those with an Eating Disorder had higher endorsement on all of the subscales relative to those without, with the exception of the lack of exercise enjoyment subscale which did not significantly differ between the groups (Naylor et al., 2011; Schlegl et al., 2018). Although results pertaining to the CET are mixed, it appears that avoidance of negative affective states, and weight control motives, are primary and unique drivers for those with eating pathology to engage in exercise.

Another assessment tool, called the Reasons for Exercise Inventory ([REI]; Silberstein et al., 1988), assesses motivations for exercise engagement (not necessarily disordered exercise engagement) using seven subscales, including weight control, fitness, health, body tone, physical attractiveness, mood-enhancement, and enjoyment. One study found that endorsements of the weight control, attractiveness, body tone and mood-enhancement motivation subscales were stronger among those with an Eating Disorder relative to those without (Mond & Calogero,

2009), while another study found that those with an Eating Disorder had stronger endorsement of the mood-enhancement motive for exercise and weaker endorsement of fitness- and health-related motives, relative to those without (Bratland-Sanda et al., 2010). Another study conducted a factor analysis on the REI and found four underlying factors (i.e., fitness/health management, appearance/weight management, stress/mood management, and socializing): only the appearance/weight management factor subscale was associated with total DE symptom scores among an undergraduate sample (Cash et al., 1994). Together, the research suggests that those with eating pathology may engage in exercise to avoid negative affective states and control weight and appearance, while those without eating pathology may engage in exercise for health and fitness purposes. This research helps illuminate why those with eating pathology continue to engage in exercise, even if it results in negative affective experiences.

Research has also begun to examine if there are differences in exercise motivations between different types of Eating Disorder diagnoses. One study, using the Exercise Motivations Inventory (14 subscales of various exercise motivations) found that those with Anorexia Nervosa had stronger endorsement of exercising to manage stress relative to those without eating pathology, and that those with Anorexia or Bulimia Nervosa had stronger endorsement of exercising for enjoyment, challenge, social recognition and weight management, relative to those without eating pathology (Schlegl et al., 2018). Interestingly, the researchers also found that those with Bulimia Nervosa had stronger endorsement of exercising for appearance reasons relative to those with Anorexia Nervosa or those without eating pathology (Schlegl et al., 2018). Another study found that those with Bulimia Nervosa and an Eating Disorder Not Otherwise Specified did not differ from each other on any of the CET subscales, but that both groups had stronger endorsement across all of the CET subscales (with the exception of exercise rigidity)

relative to those with Anorexia Nervosa (Sauchelli et al., 2016). In contrast, other studies did not find significant differences between Eating Disorder diagnostic groups on motivations and beliefs about exercise (Calogero & Pedrotty, 2004; Danielsen et al., 2016). While it does not appear that there are clear patterns and systematic differences in motivations between eating disorder diagnoses, the results suggests that differences in exercise motivations between various constellations of eating pathology symptoms do indeed exist. Additional research is needed to clarify these results to further understand these differences, and in turn, how it may impact corresponding exercise recommendations across eating pathology presentations.

There is also very little research investigating differences in motivations for exercise between those with and without subclinical DE, between subclinical DE symptom presentations, or across the spectrum of DE symptom severities. In terms of severity, it may be that exercise experiences and motivations are relatively similar between those without DE and those with DE when the DE is less severe, and thus, exercise is safe and effective for those with mild DE. Conversely, it may be that exercise experiences and motivations differ between those with mild DE and those without, as those with *any* DE likely experience elevated body preoccupation and dissatisfaction and may be at-risk for exercise to be harmful. These gaps in the research have impeded knowledge about if, and how, exercise may be helpful or harmful across different severities of DE. More research is needed to make corresponding recommendations, particularly within the realm of subclinical DE, given the high prevalence of these behaviours.

1.4 Psychological Consequences of Disordered Exercise

Although some people with Eating Disorders report negative psychological experiences (e.g., guilt, distress, compulsivity) when engaging and/or not engaging in exercise (Brunet et al., 2021), research in this area is generally limited to clinical samples that employ cross-sectional

and retrospective reporting methods. Retrospective reporting compromises ecological validity of findings as it does not capture the dynamic processes of emotional and psychological experiences as they occur in real-time and is subject to biases (Mill et al., 2016). This area of research has also been particularly limited by the lack of consensus surrounding the operationalization of disordered exercise, as researchers have struggled to examine the psychological consequences of an imprecise construct. However, these limitations may be addressed by comparing psychological consequences of exercise between those with and without eating pathology using intensive sampling techniques (i.e., administering one or more assessments within a day).

Based on operant conditioning principles of behaviour (Staddon & Cerutti, 2003), if a behaviour is followed by a desirable consequence (e.g., increase in mood, tangible reward, avoidance of something aversive, etc.) the behaviour will be maintained or increase, whereas if a behaviour is followed by an aversive consequence (e.g., a tangible punishment, a decrease in happiness, taking away something desirable, etc.), the behaviour will decrease or be extinguished. Investigating the dynamic, psychological consequences of disordered exercise as they occur in real-time using intensive sampling methods can help to clarify the helpful or harmful impacts that it has on individuals and the factors that may maintain this behaviour. One robust correlate of exercise, which may serve to shape engagement in exercise, is mood regulation (Boyd et al., 2007; Furnham et al., 2002; Meyer et al., 2011; Mond & Calogero, 2009). In eating pathology research, the mood regulation model of eating pathology seeks to explain why individuals continue to engage in DE (which would extend to disordered exercise, as it is considered a compensatory DE behaviour), despite the aversive physical consequences of DE engagement. Specifically, the mood regulation model of DE purports that negative affect

often serves as an important trigger for DE, and that negative affect is temporarily reduced after a DE episode as DE may help individuals cope with negative affect by providing comfort or escape from their negative internal state, thereby negatively reinforcing engagement (Hawkins & Clement, 1984; Heatherton & Baumeister, 1991). This is in concordance with Meyer and colleagues' (2011) hypothesis that compulsive exercise is positively reinforced by desired affect regulation, along with weight changes. However, no known research has explicitly tested the mood regulation model within the context of exercise among those with eating pathology using an intensive sampling approach, limiting our understanding of the impacts of exercise on mood among this subpopulation.

Although negative affect appears to decrease and positive affect appears to increase following exercise among non-ED clinical samples and healthy controls, it is unknown if this result generalizes to those with eating pathology (Chan et al., 2019). Directly testing the consequences of exercise on mood using an intensive sampling approach is particularly important for those with eating pathology as this population tends to experience diminished interoceptive awareness of bodily cues, diminished awareness of emotional states, denial of some mental health symptoms, and consequently, may be less reliable in reporting (particularly retrospectively) their mood (Bernatova & Svetlak, 2017; Konstantakopoulos et al., 2011). Based on a robust body of research supporting the benefits of exercise on mood among those without eating pathology (Chan et al., 2019), but the prevalence of negative psychological experiences from exercise among those with eating pathology (Brunet et al., 2021; Meyer et al., 2011), it may be that exercise provides improvements in mood for both those with and without eating pathology, but that those with eating pathology experience smaller improvements due to their diminished interoceptive awareness, or, the neutralization of these improvements due to the

negative affective experiences that concurrently occur (e.g., anxiety, distress, self-criticism). One study found that exercise was associated with positive affect for those high in maladaptive eating attitudes, but negative affect for those low in maladaptive eating attitudes, indicating that severity of eating pathology cognitions and attitudes may also hold a role in the impacts of exercise on mood (Thome & Espelage, 2004). Similarly, it may be that although exercise elicits negative psychological experiences for those with eating pathology (e.g., intrusive and repetitive thoughts; Brunet et al., 2021), it may also improve one's general mood as it serves the goal of addressing/changing one's overvalued weight, resulting in an overall improvement in mood, albeit minor. Investigating how mood changes from pre- to post-exercise would illuminate this dynamic process, how it may operate to reinforce engagement in exercise, and inform if exercise is helpful or harmful to mood among those with subclinical DE.

In addition to mood, the impacts of exercise on body satisfaction are not well understood among those with eating pathology. Body satisfaction is a particularly relevant correlate to examine in the context of exercise among this subpopulation, as those with eating pathology endorse more body dissatisfaction, along with more weight and shape-related motivations for engaging in exercise, relative to those without eating pathology (Meyer et al., 2016; Naylor et al., 2011; Schlegl et al., 2018). Although exercise has been associated with increases in self-esteem, body image, and body satisfaction among non-clinical samples and healthy controls (Campbell & Hausenblas, 2009; Carraça et al., 2021; Cekin, 2015; LePage & Crowther, 2010), the centrality of body dissatisfaction within eating pathology suggests that exercise may have a different impact on this subpopulation (Brunet et al., 2021). Those with eating pathology may be at risk to feel even more dissatisfied with their bodies if their desired weight-related outcome is not achieved through exercise. Indeed, a cross-sectional study found that the positive association

between a single bout of moderate-vigorous exercise and improved body image among university women, which was sustained 20 minutes later, but that this association was mediated by perceived self-fatness - a common cognition among those with eating pathology (Salci & Martin Ginis, 2017). This result suggests that how one perceives their body may explain the impact of exercise on body image (Salci & Martin Ginis, 2017). In support of this, one review found positive associations between engagement in disordered exercise and body dissatisfaction among those with Eating Disorders (Meyer et al., 2011), indicating that exercise may negatively impact body satisfaction among those who have negative cognitions and perceptions of their bodies. However, another review found that closely monitored exercise (i.e., a graded exercise program is followed, nutritional needs are met, a multi-disciplinary team is involved, exercise-related psychopathology is screened for, etc.) can help to reduce body dissatisfaction among those with Eating Disorders (Cook et al., 2016). Understanding how exercise impacts body satisfaction among those with subclinical DE relative to those without, particularly when the guidelines put forth by Cook and colleagues (2016) are not met (as such recommendations may be inaccessible to individuals), would help to clarify if exercise is helpful or harmful for body satisfaction for this population. Further, using intensive sampling techniques that capture this dynamic process as it unfolds would enhance the validity of such findings.

1.5 Behavioural Consequences of Disordered Exercise

In addition to uncovering the psychological consequences of disordered exercise, it is also important to investigate the behavioural consequences of exercise. Given that central characteristics of disordered exercise are purported to be compulsiveness, obsessiveness, and rigidity (Meyer et al., 2011; Taranis et al., 2011), and that some women with Eating Disorders report increased compulsiveness from exercise engagement (Brunet et al., 2021), it may be that

those with subclinical DE experience an increase in compulsive behaviours after exercise. One compulsive behaviour that is common among women with Eating Disorders is body checking (APA, 2022). Body checking is defined as repeated and compulsive evaluation of one's body and can occur among those with Body Dysmorphic Disorder, Eating Disorders, illness-anxiety, those who engage in DE, and even among some healthy women (Haase et al., 2011; Mitchison et al., 2013; Shafran et al., 2004). Common body checking strategies include self-weighing, mirror gazing, pinching or measuring body parts, assessing the fit of one's clothing, and comparing one's weight or shape to others as a way of evaluating one's appearance (Opladen et al., 2022). Cognitive behavioural models of eating pathology purport that body checking can contribute to the onset, maintenance, and greater severity of eating pathology as it serves to highlight and increase focus on perceived body imperfections and is associated with same-day negative affect and body dissatisfaction (Haase et al., 2011; Mountford et al., 2006; Opladen et al., 2022; Stefano et al., 201; Zaitsoff et al., 2020). Interestingly, one study observed high frequencies of body checking (i.e., average of 27 episodes per day) in a non-clinical sample who had high levels of body dissatisfaction, but did not necessarily engage in DE, highlighting the pervasiveness of these behaviours (Stefano et al., 2016). Given the pervasiveness of body checking among clinical and non-clinical samples, its role in the onset and perpetuation of eating pathology symptoms, and that exercise it appears to be a critical construct to evaluate in

Body checking in the context of exercise for those with DE is particularly relevant: when exercise is engaged in for the purpose of changing one's weight, shape, or musculature, those with DE may engage in compulsive body checking behaviours to assess if the exercise period has provided them with their desired weight-related outcomes and/or to evaluate their progress (Zheng et al., 2021). Despite this, our understanding of the impacts of exercise on body checking

is limited as only one known study has investigated this association (Zheng et al., 2021). The study found that body checking was higher among males with muscle dysphoria relative to males without, and that engaging in higher frequencies, durations, and intensities of weight training exercise resulted in more body checking behaviours among those with dysmorphia but not among those without (Zheng et al., 2021). The preliminary evidence suggests that the level of vigor of exercise is important in the context of body checking as higher levels of exercise lead to more frequent body checking behaviours among those with muscle dysphoria, but not among those without dysphoria. The researchers theorized that higher intensities of exercise may be associated with greater expectations for how the period of exercise may immediately change one's weight or shape, and accordingly, may lead to more body-checking to evaluate such expectations (Zheng et al., 2021). The results indicate that lower intensities of exercise may not increase body checking among those with high body preoccupation and dysmorphia, while higher intensities may. Additional research is needed to replicate and extend these findings by comparing impacts of varying exercise intensities between those with and without DE, rather than exclusively between those with and without muscle dysmorphia. Understanding if and how exercise impacts body checking, and thus risk for DE symptoms, is critical to understanding how exercise, and different exercise intensities, may either be helpful or harmful to those with eating pathology.

1.6 Limitations of the Literature

Although exercise is typically viewed as health-promoting behaviour, research also acknowledges the risks that exercise may pose for those with eating pathology due to its potential for abuse and over engagement (Cook et al., 2016; Ng et al., 2013; Viña et al., 2012). It remains unclear if, and under what circumstances, exercise may be an appropriate strategy for

those with subclinical DE. Unfortunately, despite the prevalence of disordered exercise (Dalle Grave et al., 2008; Davis et al., 1997; Trott et al., 2020), our understanding and operationalization of the construct remains unclear, limiting our ability to identify and directly examine the impacts of disordered exercise among those with DE. Moreover, this lack of consensus on operationalization has resulted in difficulties interpreting existing research, synthesizing results, and executing forthcoming disordered exercise research. An alternative approach, which can still inform exercise considerations among those with DE, is to compare experiences of exercise between those with and without eating pathology. Investigating differences in motivations for exercise between those with and without exercise may be a key frontier in understanding unique exercise experiences, and why it continues to occur even when it elicits negative affect, among this subpopulation. Understanding how motivations for exercise differ between those with and without eating pathology can in turn, may help differentiate healthy from disordered exercise in future research.

Next, while research has established psychological and personality correlates of disordered exercise (Meyer et al., 2011), there is less understanding about the direct psychological and behavioural impacts of exercise among those with subclinical DE. Specifically, we have limited knowledge of the ways in which exercise may be helpful or harmful among this population and the circumstances associated with such outcomes. Given the centrality of mood regulation and body dissatisfaction in eating pathology, research is needed to directly test the impacts of exercise on these relevant *psychological* factors for those with eating pathology. Likewise, while there is an association between disordered exercise and compulsivity (Meyer et al., 2011), there is limited research on how exercise, and different intensities of exercise, may be associated with compulsive behaviours such as body checking – a key factor in

the etiology and maintenance of eating pathology. Examining if vigor of exercise increases the likelihood and risk for engagement in body checking behaviours (e.g., self-weighing and measuring or pinching oneself) among those with DE, would illuminate the impacts of exercise on these relevant *behavioural* factors. Given that those with DE place a high value on weight and shape, and the utility of exercise in changing one's body, exercise is a vulnerable activity for those with eating pathology. We require a better understanding of its impacts on this subpopulation in order to safely harness the benefits it may offer, and protect against the negative consequences it may carry.

One final, overarching limitation of the current literature is the use of cross-sectional study designs and retrospective reporting. Limitations of retrospective reports, such as validity and reliability concerns, and a poor ability to examine dynamic processes, are well-documented (Ebner-Priemer et al., 2009; Hofer et al., 2002). Specific to this field, those with eating pathology experience diminished insight, as well as lower interoceptive and emotional awareness (Bernatova & Svetlak, 2017; Konstantakopoulos et al., 2011), relative to people without eating pathology, further limiting the validity and reliability of retrospective reporting methods in this area. Additionally, research suggests that engagement in exercise may be overreported by participants as it is seen as a socially desirable behaviour (Adams et al., 2005; Brenner & DeLamater, 2014). Intensive sampling methods, such as daily diary or ecological momentary assessments, can address many of these limitations by sampling the same participants multiple times within shorter time frames (e.g., one or more times a day). Intensive sampling allows researchers to collect ecologically valid data as participants go about their daily lives, increasing the validity, reliability, and granularity of the data, which is particularly important when investigating: 1) samples with recall difficulties, 2) behaviours that may be susceptible to social

desirability bias (i.e., exercise), and 3) dynamic psychological and behavioural phenomena at the day-level (e.g., same-day changes in mood). Despite the suitability of intensive sampling methods for those with eating pathology, and that some studies have harnessed these methods to examine phenomena surrounding engagement in other types of DE (e.g., changes in affect from pre- to post-binge episode; Haedt-Matt & Keel, 2011), research has yet to extend these methods to disordered exercise. Research that harnesses intensive sampling designs in this field would facilitate the investigation of motivations and consequences of exercise in real-time while limiting the threat of various biases by using shortly spaced within-person assessments. This study addresses each of these identified limitations by examining differences in **motivations** and **consequences** of exercise between those with and without eating pathology, using intensive sampling techniques, to enhance our understanding of the characteristics that motivate and maintain disordered exercise, and illuminate the benefits and risks that exercise may carry for those with eating pathology.

