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Exercise dependence, affect, and eating disorder symptoms after treatment discharge.

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By

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Abstract

Eating disorders (EDs) have been proven to be life-threatening, yet these disorders are still prominent in Western society. The current study focuses on exercise dependence, negative affect, positive affect, and ED symptoms in individuals discharged from ED treatment. While ED recovery varies at the individual level, exercise dependence and affect are particularly important to analyze due to the complex and interconnected relationships with each other and ED symptoms. For example, routine exercise can be used to lessen negative affect, but exercise dependence can lead to an increase in negative affect. As patients in recovery begin to add exercise back into their lives, it is important to identify and understand healthy versus dependent (excessive) exercise. The current study (N = 168 participants) utilized MANOVA and path analysis to a) test if there were changes in exercise dependence, affect, and ED symptoms across the two months post discharge and b) to examine how these symptoms relate to each other across this time period. Results revealed that there were no significant changes in variables across the time period and that all variables predicted themselves between each time frame. In addition to these predictive relationships, negative affect in T2 predicted ED symptoms in T3. Our findings suggest that addressing exercise dependence, negative affect, positive affect, and ED symptoms in the first critical two months post treatment discharge can promote higher and more sustainable recovery outcomes.

Lay Summary

Eating disorders (EDs) have been proven to be life-threatening psychological disorders yet are still common in current society. Due to the complexity of EDs, recovery may look different for each individual. The average recovery process can take up to nine years, but the first two months post-discharge are some of the most crucial time periods for sustainable recovery. Different factors (unhealthy exercise, emotions, body shape and weight concerns, and ED symptoms) can be analyzed in order to predict future outcomes involving the evolution of an ED.

The study tested how unhealthy exercise, emotion, and ED symptoms relate to each other after treatment discharge. Our results revealed no significant relationship across the two months after treatment discharge. Unhealthy exercise, emotions, and ED symptoms all predicted themselves for the next month. Besides this relationship, one other significant realtionship was found between negative emotion during the first month and ED symptoms for the following (second) month. Targeting negative emotions earlier on in the recovery process may help prevent ED symptoms in upcoming months. Further research should address other influential factors (e.g., societal standards, body image, healthy exercise) and their relationship to ED recovery in order to identify ways to improve treatment for EDs.

Exercise Dependence, Affect, and Eating Disorder Symptoms After Treatment Discharge

Eating disorders (EDs) are life-threatening psychological disorders that cause impairment on physical, emotional, and cognitive domains (American Psychiatric Association [APA], 2013). EDs are common, with 1 of every 10 individuals being diagnosed in their lifetime, and in 2019, 10,200 individuals died due to a direct result of an ED (Deloitte Access Economics, 2020). These statistics demonstrate the danger of EDs and the importance of understanding them.

Eating Disorder Diagnoses and Recovery

Two common EDs are Anorexia Nervosa (AN) and Bulimia Nervosa (BN). AN presents as a restriction of food to reduce weight or shape resulting in a low body weight for age and height. Differently, BN presents as the intake of a large amount of food and feeling out of control followed by compensatory behaviors (e.g., excessive exercise, self-induced vomiting, use of diet pills, restriction; APA, 2013). Given the complexity and heterogeneity of EDs, generalized treatment for these disorders needs to be improved during the first two crucial months after treatment discharge to promote and sustain recovery transdiagnostically (Bardone et al., 2010; Stiles-Shields et al., 2011).

Full ED recovery has been defined as no fasting, purging, or binge eating behaviors in the past three months, a body mass index of ≥ 18.5 kg/m^2, and Eating Disorder Examination-Questionnaire (EDE-Q) scores within one standard deviation (*SD*) of age-based community norms (Bardone et al., 2010). Further, the recovery process is often long and has several stages, the first stage being partial remission or recovery, which is defined by the same criteria as full recovery with the exception that EDE-Q scores remain elevated (Bardone et al., 2010). In short, partial remission is characterized by the normalization of physical and behavioral ED symptoms but with the persistence of cognitive symptoms.

