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Exercise as a Predictor of Change in Self-Reported Marital Satisfaction and Behaviors of Couples in Therapy

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ABSTRACT

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Recent studies looking to link physical exercise with beneficial couple outcomes have had mixed results, showing benefits for females but not males in some instances, and even negative effects for males in one instance. However, these studies used self-report data for exercise which may suffer from reporting errors. This study analyzed how daily exercise, measured by participants wearing accelerometers, impacts marital satisfaction, positive behaviors, and negative behaviors in a clinical population. The data was analyzed using multilevel models to determine how time spent exercising impacted individuals and their partners in terms of relationship outcomes. Results indicated small but significant relationships between female exercise and decreases in both marital satisfaction and positive behaviors for females, as well as increases in marital satisfaction for males. Increases in male exercise were also associated with decreases in marital satisfaction and positive behaviors for females. Further research is recommended to elucidate the findings that exercise is beneficial for some partners, but not others. Clinicians are advised to continue working with couples to improve marital satisfaction through emotional regulation techniques and widening the window of tolerance.

Keywords: marital satisfaction, positive relationship behaviors, negative relationship behaviors, Window of Tolerance, emotion regulation, exercise

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Increasing marital satisfaction is an understandable goal of couples engaging in therapy, as research has shown marital satisfaction is significantly correlated with overall life satisfaction (Carr et al., 2014). Furthermore, higher marital satisfaction has been found to be a predictor of better mental and emotional health. (Halford & Pepping, 2019; Whisman & Uebelacker, 2006). Although the benefits of a satisfying marriage are well documented, knowing how to achieve greater marital satisfaction is not always clear. Even when couples are struggling and make the decision to attend therapy together, positive results are not guaranteed. On average, couples receiving therapy for distress are better off at termination than 80% of couples in a no-treatment group (Shadish & Baldwin, 2003). However, in a study of couples at two years after termination, assessments showed significant deterioration in 30% to 60% of couples (Jacobson et al., 1987).

In the realm of couple and family therapy, there are several general components of the therapeutic process that tend to lead to positive change. These are the order and structure all therapeutic models provide, qualities of the therapist such as empathy and compassion, motivation of the clients, and contextual factors such as a positive therapeutic alliance (Davis, 2019). While these common factors are often beneficial, a consensus on what specific methods yield the most positive change for clients has not yet been reached. Depending on the model being used, therapists may focus on communication patterns, behavioral interactions, cognitive change, emotion recognition, and mutual acceptance, although oftentimes it is a combination of all of these (Halford & Pepping, 2019). Furthermore, therapists may employ more specific tactics to elicit change in their clients such as encouraging clients to practice mindfulness, write in a journal, track behaviors or emotions, or start or increase physical exercise (Kazantzis & L'Abate,

2007). Understanding the link between exercise and marital satisfaction in couples would help guide practitioners in the specific goals they set for clients and help clients better understand the reasoning behind assignments to generate greater client buy-in.

Literature Review

Satisfaction in marriage, as well as positive and negative behaviors within marriage are crucial constructs to study because they impact individual and partner mental health (Choi & Marks, 2008; Hawkins & Booth, 2005; Peterson-Post et al., 2014; Uecker, 2012). Increases in marital satisfaction occur for numerous reasons, and this study focuses on the role exercise may play. The window of tolerance framework (Siegel, 2012) and the concept of emotion regulation (Thompson, 1994) provide the theoretical basis for why exercise in couples attending therapy should enhance marital satisfaction. The following literature review also addresses how exercise impacts individual functioning, the importance of improving satisfaction in marriage, an analysis of past research, and justification for the current study.

Window of Tolerance

Conceptually, the window of tolerance model (Siegel, 1999) suggests everyone has an optimal zone, or range, of functioning in response to arousal. When operating within this optimal zone, called the window of tolerance, people have the ability to be flexible, adaptive, coherent, energized, and stable in their emotional and cognitive experiences (Siegel, 2020). Once a person departs from their optimal arousal zone, their responses become either extremely rigid or chaotic. Far from the flexible and adaptive characteristics within the window of tolerance, rigid and chaotic responses may be characterized by racing thoughts, reflexive or avoidant behaviors, perceptual distortions, or unbridled fury (Siegel, 2020). Therefore, expanding the size of the

window of tolerance and maximizing the time spent within this window can support optimal functioning.

