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Translating research to practice: Outcomes of including research-based physical activity guidelines in eating disorders treatment

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Abstract

Background: A growing body of research has identified efficacious techniques for physical activity as an adjunct to eating disorders (ED) treatment, but these effects have not yet been replicated outside of research environments. Thus, there is a need for translational research to examine the application of research-derived knowledge in real world settings.

Objective: To examine translation of research-derived physical activity guidelines to practice in an ED treatment center. It was hypothesized that the inclusion of physical activity guidelines in treatment will result in significant reductions in ED symptoms and exercise compulsions.

Methods: This cohort study examined blinded outcomes data collected at admission and discharge from treatment. Participants [N=382, M age=28.40(SD=9.17), 87.3% female, 59.68% anorexia nervosa, 14.47% BN, 6.18% BED, 1.08% ARFID, 18.81% OSFED] were grouped by level of compulsive exercise. Repeated measures ANOVA were used to examine changes between admission and discharge and group differences in treatment response for ED symptoms, exercise compulsions, and outcomes variables.

Results: Significant changes from admission to discharge from treatment were observed for all study variables. Individuals that compulsively exercise reported higher ED symptoms [$F(2,364)=14.679$, $p<.001$, $\eta 2=.075$], anxiety[$F(2,345)=8.238$, $p<.001$, $\eta 2=.046$], and difficulties in emotion regulation scores[$F(2,349)=3.140$, $p=.044$, $\eta 2=.018$] and lower quality of life [$F(2,343)=7.673$, $p=.001$, $\eta 2=.043$]. No significant interaction effects were observed for outcome variables. Moreover, the indirect effect was significant for exercise compulsions and self-compassion on the physical activity and ED symp-

toms relationship. This parallel mediation model accounted for 45.16% of the variance in the relationship among physical activity behavior and ED symptoms.

Conclusions: Research-derived guidelines for the use of physical activity in ED treatment can successfully be translated to real-world clinical settings. Thus, this study provides evidence for emerging therapeutic techniques that may be adopted in clinical settings. Implications and next steps for translational research are discussed.

Keywords: eating disorders; exercise; translation to practice; dissemination; clinical guidelines; dysfunctional exercise; physical activity

1.INTRODUCTION

Eating disorders (ED) are a group of mental illnesses (e.g., anorexia nervosa (AN), bulimia nervosa (BN), binge-eating disorder (BED), avoidant/restrictive food intake disorder (ARFID), & other specified feeding and eating disorders (OSFED)) characterized by persistent disturbances of eating or eating-related behaviors that result in significant psychosocial impairment,[1,2] reduced quality of life, substantially increased mortality, and direct and indirect financial burdens.[3] Overall prevalence of EDs range between 2.0% and 13.5% and have been increasing over recent years.[2] Treatments tend to be lengthy, intense, and expensive.[3] Furthermore, individuals seeking treatment use health services more frequently than individuals without ED.[4] In a recent study examining hospital readmissions for a variety of psychiatric illness, ED were unique in that a significant relationship was found whereby fewer number of days in treatment strongly predicted readmission within one year of initial discharge.[5] Therefore, the combined severe nature of ED, high cost of treatment, added healthcare burden, high mortality, and risk of relapse provide substantial and rational support for examining efficacious, easily disseminated, and cost-effective ED treatment.

Factors that may improve ED treatment must be able to impact multidimensional factors that have been identified in the etiology of ED.[6] Simply said, it may be more parsimonious to identify treatment strategies that impact both psychological and physiological processes, and therefore provide a greater impact on the progression of multiple ED factors. Accordingly, the comprehensive neurostructural, neurocognitive, physical, and social benefits provided by physical activity have led researchers to consider physical activity as an adjunct to ED treatment.[7] The beneficial effects of therapeutic forms of physical activity have been as or more effective as standard ED treatments, such as cognitive behavioral therapy or nutritional counseling.[8,9] Several literature reviews have concluded that pairing supervised physical activity with psychotherapy and psychoeducation can be effective.[10-18] It is important to note that none of these reviews reported adverse effects of including physical activity with ED treatment. In fact, several reviews have explicitly stated that when nutritional needs are satisfied, physical activity may be safe.[13,18] These results are encouraging and suggest that under close multidisciplinary supervision and in the absence of medical contraindications, nutritionally supported physical activity may be an efficacious adjunct to standard ED treatment.