Chapter 2: Research Aims

2.1 Aim 1: Examine How DE Status and DE Concerns are Related to Motivations for Exercise

To further understand how motivations for exercise differ between those with and without DE, and if motivations differ across eating pathology symptom presentations, Aim 1 of this study examined if there are associations between: 1) DE status (i.e., those with and without a recent history of DE) and various motivations for exercise[3], and 2) three DE-related concerns (i.e., engagement in restrained eating, shape concerns, and concerns around eating) and various motivations for exercise. I had several hypotheses for Aim 1. First, research suggests that motivations pertaining to controlling one's weight, avoiding negative affect related to missing exercise (e.g., guilt), and following rules/rigid expectation related to exercise, may differentiate those with and without eating pathology (Meyer et al., 2016; Naylor et al., 2011; Schlegl et al., 2018; Taranis et al., 2011). As such, I hypothesized that those who have recently engaged in DE will have stronger endorsement of motivations for exercise relating to weight control (**Hypothesis 1a**), avoiding negative affect **(Hypothesis 1b**), and rule following (**Hypothesis 1c**), relative to those who have not recently engaged in DE. Given that mood improvement does not consistently differentiate those with and without eating pathology (Meyer et al., 2016; Naylor et al., 2011; Schlegl et al., 2018; Taranis et al., 2011), and the mixed results pertaining to body satisfaction among those with eating pathology (Cook et al., 2016; Meyer et al., 2011) in the

[3] The current study examined motivations and experiences pertaining to any sustained body movement. Research indicates there is a distinction between physical activity (i.e., unstructured and/or unplanned body movement; e.g., playing with kids) and exercise (i.e., structured and/or planned body movement with the objective of improving one's health or fitness; e.g., weight lifting [Dasso, 2019]). While a few periods of movement that were captured in the current study were likely unplanned (i.e., playing with kids) and thus may be best described as physical activity, majority of movement periods that were captured in the study were likely planned and thus, may be best described as exercise (i.e., yoga). Moreover, past research in this field has examined *exercise* in the context of being disordered, not physical activity. Therefore, for brevity and ease of reading, the term exercise will be used throughout the current study refer to past research, as well as to refer to any period of physical activity or exercise in the current study, whether it was planned or not. Limitations of combining periods of physical activity and exercise are discussed in the limitations section.

context of exercise, I did not have a hypotheses for mood regulation, building muscle, or feeling better about one's body.

Next, this study investigated if three continuous, DE-related concerns are associated with various motivations for exercise, including concerns around eating (e.g., preoccupation with eating, food or calories, eating in secret, guilt about eating), concerns about one's shape (e.g., preoccupation with shape and weight, dissatisfaction with shape, discomfort seeing own body, feeling fat), and engagement in restrained eating (e.g., restraint or avoidance of eating, following dietary rules, avoidance of food). Although no known research has investigated associations between motivations for exercise and these DE-related concerns, research has investigated differences in exercise motivations between different eating pathology symptom presentations (Sauchelli et al., 2016; Schlegl et al., 2018). Given that people engage in restrained eating do so with the specific goal of reducing their weight or changing their shape, and that those with shape concerns often report a desire to lose weight (APA, 2022; Vancampfort et al., 2015), I hypothesized that those with more restrained eating (**Hypothesis 1e)** and shape concerns (**Hypothesis 1f)** would more strongly endorse exercising for the purpose of weight control, relative to those with fewer restrained eating or shape concerns respectively. Moreover, given that people with shape concerns have a desire to lose weight, and therefore may feel guilty when they do not engage in goal-directed behaviour (e.g., exercise to lose weight), I also hypothesized that those with greater shape concerns would more strongly endorse exercising to avoid negative affect (**Hypothesis 1g**), relative to those with fewer shape concerns.

2.2 Aim 2: Compare Consequences of Exercise on Mood and Body Satisfaction in People With and Without Recent DE

To further understand the psychological consequences of disordered exercise, namely on mood and body satisfaction, Aim 2 of this study examined: 1a) if there are significant changes in mood from pre- to post-exercise and 1b) if these changes differ between those with and without recent DE, and 2a) if there are significant changes in body satisfaction from pre- to post-exercise and 2b) if these changes differ between those with and without recent DE. Research indicates that exercise may be beneficial in terms of mood for healthy controls and for those with Eating Disorders under certain circumstances (i.e., followed bv a multidisciplinary team, nutrition needs are met, following a graded exercise program, screened for exercise-related pathology, etc.), but may elicit negative affective experiences for others with eating pathology (Chan et al., 2019; Cook et al., 2016). Therefore, I hypothesized that mood would significantly increase from pre- to post-exercise (when controlling for DE status; **Hypothesis 2a**), but that those *without* recent DE will experience a greater increase in positive mood from pre- to post-exercise, relative to those with recent DE (**Hypothesis 2b**). Next, research suggests that exercise can improve body satisfaction for those without eating pathology, but has been found to both improve and decrease body satisfaction for those with eating pathology (Campbell & Hausenblas, 2009; Carraça et al., 2021; Cekin, 2015; LePage & Crowther, 2010). Therefore, I hypothesized that body satisfaction would increase from pre- to post-exercise (when controlling for DE status; **Hypotheses 2c**), but that those *without* recent DE will experience greater increases in body satisfaction relative to those with recent DE from pre- to post-exercise, relative to those with recent DE (**Hypothesis 2d**).

2.3 Aim 3: Examine How Exercise Intensity Relates to Same-Day Body Checking Behaviours in People With and Without DE

To extend past research conducted by Zheng and colleagues (2021) and to better understand the behavioural consequences of disordered exercise on body checking, Aim 3 of this study examined if there are 1a) significant associations between daily exercise levels (i.e., no/minimal, light, moderate-vigorous) and same-day body size checking behaviours (e.g., body pinching, mirror gazing) and 1b) if these associations differ depending on DE status, and 2) significant associations between daily exercise levels (i.e., no/minimal, light, moderate-vigorous) with same-day self-weighing, and 2b) if these associations differ depending on DE status. Based on the study conducted by Zheng and colleagues (2021), preliminary research indicates that there is a positive association between intensity of exercise and frequency of body checking as those who engage in more intense exercise may have greater expectations for a change in their bodies after exercise. Therefore, I hypothesized that there will be a stronger, positive, coupled association between engagement in moderate-vigorous exercise and same day body size checking behaviours (**Hypothesis 3a**) as well as self-weighing (**Hypothesis 3b**) among those who have recently engaged in DE, relative to those who haven't.

Chapter 3: Methods

The current study occurred in the context of a larger project that was being conducted in Dr. Sam Liu's Digital Health Lab at the University of Victoria, titled "*Assessing physical activity and motivation in wearable activity monitor users and former users*". The project received approval from the University of Victoria's Human Research Ethics Board (HREB #21-0404). The larger project aimed to examine differences in motivations for exercise between those who continue to use, or have discontinued use of, a wearable activity tracker (e.g., Apple watch, Fitbit) using a 14-day daily monitoring protocol. Participants received cash or bonus course credit for their participation (see compensation details in the Procedures section). Data collection launched in February 2022 and concluded in April 2023. The current study harnessed the infrastructure of the larger project: select measures and items were added to the larger project's protocol to address this study's research aims.

3.1 Participants

Participants in this study were students from the University of Victoria, as well as Canadian adults from the community. Eligibility requirements for participation were the following: aged 18 years old or older; currently use or have previously used a wearable activity tracker; speak and read English; live in Canada; own an iPhone/Android smartphone and willing to complete app-based surveys on a smartphone for the duration of the study. There were no exclusion criteria. Participants were recruited from the University of Victoria's student population via the University of Victoria's psychology study participation system (SONA), from across Canada via advertisements on various websites (e.g., craigslist, Reddit) and social media sites (e.g., Twitter, Instagram, Facebook), as well as through the REACH BC online platform which connects study volunteers with health studies. Advertisements were posted in social media

groups and pages that were relevant to disordered eating (e.g., disordered eating subReddit pages; National Eating Disorder Information Centre website) to ensure adequate sampling of participants with recent DE engagement for analyses.

3.2 Study Design and Power

The current study was comprised of an online baseline survey and a 14-day daily self-monitoring protocol that was administered through a smartphone app. The self-monitoring protocol consisted of one daily diary survey that was completed each evening by participants (i.e., a time-contingent survey), and surveys that were completed before and after a participant engaged in a period of exercise (i.e., event contingent surveys). Given that the study primarily examined behavioural and psychological phenomena a) as they occurred in close temporal proximity to exercise engagement (e.g., motivations for exercise, mood changes from exercise, intensity and duration of exercise), and b) that were discrete episodes that could be reported at the end of the day (e.g., body-checking), an ecological momentary assessment design wherein surveys are delivered at various times throughout the day (i.e., multiple signal-contingent surveys) did not appear necessary. Instead, a combination of time-contingent and event-contingent survey design was chosen as it reduced participant burden while sufficiently capturing the phenomena of interest.

Given that observations within individuals are related to one another, multilevel modelling was the primary analytic method used (see more detail in the Planned Analyses section). Techniques to estimate power for multilevel modeling (MLM) analyses require researchers to estimate various parameters *a priori*, such as the number of Level-1 observations and the expected effect sizes (Snijders, 2014). Given these parameters were unknown for the current study, the proposed sample size was based on existing prevalence rates of constructs of interest,

as well as previous studies' sample sizes that harness intensive longitudinal designs to investigate exercise and DE, rather than a formal power analysis.

Research suggests that between 13.5%- 20% of undergraduate students have a lifetime history of DE (Eisenberg et al., 2011; Luce et al., 2008; Prouty et al., 2002; Tavolacci et al., 2015); however, very few studies provide estimates of recent or current DE among this subpopulation. A previous study conducted with University of Victoria undergraduate students (n =347) using similar recruitment methods, found monthly rates of DE ranging from 16% to 55% when examined across several months (Legg, 2019). Accordingly, to accrue a minimum of 60 participants with a history of DE – a sample size of DE that is comparable with prior studies (see Table 1) – this study aimed to recruit 400 participants total on the assumption that a minimum of 15% (i.e., 60 people) would endorse a history of DE.

An additional consideration for power is the number of episodes/observations of the variables of interest that will occur within the length of study, as number of within-person observations also contributes to power (Macdonald & Stawski, 2014). Canadian statistics suggest that adults engage in an average of 27.56 bouts of physical activity (i.e., unstructured or unplanned) each month that last over 15 minutes, suggesting that many adults engage in approximately one period of physical activity (or what will be referred to as exercise, for the purposes of this study) per day (Center for Surveillance and Applied Research, 2023). Accordingly, I expected that most participants in the study would endorse at least one episode of exercise per day that lasts 10 or more minutes, during the 14-day protocol. In terms of exercise intensity, only 17.5% of Canadian adults engage in 150 minutes or more of moderate-vigorous activity per week. However, many of the Canadian adults that meet the minimum exercise guidelines are between the ages of 18-49 (Center for Surveillance and Applied Research, 2021;

Prince et al., 2021), and older adults tend to be more sedentary than younger adults (Statistics Canada, 2022). Given our recruitment techniques were expected to be weighted towards young adults, and the study's requirements that only individuals who currently monitor aspects of their fitness, or have in the past, participate in the study, I expected that the sample would have a greater propensity towards exercise relative to the general Canadian population. As such, I expected that approximately 30% of the sample would meet the minimum exercise guideline for moderate-vigorous exercise engagement each week, ensuring adequate variability in exercise intensity within the study. Additional constructs that were considered in terms of power were the number of body checking and self-weighing episodes that may be observed. In a sample of undergraduate women (n = 22) who were high in body dissatisfaction, but did not necessarily engage in DE, and who completed assessments for five days, all participants engaged in at least one episode of body checking per day (i.e., eight different behaviours including weighing oneself and feeling/pinching stomach to measure fatness), with an average of 27.85 episodes per day (Stefano et al., 2016). As such, I expect to observe at least one endorsement of body checking and one endorsement of self-weighing during the study for at least 80% of participants with DE.

To further assess the suitability of the length of the daily diary protocol, previous intensive sampling studies were consulted. A recent systematic review of intensive sampling studies (i.e., studies that assess participants one or more times a day, for several days, including daily diary and ecological momentary assessment studies) of binge eating (predominantly clinical samples with BED and BN) indicated that sample sizes have ranged from eight to 60 participants (Mean N = 28.7) with sampling durations of two to 21 days (Mean duration = 10.2 days; see Haedt-Matt & Keel, 2011). Fewer intensive longitudinal studies have been conducted on non-clinical samples and/or those with subclinical DE; Table 1 presents a summary of known studies that

have used intensive sampling techniques with either a nonclinical sample and/or to examine subclinical DE behaviours, many of which included disordered exercise as a DE behaviour. Based on Table 1, a study protocol of 14 days appears to be an adequate and well-accepted study length to examine DE behaviours, such as disordered exercise, using intensive sampling. Moreover, Table 1 suggests that sample sizes between 30-60 participants are common in this area of research. Given that my sample was non-clinical, and there are no DE requirements to be eligible for participation in this study, recruiting more participants than prior studies (Table 1) was important to ensure adequate observations of potentially disordered exercise. Similarly, previous studies using intensive sample methods to examine daily exercise engagement among non-clinical samples suggest a 7- to 14-day protocol is typical, with sample sizes ranging from 66 to 166 (e.g., Dalton, 2022; Guerin et al., 2013; Hachenberger et al., 2023; Ivarsson et al., 2021). Together, past research supports the 14-day protocol of the current study and suggests that the anticipated sample size of 400 participants is much greater than has been achieved in previous, comparable studies.

There was limited information to inform the anticipated compliance for the current study (see Table 1), however, other studies conducted on clinical and non-clinical adults samples that harnessed mobile intensive sampling methods (and examine a variety of health-related outcomes) achieved a pooled compliance rate of 81.9% (Williams et al., 2021). Accordingly, I expected study protocol compliance to be approximately 80%.

Table 1. Study characteristics of previously published intensive sampling longitudinal studies of Eating Disorders and DE in undergraduate and community samples.

Study	N	Sample Characteristics	Days	Scheduled assessments per day	Event-contingent assessments?	Compliance (mean or %)

(Katan & Kelly, 2021)	124	Community sample, met criteria for BN	14	1	No	12.43/14 surveys
(Sherry & Hall, 2009)	566	Undergraduate sample	7	1	No	90.0%
(Smith et al., 2021)	40	Clinical & community samples with binge eating	10	5	Yes	90.3% to signal contingent
(Wegner et al., 2002)	27	Undergraduates with binge eating	14	7	No	76%
(Mason et al., 2016)	54	Undergraduates with past week binge eating	14	1	No	9.22/14 surveys

3.3 Procedures

3.3.1 Baseline Survey.

Interested participants clicked on a link that was provided in the study advertisement, which automatically directed participants to the online baseline survey. The baseline survey was hosted on SurveyMonkey. The first few questions of the baseline survey assessed participants' eligibility for the study. Ineligible participants were automatically re-directed to a page informing them of their ineligibility and thanking them for their time. Eligible participants were prompted to read and agree to a letter of consent which outlined the nature and purpose of the study, its risks and benefits, and the compensation structure. Participants who consented to participate in the study were then automatically directed to complete the baseline self-report survey. The survey took approximately 50 minutes to complete and asked participants questions pertaining to their demographics, current level of daily exercise, general motivation style, motivations for exercising, current or past wearable activity tracker use, social media use, as well as their experiences with DE cognitions, DE behaviours, body consciousness, mood and anxiety. Finally, participants were asked to provide their email address so that they could be contacted by

the research team and enrolled in the daily monitoring portion of the study. Participants were awarded 1% bonus course credit (i.e., 1.0 SONA credit, if eligible) for completing the baseline survey. Participants who were not eligible for SONA were not compensated for the baseline survey (see Section 3.3.2 for additional information pertaining to study compensation structure).

3.3.2 Daily Diary Procedures.

Within 2 business days of completing the baseline survey, participants were contacted by a member of the research team via email. The email functioned to orient participants to the daily monitoring protocol and provided instructions for the smartphone app that they were required to download and use to complete the daily surveys (i.e., *Pathverse*[4]). The email also informed participants of their start date for the daily diary portion of the study, which was the Monday immediately following when the participant had completed their respective baseline survey. Participants received a reminder email the Friday before they were scheduled to begin the daily diary portion of the study, which reminded them to download *Pathverse* and setup their account before their Monday start date.

The daily monitoring protocol consisted of both event-contingent and time-contingent surveys for 14 consecutive days. Time-contingent surveys were completed each evening, while event-contingent surveys were completed directly before and directly after a participant engaged in a period of exercise. First, participants were asked to complete brief surveys before and after they engaged in their "main" period of exercise that day that they anticipated would last 10

[4] Pathverse is a "no code" platform created by Dr. Sam Liu in the UVic Digital Health Lab that allows researchers to easily create and host online interventions and health studies. Pathverse offers both a desktop platform for researchers to design health interventions and studies, as well as a smartphone app for participants to use during the relevant intervention or study. The Pathverse app is freely available for both Apple and Android smartphones. All data from Pathverse are hosted on a secure server within Canada.

minutes or longer. The pre-exercise survey reminded participants that if they planned to exercise that day, to complete the pre-exercise survey before beginning their session. While research indicates a distinction between physical activity (i.e., unstructured and/or unplanned body movement) and exercise (i.e., structured and/or planned body movement with the objective of improving one's health or fitness; Dasso, 2019), the study design made it likely that only planned exercise or anticipated physical activity would be captured in the study, and any unplanned physical activity would have been missed by the pre-exercise survey. For clarity, the current study will henceforth refer to any exercise or physical activity that was captured in the study as "exercise." The pre-exercise survey asked participants about their motivations for anticipated engagement in exercise, along with their mood and body satisfaction. The post-exercise survey asked participants about the duration, intensity, and type of exercise that they engaged in, along with a re-assessment of their mood and body satisfaction. To support participants in remembering to complete these pre- and post-exercise surveys, participants received a smartphone notification each morning at 5 a.m. reminding them that the exercise surveys for the given day were unlocked and available for completion. Participants could complete a pre- and post-exercise survey at any point during the day, however, these surveys could only be completed once within a given day, meaning that the surveys could not be completed multiple times if a participant engaged in multiple exercise sessions within a single day. Additionally, the pre- and post-exercise surveys were only available for a 24-hour period and re-set at 5 a.m. (i.e., participants are not able to complete the exercise surveys retrospectively the next day). The pre- and post-exercise surveys each took approximately 2 minutes to complete.