In more physiological detail, the window of tolerance is a model of arousal of the autonomic nervous system (ANS). The ANS is made up of the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS) and both systems play a role in our emotional responses to different states of arousal (Corrigan et al., 2011). When stress or arousal reaches a certain threshold, the SNS is triggered and the fight-or-flight response is engaged, resulting in bodily adjustments such as dilated pupils, increased heartrate, and activated sweat glands (Siegel, 1999). The PNS is de-arousing and regulates necessary bodily functions such as digestion, energy conservation, and is characterized by a slower heartrate and a general feeling of calm. However, excessive PNS activity can lead to extensive energy conservation processes, leaving an individual feeling mentally shut down or almost numb (Siegel, 2020).

Heightened stress or arousal that activates the SNS impacts our cognitive and emotional functioning. When the SNS is triggered, brain function within the prefrontal cortex diminishes and activity within the amygdala intensifies (Terpou et al., 2019). The prefrontal cortex is vital in maintaining working memory, monitoring and inhibiting behavior in a rapidly changing environment, and regulating attention and emotion. With these necessary functions largely inaccessible, the amygdala activates stress pathways which leads to a release of noradrenaline and dopamine, prompting more reactive and habitual responses (Arnsten, 2009). As the rapid responses of the amygdala take control, the ability to maintain meaningful connection with others becomes much more difficult. However, Siegel states that processes that help people soothe their physiology can help create and strengthen neural habits of connection (2012), which is especially helpful for couples in therapy.

The window of tolerance concept is important to the construct of marital satisfaction and positive and negative behaviors because operating from the safety of the window of tolerance gives couples the best chance to interact with their partner in constructive ways. When couples are over aroused and acting from a place outside the window of tolerance, impulsivity, perceptual distortions, and racing thoughts can have a negative impact on relationship functioning which can contribute to dissatisfaction and an increase in negative behaviors (Corrigan et al., 2011). Exercise can help individuals both widen the window of tolerance, which increases capacity to deal with emotional states and stimuli, and to stay within the window of tolerance instead of automatically shifting into hyperarousal mode (Bernstein & McNally, 2017, 2018; Zhang et al., 2019). Emotion regulation is the process that enables one to temper emotions to a more bearable level and stay within the window of tolerance for optimal functioning (Constant et al., 2020).

Emotion Regulation

Emotion regulation, defined as the ability of an individual to modify the experience and expression of emotions (Gross, 1998) aids in soothing physiology. The process of emotion regulation includes "monitoring, evaluating, and modifying emotional reactions" to achieve specific goals (Thompson, 1994, pp. 27–28). Although the desired goals vary greatly by person and situation, in the context of marital satisfaction and positive behaviors, emotion regulation is often used to modulate negative or unhelpful emotions. As previously mentioned, regulating reactive emotions facilitates shifting back to increased prefrontal cortex activity, or a return to the window of tolerance, enabling an individual to think and act more judiciously (Siegel, 2020).

In relationships, emotion regulation is a significant skill because it allows for people to modulate negative affect and disengage during conflict, which may benefit the relationship as a

whole (Bloch et al., 2014; Constant et al., 2020). Because conflictual interactions produce negative reciprocity, without emotion regulation skills, couples' conflicts escalate as they spar back and forth (Gottman & Levenson, 1992). Therefore, the better someone is at emotionally regulating, and the more time they spend within their optimal window of tolerance, the more they can engage with their partner in a constructive or positive way, possibly leading to a more satisfying relationship. This idea is supported by a study finding couples who engaged in more adaptive cognitive emotion regulation, such as positive refocusing and reappraisal, showed higher marital satisfaction scores (Rusu et al., 2019). Interestingly, this pattern may be reciprocal, as relationship satisfaction has been seen to improve people's emotional regulatory processes (Oaten & Cheng, 2006).

There is mounting evidence to support exercise as a means to both widen the window of tolerance and improve emotion regulation abilities (Bernstein & McNally, 2017, 2018; Giles et al., 2018; Oaten & Cheng, 2006; Zhang et al., 2019). Therefore, exercise may be especially beneficial to couples experiencing high conflict or distress, as it may help couples stay in the window of tolerance and more effectively utilize emotion regulation techniques. Both outcomes may help individuals use higher-level cognitive processes to have more constructive interactions, and therefore improved marriage satisfaction.