Psychological factors, but not physical activity amount or intensity, have been shown to mediate the relationship between physical activity and ED symptoms.[19-23] That is, compulsions are defined by obsessive thinking, urge to perform physical activity behavior, and the capacity of physical activity to appease negative affect.[24,25] Conversely, self-compassion is an adaptive emotional regulation strategy that has been associated with lower eating pathology, reduced body image concerns, and greater positive body image.[26] Thus, initial research identifying psychological factors as mediators of the physical activity and ED relationship

have provided potential targets for intervention[27] and a basis for continued examination of how physical activity may regulate affect in ED.[25,28] Therefore, continued examination of the potential role of affect regulation in physical activity and ED has been recently suggested.[29]

The generally positive outcomes and research-derived clinical guidelines that suggest how physical activity may be efficaciously included in ED treatment are encouraging and warrant further investigation of how to translate this knowledge into clinical practice. However, there is a scarcity of research quantifying treatment outcomes in clinical practice[30] despite recent increases in the number of individuals seeking ED treatment.[31] Moreover, evaluating outcomes in clinical settings is a necessary step for translating research-derived knowledge into clinical practice.[32] Therefore, the purpose of this study was to examine outcomes of a stepped care ED treatment facility that implemented research-derived physical activity guidelines.[10] It was hypothesized that individuals with a history of compulsive exercise related to their ED will report more severe acuity in clinical outcomes than those that do not compulsively exercise. It was further hypothesized that the inclusion of physical activity guidelines to treatment will result in significant reductions in ED symptoms and exercise compulsions. Finally, the mediational role of exercise compulsions and self-compassion was tested. It was hypothesized that exercise compulsions and self-compassion will mediate the relationship among physical activity and ED symptoms.

2.METHODS

Participants

Inclusion criteria was age 18 or older and receiving treatment at a stepped care (i.e., residential, partial hospitalization, and intensive outpatient levels of care) ED treatment center in the United States between January 2019 and January 2021. A total of 528 adult patients were eligible. Exclusion criteria were subclinical ED diagnosis (n=77). Additionally, individuals with less than 28 days of treatment were excluded to prevent inaccuracies in measurement of symptoms as assessed by the Eating Disorders Examination Questionnaire (EDE-Q)[33] (n=69). The final sample included N=382 [M age=28.40(SD=9.17),4.4% male, 88.2% female, 1.4% trans-male, 0.3% trans-female, 3.6% nonbinary, 1.9% gender queer, 0.3% other gender] participants that completed assessments at admission and discharge from treatment. Diagnoses were made using DSM5[1] criteria by clinical interview administered by a trained psychiatrist (59.68% AN, 14.47% BN, 6.18% BED, 1.08% ARFID, 18.81% OSFED). The distribution of participants at each level of care did not differ at admission [$\chi 2(4)=5.095$, $p=.278$] or discharge [$\chi 2(4)=6.984$, $p=.137$]. Most clients admitted to the residential level of care (71.73%) and discharged from intensive outpatient (53.14%). The mean length of stay was 94.17 days (SD=53.94).

Procedures

The study design was a retrospective chart review of blinded outcomes data from an ED treatment center. Of note, all participants received and signed an informed consent form at admission to

treatment and therefore knew their blinded data could be used as part of this research. No participants declined their data for inclusion in this study. This study was reviewed by an external Institutional Review Board (Advarra, Inc. Columbia, MD).

Treatment

Treatment was delivered at a general ED treatment center providing residential, partial hospitalization, and intensive outpatient levels of care. The treatment model included integrated approaches for psychotherapy (e.g., evidence-based practices including cognitive behavioral therapy, dialectical behavioral therapy, acceptance and commitment therapy, etc.), dietetics, and medical aspects of ED care.[3] A comprehensive literature review[10] summarized evidence-based techniques into the following 11 guidelines: 1- Use a multidisciplinary team; 2- Continuously monitor medical and safety concerns; 3- Screen for pathological attitudes, cognitions, or expectations about exercise; 4- Create a contract stipulating how and when physical activity will be used in treatment; 5- Include psychoeducation that addresses: physical activity for health benefits; how to recognize when physical activity is becoming problematic, development of healthy attitudes and physical activity behaviors, body awareness (i.e. understanding physiological states, injury, and pain), physical activity for health versus as a compensatory behavior, exercise identity, and identifying overtraining or burnout, 6- Focus on positive reinforcement, 7- Create a graded physical activity program that slowly increases intensity, duration, and frequency; 8- Process biofeedback during and after physical activity; 9- Tailor physical activity mode to the psychological and physical health needs of the individual; 10- Account for nutritional needs during physical activity; 11- Process attitudes, cognitions, beliefs, and/or expectations before, during, and after each physical activity session. Thus, all physical activity-related interventions following these guidelines[10] were executed by a multidisciplinary team of psychologists, dieticians, nurses, psychiatrics, and counselors. All decisions about participation in any aspect of physical activities, exercises, and/or cognitive aspects of the physical activity interventions were discussed during treatment team meetings. Decisions about appropriateness of pre-physical activity evaluations, progression and regression in physical activity type or amount, safety concerns, and energy expenditure followed the 10th edition of the American College of Sports Medicine's exercise testing and prescription guidelines.[34] Specific techniques included a short stretching session each morning, one-hour sessions per week in each of the following areas: relaxation techniques, yoga, and psychoeducation on exercise-related topics (e.g., self-efficacy, motivation, beliefs, goal setting, athletic identity, safety, injury, and rest), and three to four one-hour movement experientials each week. Notably, movement experientials included games, sports, and activities selected to elicit a functional relationship of physical activity in the ED (e.g., teamwork, competitiveness, perfectionism, etc.) and were paired with processing the experience. Because the cognitive components related to