Time-contingent surveys were completed each evening after 5 p.m. The evening surveys were available to participants to complete between 5 p.m. and 11:59 p.m., and participants were

reminded to complete the daily survey each evening via a push notification on their smartphone at 5 p.m. Similar to the exercise surveys, participants were unable to retrospectively complete any surveys that they missed after the survey window closed to minimize recall bias and support the ecological validity of the data. The evening surveys asked participants if they remembered to complete their exercise surveys that day (if applicable), as well as about their social media use, engagement in body checking and weighing behaviours, engagement in DE, and body preoccupation that day. Each evening survey took less than 2 minutes to complete (the event- and time-contingent surveys totalled a maximum of 6 minutes per day). Thus, the maximum participation time for the full 14-day daily monitoring protocol was approximately 90 minutes.

Several strategies were used to increase participant retention and protocol adherence. In addition to reminder emails prior to beginning the study, and the daily push notifications, all participants received a personalized email on day 3 of the daily monitoring protocol providing feedback on how many of the three available evening surveys they had completed so far, their accrued compensation, a reminder of the compensation structure, as well as encouragement to reach out to the research team if they were having any technical difficulties. Compensation structures that provide incentives for each survey completed with bonuses has been shown to bolster participant retention and compliance (Wrzus & Neubauer, 2022). Accordingly, compensation in the current study was prorated based on the number of evening surveys completed: participants received compensation on a per-survey basis to encourage retention and adherence. Pro-rating was *not* based on the number of exercise surveys completed in order to avoid incentivizing participation in exercise and compromising the ecological validity of the study. Participants who were receiving Psychology course credits were able to earn up to 1.5% that could be applied to their final grade of an eligible Psychology course for completing evening

surveys. Credits, and therefore the percentage that could be applied to the participants' final psychology course grade, were pro-rated (e.g., if participants completed 7 of the 14 possible evening surveys, they were awarded half of the total possible credits [0.75% course grade bonus]). Moreover, participants earning course credit who completed 10 or more of the evening surveys were entered into a draw for one of three $50 Amazon electronic gift cards. Participants who were not eligible to earn course credit, and were receiving cash compensation instead, earned $1 per evening survey completed, and a $10 bonus for completing 10 or more of the evening surveys (a maximum compensation amount of $24, provided via Amazon.ca electronic gift card).

3.4 Measures

3.4.1 Baseline Measures.

Disordered Eating Group Status and Disordered Eating Concerns

Participants' current DE symptoms and DE-related concerns were assessed using the Eating Disorder Examination Questionnaire (EDE-Q; Fairburn & Beglin, 2008). The EDE-Q is a validated, 28-item self-report questionnaire that assesses the frequency of engagement in various DE behaviours, as well as range of concerns associated with eating pathology (e.g., "Has thinking about shape or weight made it very difficult to concentrate on things you are interested in [for example, working, following a conversation, or reading?]; "Have you had a definite fear that you might gain weight?"). Items were rated using two frequency based ordinal scales (i.e., "None of the times", "Every time", etc., or "No days", "Everyday", etc.) and a Likert scale (i.e., "Not at all", "Markedly", etc.). The EDE-Q is comprised of four subscales: eating concerns (e.g., preoccupation with eating, food or calories; eating in secret; guilt about eating), shape concern (e.g., preoccupation with shape and weight; body dissatisfaction; discomfort seeing own body;

feeling fat), weight concern (e.g., overvaluation of weight; dissatisfaction with weight; desire to lose weight), and restrained eating (frequency of engagement in restraint or avoidance of eating; dietary rules; avoidance of food). This study used the shape concern, eating concern, and restrained eating subscale scores from the EDE-Q (Fairburn & Belgin, 1994), but did not include the weight concern scale there is an overlap of items on the weight and shape concern subscales (i.e., the shape concern subscale includes several items from the weight concern subscale). Further, the shape concern subscale is comprised of more items than the weight subscale, and has a higher mean score based on a community sample of women relative to the weight subscale, indicating it may be more sensitive to a range of shape concern severities. The EDE-Q has good sensitivity and specificity in differentiating cases of Eating Disorders from non-cases, adequate to excellent test-retest reliability, and good concurrent and criterion validity (Berg et al., 2012; Mond et al., 2004). Norms for the EDE-Q have been established among non-clinical undergraduate women (Luce et al., 2008).

To determine DE group status (i.e., whether participants have a recent history of DE versus no recent history of DE), the frequency of several DE behaviors were examined using items adapted from the EDE-Q. Instead of asking about the past 28 days, as in the standard EDE-Q, participants were asked about their DE engagement in the past three months to adapt to a non-clinical sample (i.e., "How many times in the past 3 months have you engaged in the following behaviours in order to **prevent weight gain or counteract the effects of eating**…"). Questions assessed restricted eating [i.e., "…*gone for long periods (8 waking hours) without eating anything at all, or severely limiting your calorie intake (i.e., 1200 or less), with the specific goal of losing weight or preventing weight gain (i.e., not for medically supervised diets, or religiously sanctioned fast)?)"*, vomiting (i.e., "*Made yourself vomit*"), and laxative/diuretic use ("*Used*

laxatives or diuretics (water pills)?"), and excessive exercise *("Engaged in intense exercise specifically to counteract the effects of eating?").* For binge eating, the survey asked [i.e., *How many times* ***per month*** *on average* ***over the past 3 months*** *have you eaten an unusually large amount of food* ***AND*** *experienced a loss of control? (if not applicable, please select 0)].* The response option format for these items was a drop-down menu ranging from "0" to "60+". Binge eating responses were multiplied by three to get an average frequency cunt over the past three months. An extreme group design was used to categorize participants into one of two DE status groups: participants who endorsed three or more episodes of restricted eating, binge eating, vomiting, *or* laxative/diuretic use in the past three months were assigned to the 'recent DE' group (coded as 1), and participants who endorsed two or fewer episodes were assigned to the 'no recent DE' group (coded as 0). The EDE-Q specifies that an average of one DE episode per week, for the past three months qualifies as clinical severity and criteria for an Eating Disorder (Fairburn et al., 2014). The current study adapted this criterion for a non-clinical sample engaging in recent DE, and thus, used a cut off of three of more episodes of DE within the past three months indicating a pattern of an average of one or more DE episodes per month. This cut off is intended to create an extreme group design to differentiate those with recent DE from those without recent DE, while not creating such a stringent requirement for the recent DE group that it would unintentionally exclude those with low but consistent levels of recent DE from this group. Excessive exercise was not considered or included in creating the DE group status variable given its construct limitations and potential overlap with outcomes of interest.

Depressive Symptoms

Depressive symptoms were assessed using the Patient Health Questionnaire – 8 item version (PHQ-8; Kroenke et al., 2009). The PHQ-8 is a well-validated questionnaire that screens

how frequently participants have been bothered by common symptoms of depression over the past two weeks (e.g., feeling down, depressed or hopeless; sleep difficulties; low energy). The 8-item version of the PHQ is an adaptation from the widely used 9-item version: it omits an item assessing for suicidal ideation. Items were rated on a 4-point Likert scale ranging from 0 (i.e., "Not at all") to 3 (i.e., "Nearly every day"), and total scores were used to index depression severity. The PHQ-8 has been validated for diagnostic use in clinical samples and is appropriate for use in population samples where depression is a secondary outcome (Kroenke et al., 2009).

Anxiety Symptoms

Anxiety symptoms were assessed using the Generalized Anxiety Disorder – 7 item version (GAD-7; Spitzer et al., 2006). The GAD-7 is a well-validated self-report questionnaire that screens how frequently participants have been bothered by common symptoms of anxiety over the past two weeks (e.g., feeling nervous, anxious or on edge uncontrollable worry trouble relaxing). Items were rated on a 4-point Likert scale ranging from 0 (i.e., "Not at all") to 3 (i.e., "Nearly Every Day") and total scores were used to index anxiety severity. The GAD-7 has excellent internal consistency (Johnson et al., 2019) and good reliability and validity in community samples (Löwe et al., 2017).

Gender

Participants were asked about their gender identity using a single item that was created for the purposes of this study (i.e., "What is your gender identity?"). Response options included "Male", "Female", "Non-binary/Non-gender conforming", "Do not know/Prefer not to answer", and "Other". Given low endorsement for the Non-binary/Non-gender conforming and Other response options (see Results section), these two response options were combined with the Male group to create a "non-Female" gender variable (coded as 0). Females were maintained as a

separate category (coded as 1). Those who endorsed "Do not know/Prefer not to answer" were coded as missing.

Age

Participants were asked about their age using a single item that was created for the purposes of this study (i.e., " Please select your age in years"). Participants selected their age from a drop-down menu, which ranged from "18" to "99" years old.

Race

Participants were asked about their race using a single item that was created for the purposes of this study (i.e., " Please specify your race (check all that apply)"). Participants selected checked the race(s) that applied to them from the following response options: "White or Caucasian"; "Black or African American"; "First Nations"; "Métis"; "Inuit"; "Asian"; "Native Hawaiian or other Pacific Islander"; "I don't know/prefer not to answer"; "Other (please specify)." Due to no endorsement of the Indigenous Peoples, Native Hawaiian, or the Other race categories, race was recoded to only include White, Black, and Asian, and those who endorsed "I don't know/prefer not to answer" were coded as missing.

Income

Participants were asked about their family income using a single item that was created for the purposes of this study (i.e., " What is your total combined family income for the past twelve months, before taxes, from all your sources, wages, public assistance/benefits, help from relatives, alimony, and so on? If you do not know your exact income, please estimate."). Participants selected their income from the following options: "Less than $12,500"; $12,500-$26,999"; "$27,000-$43,999"; "$44,000-$59,999"; "$60,000-$74,999"; "$75,000-$99,999"; "$100,000-$149,000"; "More than $150,000"; "Do not know/Prefer not to answer."

Baseline Exercise

Participants were asked about the number of hours they spent engaging in moderate and vigorous exercise on a typical. Participants entered the number of hours or the number of minutes they engaged in such exercise per day. Number of minutes spent engaging in such exercise was recoded as the following: 1-30 minutes (coded as 0), 31-60 minutes (coded as '1'), and anything more than 60 (coded as '2').

3.4.2 Pre- and Post-Exercise Daily Diary Survey Measures.

Motivations for Exercise

In the pre-exercise survey, participants were asked to rate various reasons or motivations to engage in exercise. The motivations for exercising were drawn from the Behavioural Regulation in Exercise Questionnaire - Version 3 (BREQ-3: Markland & Tobin, 2004), and additional items were drawn and adapted from the REI (Silberstein et al., 1988), the CET (Taranis et al., 2011). Participants rated how much each reason/motivation influenced their decision to exercise on a Likert scale ranging from 1 (i.e., "Not at all") to 7 (i.e., "A lot"). Given the hypothesized relevance of mood regulation, weight control, avoidance of negative affect due to non-exercise, and rule driven behaviour in differentiating those with and without eating pathology (Cook et al., 2016; Naylor et al., 2011; Schlegl et al., 2018), this study used and analyzed eleven exercise motivation items that were related to these domains. Exercise motivations that examined a similar domain were combined to create four subscales, which was supported by an examination of correlations between items (see Results section). The subscales indexed endorsement of the four motivation domains and provided improved construct validity above and beyond what single items could provide. Combining single items into subscales also reduced the chances of a Type I error occurring within analyses. First, a *mood regulation* subscale was created from the following items: "Because I think it will improve my mood",

Because I think it will relieve stress." Next, a *weight control* subscale was created from the following items: "Because I want to control my weight or prevent weight gain", "Because I need to burn off the number of calories I have eaten, or will eat, today", "Because I want to lose weight." An *avoidance of negative affect* subscale was created which included: "Because I would feel anxious or distressed if I don't", "Because I would feel guilty to not do it." A subscale that captured self-imposed *rule following* was created, which included: "It's part of my training schedule", "It's something I have to do." Two final exercise motivation items, which did not appear to measure any of the aforementioned domains, were not combined with other items and were analyzed as individual items "Because I want to build muscle", "Because I think it will make me feel better about my body".

Body Satisfaction

Participants rated their current body satisfaction, before and after they exercised, using a single item that was created for the purposes of this study: "How do you feel about how your body looks right now?". Participants provided body satisfaction ratings on a sliding scale ranging from 1 (i.e., "Terrible") to 10 (i.e., "Extremely Good") in both the pre- and post-exercise surveys.

Mood

Participants rated their current mood, before and after they engaged in exercise, using a single item, which was created for the purposes of this study: "How would you rate your mood right now?". Participants provided mood ratings on a sliding scale ranging from 1 (i.e., "Terrible") to 10 (i.e., "Extremely Good") in both the pre-exercise and the post-exercise surveys.

Exercise Characteristics

In each post-exercise survey, participants were asked about the duration of the exercise period (i.e., “How long did your exercise session last?”), with seven response options that offered a range of 10-minute increments which spanned from: “1-10 minutes” to “More than 60 minutes.” Response options for exercise duration were recoded from to span from 0 to 7 to be included as a covariate within the Aims 1 and 2 models. Participants were also asked about the perceived exercise intensity or exertion (i.e., “How hard was the activity?”), with six response options which spanned from: “1-Very Light”; “2-Light”; “3-Moderate”; “4-Hard”; “5-Very hard”; “6-My Max effort”. Response options for exercise intensity were recoded to span from 0 to 6 to be included as a covariate within the Aims 1 and 2 models. To examine the specific impacts of different levels of exercise on outcomes of interest in Aim 3, daily levels of exercise were recoded and classified into three groups: No/Minimal Exercise (i.e., 10 minutes or less at any intensity), Light Exercise (more than 10 minutes rated 3 or lower in intensity), or Moderate to Vigorous Exercise (more than 10 minutes rated 4 or higher in intensity).

3.4.3 Evening Daily Diary Survey Measures.

Body Size Checking Behaviours

Engagement in body checking behaviours was assessed in each evening survey using a single item created for the purposes of this study: “Did you check your body size today [pinching parts of your body, looking in the mirror, taking selfies of your body]”. The response options included “Yes” (coded as 1) or “No” (coded as 0).

Self-Weighing

Engagement in self-weighing was assessed in each evening survey using a single item created for the purposes of this study: “Did you weigh yourself today?". The response options included “Yes” (coded as 1) or “No” (coded as 0).

3.5 Planned Analyses

Descriptive statistics assessed the sample demographics and were conducted in IBM SPSS Statistics (Version 26). Simple frequency and Spearman's correlation analyses were conducted to examine the distributions of variables included in the study. Chi-square and t-tests were used to compare the prevalence of various demographic and mental health characteristics between those with and without a recent history of DE, to assess comparability of the two DE status groups. Moreover, chi-square and t-tests were used to compare the prevalence of various demographic and mental health characteristics between participants who only completed the baseline questionnaire and participants who also provided follow-up data, to assess the comparability of those who dropped out versus continued with the study.

Studies that involve repeated sampling of participants garner data that are non-independent (i.e., multiple observations nested within individuals). Accordingly, multilevel modeling (MLM) was employed for all focal analyses, which does not assume independence of observations. All MLM analyses were conducted in Hierarchical Linear Modelling software, Version 8.1.4.14 (Raudenbush & Congdon, 2021). I employed maximum likelihood estimation (for linear models) and reported robust standard errors to maximize statistical power and provide conservative estimates of effects for linear models (Garson, 2014). Penalized quasi-likelihood (PQL) estimation methods were employed for non-linear models, which is an acceptable method when population variances are within the normal range and when the probability of the outcome occurring is not significantly skewed (Raudenbush, Bryk, & Congdon, 2019). Moreover, population-specific outcomes were interpreted for non-linear models, as population-specific effect estimates average effects across the entire sample of data and allow for generalizable statements to be made about significant associations.

3.5.1 Aim 1: Examining Motivations for Exercise

To address Aim 1, I conducted two series of MLMs to examine: 1) associations between DE status and various motivations for exercise, and 2) associations between three DE-related concerns (i.e., eating concerns, shape concerns, and restrained eating) and various motivations for exercise. First, a series of linear MLMs were conducted that examined if DE status (i.e., those with or without recent DE) was associated with endorsement of six different motivations for exercise (i.e., mood regulation, avoidance of negative affect, rule following, weight control, to build muscle, and to feel better about one's body). Each of the six exercise motivations were specified as dependent variables and thus, were modeled separately. DE status was entered at the Level-2 intercept and was the focal independent variable within the models.