Exercise Dependence

A prevalent ED behavior is exercise dependence (Stice et al., 2021), which falls under the all-encompassing term of excessive exercise. The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) states that excessive exercise must interfere with desired activities, occurs even when injury or illness are present, and/or presents at inappropriate times or places (APA, 2013). However, to be considered exercise dependence, there must be a dependent quality, similar to substance abuse, which is characterized by three of the following seven presentations: tolerance, withdrawal, intention effects, lack of control, time, reduction in other activities, and continuance (Hausenblas & Downs, 2002; McGilley, 2014; Scharmer et al., 2020). When these factors are totaled together, a relationship with exercise can become very dangerous (LePage et al., 2012). About 80 percent of individuals diagnosed with AN have exercise dependence as a symptom, where 40 percent of individuals diagnosed with BN do (Scharmer et al., 2020). Thus, it is important to understand exercise dependence in order to further inform the development of more effective ED treatments.

Conversely, when not dependent or excessive, exercise can contribute to weight restoration and positive body image in some cases (Diers et al., 2020; McGilley, 2014). For example, yoga is used as a meditative movement and healing practice in many ED treatment centers (Diers et al., 2020). Research, however, is inconsistent on this topic. While yoga improved ED symptomatology (such as body image and acceptance) in some groups (Diers et al., 2020), it was not correlated with positive or negative affect in other cases (Nisticò et al., 2021).

The reason for the inconsistency may be due to the effects that exercise has on the body – while exercise dependence is a serious behavior in EDs and can lead to increased illness or

injury, some aspects of exercise may serve as a healing agent (McGilley, 2014). The amount of exercise and the dependence on exercise are important in this distinction. For example, when non-dependent exercise is performed, mood remains steady or may improve, but when exercise dependence occurs, mood may worsen (LePage et al., 2012). The complicated and potentially life-threatening relationships between exercise and EDs demonstrate the importance of not only observing changes in exercise habits but also of examining the association between exercise dependence, positive affect, negative affect, and ED symptoms.

Impact of Affect

Affect (i.e., mood/emotion) is crucial to observe in treatment, as cognitive behavioral therapy (CBT) highlights the importance of the positive and negative affect associated with ED cognitions (Fairburn et al., 2015; Bardone et al., 2010). CBT is a treatment method that addresses ED psychopathology in all EDs, but specifically helps to alter behaviors, such as restriction, binge eating, and exercising in secret, as well as hidden beliefs, such as cognitions involving self-esteem or self-worth regarding exercise (Fairburn et al., 2015). In the recovery process of EDs, CBT is often used as the first line of treatment. One must observe both the negative affect that may be associated with food, exercise, and/or ED symptoms earlier on in recovery as well as the positive affect that these ED symptoms may bring regarding stress relief and how they may change over time. Exercise, for individuals with an ED, can become dependent when individuals use it to avoid negative affect (e.g., depressed mood, increased anxiety, etc.) and as an attempt to change their body shape/size (Scharmer, et al., 2020).

Limitations in the Literature

There is limited research that has explored the relationship between exercise dependence, positive affect, negative affect, and ED symptoms. A majority of past research simply touches on

the prevalence of ED symptoms and behaviors and how they may change with treatment (e.g., Chapa et al., 2020; Linardon et al., 2018; Stiles-Shields et al., 2011). The research about the various correlations between ED symptoms, such as lesser restriction resulting in increased body image concern (LePage et al., 2012; Stice et al., 2021; Stiles-Shields et al., 2011), do not specifically regard exercise dependency, affect, and ED symptoms. Past research also touches mainly on changes in affect or ED symptoms in treatment and is largely limited to cross-sectional analysis. In order to address the root causes of EDs, one must consider the various factors that are contributing to it and how they change over time. Once we begin to know more about the relationships between exercise dependence, positive affect, negative affect, and ED symptoms and their impact on one another, we can develop more effective treatment.