physical activity, but not physical effects of physical activity, have been found to mediate[19-23] the physical activity and ED relationship, emphasis was placed on processing emotional and cognitive aspects of physical activity. Therefore, all processing included developing understanding of biofeedback, emotional states and understanding the cognitive aspects affecting the experience before, during, and after physical activity or refusal to participate in physical activity. Thus, individuals that refused to or were not able to participate in physical activity aspects engaged in processing the cognitive aspects about physical activity and/or exercise resistance and how it relates to their ED. All participants received the same treatment.

Statistical Analyses

At admission to treatment, the EDE-Q[33] and Compulsive Exercise Test (CET)[35] were used to group participants by their level of compulsive exercise. The 'No Compulsive Exercise' group (39.2%) consisted of individuals who reported zero episodes of driven exercise on the EDE-Q. The 'Mild Compulsive Exercise' group (18.5%) included individuals reporting more than one episode of compulsive exercise on the EDE-Q and CET scores below 15.[36] The 'Compulsive exercise' group (42.2%) included individuals reporting more than one episode of compulsive exercise on the EDE-Q and CET scores of 15 or higher. Repeated measures ANOVAs were run to determine potential within group differences in outcome variables from admission to discharge and between group differences. The time by group interaction term was used to examine potential group differences in trajectories of change for each outcome variable.

Parallel mediation analyses were used to test exercise compulsions and self-compassion as potential parallel mediators on the physical activity-to-ED symptoms relationship while accounting for the shared variance between them.[37] A difference score model[38] was used for estimating the mediation effect. First, correlations were used to determine the potential mediation relationship of admission to discharge change in CET scores (M=2.00, SD=3.72) and Self-Compassion Scale (SCS) scores (M=-0.4493, SD=0.70) on change in Leisure-Time Exercise Questionnaire (LTEQ) scores (M=12.87, SD=49.91) and EDE-Q scores (M=1.76, SD=1.34). The PROCESS method for mediation was used.[37] Specifically, analyses testing the a1 path [i.e. the effect of LTEQ scores (independent variable) on CET scores (mediator variable)], a2 path [i.e., the effect of LTEQ on SCS scores (mediator variable)], b1 path [i.e., the effect of CET on EDE-Q scores (dependent variable)], b2 path [i.e., the effect of SCS on EDE-Q scores (dependent variable)], the c' path [i.e., the direct effect of the independent variable on the dependent variable], and c path [i.e., the total effect of the independent variable on the dependent variable] were conducted (see Figure 1). Furthermore, an estimate of the indirect effect was tested using the standard error and 95% confidence intervals calculated from 5,000 bootstrapped samples.

3.MEASURES

Demographics

A general demographic questionnaire assessed age, education level, ethnicity, race, sex, gender,

sexuality, marital status, being a student, and previous number of ED treatments. Diagnosis, level of care, and length of stay was obtained through chart review.

Eating Disorder Examination Questionnaire

The EDE-Q[33] was used to assess ED symptoms. The EDE-Q assesses ED cognitions and behaviors during the preceding 28 days and yields a global score. Higher scores indicate more severe ED symptoms. The questionnaire has demonstrated good psychometric properties and correlates with a clinical interview version.[39] The Cronbach's alphas in the current study were α=.844 at admission and α=.954 at discharge.

The Eating Disorder Quality of Life Scale (EDQOLS)

The EDQOLS[40] is a 40-item measure of how an ED is impacting one's quality of life. A total score with higher scores indicates better quality of life. The EDQOLS was validated on a sample of ED inpatients.[40] The Cronbach's alphas in the current study were α=.893 at admission and α=.966 at discharge.

State-Trait Anxiety Inventory (STAI)

The STAI[41] was used to assess state anxiety. The STAI includes 20 items that assess state anxiety and 20 that assess trait anxiety. Only state anxiety items were included in the current study's analyses. Higher scores indicate more anxiety. The STAI has been widely used in a variety of populations and has demonstrated good psychometric properties.[42] The Cronbach's alphas in the current study were α=.921 at admission and α=.966 at discharge.