Exercise and Individual Well-Being

Exercise provides physical, mental, and emotional benefits for individuals. Physical activity has been associated with lower incidents of obesity, coronary heart disease, type 2 diabetes, Alzheimer's disease, and dementia (Reiner et al., 2013). Furthermore, exercise is linked with positive change in mood states such as anxiety, depression, and stress (Mikkelsen et al., 2017). Specifically, exercise has been found to be both a short- and long-term emotion regulation

technique, which is especially relevant to this study, as couples could potentially reap the benefits of exercise in both the short term, and over time (Oaten & Cheng, 2006). The mental and emotional benefits of exercise are of special interest, as these have shown to impact window of tolerance and emotion regulation.

Emotional Benefits

There is ample evidence that supports exercise to improve emotional health. One of the ways exercise may aid emotional well-being is by increasing a person's ability to regulate their emotions. In one study of adults, participants showed heightened psychological distress in response to daily stressful events, however those who were physically active showed less distress than their non-active counterparts (Puterman et al., 2017). Exercise does not shield people from stressful situations, but it may change the way they respond. Similarly, another study of young adults found that those who exercised, rather than stretched, showed a greater measure of emotional resilience in response to a stressor (Bernstein & McNally, 2018). Lastly, the outcome of an all-female, eight-week moderate jogging and mindful yoga intervention found the experimental group participants significantly improved their implicit emotion regulation abilities in relation to the control group (Zhang et al., 2019). Implicit emotion regulation occurs without intention or conscious thought, and can contribute to better mental health (Gross & Thompson, 2007). All studies highlight the role exercise plays in improving emotional regulation capabilities. Furthermore, research supports the idea that those who are better able to regulate their emotions have more success in relationships (Bloch et al., 2014). This information helps lay the foundation for the basic hypothesis of this study. If exercise can improve emotional regulation, and better emotion regulation is correlated with more satisfying relationships, couples

who engage in more exercise should show higher relationship satisfaction and positive behaviors, as well as lower negative relationship behaviors.

Exercise Intensity

While all physical movement provides some sort of benefit, to reap the aforementioned emotional advantages, exercise intensity must be considered (Chekroud et al., 2018). Moderate or vigorous exercise has been shown to decrease insomnia and depression, buffer the stress response, improve cognitive functioning, and enhance mood (Childs & de Wit, 2014; Gerber et al., 2014; Nakagawa et al., 2020). These same benefits are not always gained with lower intensity physical exercise. Compared to walking, moderate to vigorous exercise showed greater mental health benefits such as increased active coping, decreased state anxiety, increased personal growth, and fewer instances of behavioral disengagement, or avoidance, in young adults (Nakagawa et al., 2020). Another study revealed vigorous physical activity was associated with less stress, depression, and mental health problems as compared to moderate physical activity, strengthening the connection between higher intensity exercise and increased mental health benefits (Gerber et al., 2014).

There is no definite consensus on the specific biological processes by which exercise, specifically higher intensity exercise, impacts mental health. Studies have identified biological mechanisms such as changes in neuroplasticity, inflammation (BDNF production), the neuroendocrine response, and oxidative stress as possible pathways linking exercise and mental health (Kandola et al., 2019; Zhang et al., 2019). With emotion regulation specifically, exercise has been linked to enhancing emotion regulation skills by improving activation and function of the default mode network (DMN), part of the prefrontal cortex of the brain. People with depression show volumetric reductions in DMN, however multiple studies support the link

between physical activity and volumetric increases in these brain regions (Gujral et al., 2017). Because the prefrontal cortex is fundamental to cognitive tasks such as reappraisal, decision making, flexibility, and impulse inhibition (Kelley et al., 2019), improving the function of one's prefrontal cortex could lead to decreased affect reactivity (Smith & Merwin, 2021). While the direct impact of exercise can help individuals by widening the window of tolerance or bettering emotion regulation abilities, we are also interested in studying how exercise impacts the interaction of individuals within a marriage, as marriage quality can be a significant predictor of overall health (Hawkins & Booth, 2005).