Current research findings investigating the relationship between EDs and exercise is highly inconsistent, thus informing the need to explore the relationship longitudinally. Again, we know that different symptoms drive EDs and lead to different outcomes for each person. Therefore, instead of solely investigating the presence of exercise dependence, affect, and ED symptoms as separate factors, this research will explore the relationship between these factors and how they may impact remission.

Current Study

In the current study (N = 168), we aim to test (1) how exercise dependence, positive affect, negative, and ED symptoms and their severity differ across stages after treatment discharge, and test (2) the relationship between exercise dependence, positive affect, negative affect, and ED symptoms across two months for patients after treatment discharge. We predict that exercise dependence and ED symptoms will have a positive relationship. We also anticipate that exercise dependence will increase over time as the participants go through their recovery

process (e.g., participants may begin to add body movement back into their lives), and given the interlocking nature of these aspects of EDs, we predict positive affect, negative affect, and ED symptoms will also increase. Essentially, we anticipate a mutually reinforcing cycle between these four factors.

Methods

Participants & Procedure

The participants for this analysis were 168 individuals that have been diagnosed with an ED (see Table 1). Criteria for participation in the current study were (1) recent discharge from either a residential, partial, or an outpatient ED hospital program and (2) diagnosis of an ED via the Eating Disorder Diagnostic Scale (EDDS) which is a self-report questionnaire (Stice et al., 2000). One hundred twenty-five of the 168 participants disclosed current treatment, 96 (57.1%) were part of outpatient treatment, 16 (9.5%) were in an intensive outpatient program (IOP), five (3.03%) were currently in partial hospitalization, and eight (4.7%) were in residential treatment. Participants filled out online measures to assess exercise dependence, positive affect, negative affect, and ED symptoms. These questionnaires were completed at three time points, which were each one month apart (T1, T2, T3). T1 was directly after treatment discharge, T2 was one month after treatment discharge, and T3 was two months after treatment discharge.

Measures

Exercise Dependence Scale-Revised (EDS-R; Hausenblas & Downs, 2002) is a 27-item questionnaire made up of seven subscales (scored 0-6) used to measure exercise dependent symptoms in participants. Each subscale assesses one of seven criteria (i.e., tolerance, withdrawal, intention effects, lack of control, time, reduction in other activities, and continuance) that a participant may experience. Based on the answers to each question, the participant is

classified as at-risk, nondependent-symptomatic, and nondependent-asymptomatic. To measure the changes in the symptoms overtime, the questionnaire was administered at baseline, one month, and two months. The EDS-R has very good psychometric properties (Hausenblas & Downs, 2002). In the current study, the internal consistencies proved to be excellent (α =.94-.97). The average score on the EDS-R was 59.55 (*SD* = 25.15; range = 20-112) at T1, 61.95 (*SD* = 19.30; range = 20-113) at T2, and 63.87 (*SD* = 18.82; range = 20-120) at T3.

Positive and Negative Affect Scale (PANAS; Watson et al., 1988) is a self-reporting questionnaire that consists of two mood scales: one positive (i.e., active, alert, attentive, determined, enthusiastic, excited, inspired, interested, proud, strong) affect including 10 questions and one negative (i.e., afraid, scared, nervous, jittery, irritable, hostile, guilty, ashamed, upset, distressed) affect including 10 questions (20 total). A 5-point scale was used for scoring with 1 being very slightly or not at all, and 5 being extremely. The PANAS holds good internal consistency, convergent, and discriminant validity (Watson et al., 1988). In the current study, the positive affect subscale showed good internal consistency (α =.79-.89) as did the negative affect scale (α =.79-.88). The average score on the positive affect scale was 27.98 (*SD* = 7.89; range = 11-49) at T1, 28.03 (*SD* = 5.56; range = 10-46) at T2, and 27.95 (*SD* = 5.66; range = 10-50) at T3. The average score on the negative affect scale was 30.18 (*SD* = 8.13; range = 13-48) at T1, 30.80 (*SD* = 5.72; range = 13-46) at T2, and 30.38 (*SD* = 5.50; range = 13-50) at T3.