Although there are known effects of engaging in 150 minutes or more of moderate-vigorous exercise per week on improving general mental health and wellbeing (Lindwall et al., 2014; Nakagawa et al., 2020; Statistics Canada, 2021), there is a paucity of research elucidating the daily amount of exercise needed to produce same-day wellbeing and mood benefits. Existing, but limited research using a non-clinical sample suggests that engaging in ten or more minutes of moderate-vigorous exercise may produce same-day increases in mood, and other research suggests that there are no significant differences between durations of exercise that last longer than ten minutes on improvements in mood (Hansen et al., 2001; Yeung, 2003). Another study found that 30 minutes of light exercise was effective in improving same-day mood, and that there were no significant differences between higher intensities of 30-minute exercise bouts among women with depression on mood improvements (Meyer et al., 2016). Thus, daily exercise duration and exercise intensity were entered as separate variables to help ensure that associations between DE status and motivations for exercise were not attributable to within-person effects of engaging in different levels of exercise within a given day. The exercise covariates were grand-

mean centered. Grand-mean centering facilitates interpretation of the coefficients, as scores reflect deviations from the sample mean on these characteristics (in other words, denoting if participants' scores are higher or lower than the sample average). Thus, all other coefficients can be interpreted as the effect when grand-mean centered constructs are at the sample mean.

Next, Time was parameterized to represent the number of observations of exercise during the daily diary portion of the study (i.e., the first observation of exercise during the study was coded as 0, the second observation of exercise was coded as 1, and so on) and was entered as an uncentered Level-1 covariate (so that Time is 0 at the intercept). Next, I included the following covariates: sex, age, depression and anxiety. Prior research shows that DE is more prevalent among females (relative to males), younger adults (relative to older adults), and is positively associated with depression and anxiety (Forrester-knauss & Stutz, 2012; Hudson et al., 2007; Ward et al., 2019), while more recent results are mixed pertaining to socioeconomic status and race (Cheng et al., 2019; Mulders-Jones et al., 2017). Thus, all covariates were tested in null models for each exercise motivation. While results did not reveal clear patterns of correlations, gender, age, depression, and anxiety were each significant (p's <.001) within one or more models, while race and income were not significant within any models (p's > .05). Therefore, to ensure consistency across models, gender (coded 0 = non-female; 1 = female), age (grand-mean centered), depression scores (grand-mean centered), and anxiety scores (grand-mean centered) were included as Level-2 covariates at the intercept for all models within the study to help ensure that associations between DE status and motivations for exercise were not attributable to these demographic or mental health characteristics. I used a random effects model to allow between-person variability in both the intercepts and slopes. The decomposed MLM equation for this series of MLMs is below in Figure 1.

Level 1 Equation:

$$Exercise\_Motivation_{ij} = \pi_{0i} + \pi_{1i}(Exercise\_Duration_{ij}) + \pi_{2i}(Exercise\_Intensity_{ij}) + \pi_{3i}(Time_{ij}) + e_{ij}$$

Level 2 Equation:

$$\pi_{0i} = ß_{00} + ß_{01}(Gender) + ß_{02}(Age) + ß_{03}(Depression) + ß_{04}(Anxiety) + ß_{05}(DEStatus) + u_{0i}$$

$$\pi_{1i} = ß_{10} + u_{1i}$$

$$\pi_{2i} = ß_{20} + u_{1i}$$

$$\pi 3_i = ß_{30} + u3_i$$

Figure 1. MLM equation for model examining if DE status (i.e., recent or no recent engagement in DE) is associated with endorsement of a given exercise motivation when controlling for the within-person effects of daily exercise duration, exercise intensity, and number of exercise observations (time), and the between-person effects of gender, age, anxiety and depression.

A second series of MLMs was conducted to examine if three DE-related concerns (i.e., eating restraint, eating concerns, and shape concerns) were associated with the same six exercise motivation categories. Exercise motivations were specified as the dependent variable and modeled separately. The three DE-related concerns were grand-mean centered and entered at the Level 2 intercept as the focal independent variables within the models. The models also included the same time parametrization and covariates (with the same centering practices), as the previously described model (Figure 1), as results pertaining to the covariates in the context of the null models were also the same. I used a random effects model to allow between-person variability in both the intercepts and slopes. The decomposed equation for this series of MLMs is below in Figure 2.

Level 1 Equation:

$$Exercise\ \_Motivation_{ij} = \pi_{0i} + \pi_{1i}(Exercise\_Duration_{ij}) + \pi_{2i}(Exercise\_Intensity_{ij}) + \pi_{3i}(Time_{ij}) + e_{ij}$$

Level 2 Equation:

$$\pi_{0i} = ß_{00} + ß_{01}(\text{Gender}) + ß_{02}(\text{Age}) + ß_{03}(\text{Depression}) + ß_{04}(\text{Anxiety}) + ß_{05}(\text{EatingConcern}) + ß_{06}(\text{Restraint}) + ß_{07}(\text{ShapeConcern}) + u_{0i}$$

$$\pi_{1i} = ß_{10} + u_{1i}$$

$$\pi_{2i} = ß_{20} + u_{2i}$$

$$\pi_{3i} = ß_{30} + u_{3i}$$

Figure 2. MLM equation for model examining if DE-related concerns (i.e., eating concerns, restrained eating, and shape concerns) are associated with endorsement for a given exercise motivation when controlling for the within-person effects of daily exercise duration, exercise intensity, and number of exercise observations (time), and the between-person effects of gender, age, anxiety, and depression.

3.5.2 Aim 2: Consequences of Exercise on Mood and Body Satisfaction

To address Aim 2, I conducted two MLMs that examined whether DE status moderated changes in: 1) mood from pre- to post-exercise, 2) body satisfaction from pre- to post-exercise. To assess if mood scores significantly changed from pre- to post-exercise, assessment type was indexed using a new variable wherein mood assessments that occurred before exercise were coded as '0' and mood assessments that occurred after exercise were coded as '1' (i.e., a Pre- versus Post-Assessment variable). This Pre- to Post-Assessment variable was entered as an uncentered Level-1 focal predictor within the models such that the slope of the Assessment variable represents changes in mood scores from pre- to post-exercise. Similar to Aim 1, Time was parameterized as the number of observations of exercise during the daily diary portion of the study. Grand-mean centered daily exercise duration and exercise intensity were again included as a Level-1 covariates. Next, DE status was entered at the Level-2 intercept (i.e., predicting participant's average mood across all observations) as well as a Level-2 moderator of the

Assessment slope term. The focal moderator represents the difference in pre- to post- exercise mood changes in those with recent DE (compared to those without recent DE). To support consistency across models within the study, grand-mean centered depression, anxiety, and age, along with gender (uncentered), were retained as Level-2 covariates in the model to help ensure that changes in mood from pre- to post-exercise is not attributable to demographic or mental health characteristics. I used random effects models to allow between-person variability in both the intercepts and slopes.

An identical process was used to construct a MLM that assessed if body satisfaction from pre- to post-exercise, and if DE status moderated changes in body satisfaction from pre- to post-exercise. The decomposed MLMs for mood and body satisfaction are represented below in Figures 3 and 4.

Level 1 Equation:

$$Mood_{ij} = \pi_{0i} + \pi_{1i}(\text{Pre- versus Post-Assessment}_{ij}) + \pi_{2i}(\text{Exercise\_Duration}_{ij}) + \pi_{3i}(\text{Exercise\_Intensity}_{ij}) + \pi_{4i}(\text{Time}_{ij}) + e_{ij}$$

Level 2 Equation:

$$\pi_{0i} = ß_{00} + ß_{01}(\text{Gender}) + ß_{02}(\text{Age}) + ß_{03}(\text{Depression}) + ß_{04}(\text{Anxiety}) + ß_{05}(\text{DEStatus}) + u_{0i}$$

$$\pi_{1i} = ß_{10} + ß_{11}(\text{DEStatus}) + u_{1i}$$

$$\pi_{2i} = ß_{20} + u_{2i}$$

$$\pi_{3i} = ß_{30} + u_{3i}$$

$$\pi_{4i} = ß_{40} + u_{4i}$$

Figure 3. MLM equation for model examining if mood changes from pre- to post-exercise, and if this association differs between those who have and have not recently engaged in DE (i.e., is moderated by DE status) when controlling for the within-person effects of daily exercise

duration, exercise intensity, number of exercise observations (time), and the between-person effects of gender, age, anxiety, depression and DE status.

Level 1 Equation:

$$BodySatisfaction_{ij} = \pi_{0i} + \pi_{1i}(\text{Pre- versus Post-Assessment}_{ij}) + \pi_{2i}(Exercise\_Duration_{ij}) + \pi_{3i}(Exercise\_Intensity_{ij}) + \pi_{4i}(Time_{ij}) + e_{ij}$$

Level 2 Equation:

$$\pi_{0i} = ß_{00} + ß_{01}(Gender) + ß_{02}(Age) + ß_{03}(Depression) + ß_{04}(Anxiety) + ß_{05}(DEStatus) + u_{0i}$$

$$\pi_{1i} = ß_{10} + ß_{11}(DEStatus) + u_{1i}$$

$$\pi_{2i} = ß_{20} + u_{2i}$$

$$\pi_{3i} = ß_{30} + u_{3i}$$

$$\pi_{4i} = ß_{40} + u_{4i}$$

Figure 4. MLM equation for model examining if body satisfaction changes from pre- to post-exercise, and if this associated differs between those who have and have not recently engaged in DE (i.e., is moderated by DE status) when controlling for the within-person effects of daily exercise duration, exercise intensity, number of exercise observations (time variable), and the between-person effects of gender, age, anxiety, depression and DE status.

3.5.3 Aim 3: Consequences of Exercise on Body Checking and Weighing

To address Aim 3, I conducted two MLM's that examined if daily exercise levels are associated with same day: 1) body checking behaviours or 2) self-weighing behaviours, and if 3) these associations are moderated by recent DE status. Given that body checking behaviours and self-weighing were dichotomously assessed (present/absent), Hierarchical Generalized Linear Models that employed a Bernoulli distribution were used to account for the binary format of the dependent variables. The Bernoulli distribution utilizes a logit link function which then provides

a log odds value of an outcome, rather than the raw outcome itself, as the output (Garson, 2014). In other words, a Bernoulli distribution quantifies the probability of an event of interest occurring (i.e., body checking and weighing).

First, I assessed if engagement in various levels of exercise within a given day share a coupled association with odds of same day body checking, and if DE status moderated this association. Body checking was entered as the dependent variable. Time was parameterized as days in study (i.e., Day 1 was coded as 0, Day 2 was coded as 1) and included as a Level-1 covariate, as body checking and self-weighing are assessed at the day level. Intensity and duration of daily exercise were transformed into a series of dummy variables, so that each level of exercise engagement (i.e., No/Minimal Exercise, Light Exercise, Moderate-Vigorous Exercise; see Measures section) could be examined to see if it shares a coupled association with odds of same-day body checking. The No/Minimal Exercise group was used as the reference group within the dummy coding such that intercepts reflect the probability of engaging in body checking on days when No/Minimal Exercise was engaged in, and the coefficients reflect the probability of engaging in body checking on days when Light Exercise or Moderate-Vigorous Exercise was engaged in. Daily exercise level dummy variables (i.e. Light and Moderate-Vigorous Exercise) were entered at Level-1 and were the focal predictors. DE Status was entered at the Level-2 intercept, and as a Level-2 focal moderator of both dummy exercise level variables. While $ß_{20}$ and $ß_{30}$ represents the odds of body checking among those *without* a recent DE history who engage in Light Exercise and Moderate-Vigorous Exercise respectively, $ß_{21}$ and $ß_{31}$ represents the odds of body checking among those *with* a recent DE history (relative to those without a DE history) who engage in Light Exercise and Moderate-Vigorous Exercise respectively. To support consistency across models within the study, grand-mean centered

depression, anxiety, and age, along with gender (uncentered) variables were included at the Level-2 intercept. I used a random effects model to allow between-person variability at both the intercepts and slopes, however, the random effect for time was constrained as I did not expect an effect of days in study on body checking behaviours. A similar model was constructed to assess if daily exercise level was associated with same day self-weighing, and if DE status moderates these coupled associations. The decomposed MLMs for body checking and self-weighing are represented below in Figures 5 and 6.

Level 1 Equation:

$$\text{Prob}(Body\_Checking_{ti}=1|\pi_i) = \phi_{ti}$$

$$\log[\phi_{ti}/(1 - \phi_{ti})] = \eta_{ti}$$

$$\eta_{ti} = \pi_{0i} + \pi_{1i}*(Time_{ti}) + \pi_{2i}*(Light\_Exercise_{ti}) + \pi_{3i}*(Moderate/Vigorous\_Exercise_{ti})$$

Level 2 Equation:

$$\pi_{0i} = ß_{00} + ß_{01}(\text{Gender}) + ß_{02}(\text{Age}) + ß_{03}(\text{Depression}) + ß_{04}(\text{Anxiety}) + ß_{05}(\text{DEStatus}) + u_{0i}$$

$$\pi_{1i} = ß_{10}$$

$$\pi_{2i} = ß_{20} + ß_{21}(\text{DEStatus}) + u_{2i}$$

$$\pi_{3i} = ß_{30} + ß_{31}(\text{DEStatus}) + u_{3i}$$

Figure 5. MLM equation for model examining if levels of daily exercise (i.e., No/Minimal Exercise, Light Exercise, Moderate-Vigorous Exercise dummy coded) are associated with a higher probability of same-day body checking and if these associations differ between those who have and have not recently engaged in DE (i.e., are moderated by DE status) when controlling for the for the within-person effects of days in study (time), and the between-person effects of gender, age, anxiety, depression, and DE status.

Level 1 Equation:

$$\text{Prob}(Self\text{-}Weighing_{ti}=1|\pi_i) = \phi_{ti}$$

$$\log[\phi_{ti}/(1 - \phi_{ti})] = \eta_{ti}$$

$$\eta_{ti} = \pi_{0i} + \pi_{1i}*(Time_{ti}) + \pi_{2i}*(Light\_\ Exercise_{ti}) + \pi_{3i}*(Moderate/Vigorous\_\ Exercise_{ti})$$

Level 2 Equation:

$$\pi_{0i} = ß_{00} + ß_{01}(\text{Gender}) + ß_{02}(\text{Age}) + ß_{03}(\text{Depression}) + ß_{04}(\text{Anxiety}) + ß_{05}(\text{DEStatus}) + u_{0i}$$

$$\pi_{1i} = ß_{10}$$

$$\pi_{2i} = ß_{20} + ß_{21}(\text{DEStatus}) + u_{2i}$$

$$\pi_{3i} = ß_{30} + ß_{31}(\text{DEStatus}) + u_{3i}$$

Figure 6. MLM equation for model examining if levels of daily exercise (i.e., No/Minimal Exercise, Light Exercise, Moderate-Vigorous Exercise dummy coded) are associated with a higher probability of same-day self-weighing and if these associations differ between those who have and have not recently engaged in DE (i.e., are moderated by DE status) when controlling for the for the within-person effects of days in study (time), and the between-person effects of gender, age, anxiety and depression.

Chapter 4: Results

4.1 Sample Descriptives

Of the 714 participants who completed the baseline questionnaire, 684 participants remained in the baseline data file after removing participants who provided multiple responses, and may have been repeatedly and/or randomly completing the baseline survey. See Table 2 for demographic information of the baseline sample after data cleaning. Notably, distribution of participants with (n = 334) and without (n = 337) a recent history of DE was approximately equal in the baseline sample, and the age range spanned 18-76 years old ($Mean_{Age}$ = 26.85, SD = 8.72). Of the 684 participants who provided eligible baseline responses, only 384 participants provided eligible data during the daily diary portion of the study (43.86% attrition). Chi-square analyses revealed that non-students were more likely to participate in the daily diary portion of the study, relative to students ($\chi^2(2) = 59.98$, $p < .001$). People *without* recent DE were more likely to participate in the daily diary portion, relative to those with recent DE ($\chi^2(1) = 4.54$, $p = .033$). However, results for gender ($p = .125$) and income ($p = .202$) were non-significant between who did and did not go on to participate in the daily monitoring portion of the study. Independent samples t-tests did not reveal significant differences in average scores of depression ($p = .435$), anxiety ($p = .055$), or age ($p = .953$) between those who did and did not participate in the daily monitoring portion of the study. Taken together, the results suggest that students and those with recent DE had greater odds of dropping out of the study after baseline, however, these variables were still relatively balanced in the final sample. See Table 2 for demographic information of the final sample that provided both baseline and follow-up data (n = 384). Within the final sample, the age range spanned from 18-76 years old ($Mean_{Age}$ = 27.04, SD = 9.07).

Table 2. Descriptive demographic statistics of the cleaned baseline sample (n = 684) and the final sample that also provided follow-up data and thus was retained for focal analyses (n = 384).