Marital Satisfaction and Behaviors

Marriages have the power to greatly impact individuals, couples, families, and society in both positive and negative ways. Relationship satisfaction is a widely studied construct within the social sciences (Graham et al., 2011), in large part because of the far-reaching reverberations it can generate within family member's lives (Hawkins & Booth, 2005; Robles et al., 2014). While many studies focus on marital or relationship satisfaction in general, there is much to learn by also investigating specific relationship behaviors. Marital satisfaction is a complex, multi-dimensional variable, therefore using a two-factor model of both positive and negative behaviors allows for a more well-rounded picture of the marriage relationship (Fincham & Linfield, 1997). Utilizing behavioral indicators of marital satisfaction also gives researchers the chance to see day to day changes, which general overall marital quality questions may miss.

Marital Satisfaction and Mental Health

While there is research that touts the mental health advantages of marriage (Simon, 2002), not all marriages are created equal, and marriages with low satisfaction generally do not reap those benefits (Kiecolt-Glaser & Newton, 2001). There is ample research linking marital

distress with poor mental health. In general, individuals who are unmarried have better psychological health than those in unhappy marriages (Williams, 2003). Studies with U.S. populations have shown marital distress associated with bipolar disorder, alcohol use disorders, generalized anxiety disorder, as well as increased likelihood of suicide ideation (Whisman & Uebelacker, 2006). Marital conflict has been found to lead directly to increases in depression and functional impairment (Choi & Marks, 2008). Anxiety is also impacted by marital satisfaction, as a meta-analysis found marriage dissatisfaction to be a trigger for and maintainer of anxiety disorders (Kasalova et al., 2017). Furthermore, staying in an unhappy marriage long-term has also been shown to negatively impact an individual's self-esteem (Hawkins & Booth, 2005). Based on these findings, understanding if and how exercise affects marital satisfaction is important work to do.

Benefits and Risks of Marital Behaviors

Among researchers, marital behaviors are referred to using a variety of terms such as protective factors, spousal support, relational skills, adaptive skills, problem areas, risk factors, conflict behaviors, and negative interactions (Lawrence et al., 2008). This paper uses the simple labels of positive and negative behaviors to encapsulate the previously listed terms. Much like overall marital satisfaction, positive and negative behaviors within a marriage are correlated with a wide range of beneficial and deleterious consequences. For instance, positive behaviors and partner support have been linked with higher levels of oxytocin and faster wound healing (Gouin et al., 2010), reduced stress response (Taylor, 2011), lower systolic blood pressure (Grewen et al., 2005), and buffered effects of economic stress (Conger et al., 1999). On the other hand, negative behaviors in a relationship, such as criticism and withdrawal, are correlated with lower levels of vasopressin which helps regulate blood pressure (Gouin et al., 2010), and increased

depressive symptoms, (Peterson-Post et al., 2014). Both positive and negative behaviors have distinct outcomes, which makes tracking both types of behaviors necessary.

There is also a link between patterns of positive and negative behaviors and marital satisfaction. Higher levels of negative behavior in conjunction with lower levels of positive behavior predict more rapid declines in husbands' and wives' marital satisfaction (Bradbury & Karney, 2004). Interestingly, the same declines are not seen in couples with high levels of negative *and* positive behavior, suggesting the dearth of positive behaviors enhances the deleterious effects of the negative behaviors. The idea that positive behaviors have a protective quality in relationships has been supported in multiple studies, and is an important reason to track positive behaviors in a study such as this one (Otero et al., 2019). This study focuses on marriage satisfaction, positive behaviors, and negative behaviors because all three are significant for individuals and couples.

Exercise to Change Marital Satisfaction and Behaviors

In a meta-analysis of MFT interventions, researchers found marriage and family therapists produce clinically significant results in 40% to 50% of those treated (Shadish & Baldwin, 2003). However, Gottman (1999) found couple therapy led to long-term meaningful improvements in only 11% to 18% of couples. Because therapy is not always effective, it is important to study what *does* lead to positive change in couple relationships.

The purpose of this study is to specifically examine one of the many variables at play: exercise. Specifically, the goal of this study is to better understand the impact exercise has on couple satisfaction and couple behaviors of clinically distressed partners. As has been outlined, research regarding the cognitive and emotional benefits of exercise support the hypothesis that exercising would be beneficial to distressed couples in therapy, as it would help widen their

window of tolerance and better emotionally regulate. However, although previous studies have investigated similar variables, results have been mixed.