Post-Traumatic Stress Disorder Checklist (PCL-5)

The PCL-5[43] is a self-report measure of symptoms of Post-Traumatic Stress Disorder. Participants were asked to briefly describe their trauma and respond to 20 items on a 5-point Likert, with higher scores indicating more trauma symptoms. The PCL-5 has demonstrated good psychometrics.[44] The Cronbach's alphas in the current study were α=.931 at admission and α=.955 at discharge.

Difficulties in Emotion Regulation Scale-18 item version (DERS-18)

The DERS-18 assesses self-perceived emotion regulation ability.[45] The DERFS-18 includes 18 items with higher scores indicating more difficulty with regulating emotions. The Cronbach's alphas in the current study were α=.870 at admission and α=.927 at discharge.

Patient Health Questionnaire (PHQ-9)

The PHQ-9 is a 9-item assessment of depression.[46] Responses are summed and yield a measure of depression severity (e.g., 1-4 indicates minimal depression, 5-9 mild depression, 10-14 moderate depression, 15-19 moderately severe depression, and 20-27 severe depression). The scale is a valid and reliable measure of depression.[46] The Cronbach's alphas in the current study were α=.881 at admission and α=.910 at discharge.

Compulsive Exercise Test (CET)

The CET is a 24-item measure of exercise compulsions specific to ED.[35] It is the preferred measure of exercise in ED.[47] Responses are on a 6-point Likert scale and yield a total score, with higher scores indicating more exercise compulsions. A cutoff score of 15 has been established as having acceptable sensitivity and specificity in ED patients.[36] The CET is validated[35] and is acceptable for use in adults with ED.[36] The Cronbach's alphas in the current study were α=.926 at admission and α=.934 at discharge.

Leisure-time Exercise Questionnaire (LTEQ)

The LTEQ is a self-report of the frequency and duration of strenuous, moderate, and mild bouts of physical activity during a typical week.[48] Each of the subscale scores are converted into metabolic equivalents (METS; [Mild x 3] + [Moderate x 5] + [Strenuous x 9]) and summed to provide an estimate of total METS expenditure from physical activity for an average week. Mild bouts of physical activity were excluded from analyses, reflecting current validated use of the LTEQ.[49]

Self-Compassion Scale-Short Form

The SCS-SF is a 12-item version of the Self-Compassion Scale. The SCS-SF that operationalizes self-compassion as experiencing kindness, a sense of common humanity, mindfulness, and lessened indifference toward the suffering of others.[50] Higher scores indicate more self-compassion. The Cronbach's alphas in the current study were α=.847 at admission and α=.917 at discharge.

4.RESULTS

Group Demographic Differences

Means and standard deviations for all study variables are included in Table 1. No differences among groups were observed for education level [$\chi2(12)=11.756$, p=.466], ethnicity [$\chi2(2)=.1.755$, p=.416], race [$\chi2(12)=16.276$, p=.179], sex [$\chi2(2)=3.758$, p=.153], gender [$\chi2(6)=9.997$, p=.125], marital status [$\chi2(14)=22.895$, p=.062], being a student [$\chi2(2)=5.230$, p=.073], or previous number of treatments (F(2, 237) 0.034, p = .966). However, the proportion of participants that were heterosexual [$\chi2(2)=13.927$, p=.001] and diagnosed with AN [$\chi2(10)=28.854$, p=.001] were higher in the compulsive exercise group.

Within Group Differences

A significant effect was observed for all study variables (see Table 2), thus indicating significant changes from admission to discharge from treatment. That is, there was a significant decrease observed for EDE-Q [$F(1,364)=551.949$, $p<.001$, $\eta^2=.603$], STAI [$F(1,345)=174.542$, $p<.001$, $\eta^2=.336$], DERS-18 [$F(1,349)=127.749$, $p<.001$, $\eta^2=.268$], PCL-5 [$F(1,197)=68.983$, $p<.001$, $\eta^2=.259$], PHQ-9 [$F(1,249)=194.779$, $p<..01$, $\eta^2=.439$], CET [$F(1,333)=77.632$, $p<.001$, $\eta^2=.189$], LTEQ [$F(1,290)=17.616$, $p<.001$, $\eta^2=.057$], and a significant increase in EDQOLS [$F(1,343)=501.753$, $p<.001$, $\eta^2=.594$] and SCS-SF scores [$F(1,323)=115.541$, $p<.001$, $\eta^2=.263$] from admission to discharge.