Eating Disorder Examination Questionnaire Version 4.0 (EDE-Q; Fairburn & Beglin, 1994) evaluates ED symptom (e.g., restriction, binge eating, self-induced vomiting, misuse of diet pills) severity and frequency. The questionnaire consists of 42 items that make up four subscales (scored 0 to 6) or frequency questions that which all assess ED pathology. To measure ED severity, the EDE-Q global score was used at baseline, one month, and two months. The

global score is calculated by averaging the four subscales (i.e., restraint, eating concern, shape concern, and weight concern). The EDE-Q has been shown to have good psychometrics (Fairburn & Beglin, 1994). The internal consistency was acceptable-to-good at all time points (α = .76-.81). The average score on the EDE-Q was 3.16 (*SD* = 1.48; range = .05-5.70) at T1, 3.04 (*SD* = 0.97; range = .05-5.65) at T2, and 3.18 (*SD* = .89; range = .00-5.70) at T3.

Analyses

The two analyses used were a MANOVA through IBM SPSS (28) and a path analysis model through the Lavaan package in RStudio (Rossel, 2012). To answer aim (1), we used a MANOVA to examine the differences between exercise dependence, positive affect, negative affect, and ED symptomatology across the timepoints. To test the relationships between exercise dependence, positive affect, negative affect, and ED symptomatology across the three timepoints (aim (2)), path analysis model was utilized. As seen in Table 2, we ran zero order correlations through SPSS to estimate these relationships when no other variables were being accounted for.

Results

MANOVA

There were no significant changes between exercise dependence, positive affect, negative affect, and ED symptoms over the three time periods. This insignificance indicates there were no differences in exercise dependence, positive affect, negative affect, and ED symptoms between the different time points, $F(2, 166) = 2.10$; $p = .125$.

Path Analysis

Model fit was excellent (CFI = 1.00, TLI =1.00, RMSEA = 0.00, SRMR = 0.04). As seen in Figure 3, exercise dependence, positive affect, negative affect, and ED symptoms all predicted

themselves at the next time point. Besides the prospective relationships within symptoms, there was a significant predictive relationship between T2 negative affect and T3 ED symptoms.

Discussion

The current study aims to analyze the relationship between common symptoms in EDs, such as exercise dependence, positive affect, negative affect, and ED symptoms. In order to assess how these factors played a role on each other through the recovery process, participants completed surveys regarding these factors at ED treatment discharge, one month after treatment discharge, and two months after treatment discharge. We predicted that exercise dependence and ED symptoms would have a positive relationship, exercise dependence would increase over time, and negative affect, positive affect, and ED symptoms would also increase over the recovery process. In short, we concluded that these four factors would likely work in a cyclical pattern across the recovery of participants.

Our hypothesis that exercise dependence, positive affect, negative affect, and ED symptoms would increase over time was not supported by the results. There was no significant change in these different variables. Our hypothesis that exercise dependence and ED symptoms would positively predict each other was also not supported. The only significant relationship that we found was from negative affect to ED symptoms between T2 and T3. While our initial hypotheses were not supported by the data, there are implications based off our findings that support different approaches to treatment including the addition of exercise during or after treatment. These results were both consistent and not consistent with past findings (Diers et al., 2020; Nisticò et al., 2021).

Our results supported past hypotheses involving the lengthy duration of treatment (Fairburn et al., 2015). It is important to consider factors that may have impacted our findings.

For example, we examined exercise dependence, so a healthier relationship with exercise would not be included in this analysis. Participants could have had healthy routines and relationships with exercise, but we would not be able to tell via these results alone. If this were the case, we may have seen an increase in positive affect since the increase of positive affect with the incorporation of certain exercise such as yoga has been supported by past research (Diers et al., 2020). With the knowledge of exercise dependence and healthy relationships with exercise, we may be able to further expand upon the treatment trajectories between different EDs.