	Baseline Sample (n = 684)	**Final Sample (n=384)**
Characteristic	Number (%)	Number (%)
Gender		
Male	233 (34.1%)	104 (31.9%)
Female	425 (62.1%)	204 (62.6%)
Non-binary/Gender non-conforming	3 (.4%)	2 (0.6%)
Prefer not to answer	23 (3.4%)	16 (4.9%)
Recent History of DE		
Yes	334 (49.0%)	146 (44.8%)
No	347 (51.0%)	189 (55.2%)
Race/Ethnicity		
White	508 (74.3%)	231 (71.8%)
Black	70 (10.2%)	43 (14.0%)
Asian	87 (12.7%)	44 (14.3%)
Missing	19 (2.7%)	0 (0%)
Income (CAD)		
Less than $12,500	53 (7.7%)	21 (6.4%)
$12,500 - $26,999	66 (9.6%)	31 (9.6%)
$27,000 -$43,999	41 (6.0%)	22 (6.8%)
$44,000 - $59,999	70 (10.2%)	42 (13.0%)
$60,000 - $74,999	54 (7.9%)	31 (9.6%)
$75,000 - $99,999	84 (12.3%)	39 (12.0%)
$100,000 - $149,000	113 (16.7%)	49 (15.1%)
More than $150,000	95 (13.9%)	42 (13.0%)
Current Student		
Yes	320 (46.8%)	181 (55.5%)
No	364 (53.2%)	145 (44.5%)
Education Level		
12th grade or less	20 (2.9%)	7 (2.1%)
Highschool graduate or GED	161 (23.5%)	71 (21.5%)
Some college/AA degree/technical school training	148 (21.6%)	72 (22.1%)
College graduate	162 (23.7%)	97 (29.8%)
Graduate degree	184 (26.9%)	76 (23.3%)
Prefer not to answer	9 (1.3%)	3 (0.9%)

Chi-square analyses were conducted to examine if there were differences in proportions of racial group distribution, income, educational attainment, average levels of exercise, and gender between those with and without a recent history of DE within the final dataset. Results were non-significant for racial groups (p = .251), educational attainment (p = .767), gender (p = .593), but were significant for income groups (χ^2 = 13.12, df = 6, p = .045). Examination of the several significant differences in distribution of income groups between the DE status groups did not reveal a clear pattern of lower or higher incomes between the two groups, indicating that while significant differences between DE status groups exist in terms of income, there did not appear to be *systematic* income differences between the groups. Next, independent samples t-tests were used to examine if there were differences between those with and without a recent history of DE on total scores of depression, anxiety, age, weight, shape and eating concerns and restrained eating, as well as engagement in moderate and vigorous exercise. Results revealed that those with a recent history of DE had significantly higher average scores of depression (t(324)= -6.51, p <.001), anxiety (t(324) = -5.29, p < .001), and average daily minutes of engagement in moderate exercise (t(347 = -2.45, p = .015), relative to those without a recent DE history, indicating that these are relevant control variables, even if not significant in all null models. Age (p = .581), average daily hours of engagement in moderate (p = .586) and vigorous (p = .564) exercise, and average daily minutes of engagement in moderate exercise (p = .098), did not significantly differ between DE status groups. As expected, results also revealed that those with a recent history of DE had significantly higher average scores of restrained eating (t(324) = -5.31, p < .001), eating concerns (t(324) = -6.83, p < .001), shape concerns (t(324) = -10.39, p <.001), and weight concerns (t(324) = -6.66, p < .001), relative to those without recent DE, substantiating the extreme group design used within the study.

Daily rates of completion of the evening surveys ranged from 63.5% to 79.4% across the 14-day daily monitoring portion of the study (see Table 3). Participants completed an average of 9.96/14 evening surveys throughout the study, which is equivalent to 71.1% pooled compliance. Table 4 further breaks down of the frequency of number of evening surveys completed. In terms of exercise survey completion, a pooled compliance calculation suggests 86.0% compliance in completing the pre- and post-exercise surveys when a period of exercise actually occurred *and* the evening survey was completed, across the 14 days (see Table 3).

Table 3. Survey completion rates and compliance.

Variable	**Number of Surveys Completed (% Completion)**
Baseline Surveys Completed	684
Evening Surveys Completed	384
Day 1	274 (71.4%)
Day 2	287 (74.7%)
Day 3	305 (79.4%)
Day 4	287 (74.7%)
Day 5	276 (71.9%)
Day 6	264 (68.8%)
Day 7	273 (71.1%)
Day 8	277 (72.1%)
Day 9	274 (71.4%)
Day 10	273 (71.1%)
Day 11	285 (74.2%)
Day 12	244 (63.5%)
Day 13	247 (64.3%)
Day 14	257 (66.9%)
Variable	**Number of Surveys Completed (%)**
Daily Exercise Survey Compliance Across Study	
Exercised, but did not complete survey	341(13.9%)
Exercised and completed survey	2095 (86.0%)

Table 4. Frequencies of number of completed evening surveys.

Number of Completed Evening Surveys	**Frequency (%)**

1	12 (3.1%)
2	12 (3.1%)
3	10 (2.6%)
4	11 (2.9%)
5	12 (3.1%)
6	11 (2.9%)
7	18 (4.7%)
8	23 (6.0%)
9	31 (8.1%)
10	37 (9.6%)
11	46 (12.0%)
12	44 (11.5%)
13	44 (11.5%)
14	73 (19.0%)

Table 5 and Table 6 further characterize the distribution of the key variables within the study. Tabachnick and Fidell (2013) suggest that in samples larger than 200 participants, small to moderate deviations from normality in skewness and kurtosis often do not make substantive differences in parameter estimates. Others suggest that within larger samples, skewness should not exceed three while kurtosis should not exceed ten (Aminu & Shariff, 2014; Kline, 2012). Based on these guidelines, all continuous variables are considered to be normally distributed. Average depression in the sample was considered to be in the moderate range (Kroenke et al., 2009), while average anxiety was considered to be in the mild range within the sample (Spitzer et al., 2006), based on published norms for each measure (Table 5). In terms of those with a recent history of DE, fasting was the most prevalent DE behaviour, followed by binge eating (Table 5). For DE cognitions and concerns within the sample, scores on eating restraint, eating concerns, and shape concerns were higher relative to most previously published norms within female community and undergraduate samples (Fairburn, 1994; Keane et al., 2017; Luce et al., 2008; Mond et al., 2004), but lower than inpatient samples with clinical eating disorders (Jennings & Phillips, 2017). The most recent norms that were drawn from a non-clinical, female,

university sample (Keane et al., 2017) indicated mean scores of 1.30(1.28 SD) for restraint, 0.79(1.12 SD) for eating concerns, 2.18(1.66) for shape concerns, and 1.75(1.57 SD) for weight concerns, suggesting the current sample had similar scores relative to these non-clinical norms. Participants engaged in an average of 6.4 periods of exercise throughout the 14-day duration of the study, and over half of these periods of exercise were rated as moderate-vigorous intensity (Table 6). The top three types of exercise endorsed throughout the study were walking, jogging/running, and weightlifting, indicating that the most prevalent types of exercise were structured, rather than unstructured (e.g., gardening) (Table 6). Participants reported an average of 4.9 episodes of body checking and 3.2 episodes of self-weighing throughout the 14-day duration of the study (Table 6). These descriptive statistics indicate that the planned analyses were well-powered, and that running the planned linear (Aims 1 and 2) and non-linear models (Aim 3) were appropriate.

Table 5. Descriptives of key baseline variables within final sample (n = 384).

Variable	**Min.**	**Max.**	**Mean (SD)**	**Skewness**		**Kurtosis**	
				Statistic	SE	Statistic	SE
Eating Restraint	0	6	1.83(1.45)	.424	.134	-.354	.269
Eating Concerns	0	6	1.12(1.31)	.997	.134	.129	.269
Shape Concerns	0	6	2.49(1.61)	.409	.134	-.659	.269
Anxiety	0	21	6.69(5.58)	.688	.135	-.272	.269
Depression	0	24	7.51(5.90)	.659	.135	-.379	.269
Mod. Exercise							
Minutes	0	60	17.80(17.07)				
Hours		60	1.36(3.84)				
Vig. Exercise							
Minutes	0	90	17.90(17.50)				
Hours	0	60	1.70(3.95)				

DE Episode Frequency				
	Min.	**Max.**	**Mean**	**Percentage**
Binge Eating in past 3 months	0	24	3.96	45.8%

Fasting in past 3 months	0	57	4.56	52.1%
Purging in past 3 months	0	37	0.76	14.4%
Laxative use in past 3 months	0	42	1.10	14.5%

Note. Min. = minimum; Max. = maximum; SD = standard deviation; Mod. Exercise = Moderate Exercise = average amount of moderate exercise engaged in on a typical day; Vig. Exercise = average amount of vigorous exercise engaged in on a typical day. Percentage of each type of DE was calculated based on the total number of all DE episodes observed within the past 3 months (e.g., of all the DE episodes observed in the prior three months, 45.8% were binge eating). The EDE-Q only asks if binge eating occurred (yes/no) within the past 3 months, thus, descriptive statistics could not be obtained and are noted by '-' instead.

Table 6. Descriptives of key daily diary variables across study.

Variable	**Min.**	**Max.**	**Mean (SD)**	**Skewness**		**Kurtosis**	
				Statistic	SE	Statistic	SE
Mood Rating	1	10	7.18(2.17)	-.608	.034	.098	.069
Body Satisfaction Rating	1	10	6.65(2.39)	-.376	.034	-.393	.069
Exercise Duration	1	7	4.19(1.89)	.010	.029	-1.078	.069
Exercise Intensity	1	6	2.93(1.17)	.196	.029	-.058	.069
Variable	**Episode Frequency (%)**						
Periods of Exercise							
Yes, I exercised today	2,443 (63.9%)						
No I didn't exercise today	1,380 (36.1%)						
Types of Exercise							
Aerobics	76 (3.1%)						
Cycling	149 (6.1%)						
Cardio Machine	115 (4.7%)						
Gardening/Yard Work	49 (2.0%)						
Hiking	74 (3.0%)						
Housework	104 (4.2%)						
Jogging/Running	430 (17.6%)						
Playing with kids	7 (0.2%)						
Snow sports (e.g., skiing)	12 (0.5%)						
Sports (i.e., soccer)	12 (0.5%)						

Swimming	22 (0.9%)
Walking	741 (30.3%)
Weight Lifting	364 (14.9%)
Yoga	74 (3.0%)
Other	154 (6.3%)
Exercise Intensity	
Minimal	230 (9.4%)
Light	588 (24.1%)
Moderate-Vigorous	1625 (66.5%)
Body Checking	
Yes	4,149 (50.5%)
No	4,061 (49.5%)
Weighing Self	
Yes	2,761 (33.6%)
No	5,449 (66.4%)

Note. Minimal = 10 minutes or less at any intensity; Light = more than 10 minutes rated 3 or lower in intensity; Moderate-Vigorous = more than 10 minutes rated 4 or higher in intensity.

Spearman's correlations were conducted to examine the *a priori* amalgamation of the motivation items into various subscales (see Table 7) for Aim 1, as there were too few items to conduct a Confirmatory Factor Analysis. Results (Table 7) indicated that specific motivation items that were combined to create a given subscale were *moderately* (0.4-0.6) to *strongly* (>0.6) correlated with one another (Akoglu, 2018). The two items that were not combined with any other items (i.e., "To feel better about my body"; "To build muscle"), shared *weak* (<0.4) correlations with one another and *moderate* to *strong* correlations with other exercise motivations. However, given that the face validity of these items did not appear to match the face validity of the items they were more strongly correlated with, these items were retained as separate, stand-alone items as planned. Finally, Spearman's correlation analyses were conducted to examine how various DE concerns were related to one another, for the purposes of assessing their suitability to be entered within the same model for Aim 3 (Table 8). Results from Table 8 indicated *moderate* to *strong* correlations between each of the three DE concern variables.

However, all correlations are below suggested threshold of 0.8 for suggesting multicollinearity (Berry & Feldman, 1985), supporting the planned analyses to enter these three variables into the same model(s).

Table 7. Spearman's Correlations between various motivations for exercise.

	Improve Mood	Relieve Stress	Lose Weight	Burn Calories	Control Weight	Anxious If I Don't	Feel Guilty	Something I Have To	Training Schedule	Feel Better About Body	Build Muscle
Improve Mood	**1**	**.791****	.241**	.279**	.284**	.444**	.336**	.340**	.400**	.552**	.337**
Relieve Stress	**.791****	**1**	.268**	.309**	.305**	.483**	.346**	.343**	.399**	.553**	.314**
Lose Weight	.241**	.268**	**1**	**.761****	**.836****	.453**	.460**	.435**	.262**	.493**	.236**
Burn Calories	.279**	.309**	**.761****	**1**	**.729****	.530**	.527**	.553**	.388**	.531**	.234**
Control Weight	.284**	.305**	**.836****	**.729****	**1**	.477**	.477**	.434**	.287**	.540**	.308**
Anxious If I Don't	.444**	.483**	.453**	.530**	.477**	**1**	**.695****	.584**	.473**	.582**	.342**
Feel Guilty	.336**	.346**	.460**	.527**	.477**	**.695****	**1**	**.682****	.452**	.545**	.344**
Something I Have to Do	.340**	.343**	.435**	.553**	.434**	.584**	**.682****	**1**	.536**	.536**	.314**
Training Schedule	.400**	.399**	.262**	.388**	.287**	.473**	.452**	.536**	**1**	.482**	.468**
Feel Better About Body	.552**	.553**	.493**	.531**	.540**	.582**	.545**	.536**	.482**	**1**	.384**
Build Muscle	.337**	.314**	.236**	.234**	.308**	.342**	.344**	.314**	.468**	.384**	**1**

Note. Items that are combined to create a subscale, and their corresponding correlations to one another, are shaded the same color. All correlations that are considered strong (>0.6) based on Akoglu's (2018) guidelines are bolded.

Table 8. Spearman's Correlations between various DE concerns.

Variable	Shape Concerns	Eating Concerns	Eating Restraint
Shape Concerns	1	.664**	.552**
Eating Concerns	.664**	1	.589**
Eating Restraint	.552**	.589**	1

Note. * = p<.05; ** = p<.01; *** p <.005

4.2 Aim 1 Results: Motivations for Exercise

Table 9 presents coefficients for Aim 1 models investigating if DE status is associated with various motivations for exercise. In terms of significant covariates, female gender was negatively associated with most exercise motivations *except* to regulate mood and follow self-imposed rules. Older age was positively associated with exercising to regulate mood, control weight, and follow rules/training schedule. Longer exercise duration was positively associated with exercising to build muscle, while greater exercise intensity was positively associated with exercising to regulate mood, build muscle, feel better about one's body, and follow rules/training schedule. Finally, number of exercise observations (time), was negatively associated with exercising to regulate mood, control weight, follow rules/training schedule, and feel better about one's body.

Focal effects revealed that DE status was significantly and positively associated with all motivations for exercise, *except* for building muscle. In support of **Hypotheses 1a-c**, those with a recent history of engaging in DE behaviours had significantly stronger endorsement of exercising to control their weight (**1a**), to avoid negative feelings (**1b**), and to follow exercise rules/training schedule (**1c**), relative to those without recent DE. Although no additional hypotheses were made for the remaining three motivations for exercise, those with a recent history of DE also had

significantly stronger endorsement of exercising to regulate mood and to feel better about one's body, relative to those without recent DE.

Table 9. Aim 1. results examining if DE status predicts exercise motivations.

Parameters	**Mood Regulation**	**Weight Control**	**Avoiding Negative Affect**	**Rule Following**	**Feel Better About Body**	**Build Muscle**
Fixed Effect	*Coefficients (Standard Error)*					
Intercept ($ß_{00}$)	11.06(.410)***	12.16(.631)***	8.62(.375)***	9.35(.356)***	5.01(.178)***	5.12(.180)***
Depression ($ß_{01}$)	-0.07(.038)	0.05(.095)	0.07(.065)	-0.06(.055)	-0.00(.026)	0.01(.031)
Anxiety ($ß_{02}$)	0.07(.038)	0.08(.101)	0.028(.067)	0.02(.059)	0.03(.030)	-0.01(.032)
Gender ($ß_{03}$)	-0.01(.256)	-1.76(.634)**	-1.76(.420)***	-2.55(.383)	-0.60(.178)***	-0.44(.194)*
Age ($ß_{04}$)	0.03(.012)**	0.11(.032)***	0.03(.018)	0.04(.018)*	0.01(.010)	-0.00(.010)
DE Status ($ß_{05}$)	0.56(.268)*	3.50(.625)***	1.16(.431)**	1.37(.387)***	.98(.178)***	0.08(0.201)
Exercise Duration ($ß_{10}$)	.06(.034)	0.01(.039)	0.01(.032)	0.04(.047)	.00(.021)	0.04(.020)*
Exercise Intensity ($ß_{20}$)	.14(.050)**	0.09(.060)	0.04(.061)	0.17(.054)***	.15(.032)***	0.11(.034)***
Time ($ß_{30}$)	-.079(.024)***	-0.066(.032)*	-0.00(.018)	-0.06(.017)***	-0.04(.013)**	-0.02(.013)
Random Effects	*Variance Component (Standard Deviation)*					
Intercept (u_{0i})	3.48(1.864)***	21.97(4.69)***	9.07(3.012)***	7.65(2.766)	1.75(1.324)***	2.09(1.45)***
Exercise Duration (u_{1i})	0.04(.204)	0.02(.132)	0.01(.103)	.209(.458)	0.01(.113)	.00(.056)*
Exercise Intensity (u_{2i})	0.08(.281)*	0.03(.172)	0.19(.441)*	.092(.304)	.04(.195)*	.06(.240)*
Time (u_{3i})	0.06(.248)***	0.107(.326)***	0.02(.144)***	.016(.128)	.02(.125)***	0.02(.131)***
Residual (σ^2)	1.89(1.375)	3.66(1.914)	2.35(.533)	1.868(1.367)	.76(.873)	0.69(.831)

Note. * = p<.05; ** = p<.01; *** p <.005

Table 10 presents coefficients for Aim 1 models examining if various DE concerns are associated with different motivations for exercise. In terms of significant covariates, female gender was negatively associated with exercising to avoid negative affect, follow self-imposed rules, and to feel better about one's body. Older age was positively associated with all motivations for exercise, *except* exercising to build muscle. Longer exercise duration was positively associated with stronger endorsement of exercising to build muscle, while greater exercise intensity was positively associated with stronger endorsement of exercising to regulate mood, follow rules/training schedule, feel better about one's body, and to build muscle. Finally, number of exercise observations (time), was negatively associated with most motivations for exercise, with the exception of avoiding negative affect and building muscle.