Table 1. *Study variables means and standard deviations by level of compulsive exercise prior to treatment*

	No Compulsive Exercise		Mild Compulsive Exercise		Compulsive Exercise	
Measure	Admission	Discharge	Admission	Discharge	Admission	Discharge
Eating Disorder Examination Questionnaire	4.34(0.86)	2.64(1.34)	4.61(0.83)	2.69(1.24)	4.90(0.73)	3.21(1.48)
Eating Disorder Quality of Life Scale	96.32(18.12)	126.35(29.60)	89.26(16.10)	128.56(21.05)	85.82(16.46)	118.97(30.60)
State Trait Anxiety Inventory – State Score	62.42(11.18)	51.35(15.79)	64.19(9.58)	53.70(12.34)	66.94(9.64)	57.33(15.45)
Difficulties in Emotion Regulation Scale	3.21(0.71)	2.69(0.78)	3.36(0.62)	2.81(0.73)	3.36(0.65)	2.91(0.83)
Post-Traumatic Stress Disorder Checklist for DSM5	49.56(17.71)	39.01(20.80)	53.06(12.69)	40.56(17.47)	49.42(17.44)	40.80(18.38)
Patient Health Questionnaire	17.00(5.90)	10.89(7.33)	17.70(6.29)	11.23(6.70)	18.35(5.69)	12.23(7.13)
Compulsive Exercise Test	10.19(2.87)	9.60(3.10)	12.22(2.26)	10.75(3.30)	18.05(2.06)	14.62(4.30)
Leisure-time Exercise Questionnaire	12.04(20.53)	15.71(34.45)	36.25(29.59)	25.02(25.40)	62.01(59.35)	31.60(32.43)
Self-Compassion Scale	2.09(0.52)	2.55(0.71)	2.14(0.57)	2.58(0.60)	2.03(0.47)	2.46(0.73)

Table 2. *Repeated measures ANOVA results of within group differences from admission to discharge, between group differences for compulsive exercise groups, and interaction effects showing differences in trajectories of change for outcome variables.*

	Within Effect				Interaction Effect				Between Effect			
Measure	df	F	*p*	η^2	df	F	*p*	η^2	df	F	*p*	η^2
Eating Disorder Examination Questionnaire	1,364	551.949	<.001	.603	2,364	0.788	.456	.004	2,364	14.679	<.001	.075
Eating Disorder Quality of Life Scale	1,343	501.753	<.001	.594	2,343	2.668	.071	.015	2,343	7.673	.001	.043
State Trait Anxiety Inventory – State Score	1,345	174.542	<.001	.336	2,345	37.927	.666	.002	2,345	8.238	<.001	.046
Difficulties in Emotion Regulation Scale	1,349	127.746	<.001	.268	2,349	0.571	.565	.003	2,349	3.140	.044	.018
Post-Traumatic Stress Disorder Checklist-DSM5	1,197	68.983	<.001	.259	2,197	0.762	.468	.008	2,197	0.299	.742	.003
Patient Health Questionnaire	1,249	194.779	<.001	.439	2,249	0.052	.950	.000	2,249	1.493	.227	.012
Compulsive Exercise Test	1,333	77.632	<.001	.189	2,333	22.835	<.001	.121	2,333	224.377	<.001	.574
Leisure-time Exercise Questionnaire	1,290	17.616	<.001	.057	2,290	15.357	<.001	.096	2,290	38.936	<.001	.212
Self-Compassion Scale	1,323	115.541	<.001	.263	2,323	0.090	.914	.001	2,323	1.412	.245	.009

Between Group Differences

Between group effects were not significant for PCL-5 [F(2,197)=0.299, p=.742, η^2=.003], PHQ-9 [F(2,249)=1.493, p=.227, η^2=.012], and SCS-SF scores [F(2,323)=1.412, p=.245, η^2=.009].

A consistent pattern was observed for EDE-Q [F(2,364)=14.679, p<.001, η^2=.075], EDQOLS [F(2,343)=7.673, p=.001, η^2=.043], STAI [F(2,345)=8.238, p<.001, η^2=.046], and DERS-18 scores[F(2,349)=3.140, p=.044, η^2=.018] whereby the compulsive exercise group's scores were significantly different than participants in the no compulsive exercise group. Specifically, Bonferroni post hoc analysis showed the compulsive exercise group reported higher EDE-Q scores than the no compulsive exercise group (*p*<.001), lower EDQOLS scores than the no compulsive exercise group (*p*<.001), higher STAI scores than the no compulsive exercise group (*p*<.001), and higher DERS-18 scores than the no compulsive exercise group (*p*=.042).

Significant differences were observed for CET scores [F(2,333)=224.377, p<.001, η^2=.574]. Bonferroni post hoc analysis showed the compulsive exercise group reported higher CET scores than the no compulsive exercise group (*p*<.001) and the mild compulsive exercise group (*p*<.001). Additionally, the mild compulsive exercise group reported higher CET scores than the no compulsive exercise group (*p*<.001). Similarly, differences were observed for LTEQ scores [F(2,290)=38.936, p<.001, η^2=.212]. Bonferroni post hoc analysis showed the compulsive exercise group reported higher LTEQ scores than the no compulsive exercise group (*p*<.001) and the mild compulsive exercise group (*p*=.003). Additionally, the mild compulsive exercise group reported higher CET scores than the no compulsive exercise group (*p*=.002).