The path analysis elucidated how exercise dependence, affect, and ED symptoms affected each other. However, our findings were against our hypothesis, as the only significant relationship across symptoms was between T2 negative affect and T3 ED symptoms. While these findings do not support our hypotheses, they still hold great importance and support some past research that show a relationship between negative affect and ED symptoms (Diers et al., 2020; McGilley, 2014; Nisticò et al., 2021). The relationship implies that the presence of increased negative affect in an earlier stage of recovery could then predict an increase in ED symptoms. Previous research reveals a common relapse of EDs in the first two months after treatment discharge (Bulik, 2021; Walsh et al., 2021), so if we can recognize this common relationship between negative affect in T2 and ED symptoms in T3, treatment protocol may be able to be adapted in order to address and/or target this relationship.

Limitations/Strengths

The current study has some significant strengths. The relationships between exercise dependence, affect, and ED symptoms further clarify the complexity of the ED recovery process across the first two months after treatment discharge, which is shown to be the most vulnerable time period for relapse (Bulik, 2021; Walsh et al., 2021). This study was the first to specifically

focus on exercise dependence, affect, and ED symptoms over time, thus it provided an emphasis for further exploration. As exercise is incorporated into everyday life and generally considered healthy, it can manipulate affect and possibly ED symptomatology in some cases as well. Additionally, ED recovery varies by person and diagnosis, so this transdiagnostic approach includes the different possible diagnoses and the recovery process that comes with them.

While the study has clear strengths, there are also a significant number of limitations. Firstly, this study was conducted over a two-month period after treatment discharge during which we were able to see a consistent level of exercise dependence, affect, and ED symptoms. Only one relationship was observed across these different factors. The lack of observed relationships is likely due to the time restraint that our study holds. A longer period of time for analysis could provide further information regarding exercise dependence, affect, and ED symptoms. The beginning months of the recovery process generally focus on physical improvements (e.g., weight regulation, change in movement, normalization of labs), so a prolonged analysis over many months can provide insight into the focus on thought and emotion regulation that may come with EDs.

Secondly, this study consisted of primarily white women. The high proportion of white female participants highlights the common trend of systemically excluded groups in EDs. A more racial, ethnic, and gender diversification can enhance the generalizability of the results. Instead of seeing trends for white women, one could see the trends across different groups from different backgrounds. While the study was transdiagnostic, a majority of participants were diagnosed with Anorexia Nervosa and/or atypical Anorexia Nervosa. This overpowering diagnosis can limit the flexibility of recovery between different EDs and overlook the differences between the diagnoses and the different recovery processes.

Lastly, this data was conducted via self-report questionnaires. This form of data is convenient, but the collection often includes self-bias and can skew the authenticity of the data. When one is self-reporting, the process may result in a decrease in reported behaviors due to the reporting process. Also, participants may not be able to observe thoughts, feelings, or behaviors that they are experiencing due to ED-related alterations in self-perception.

Implications

This study has implications regarding ED treatment and interventions. The results imply that negative affect may be able to be targeted in order to lessen the occurrence of ED symptoms. The relationship between negative affect and ED symptoms within the first two months after treatment discharge indicates a possible mechanism for relapse if not addressed. Clinicians may focus their efforts on negative affect through the use of dialectical behavioral therapy (DBT) exercises, CBT, mindfulness, and/or various other interventions (Vogel et al., 2021; Sewart et al., 2019; Mandal et al., 2012). On a pharmaceutical note, this study implies the possible importance of medications that can reduce negative affect and thus reduce ED symptoms (Himmerich & Treasure, 2017). A closer examination of these treatment options could increase the feasibility and effectiveness of treatment.

While this study did not solidify a relationship between exercise dependence, affect, and ED symptoms, it did show that the different factors stayed consistent over the beginning of the recovery process. It is also important to note that our results imply no increase in exercise dependence overtime, but it does not include healthier occurrences of movement and/or exercise. Regardless, exercise or movement should not be the only coping skill used to address negative affect. Rather, the data implies that a wide range of coping skills (e.g., CBT, DBT, mindfulness)

can best be used to maximize the recovery time and experience by targeting the relationship between negative affect and ED symptoms.