Focal effects revealed that restrained eating was associated with all motivations for exercise, *except* exercising to build muscle. In support of **Hypothesis 1e**, those with more restrained eating, relative to the sample mean, had significantly stronger endorsement of exercising to control their weight. Although hypotheses were not made for other exercise motivations, those with more restrained eating, relative to the sample mean, also had significantly stronger endorsement of exercising to regulate their mood, feel better about their body, avoid negative feelings, and follow exercise rules/training schedule, relative to those with less restrained eating. In support of **Hypothesis 1f**, those with greater shape concerns, relative to the sample mean, had significantly stronger endorsement of exercising to control their weight, relative to those with fewer shape concerns. Contrary to **Hypothesis 1g**, shape concerns were *not* associated with exercising to avoid negative affect. Although no additional hypotheses were made for other exercise motivations, those with greater shape concerns, relative to the sample mean, had significantly stronger endorsement of exercising to feel better about their body,

relative to those with fewer shape concerns. No hypotheses were made for eating concerns, and results revealed that eating concerns were not significantly associated with any exercise motivations.

Table 10. Aim 1 results examining if DE concerns predict exercise motivations.

Outcome	**Mood Regulation**	**Weight Control**	**Avoiding Negative Affect**	**Rule Following**	**Feel Better About Body**	**Build Muscle**
Fixed Effect	*Coefficients (Standard Error)*					
Intercept (ß$_{00}$)	11.18(.209)***	13.42(.420)***	8.85(.297)***	9.71(.291)***	5.36(.137)***	5.09(.150)***
Depression (ß$_{01}$)	-0.07(.038)	-0.08(.081)	0.01(.065)	-0.07(.057)	-0.02(.03)	0.01(.031)
Anxiety (ß$_{02}$)	0.07(.040)	-0.00(.084)	0.00(.067)	0.02(.063)	.02(.03)	-0.02(.032)
Gender (ß$_{03}$)	0.23(.268)	-1.00(.548)	-1.23(.420)***	-2.09(.408)***	-0.375(.178)*	-0.35(.202)
Age (ß$_{04}$)	0.03(.011)**	0.12(.026)***	0.04(.018)*	0.04(.017)*	.02(.009)*	-.00(.010)
Restraint (ß$_{05}$)	0.05(.020)**	0.25(.049)***	1.13(.431)***	0.12(.039)**	.067(.014)***	0.02(.016)
Eating Concerns (ß$_{06}$)	0.04(.025)	0.03(.059)	0.07(.046)	0.05(.043)	0.00(.017)	0.03(.022)
Shape Concerns (ß$_{07}$)	-0.03(.016)	0.17(.033)***	0.03(.025)	-0.00(.025)	0.02(.010)*	-.01(.013)
Exercise Duration (ß$_{10}$)	.06(.034)	0.01(.039)	0.02(.032)	0.05(.047)	0.01(.021)	0.04(.019)*
Exercise Intensity (ß$_{20}$)	.14(.050)**	0.08(.061)	0.03(.061)	0.17(.054)**	0.14(.032)***	0.11(.034)***
Time (ß$_{30}$)	-.079(.024)***	-0.068(.032)*	-0.00(.018)	-0.06(.017)***	-0.39(.012)**	-0.02(.013)
Random Effects	*Variance Component (Standard Deviation)*					
Intercept (u_{0i})	3.48(1.830)***	15.00(4.67)***	7.45(2.730)***	7.20(2.68)***	1.48(1.219)***	2.062(1.435)***
Exercise Duration (u_{1i})	.04(.205)	0.02(.143)	0.01(.106)	0.21(.460)***	0.012(.110)	.00(.057)
Exercise Intensity (u_{2i})	.08(.286)*	0.04(.191)	0.20(.450)*	.09(.300)*	0.04(.202)	.06(.241)***
Time (u_{3i})	0.06(.249)***	0.11(.330)***	0.02(.144)***	.016(.129)***	0.02(.124)***	0.02(.131)***

Residual (σ^2)	1.89(1.375)	3.65(1.910)	2.35(1.533)	1.87(1.366)	0.76(.874)	.691(.831)

Note. * = p<.05; ** = p<.01; *** p <.005

4.3 Aim 2 Results: Consequences of Exercise on Mood and Body

Table 11 presents coefficients for Aim 2 models pertaining to changes in mood following exercise. In terms of significant covariates, female gender was negatively associated with mood scores before exercise. Exercise duration and intensity was positively associated with mood before exercise. Finally, having a recent history of DE was positively associated with mood before exercise.

Focal effects revealed that, in support of **Hypothesis 2a**, mood significantly improved from pre- to post-exercise. Next, in support of **Hypothesis 2b**, DE status significantly moderated this association. Specifically, those with a recent history of DE had smaller increases in mood from pre- to post-exercise, relative to those without a recent history of DE. In other words, how much mood improves from pre- to post-exercise differs based on DE history, such that those with recent DE experience smaller improvements in mood from exercising, although they still experienced a net gain in mood.

Table 11. Aim 2 results examining if DE status predicts changes in mood scores from pre- and post-exercise.

Parameters	**Mood**
Fixed Effect	*Coefficients (Standard Error)*
Intercept ($ß_{00}$)	6.84(.186)***
Depression ($ß_{01}$)	-0.04(.029)
Anxiety ($ß_{02}$)	-0.03(.029)
Gender ($ß_{03}$)	-0.62(.187)***
Age ($ß_{04}$)	0.016(.009)
DE Status ($ß_{05}$)	.422(.204)*

Exercise Duration ($ß_{10}$)	0.09(.023)***
Exercise Intensity ($ß_{20}$)	0.15(.030)***
Time ($ß_{30}$)	0.001(.011)
Pre- versus Post-Exercise (Assessment) ($ß_{40}$)	0.84(.081)***
DE Status ($ß_{41}$)	-0.266(.122)*
Random Effects	*Variance Component (Standard Deviation)*
Intercept (u_{0i})	1.950(1.397)***
Exercise Duration (u_{1i})	0.034(.185)***
Exercise Intensity (u_{2i})	0.021(.144)
Time (u_{3i})	0.008(.087)***
Pre- and Post-Exercise(u_{4i})	0.425(.652)***
Residual (σ^2)	1.532(1.238)

Note. * = p<.05; ** = p<.01; *** p <.005

Table 12 presents coefficients for Aim 2 models pertaining to changes in body satisfaction following exercise. In terms of significant covariates, depression scores were negatively associated with body satisfaction before exercising. Female gender was negatively associated with body satisfaction before exercising. Exercise duration and intensity were positively associated with body satisfaction before exercise.

Focal effects revealed that in support of **Hypothesis 2c**, body satisfaction significantly increased from pre- to post-exercise. However, contrary to **Hypothesis 2d,** DE status did *not* significantly moderate this association. In other words, exercising is associated with improvements in body satisfaction, regardless of DE status.

Table 12. Aim 2 results examining if DE status predicts changes in body satisfaction scores from pre- and post-exercise.

Parameters	**Body Satisfaction**

Fixed Effect	*Coefficients (Standard Error)*
Intercept (ß$_{00}$)	6.68(.222)***
Depression (ß$_{01}$)	-0.08(.029)**
Anxiety (ß$_{02}$)	-0.01(.029)
Gender (ß$_{03}$)	-1.15(.231)***
Age (ß$_{04}$)	0.00(.011)
DE Status (ß$_{05}$)	0.26(.244)
Exercise Duration (ß$_{10}$)	0.04(.019)*
Exercise Intensity (ß$_{20}$)	0.10(.026)***
Time (ß$_{30}$)	0.01(.012)
Pre- versus Post-Exercise (Assessment) (ß$_{40}$)	0.66(.084)***
DE Status (*ß$_{41}$*)	-0.08(.115)
Random Effects	*Variance Component (Standard Deviation)*
Intercept (u_{0i})	3.06(1.750)***
Exercise Duration (u_{1i})	0.02(.140)***
Exercise Intensity (u_{2i})	0.02(.127)
Time (u_{3i})	0.01(.115)***
Pre- and Post-Exercise(u_{4i})	0.48(.695)***
Residual (σ^2)	1.11(1.056)

Note. * = p<.05; ** = p<.01; *** p <.005

4.4 Aim 3 Results: Consequences of Exercise on Body Checking and Self-Weighing

Table 13 presents coefficients for Aim 3 models investigating if level of exercise is associated with body checking, and if DE status moderates this association. In terms of significant covariates, female gender was negatively associated with odds of body checking.

Focal effects revealed that there were no associations between level of exercise (i.e., light or moderate-vigorous exercise, versus no/minimal exercise) and body checking. In other words,

the exercise duration and intensity are not related to instances of same-day body checking. Moreover, contrary to **Hypothesis 3a**, DE status did not have a significant moderating effect on the association between moderate-vigorous exercise and body checking. Although no hypothesis was made for light exercise, DE status also did not significantly moderate the association between light exercise and body checking.

Table 13. Aim 3 results examining if DE status predicts body checking behaviours.

Parameters	**Body Checking**		
Fixed Effect	*Coefficients (Standard Error)*	*Odds Ratio*	*Confidence Interval*
Intercept ($ß_{00}$)	-.44(.367)	0.64	(0.313,1.331)
Depression ($ß_{01}$)	0.06(.040)	1.06	(.979,1.148)
Anxiety ($ß_{02}$)	-0.03(.040)	0.97	(0.900,1.055)
Gender ($ß_{03}$)	-0.54(.256)*	0.58	(0.350,0.961)
Age ($ß_{04}$)	-0.02(.014)	0.97	(0.949,1.004)
DE Status ($ß_{05}$)	0.396(.428)	1.49	(0.639,3.456)
Time ($ß_{10}$)	0.03(.014)	1.03	(0.997,1.055)
Light Exercise ($ß_{20}$)	0.49(.318)	1.63	(0.872,3.046)
DE Status ($ß_{21}$)	-0.01(.492)	0.99	(0.375,2.605)
Moderate-Vigorous Exercise ($ß_{30}$)	0.526(.306)	1.69	(0.926,3.093)
DE Status ($ß_{31}$)	0.076(.463)	1.08	(0.433,2.688)
Random Effects	*Variance Component (Standard Deviation)*		
Intercept (u_{0i})	9.845(3.138)***		
Time (u_{1i})	0.285(.534)***		
Light Exercise (u_{2i})	5.018(2.240)***		
Moderate-Vigorous Exercise (u_{3i})	4.908(2.15)**		

Note. * = p<.05; ** = p<.01; *** p <.005

Table 14 presents coefficients for Aim 3 models investigating if level of exercise is associated with self-weighing, and if DE status moderates this association. In terms of significant covariates, female gender was positively associated with odds of self-weighing. Age and days in study were positively associated with self-weighing.

Focal effects revealed that there were no associations between level of exercise, namely the duration and intensity of exercise (light, moderate-vigorous, versus no/minimal), and same-day self-weighing. Moreover, contrary to **Hypothesis 3b**, DE status did not significantly moderate the association between moderate-vigorous exercise and same-day self-weighing. Although no hypothesis was made, DE status also did not significantly moderate the association between light exercise and same-day self-weighing.

Table 14. Aim 3 results examining if DE status predicts self-weighing behaviours.

Parameters	**Self-Weighing**		
Fixed Effect	*Coefficients (Standard Error)*	*Odds Ratio*	*Confidence Interval*
Intercept ($ß_{00}$)	-0.67(.241)**	0.51	(0.319,0.826)
Depression ($ß_{01}$)	0.02(.027)	1.02	(0.968,1.078)
Anxiety ($ß_{02}$)	-0.05 (.026)	0.96	(0.906,1.007)
Gender ($ß_{03}$)	2.196(.194)***	0.36	(0.245,0.525)
Age ($ß_{04}$)	0.045(.010)*	1.02	(1.002,1.044)
DE Status ($ß_{05}$)	0.858(.307)	1.39	(0.760,2.547)
Time ($ß_{10}$)	0.133(.009)***	1.03	(1.015,1.053)
Light Exercise ($ß_{20}$)	0.10(.171)	1.11	(0.792,1.552))
DE Status ($ß_{21}$)	0.11(.296)	1.12	(0.623,2.001)
Moderate-Vigorous Exercise ($ß_{30}$)	-0.01(.168)	0.99	(0.711,1.380)
DE Status ($ß_{31}$)	0.53(.293)	1.70	(0.958,3.032)
Random Effects	*Variance Component (Standard Deviation)*		
Intercept (u_{0i})	9.158(3.026)***		

Time (u_{1i})	0.162(.403)***
Light Exercise (u_{2i})	5.293(2.301)
Moderate-Vigorous Exercise (u_{3i})	6.283(2.507)**

Chapter 5: Discussion

The overarching goal of the current study was to better understand the exercise experiences of those with recent DE to help inform the circumstances in which exercise may be helpful or harmful for this subpopulation. The lack of a clear operationalization of "disordered exercise" has made it difficult for researchers to disentangle the impacts of healthy versus disordered exercise among those with eating pathology. Instead, the current study examined the experiences and consequences of exercise for those with recent engagement in DE, relative to those without a recent engagement in DE, to illuminate exercise experiences that are unique to those with recent DE. Results from the current study extend our understanding of exercise experiences for those with recent DE in several ways. First, the results indicate that those with recent DE, and those with greater DE-related concerns, more strongly endorse several exercise motivations than those without recent DE or fewer DE concerns, providing insight into the different reasons *why* this subpopulation engages in exercise relative to those without recent DE. Next, exercising provides mood and body satisfaction benefits to those with DE. However, the benefits to mood are smaller relative to those without recent DE, whereas there was no difference between groups in benefits to body satisfaction. These results inform ways that exercise can be beneficial to those with recent DE. Finally, intensity and duration of exercise were not related to same-day body checking or self-weighing behaviours, indicating that vigor of exercise may not carry risks for engagement in compulsive behaviours for those with recent DE. The implications of each of these three findings are discussed in detail below.

Motivations for Exercise

In support of **Hypotheses 1a-c**, those with a recent history of DE more strongly endorsed exercising to control their weight, avoid negative feelings, and follow exercise rules/training

schedule, relative to those without recent DE, even when controlling for gender, age, and anxiety and depressive symptoms. These results align with several studies that have found that exercising for weight control, to avoid negative affect, and having compulsive or rigid expectations for one's exercise expectations differentiates those with and without recent DE pathology (Meyer et al., 2016; Naylor et al., 2011; Schlegl et al., 2018; Taranis et al., 2011). Given that disordered exercise is more prevalent among those with DE, and that these motivations are more strongly endorsed by those with DE relative to those without, the current results also indicate that these motivations may be important to consider in the context of identifying risk for disordered exercise. Indeed, a study conducted by White and colleagues (2023) indicates that exercising to avoid of negative emotions and for weight control, and performed in a rule-driven manner, were associated with the greatest number of ED symptoms and/or body dissatisfaction among undergraduates. The authors concluded that monitoring for exercise that is motivated by a desire to lose weight and/or to compensate for eating), to avoid distress associated with skipping exercise, and inhabits certain behavioral features like rigidity in exercise routine differentiate maladaptive from adaptive exercise and should be targeted within intervention contexts.

Body preoccupation, body dissatisfaction, and overvaluation of weight and shape are hallmark features of those with eating pathology (APA, 2022; Brechan et al., 2015; Jimenez-Lima et al., 2022). Thus, some individuals with DE search for ways to control their weight and change their shape, such as by engaging in compensatory behaviours including exercise (APA, 2022). Indeed, past research and theories emphasize the salience of weight control as a motivating factor for exercise engagement for those with eating pathology (Cash et al., 1994; Meyer et al., 2011; Mond & Calogero, 2009). Results from the current study are consistent with this, as those with recent DE had stronger endorsement of using exercise to specifically change

their weight, indicating that this is a more important reasons for exercise relative to those without recent DE. While those without eating pathology more strongly endorse health and fitness related reasons for engaging in exercise (Bratland-Sanda et al., 2010), those with eating pathology more strongly endorse reasons related to attractiveness, appearance, body tone, weight control, and how one feels or perceives their body (Bratland-Sanda et al., 2010; Mond & Calogero, 2009). Those with eating pathology may be more vulnerable to, or may have more deeply internalized, sociocultural messaging depicting the ideal female body size as slim and that lower weight is associated with higher socioeconomic status (Striegel-Moore & Bulik, 2007). However, a caveat to this finding is that exercising for health/fitness reasons versus weight control may actually be more conceptually similar than they are distinct in the current study. There are documented associations between weight and various health outcomes (Tappia et al., 2020), and thus, exercising for weight-loss may be interpreted by some participants as a reason related to their health, rather than their appearance. The current study did not examine the motivation that underlies the weight loss, namely health versus appearance, limiting our understanding of the motive that underlies exercising for weight loss. However, a prior study found that health motivations are less important to those with eating pathology relative to those without (Bratland-Sanda et al., 2010). Clinically, the results suggest that screening to determine if those with eating pathology are exercising for reasons related to their appearance versus their health, may help to further elucidate risk for their exercise to become disordered.