Interaction of Group by Time

The group by time interaction effect was not significant for EDE-Q [F(2,364)=0.7888, p=.456, η^2=.004], EDQOLS [F(2,343)=2.668, p=.071, η^2=.015], STAI [F(2,345)=37.927, p=.666, η^2=.002], DERS-18 [F(2,349)=0.571, p=.565, η^2=.003], PCL-5 [F(2,197)=0.762, p=.468, η^2=.008], PHQ-9 [F(2,249)=0.052, p=.950, η^2=.000], and SCS-SF [F(2,323)=0.90, p=.914, η^2=.001], but was significant for CET [F(2,333)=22.835, p<.001, η^2=.121] and LTEQ scores [F(2.290)=15.357, p<.001, η^2=.096].

Mediation Analyses

Results of mediation analyses indicated a significant effect for the a1 path (β=.0219, SE=.0041, p<.001), a2 path (β=-.0018, SE=.0008, p=.0292), b1 path (β=.144, SE=.0183, p<.001), b2 path (β=-.8037, SE=.0914, p<.001), and the c path (β=.0055, SE=.0015, p=.0004). However, the c' path (β=.0009, SE=.0012, p=.4720) was not significant.

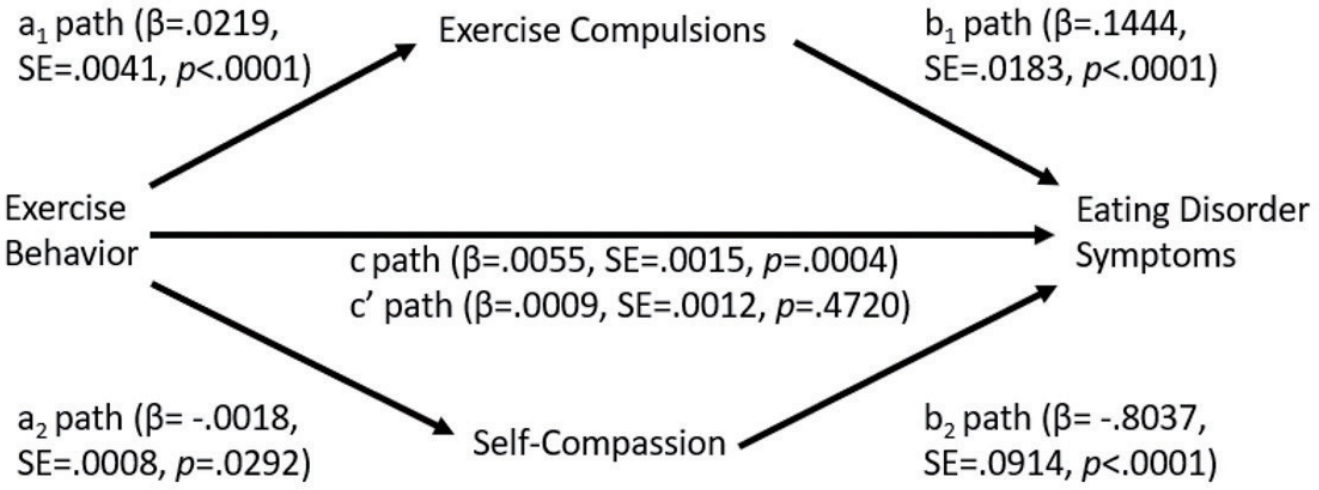
A 95% bias-corrected confidence interval based on 5,000 bootstrap samples indicated that the indirect effect =.0014, SE=.0007, 95% CI=(.0002-.0030) was significant. The indirect effect for CET =.0032, SE=.0015, 95% CI=(.0016, .0076) was significant, indicating a mediation effect. Similarly, the indirect effect for SCS=.0014, SE=.0007, 95% CI (.0002, .0030) was also sig-

nificant, indicating a mediation effect. This parallel mediation model accounted for 45.16% of the variance (R^2=.4516) in the relationship among physical activity behavior and eating disorder symptoms.