Future Research

The current study provides several avenues for future research in the ED treatment/recovery field. Firstly, since transdiagnostic data was used, we saw a wide spectrum of ED symptomatology, which further supports the need for personalized and adaptable treatment plans. Secondly, future research should examine other facets of exercise. Instead of solely observing exercise dependence, future research can analyze other facets of exercise, such as healthy movement (Vogel et al., 2021; Sewart et al., 2019; Mandal et al., 2012). Thirdly, this study could be expanded upon with the other techniques for data retrieval such as ecological momentary assessments (EMA). EMAs are quick, phone-based surveys that collect data throughout the day at different times. Additionally, more objective measures could be utilized such as wearables, which collect physiological data, and clinician reports. These forms of data collection would lessen the chance of bias, misreporting occurrences of symptoms, and/or lack of awareness of the self. Lastly, as a participant steps into the recovery process after treatment discharge, movement will be present as it is a natural part of everyday life. In the current study, the data was across a two-month time period and only included self-reporting measures of exercise dependence. Future research could increase the time after treatment discharge and include movement in any form.

Conclusion

In conclusion, this study adds to the literature about the recovery process in EDs. While our hypotheses were not fully supported (exercise dependence, affect, and ED symptoms did not significantly change over the two months; exercise dependence did not predict subsequent ED

symptoms), crucial information was still extracted from the findings (T2 negative affect predicted T3 ED symptoms). The findings show the consistency of exercise dependence, affect, and ED symptoms after treatment discharge. Our results revealed that an increase in negative affect in T2 predicted an increase in ED symptoms in T3. In order to target optimal recovery, we must address the factors that play into relapse – especially in the first two crucial months. Therefore, more research is needed in order to further the effectiveness of the ED recovery process.

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Figures and Tables

Table 1

Participant Demographic Information

		n (%)	*M* (SD)	Range
Age			26.27 (9.44)	14-59
Sex				
	Male	9 (5.4)		
	Female	159 (94.6)		
Ethnicity				
	Japanese, Japanese American	1 (0.6)		
	Black, not Hispanic origin (includes African American)	1 (0.6)		
	Hispanic	3 (1.8)		
	Multiracial, Biracial, Multiple Broad Categories	3 (1.8)		
	White, not of Hispanic origin (includes Caucasian, European American)	156 (92.9)		
	Missing	4 (2.4)		
Eating Disorder Diagnosis				
	AN	120 (71.4)		
	Atypical AN	11 (6.5)		
	BN	33 (19.6)		
	Atypical BN	1 (0.6)		
	ARFID	7 (4.2)		
	OSFED	3 (1.8)		
	EDNOS	36 (21.4)		
	Other	2 (1.2)		