Congruent with past research suggesting that those with DE often experience guilt when they miss a workout, as it is a missed opportunity to burn calories (Bardone-cone et al., 2017; Meyer et al., 2016; Mond & Calogero, 2009; Naylor et al., 2011; Schlegl et al., 2018; Taranis et al., 2011), the results revealed that those with recent DE more strongly endorse exercising to

avoid the guilt and distress associated with missing a workout. Those with eating pathology may engage in exercise to avoid or remove an aversive experience, and thus, their engagement in exercise may be negatively reinforced. This helps to inform theoretical models about why exercise or disordered exercise engagement occurs, even if it produces negative outcomes for those with eating pathology (e.g., burnout, exhaustion, injury, disappointment; Lichtenstein et al., 2020; Meyer et al., 2011; Vansteelandt et al., 2007). This is closely tied to additional results from the current study demonstrating that those with recent DE more strongly endorse exercising because they feel they must, or because it is part of their training schedule. Those with eating pathology appear to have a strict schedule and expectations for their engagement in exercise, and low tolerance for perceived failure in meeting such goals: they feel salient guilt and distress when they do not meet their self-imposed expectations (Meyer et al., 2011; Taranis et al., 2011). These rigid expectations are likely a reflection of the increased perfectionism, desire for control, compulsivity, neuroticism, and reward dependence characteristics that are more strongly observed among those with eating pathology relative to those without (Levallius et al., 2015). The personality structure of those with eating pathology likely holds a critical role in their vulnerability of engaging in exercise that is characterized by rigidity, and to experience distress when their self-imposed expectations are not met (Lichtenstein et al., 2017). Avoiding negative affective responses to exercise (Stevens et al., 2020), which may be driven by one's own expectations for their exercise, may be hallmark feature of exercise among those with recent DE and inform another reason why this subpopulation engages in exercise.

Although not hypothesized, our results also indicate that those with recent DE more strongly endorsed exercising to improve one's mood, relative to those without recent DE. While some studies have not found group differences or associations between eating pathology

symptoms and exercising for mood improvement (Chan et al., 2019; Meyer et al., 2016; Taranis et al., 2011), other studies using clinical samples found those with Eating Disorders to have greater endorsement of exercising for mood improvement relative to those without (Naylor et al., 2011; Schlegl et al., 2018). The studies do not outline the types of exercise that participants had engaged in (Meyer et al., 2016; Schlegl et al., 2018; Taranis et al., 2011). These mixed results may be due to systematic differences in the type of exercise that participants are engaging in across the studies, and the associated motivations for engaging in said type of exercise. It could be that individuals are motivated to engage in some forms of exercise, such as running (Oswald et al., 2020), for the anticipated mood benefits, but may anticipate other benefits, such as distress reduction, for other types of exercise like yoga (Harkess et al, 2016). Indeed, a review concluded that intensity, duration, and type of exercise engaged in appear to have differential impacts on mood improvements (Chan et al., 2019). Specifically, Chan and colleagues (2019) found that anaerobic exercise, particularly at a moderate intensity, provides clear benefits to mood, while the impact of aerobic at various intensities has unclear associations to mood (Chan et al., 2019). Further, the review concluded that exercise lasting 10 minutes or longer is sufficient to improve mood, with no additional benefits for longer durations. The quantitative features and type of exercise engaged in may impact motivations for exercise, and the related expectations around mood improvement, leading to mixed results across studies. Alternatively, different proportions of eating disorder diagnoses across the studies' samples may explain the different results; those with different diagnoses may have different motivations for exercising and expected impacts on mood (Naylor et al., 2011; Schlegl et al., 2018). For example, those who engage in binge eating episodes may be motivated to engage in exercise to improve their mood, whereas those with low weight, may be more motivated to exercise to burn calories but do not have expectations for

mood improvement. Future research that explicitly examines the impacts of different types of exercise and different types of eating pathology presentations on mood, may further illuminate why exercise motivations to improve mood vary across studies.

Along with improving mood, those with recent DE had stronger endorsement of exercising to feel better about one's body, relative to those without recent DE. Stronger endorsement of exercising to improve mood and perceptions about their body among those with recent DE may be due to the difficulties with mood regulation and high rates of body dissatisfaction that this subpopulation experiences (Brown et al., 2020; Jiménez-Limas et al., 2022; Leppanen et al., 2022). Given these internal difficulties, those with recent eating pathology may be more likely to seek out external, controllable behaviours, such as exercise, as methods of regulating or improving their mood and how they feel about their body (Lawson et al., 2007). Similarly, the study found that those with greater severity of DE-related concerns and cognitions also more strongly endorsed mood improvement and changing perceptions of one's body relative to those with lesser severity. Indeed, emotion regulation difficulties appear to be more salient at greater severities of eating pathology, and among those with higher BMI relative to lower (Andreescu et al., 2023; Leppanen et al., 2022). Further, researchers have hypothesized that motivations for exercise may shift across phases of illness and eating pathology severity, with those in earlier and more severe phases of illness exercising for weight-related reasons, while those with more chronic or less severe eating pathology exercising for affect regulation concerns (Schlegl et al., 2018). Differences across samples in terms of eating pathology severity may have contributed to mixed results pertaining to mood improvement across studies. Given that the current sample has less severe DE relative to clinical samples, it fits that exercising for affect regulation and body satisfaction were more relevant to those with recent DE only. Together, it

appears that regulating one's emotional state, and how they feel about their body, are key reasons for those recent DE to engage in exercise.

Results from the current study support that greater severity of DE-related concerns is more strongly associated with several motivations for exercise relative to those with less severe concerns. Those with more challenges with both restrained eating and shape concerns more strongly endorsed exercising to control weight (**Hypotheses 1e-f**) and change how they feel about their body, while only those with more restrained eating more strongly endorsed exercising to improve their mood, avoid negative affect, and follow rules/training schedules, relative to those with fewer of such DE-related concerns. There were no associations between shape concerns and exercising to avoid guilt and distress (**Hypothesis 1g was unsupported**), which is surprising given that those with greater shape concerns may feel guilty when they do not exercise, as it may be perceived as a missed opportunity to change their weight or shape. Additional research is needed to replicate and expand in this null result. However, in general, the results suggest that severity of DE-related concerns are positively associated with endorsement of several exercise motivations, indicating that those with greater eating pathology concerns and symptoms may actually have clearer ideas for why they are exercising, and greater expectations for anticipated exercise outcomes, relative to those with fewer DE concerns/symptoms. Again, this may be due to those with worse DE symptoms having greater emotion regulation challenges and body-related concerns (Andreescu et al., 2023; Brechan et al., 2015; Leppanen et al., 2022), and therefore seeking external methods (such as exercise) to change their weight, regulate their mood, or change how they feel about their bodies. Previous research indicates that greater exercise dependence (e.g., exercising to avoid feeling tense, difficulties reducing how intense one exercises, exercising despite physical problems) moderated and strengthened the association

between eating pathology severity (as measured by the EDE-Q) and quality of life problems among those with subclinical DE (Cook et al., 2014). This indicates that characteristics and motivations for exercise, in conjunction with DE severity, can have important impacts on quality of life outcomes. The results lend support for the importance of also evaluating and considering motivations for exercise across the severity spectrum of eating pathology.

Results also indicate that severity of DE-related *behaviours* is more strongly associated with certain exercise motivations relative to the severity of DE-related *cognitions*. Specifically, it appears that severity restrained eating behaviours is a more salient predictor of exercising to regulate mood, avoid negative affect, and follow exercise rules/training schedule, above and beyond the contribution of cognitive shape and eating concerns. This may be because restrained eating reflects greater DE-related pathology relative to weight and shape concerns, as engagement in restrained eating indicates one's willingness to actively take steps to address or change their shape/weight through restricted eating, despite that food restriction may be an unpleasant or aversive experience. DE-related behaviours appear more salient to one's motivations for exercise, relative to their DE cognitions, further identifying who may be at greater risk for engaging in disordered exercise and why this subpopulation engages in exercise across a range of severities. Additional research that aims to better understand how motivations for exercise may differ across DE-related behaviours and cognitions would further illuminate how such concerns are associated with different adaptive or maladaptive motivations for exercise.

A culmination of past research and the current results suggest that exercise that is motivated by the desire to control one's weight, to change how one feels about their body, to avoid guilt/distress associated with not exercising, or follow strict rules and expectations, may be

at higher risk of being disordered (Adkins & Keel, 2005; Godoy-Izquierdo et al., 2021; Martenstyn et al., 2022; Mond et al., 2008; Mond et al., 2006). Stronger endorsement of these reasons for exercise among those with eating pathology likely reflects the greater body preoccupation and dissatisfaction, fear of weight gain, and guilt around calories and eating, and in turn, the seeking out ways to change such cognitions, feelings, and/or body shape among this subpopulation (APA, 2022; Brechan et al. 2015). These exercise motivations appear to be unique to those with eating pathology, and are positively associated with eating pathology symptoms, furthering our understanding of why rates of disordered exercise are more prevalent among those with eating pathology. Engaging in exercise with clearer and rigid expectations for outcomes, particularly if one feels compelled to engage in the exercise and the outcomes are related to appearance or to avoid guilt around not burning calories, may confer risk for exercise to proliferate to become disordered. The results call for additional research and enhanced monitoring of the psychological motivations for exercise among those with DE, rather than an exclusive focus on quantitative/behavioural aspects of exercise.

Psychological Consequences of Exercise

Next, the results revealed that on average, mood improves from pre- to post-exercise among those with and without recent DE, but with smaller benefits to mood among those with recent DE. This supports and extends a robust body of literature demonstrating the benefits that exercise can have on mood among healthy controls (Chan et al., 2019). There are several possible explanations for why people with DE experience less mood-lifting benefits from exercise. First, it is important to note that the results examine group averages: it may be that some individuals with recent DE engage in healthy exercise and experience increases in positive affect and mood, while somewhat fewer engage in disordered exercise and experience negative

affect and decreases in mood (Brunet al., 2021). Thus, when the average change in mood is obtained from all of these individuals, the result is a change in the direction of mood improvements, albeit minor. Alternatively, it could be that those with recent DE experience increases in both positive and negative affect concurrently when exercising (e.g., relief and a sense of accomplishment for exercising, but enhanced body preoccupation or distress; Lichtenstein et al., 2020; Vansteelandt et al., 2007). The negative affect may somewhat neutralize the positive affective benefits, resulting in smaller improvement in general mood, on average. This hypothesis is in line with past research that used intensive sampling methods and found mixed results in terms of changes to positive and negative affect after engagement in other types of DE behaviours, such as binge eating and purging (Engel et al., 2013; Goldschmidt et al., 2012; Haedt-Matt & Keel, 2011). Alternatively, the results indicate that those with recent DE had higher average mood scores prior to exercise, relative to those without recent DE. Those with recent DE may have experienced less mood improvement, as their mood was already positive, possibly due to the anticipation of exercise. A final explanation may pertain to the difficulties recognizing changes in emotional states that those with eating pathology often have (Bernatova & Svetlak, 2017). Therefore, while exercise may provide significant improvements in mood for those with and without recent DE, those with recent DE may report smaller increases in mood due to diminished emotional awareness and reporting capacity.

Improvements in mood from pre- to post-exercise, including for those with DE, provides partial support for mood regulation models of DE. The mood regulation model of DE purports that negative affect is temporarily reduced during or after a DE episode (such as disordered exercise), thereby *negatively* reinforcing engagement in such DE (Hawkins & Clement, 1984; Heatherton & Baumeister, 1991). The current results, however, only examined changes in

general mood, and did not parse changes in positive versus negative affect. The results suggest that experiencing an average improvement in general mood from exercise, albeit smaller improvements than non-DE counterparts, may serve to *positively* reinforce engagement in exercise for those with recent DE. This is in line with Meyer and colleagues' (2011) hypothesis that compulsive exercise is *positively* reinforced by affect regulation, along with desired weight changes. Together, the results indicate that changes mood and/or affect may operate to reinforce engagement in exercise, although further research is needed to further delineate if exercise is positively reinforced, negatively reinforced, or both. Regardless, the results helps to inform how engagement in disordered exercise persists, even if negative psychological experiences or increases in negative affect co-occur.

In support of **Hypothesis 2c**, body satisfaction increased from pre- to post-exercise, further illuminating how exercise may be positively reinforced. Although body dissatisfaction is often a core feature of DE, and that exercise may enhance focus on one's body, results from the current study indicate that exercise can be beneficial for body satisfaction for those with and without recent DE. The results partially support past research indicating that exercise under certain conditions may reduce body dissatisfaction even among those with clinical Eating Disorders (Cook et al., 2016; Srismith et al., 2020), but is tempered by other results showing that disordered or "compulsive" exercise is associated with body dissatisfaction (Freire et al., 2020; Palermo & Rancourt, 2023). It is possible that majority of the periods of exercise that occurred among those who were not disordered or were not disordered to a severity that would negatively impact body satisfaction. As such, the results indicate that unmonitored exercise may be a helpful strategy for supporting mood and body satisfaction among those with recent DE. Prior research indicates that exercise is associated with increases in self-esteem, body image, and body

satisfaction among healthy controls (Campbell & Hausenblas, 2009; Carraça et al., 2021; Cekin, 2015; LePage & Crowther, 2010). Another study found that the positive association between exercise and body satisfaction is mediated by perceived self-fatness and one's body strength among those with DE (Salci & Martin Ginis, 2017), providing insight into the mechanisms that drive such benefits to body satisfaction. The current study indicates that those with recent DE may be more similar to those without recent DE in terms of the benefits of exercise on their body satisfaction, as this association was not moderated by DE status (**Hypothesis 2d** was unsupported). That being said, there may be important factors that moderate this association among those with DE that were not examined in the current study. Additional research that further explores the conditions that may moderate the benefits of exercise on body satisfaction (i.e., moderators), such as motivation for exercise, is critical to further understand the circumstances in which exercise is more or less efficacious in improving body satisfaction. Based on the current results, it appears that exercise may be a helpful avenue to immediately improve body satisfaction for those with and without recent DE.

Behavioural Consequences of Exercise

Inconsistent with **Hypotheses 3a-b**, moderate-vigorous exercise was not associated with greater odds of engaging in same-day body checking or self-weighing among those with recent DE, relative to those without recent DE, nor was light exercise. Although research indicates that engaging in exercise can lead to increases in compulsiveness among those with Eating Disorders (Brunet et al., 2021) and more body checking among males with body dysmorphia (Zheng et al., 2021), this does not appear to be the case for body checking and self-weighing among a mixed gender sample with recent DE. It may be that the DE within the current study was not severe enough to detect any differential effects on body checking and self-weighing that may exist

between the DE status groups. Notably, the confidence intervals for light and moderate-vigorous exercise, and for the moderating effects of DE, on body checking are wide relative to the respective odds ratios, indicating that there may be a number of relationships underlying the null association between exercise and body checking. For example, a meta-analysis found positive associations between eating pathology and body checking, as well as eating pathology and body avoidance (Walker et al., 2018), indicating that individuals with recent DE may either engage in very high or very low rates of body checking, or vacillate between checking and avoidance. It could be that some individuals with recent DE have very low levels of body checking as they engage in body avoidance, while others have high levels of body checking and weighing as it is a compulsive behaviour, resulting in wide confidence intervals and an unclear moderation effect. Indeed, research indicates that body checking frequency typically changes course over the course of eating pathology illness, with checking becoming more habitual and frequent as the illness worsens (Steglich-Petersen & Vara, 2023). Other research indicates that body checking can become aversive for some, and thus avoided (Fairburn et al., 1999), while other research indicates that avoidance and checking are not mutually exclusive and can alternate (Shafran et al., 2004). The researchers posit that body checking continues to occur, as it positively reinforced by the prospect of a reward, namely, disconfirming that one is overweight (albeit that this reward is often never fully disconfirmed or believed by the individual, and so, checking continues). It may be that in the current sample, a mix of very low frequency of checking in those with less severe eating pathology, along with higher frequencies of checking among those with greater pathology, or a mix of checking and avoidance, is creating muddied results.

Another explanation for the null association between moderate-vigorous exercise and body checking, but wide confidence intervals, may be related to the role of gender. Some studies

have found that weight and shape concerns were associated with body avoidance in clinical and non-clinical female samples (Farrell et al., 2004; Reas et al., 2006), however, less is known about males. It may be that gender moderates the association between exercise intensities and body checking, resulting in different patterns of body checking within the mixed gender sample. Indeed, the gender covariate indicates that males engage in significantly more body checking than females. Given that eating pathology, body dissatisfaction, weight and shape concerns, and sociocultural pressures to be thin are more prevalent among females relative to males (APA, 2022; Buote et al., 2011; Owens et al., 2010), it may be that females experience negative emotions when they self-weigh or body check, particularly if their desired body changes are not achieved. In support of this, one study found that females were more likely to experience negative impacts to their mood from self-weighing, relative to males (Hahn et al., 2021). Therefore, exercise among females predominantly may lead to avoidance of body checking. Conversely, males may engage in more body checking behaviours to examine if their period of exercise had its intended impacts on their physique (Zheng et al., 2021), leading to a null overall association among the mixed gender sample. The moderating effect of gender on body checking may be particularly relevant at higher exercise intensities, as higher intensities may incur greater expectations, and thus potential disappointment, for the impacts of one's exercise. Future research should aim to explicitly test gender as a moderator between exercise intensities and body checking and self-weighing behaviours.

The confidence intervals were smaller for the null associations between exercise intensities and self-weighing, providing greater confidence that different intensities of exercise do not incur risk for greater odds of same-day self-weighing. Cognitive and transdiagnostic theories suggest that both body checking and avoidance may be manifestations of core DE

psychopathology and serve to maintain DE-related concerns (Shafran et al., 2004). Based on the current results, it does not appear that intensity of exercise increases risk for same-day body checking or self-weighing, including for those with and without recent DE. This provides more support that exercise may be a helpful and safe adjunct treatment for those with recent DE. However, additional research is needed to uncover underlying differential associations that exist between exercise intensities and body checking, such as factors that may moderate this association.