5.DISCUSSION

The current study is an initial step in closing the gap[51] between current research-based understanding of how to include physical activity in ED treatment and clinical practice by examining out-

Figure 1. *Parallel mediation of exercise compulsions and self-compassionon the exercise and eating disorder symptoms relationship*



comes when research-derived recommendations are implemented in a clinical setting.[32] Partially consistent with the first hypothesis, individuals in the compulsive exercise group reported more severe acuity in ED symptoms, quality of life, difficulties in emotion regulation, and state anxiety than those with no history of compulsive exercise. However, no differences were observed in trauma, depression, or self-compassion symptom scores. The second hypothesis that inclusion of physical activity guidelines to treatment will result in significant reductions in ED symptoms and exercise compulsions was supported by the medium to large effect sizes observed in changes from admission to discharge for clinical outcomes. The lack of clinical complication and results showing change in outcomes from admission to discharge suggest the inclusion of physical activity in ED treatment did not interfere with treatment outcomes. Additionally, trajectories of change in outcomes were not different between groups. Taken together, these results provide initial evidence for the effectiveness of translating existing physical activity guidelines[10] into practice at stepped care treatment facilities.

Evidence-based clinical practice relies on the ability of knowledge derived from research settings to be applied elsewhere. Accordingly, Ry-

chetnik and colleagues[52] present a framework of four processes for translation to practice. The first process is to evaluate if findings from interventions delivered under experimental or research conditions are transferable to 'real life' settings. The significant reduction in ED symptoms, difficulties in emotion regulation, state anxiety, trauma, depression and compulsive exercise scores and a significant increase in quality of life and self-compassion scores observed in the current study suggests the translation of physical activity guidelines[10] may be effective in clinical settings. Notably, the lack of significant interaction effects suggests these effects were similar for all groups, regardless of exercise status. Thus, the current study challenges previous contentions that compulsively exercising individuals with ED are less likely to respond to treatment.[53] Rather, results of the current study support a more recent study that found compulsively exercising individuals with ED demonstrate a reduction in ED symptom scores in response to treatment.[54] The current study expands upon such findings by examining other outcomes associated with ED symptoms. However, these results may be due to all participants receiving a structured and adapted physical activity program as an adjunct to standard treatment rather than the participants history of compulsive exercise. Further research is needed to satisfy the remaining three processes for translating research.[52] Specifically, next steps should establish effectiveness studies that examine which factors enhance or limit the transferability of evidence. Subsequent research guided by the third process may then focus on knowledge translation to a variety of other populations (e.g., demographic differences, examining effects in specific ED diagnosis, how to translate research at various levels of care, etc.). The result in the current study that individuals that compulsively exercise were more likely to be heterosexual and diagnosed with AN may help inform this aim and should be further examined. Finally, studies are needed to satisfy the fourth process by developing and testing knowledge translation strategies that may allow scaling up from small scale or localized settings to widespread policy and programs.[52]

Including physical activity in ED treatment must avoid worsening exercise compulsions, which may lead to increases in ED symptoms.[12] Therefore, effective interventions should ideally show reductions in ED symptoms and compulsive exercise. Randomized control trials (RCT) are considered the strongest design for determining effects among variables[55] and therefore may provide a best practices comparison to consider if the reductions observed in the current study are meaningful. Three recent RCT of physical activity in ED treatment have examined ED symptoms and exercise compulsions. Mathisen and colleagues[9] observed a Hedges g effect size of 0.54 for differences in EDE-Q reduction for individuals with BN or BED enrolled in a trial of physical activity in ED treatment compared to those in the cognitive behavioral therapy group. Moreover, individuals that compulsively exercise in this study reported reduced CET scores from 14.43 at baseline to 13.14 at end of treatment, an 8.94% reduction.[56] Of note, Mathisen and col-

leagues[9] observed a significant interaction effect, whereby individuals receiving a physical activity and dietary therapy intervention showed steeper reduction in psychopathology scores than those receiving cognitive behavioral therapy by the end of treatment. Importantly, this study only included BN and BED, with a comparably lower CET scores at baseline. While no group interaction effect on EDE-Q scores was observed in the current study, all groups received the physical activity intervention and also showed reductions in ED psychopathology. In a RCT of individuals with AN, EDE-Q scores changed from 3.54 at baseline to 2.28 at end of treatment, a 35.59% reduction, and CET scores lowered from 15.70 to 11.90, a 24.20% decrease.[57] Finally, a RCT of outpatients with AN, BN, or OSFED reported Eating Disorder Examination score reduction from 3.53 at baseline to 3.45 at end of treatment, a 2.27% reduction, and CET score reduction from 17.40 to 16.90, a 2.87% reduction.[58] This study included only patients with high levels of compulsive exercise and the physical activity program was not combined with psychotherapy. It is important to note that ED symptoms were assessed using the interview version of the Eating Disorder Examination, which is highly correlated with the EDE-Q.[39] In the current study, EDE-Q scores were reduced in the compulsive exercise group from 4.90 to 3.21, a 34.49% reduction, and CET scores were reduced from 18.05 to 14.62, a 19.00% reduction. Moreover, EDE-Q reduction from 4.61 to 2.69, a 41.65% reduction, and CET reductions from 12.22 to 10.75, a 12.03% reduction, were observed in the mild compulsive exercise group. Importantly, it is difficult to make direct comparisons of these studies that included varying samples, diagnoses, treatment levels, study protocols, and other key factors that may all account for some degree of variance in results. Thus, comparisons must be taken in light of several limitations. However, the results of the current study are comparable if not stronger than the three aforementioned studies [9,56,57,58] that have examined physical activity in ED treatment. Differences may be due to the approach used in each study. That is, the previous studies[9,56,57,58] generally focused on physical activity as the main modality of treatment, while the current study followed guidelines[10] that emphasized pairing physical activity with cognitive processing. Further research is encouraged to examine these two approaches.