Table 2

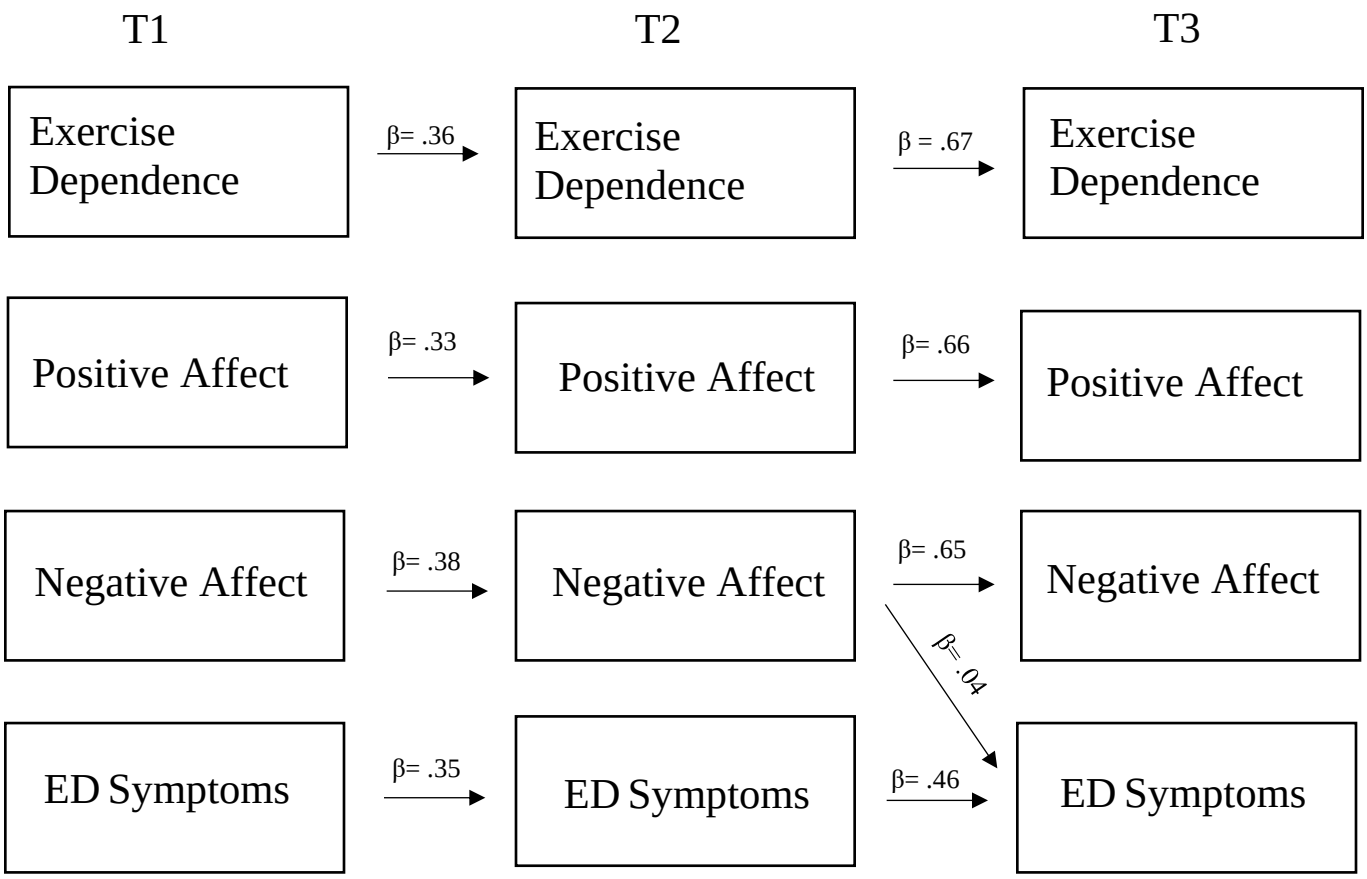
Zero Order Correlations

	1	2	3	4	5	6	7	8	9	10	11	12
1. T1 PA	-											
2. T1 NA	-.42**	-										
3. T2 PA	.49**	-.16*	-									
4. T2 NA	-.16*	.56**	-.25**	-								
5. T3 PA	.44**	-.19*	.70**	-.29**	-							
6. T3 NA	-0.14	.41**	-0.13	.68**	-0.15	-						
7. T3 ExD	.17*	0.08	.18*	.19*	.27**	.24**	-					
8. T2 ExD	0.07	.22**	.15*	.30**	0.05	.21**	.69**	-				
9. T1 ExD	.15*	.24**	0.10	.17*	0.11	0.03	.46**	.55**	-			
10. T3 ED symptoms	-.18*	.36**	-.22**	.51**	-.43**	.45**	.22**	.33**	.16*	-		
11. T2 ED symptoms	-.21**	.34**	-.39**	.51**	-.37**	.36**	.23**	.41**	.29**	.63**	-	
12. T1 ED symptoms	-.46**	.63**	-.26**	.39**	-.24**	.23**	0.08	.32**	.41**	.43**	.55**	-

Note. ** indicates that a correlation is significant at the 0.01 level. * indicates that a correlation is significant at the 0.05 level. PA = positive affect; NA = negative affect; ExD = exercise dependence

Figure 1

Path Analysis



Note. B values are significant (p<.05).