Clinical Implications

The goal of the current study was to better understand the experiences and consequences of exercise for those with DE to ultimately inform clinical considerations and/or recommendations around the suitability of exercise for this subpopulation. The current study provides information that can inform three key areas of clinical recommendations when addressing exercise among those with recent DE. First, motivations for engaging in exercise appear to be a clinically important area for consideration for those with recent DE who are engaging in exercise. Within a clinical setting, assessing and exploring why an individual is engaging in exercise may help to elucidate the level of risk that engaging in exercise may carry. Specifically, exercising to change one's weight, perception of one's body, follow rigid exercise expectations/training schedule, or to avoid negative affect, may be indicative that the exercise may become disordered, as these motivations are more strongly endorsed by those with recent DE and to greater severities of DE-related concerns. If these motivations are identified, it may be helpful for clinicians to support individuals in re-framing such motivations to be more adaptive, such as decreasing to reduce stress or improve strength (White et al., 2023). Specifically, exploring the values that underlie clients' motivations for exercise, and to reinforce or re-orient

individuals to values around health, longevity, strength, and self-esteem, may reduce risk for disordered exercise. Further, encouraging individuals to adapt body neutrality (i.e., taking a neutral stance towards one's body) by focusing on body functionality, body gratitude, while encouraging mindfulness and helping to restructure core beliefs that tie self-worth to one's body size (Pellizer & Wade, 2023), may help to re-orient individuals to exercising for more adaptive reasons. Conversely, clinicians may be cautious around recommending exercise to clients who strongly endorse exercising to lose weight, because they would feel guilty not to, because they feel they must adhere to rigid expectations, or because they have high expectations for how their body may change. Furthermore, evaluating clients' rigidity in their self-imposed rules expectations for their exercise routine appears clinically relevant, as disordered exercise appears to be characterized by compulsivity, perfectionism, and rigidity (Meyer et al., 2011). Introducing flexibility in expectations, exposure to when expectations are not met, and tolerance of negative emotions, may support client's in engaging with exercise in a healthy way.

Second, the mood and body satisfaction benefits that exercise offers also has important clinical implications. Encouraging clients to practice mindfulness of their mood and body satisfaction during exercise may support them in more fully experiencing any associated mood and body satisfaction promoting benefits, particularly among those with lower interoceptive or emotional awareness (Gibson, 2019). This may also help to re-orient individuals away from motivations for exercise related to weight and appearance, and towards motivations related to improving mood and their relationship with their body. Moreover, encouraging non-judgmental mindfulness may be particularly relevant to those with eating pathology who have rigid expectations around the physical and emotional impacts of their exercise. Monitoring and managing those with eating pathology's expectations around the degree of physical impacts, as

well as mood and body satisfaction benefits appears important, as it may help to ensure such individuals do not become discouraged if they experience different impacts than expected.

Finally, Cook and colleagues (2016) proposed recommendations around when exercise may be safe for those with clinical Eating Disorders, which included the following eleven themes: employ a multidisciplinary team of experts (physiology therapist, nutritionist, psychologist, etc.), monitor medical status (ensure adequate weight and nutrition status), screen for exercise-related psychopathology (exercise addiction and compulsivity), create a written contract of how therapeutic exercise will be used (outcomes, expectations, contingencies), include a psychoeducational component, focus on positive reinforcement (exercise can be used as a reward for treatment compliance, as it is often highly valued among those with eating pathology), create a graded exercise program (starting with small amounts of low intensity), begin with mild-intensity exercise, tailor the mode of exercise to the needs of the individual (those with low body weight benefit more from resistance training for weight restoration), include a nutritional component (ensuring nutritional needs are met and weight is stabilized), and debrief after exercise sessions (monitoring sensations experienced). The current study provides evidence in support of monitoring exercise-related psychopathology, however, also indicates that some of these guidelines may not be relevant to, or may not be accessible to, those with subclinical or recent DE. Specifically, the current results indicate that starting with mild-intensity exercise and adhering to a graded program may not necessarily be required as intensity of exercise does not appear to confer risk for increasing same-day self-weighing, and potentially body-checking, behaviours. However, it is important to note that other pertinent factors that would help to determine safety of exercise for those with DE, such as weight and nutrition status, were not considered in this study, which may qualify these results. Further, Cook and colleagues'

(2016) recommendations note that exercise can be used as a reward for those in recovery who comply with treatment and gain weight, which is likely to be less relevant to those with subclinical DE who are not admitted to a formal eating disorder program. The results suggest that exercise lasting 10 minutes or more provides benefits mood and body satisfaction for those with recent DE, and thus, is positively reinforcing in itself.

In sum, exercise appears to be a promising avenue as an adjunct treatment for those with DE, however, it may be beneficial for clinicians to implement, adapt, and integrate recommendations put forth by Cook and colleagues (20176) where possible. Exercise appears to be an appropriate and suitable recommendation for those with recent DE, with the caveat that their motivations for engaging in exercise, and possibly other factors that were not examined in the current study, should be closely monitored and addressed.

Limitations

Although the current study had several strengths including its large sample size, daily diary methodology, and advanced statistical analyses, there are several limitations that must also be considered. First, recent DE status was defined as experiencing three or more episodes of DE within the prior three months; the cut-off of three or more episodes of DE within the past three months to qualify as ‘recent DE’ was arbitrary. Although there were significant differences in EDE-Q subscale scores between the recent DE/no recent DE groups, the groups may not have been extreme enough to capture additional differences that may exist between those with more acute eating pathology and those without any history of eating pathology. Next, although according to the DSM-5-TR (APA, 2022), frequency of DE is a central marker of eating disorder pathology (i.e., “recurrent” episodes of restricting or bingeing/purging is a criterion for Anorexia; binge eating once a week for 3 months is a criterion for Bulimia and Binge Eating

Disorder), it does not capture qualitative features associated with DE that may provide more context to these experiences. That being said, qualitative functional impairment and distress are *not* listed as a diagnostic criterion for many eating disorders, as those with eating pathology may not have insight into the risks or impacts of their symptoms (APA, 2022). However, integrating preoccupation and/or other qualitative aspects associated with DE symptoms/engagement, in addition to frequency of DE, may better capture experiences of recent DE and may have strengthened and further differentiated the extreme group design.

Specific items pertaining to motivation(s) for exercise were combined to create subscales based on the face validity of such items, which were supported by correlation analyses. However, validating the structure of these subscales through quantitative methods (e.g., Confirmatory Factor Analysis) would strengthen the construct validity of the various motivations for exercise. Furthermore, using a multi-method approach, such as including an open-ended item that inquires about individuals' motivation for exercise, would further strengthen the study by capturing motivations for exercise that may not have been listed. Next, two exercise motivations, and mood and body satisfaction, were examined using single items that were created for the purposes of the study and were not validated to examine their sensitivity in capturing changes in endorsement over time. It is possible that the changes in mood and body satisfaction from pre- to post-exercise were either an under- or over-representation of actual changes experienced within participants due to known threats to validity that are associated with single item measures, as well as the interoceptive deficits that are often experienced by those with eating pathology (Bernatova & Svetlak, 2017; Konstantakopoulos et al., 2011). Finally, self-weighing and body checking were assessed in a dichotomous format (yes/no), which does not capture the frequency in which these behaviours occurred throughout the day. Further, the binary response option does

not capture subjective experiences related to body checking and self-weighing, such as urges to body check or self-weigh, active avoidance of these behaviours, or preoccupation and distress pertaining to these behaviours, which may have differed according to exercise levels.

Next, although daily dairy methods support the ecological validity of the study as they capture dynamic processes as they occur in real-time, or in closer temporal proximity to when they occur relative to retrospective reporting, there are some additional validity limitations to consider. Although compliance in completing the pre- and post-exercise surveys was acceptable, we did not assess the temporal proximity in which participants complete the pre- and post-exercise surveys relative to when their period of exercise actually occurred. It is possible that participants completed their pre- exercise survey several minutes to several hours before they began exercising, and similarly, and/or completed the post-exercise survey with significant lag time from when they actually finished their exercise. As such, the ecological validity of the results should be interpreted with this in mind; some results may have been susceptible to recall bias or may not have been fully representative of the experience that occurred *immediately* pre- and post-exercise. Furthermore, self-reporting may have been subject to social desirability biases. Some participants may have overreported or exaggerated their duration or intensity of exercise, or their motivations for exercise, if they felt pressured to endorse socially acceptable or perceived 'healthy' motivations for exercise (Adams et al., 2010). Others may have underreported their instances of body-checking and self-weighing if they felt self-conscious or aware of stigma that may surround these behaviours. Finally, the results only point towards changes in mood and body satisfaction whenever the post-exercise survey was completed, and does not provide information about if, and for how long, these benefits were sustained.

Moreover, while the study controlled for a number of demographic and mental health variables, as well as duration and intensity of exercise, there are extraneous factors that may have impacted the results that were not controlled for. For example, due to limits around model convergence, type of exercise was not examined or controlled for, which may hold a role in motivations or consequences around exercise. For example, walking may have different impacts on body checking relative to yoga, as the latter often occurs in form fitting clothing and/or in front of a mirror. While researchers have concluded that physical activity (i.e., unstructured and/or unplanned body movement; e.g., playing with kids) and exercise (i.e., structured and/or planned body movement with the objective of improving one's health or fitness; e.g., weight lifting [Dasso, 2019]) are separate constructs, past research examining disordered exercise rarely defines what constitutes exercise and/or physical activity and appear to use the terms physical activity and exercise interchangeably (e.g., Bamber et al., 2000; Boyd et al., 2007; Bratland-Sanda et al, 2010; El Ghoch et al., 2013). Similarly, the current study used the term exercise to capture structured (i.e., exercise) and unstructured body movement (i.e., physical activity), based on the premise that all movement would have been anticipated to some degree in order to complete the pre-exercise survey. Unplanned/incidental exercise and movement was not captured in the current study. Exclusively examining structured and planned exercise that was undertaken with the objective of improving one's fitness, may have helped to clarify associations examined within the study; structured and goal-directed exercise may carry different expectations, consequences, and impacts, relative to unstructured physical activity. Furthermore, some study participants (n = 28; 7.3% of final sample) were part of a collegiate or competitive sports team and required to adhere to a specific exercise regimen (i.e., Do you follow a regimented training program or diet), resulting in elevations on the rule-following motives scale

that might qualitatively differ from participants whose expectations or rules were self-imposed. Parsing out or excluding those who are high-level athletes, along with more detailed or open-ended response options for motivation endorsement, may provide further clarity to the nature of participants' endorsement of motivations.

Finally, the sample may not be completely representative of those with DE in the general Canadian population, however, it may be sufficiently generalizable to current or former wearable fitness tracker users with DE. Given that the current study was only open to current or former users of wearable fitness tracker, it is likely that participants were more active, or more interested in health and health tracking, than the average Canadian. This is supported by the relatively high engagement of exercise within the study (64%) relative to the 50% of Canadians that get the recommended amount of exercise each week (Government of Canada, 2023). Moreover, rates of recent DE may have been skewed higher in the current sample relative to the average Canadian, given that those who are interested in exercise and health tracking may be more vulnerable to engaging in disordered exercise and other DE behaviours (Wons et al., 2022). Further, the sample was skewed towards a younger demographic and may not be representative of experiences among older individuals who likely engage in different types, duration, and intensities of exercise. Nearly half of the sample was comprised of students, who are shown to have comparable levels of exercise engagement relative to the general Canadian population. Older undergraduate students (i.e., 20 or older), however, are more likely to meet the Canadian weekly movement guidelines relative to those aged 18 or 19 (Weatherson et al., 2021): the student portion of the sample may have had more variability in exercise relative to the general population. It may be helpful for results to be replicated within a broad sample of Canadians,

from an evenly distributed range of socioeconomic, student, and physical activity statuses, which includes those with DE, before generalizing conclusions to the broader population.

Future Directions

The current study points towards several avenues that may be fruitful for future research. First and foremost, additional research that aims to clarify and operationalize disordered exercise would help to inform recommendations for exercise among those with DE as it would clarify which aspects of exercise are most essential in defining "disordered exercise." Further, research that aims to create exercise guidelines for those with DE by synthesizing existing literature, adapting from existing guidelines for clinical eating disorders (Cook et al., 2016), and/or conducting original research among those with DE, is needed. Specifically, studies that employ intensive sampling techniques to examine the behavioural exercise patterns (i.e., frequency, duration, intensity, etc.), as well as the emotional (i.e., positive and negative affect, distress), psychological (i.e., body preoccupation, body satisfaction, etc.) and behavioural consequences (i.e., injury, interference with other activities) of exercise, would inform understanding of what disordered exercise looks like among this subpopulation and what features of such exercise lead to negative consequences. These results can be used to derive more relevant and thorough exercise guidelines for those with DE.

Further comparing motivations for exercise between those with and without DE, but using more clinically extreme groups (e.g., those with more frequent recent DE versus those with no history of DE), would help to substantiate the results that were found within the current study. Further, examining motivations for exercise between different DE symptoms presentations (e.g., those with predominantly restricting behaviours, those with binge eating and restricting behaviours, etc.) would elucidate how motivations for exercise, and possibly risk for disordered

exercise, differs by DE symptom constellations. However, it is important to note that motivations for exercise are just one piece of evaluating risk for disordered exercise (i.e., weight and nutrition status are likely more important), however, for those with recent DE, it may be a helpful, additional indicator for risk. Additional research that explores and identifies other indicators for risk at the subclinical level, such as personality, exercise plan and behaviours, distress around exercise, would be helpful to build a more cohesive risk model for engagement in disordered exercise. Moreover, exploring and identifying motivations for exercise that may be adaptive and lead to positive psychological outcomes, including for those with eating pathology (such as a focus on health and fitness-related motivations; Bratland-Sanda et al., 2010), would be helpful. Substantiating adaptive motivations would provide clinical direction around how maladaptive motivations for exercise could be reframed or changed within the context of treatment.

Another area for future research may be examining if different types of exercise, and exercise formats (e.g., small and large group classes, individual workout sessions) have differential impacts on exercise outcomes such as mood, body satisfaction, and distress. It may be that exercise that involves a high level of attention to the body may have a greater likelihood of eliciting negative outcomes, whereas exercise that requires less body consciousness may carry a lower likelihood. Another specific avenue for future research may be to examine how long positive impacts of exercise, such as on mood and body satisfaction, are sustained. Further, examining if there is a dose- response between exercise and positive benefits would help to inform the duration and intensity of exercise needed to experience such improvements among those with DE, and if such benefits accrue overtime with consistent exercise, particularly given that prior research indicates that highly intensive exercise may elicit displeasure (Stevens et al.,

2020). Intensive sampling methods over multi-day protocols could address such research questions.

Additional research is also needed to clarify the specific emotional processes that surround engagement in exercise for those with eating pathology, ideally using intensive ecological momentary assessment techniques, mediation and path analysis statistical techniques, and individuals with a range of eating pathology severities. While results from the current study point to improvements in general mood, which may function to positively reinforce engagement in exercise among these individuals, a more detailed understanding of the emotional processes would provide insight into: 1) the specific emotions that are experienced in the context of exercise, 2) if negative and positive emotions co-occur, 3) the relative salience of each emotion, and 4) if emotional processes differ at different severities at eating pathology. Obtaining a more detailed understanding of the emotional sequelae of exercise engagement would support these individuals and their clinicians in building insight into the potential emotion regulation function of their exercise, in developing alternative emotion regulation strategies to replace maladaptive exercise, and in better understanding if exercise recommendations should differ across pathology severities. A prior review indicates that disordered exercise can lead to more body preoccupation and dissatisfaction among those with clinical eating pathology (Meyer et al., 2011), however, highly monitored exercise may be beneficial for those with clinical eating pathology (Cook et al., 2016). Given that highly monitored exercise may not be available to those with DE, examining unmonitored exercise and body satisfaction across a range of DE severities would help clarify if, and at what point, outcomes differ across severity levels. This information would allow clinicians to best harness exercise within the context of treatment, and to avoid situations that may be detrimental to body satisfaction. In sum, future research that aims to further explore and

clarify the experiences and consequences of exercise for those with eating pathology to help ensure that exercise recommendations are clinically efficient and safe, would be of great benefit to the field.

Conclusion

Cook and colleagues' (2016) systematic review identified 11 themes of techniques that have been successful in using exercise as a safe, adjunct therapeutic treatment in the context of clinical Eating Disorders. However, some of the recommendations may not be relevant or available to those with subclinical DE. Results of the current study can help to inform exercise considerations that may be relevant to those with recent DE. First, motivation or reason for why an individual would like to engage in exercise appears relevant, as engaging in exercise to avoid distress/guilt associated with not exercising, to control or change weight, to change how one feels about their body, or follow strict rules and expectations, appear to be more strongly endorsed to those with recent DE, and particularly those with more severe DE-related concerns. Thus, understanding patient's motivations for engaging in exercise appears to be an important aspect of monitoring exercise-related psychopathology. Next, it appears that unmonitored exercise can provide positive psychological experiences for those with recent DE, namely improvements in mood and body satisfaction. Finally, there does not appear to be risks associated with engaging in moderate-vigorous exercise in terms of increasing compulsive body checking behaviours. While clinical guidelines (Cook et al., 2016) recommend engaging in exercise under the supervision of a multidisciplinary team, that exercise programs be designed using a graded approach and begin with mild intensity, these guidelines may not be necessary among those with subclinical DE. However, other clinical guidelines, such as ensuring that nutritional needs are met and weight is stabilized, are still important factors to consider before

those with DE undertake exercise. Taken together, those with recent DE may benefit in terms of their mood and body satisfaction by engaging in the recommended 150 minutes of moderate-vigorous exercise per week (Canadian Society for Exercise Physiology, 2021), but that weight and nutrition must be considered, and self or external monitoring (i.e., by a psychologist, physiotherapist, nutritionist, primary care physician, etc.) for negative consequences of exercise is important. Under such circumstances, exercise may be a helpful adjunct treatment to those with subclinical eating pathology.

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