The mediation analyses may offer further insight into the role of cognitive aspects related to physical activity and help to identify individual trajectories of whom will respond to physical activity as an adjunct to ED treatment. That is, the parallel mediation effect of physical activity compulsions and self-compassion may reflect recent ecological momentary assessment studies that have identified dualistic pathways, whereby physical activity behavior functions to decrease negative affect while simultaneously increasing positive affect,[28,59,60] induce calmness, and increase positive emotions in individuals with ED.[28] The current study's results extend the literature by supporting the contention that increasing self-compassion may be an important strategy for reducing ED symptoms[26] and may also play a role

in intervening upon dysfunctional forms of exercise. Self-compassion has been used as a guiding theory in a previous intervention that defined therapeutic physical activity in ED as any movement done with attention, purpose, self-compassion, acceptance, awareness, and connection.[61] While this previous study provides a conceptual basis for including aspects of self-compassion in physical activity interventions, the direct effect of self-compassion on dysfunctional exercise or ED symptoms was not assessed. Thus, the mediating effect of self-compassion identified in the current study provides needed empirical evidence for a previously conceptually-based suggestion for how physical activity interventions can be structured in ED treatment to be effective.

Several limitations must be considered when interpreting the results of the current study. First, the current study focused on the translation of research to practice describes the outcomes of only individuals with ED in one treatment center system. Thus, no control group nor randomization to a comparison group was available. Conducting such research within one system allowed for oversight and fidelity for adhering to each research-derived guideline.[10] However, several other factors influence the effectiveness of translating research to wider spread practice in multiple centers. Future research is needed to examine contextual factors that may identify leadership, clinical training, policy, personnel needs and expertise, monitoring, evaluation, and economic aspects that influence implementation.[32] Second, population characteristics may account for differences observed in the current study versus outcomes reported in recent RCTs.[9,56,57] A recent literature review found that of individuals receiving residential stepped care treatment, up to 69% received previous medical care or hospitalization for their ED and 90-93% of individuals previously received treatment at other residential centers.[30] Thus, the population included in the current study may represent treatment resistant individuals. Therefore, further investigations into outcomes and participant characteristics such as gender effects, diagnoses, age, ethnicity, race, treatment history, duration of illness, socioeconomic variables, and insurance status are needed to help identify trajectories of individuals that may benefit from physical activity or exercise during therapy and who may experience deterioration. Additionally, data was not available for individuals that dropped out of treatment. Thus, further research is needed to examine potential differences in those that complete versus drop out of treatment. Finally, the design of the current study adhered to the physical activity behavior recommendations outlined in research-based guidelines[10] and therefore did not allow for examining how specific exercise principles may impact ED treatment outcomes. Recent guidelines for applying fitness principles (e.g., frequency, intensity, time, and type of physical activity) have been proposed for ED treatment,[62] but have not yet been tested. Similarly, other guidelines have provided suggestions for how to reconcile physical activity and exercise with several key physiological concerns specific to ED.[63] Further research is needed to consider how fitness principles may translate to clinical practice and examine the

translation of other guidelines. For example, further examination of how to match modes of exercise activities that may impact specific core aspects of ED are needed (e.g., affect regulation, perfectionism, body image disturbance, etc.).

6.CONCLUSION

Implementing evidence-based practices in psychological treatment has lagged behind other healthcare fields.[64] Specifically, guidance for how to address physical activity as part of ED treatment has only recently become available.[10,63] Therefore, research is needed to help fill this evidence to practice gap. The current study provides an initial step in filling this gap as it pertains to advancements in ED treatment by implementing an adjunctive physical activity protocol that facilitates engagement in physical activity and processing of exercise-related cognitions. Results indicate that implementing research-derived physical activity guidelines in stepped care treatment facilities results in medium to large effect size changes in several clinical outcomes (e.g., reduction in ED symptoms, increases in quality of life, etc.). Further research is needed to continue to understand how to effectively translate this evidence-base into clinical practice. Next steps include examining knowledge translation strategies that may inform evidence-based policy, practice, and research translation strategies.[52]

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