Past Studies

One clinical study of couples in therapy (Johnson, Selland, et al., 2018) examined the effect exercise had on daily positive events in the relationship. This study measured exercise using a daily diary to track minutes exercised and open-ended questions regarding what positive events happened each day. These open-ended responses were then categorized by researchers into five main categories: no positive event, positive communication, showed support or affection, did something for or with partner, and external positives. Results from this study found that for wives, exercise was associated with increased daily positive interactions and positive communication. There was also a partner effect, as wives exercised more, husbands also reported more external positive events. However, no association was found between husband's exercise time and positive events for husbands or wives. While this study provides helpful information, it is does not use an objective measure of exercise. The Johnson-Selland study utilized self-report data and only asked the number of minutes the participants exercised each day. The current study employs a more sophisticated measure of physical activity that allows researchers to not only track precisely how many minutes of exercise occurred each day, but the percent of time spent exercising in different intensity intervals. This will provide a more accurate view of how much and what intensity of exercise leads to greatest impact.

Another study with similar variables found again that for wives, exercising on a given day was linked to positive marital events and increases in marital satisfaction levels, but that frequency of exercise in husbands was actually linked to more negative marital events in the sample (Yorgason et al., 2018). Additionally, Yorgason found no statistically significant partner

effects for either partner exercising in relation to their spouse's marital outcomes. However, once again, the Yorgason study did not measure duration or intensity of exercise, which is remedied in the current study. It should also be noted that the sample for this non-clinical study was older adults, aged 59-63 years, which may have impacted the results. The current study participants are younger and more varied, ages 22-38 years, which will make the results generalizable to a larger population.

Lastly, one clinical daily diary study examined how physical exercise, among other variables, impacted participant's views of themselves and their partner (Johnson, Mennenga, et al., 2018) . In this study, physical exercise was measured simply by answering a daily yes-no question. As a follow-up to this question, the study asked how exercise influenced how they felt about themselves, their partner, and their relationship using a five-point scale of very negative to very positive. Results assessed both within and between partner effects, and found for men and women, exercise on a given day was significantly related to feeling better about themselves (Johnson, Mennenga, et al., 2018). However, when examining relationship effects, exercise did not have a significant effect on how males or females felt about their partner, or their relationship, which differs from the previous mentioned studies. This daily diary study used a simple relationship satisfaction measure, a 5-point Likert scale question asking how exercise influences how the participant feels about themselves, their partner, and their relationship. The current study utilizes two different measures, one focused on how satisfied each participant is in different domains of the relationship, and another focused on both positive and negative behaviors. The specificity allows for more insight into how exercise impacts specific relationship domains and behaviors.

Differentiating Factors of Current Study

The three studies mentioned above bolster the argument that exercise does indeed impact individuals and couples. However, questions persist as to why exercise seems to be more beneficial for some groups and not others. To elucidate these irregularities, the current study changes how exercise is measured and how marital relationship outcomes measured. The following provides more detailed information on how these changes will be beneficial to the current study.

Participants in this study wore accelerometers, which are devices to monitor and measure movement and to gather physiological data. These accelerometers not only track how much movement a person engages in, but also measure heartrate, to differentiate between light, moderate, vigorous, and very vigorous exercise. As has been stated, exercise intensity matters, especially when investigating emotional and mental benefits of exercise. Of the studies mentioned above, all used daily self-report data, which may be over or under-reported (Prince et al., 2008). Utilizing an objective, reliable, valid, and accurate measurement tool such as an accelerometer, gives more credence to the findings of the study. As this is a study investigating the relationship between exercise and marital satisfaction and behaviors, the need for valid exercise data is paramount to making sound connections.

Additionally, the way marital satisfaction is measured differs slightly from previous studies. This study takes an identical approach to that of the Yorgason study (2018), measuring marital satisfaction within different domains, as well as daily positive and negative behaviors. The use of both perceptual questions and behavioral questions gives more flexibility for the analysis. Perhaps exercise impacts a person's perception of their relationship but does not necessarily increase or decrease positive or negative events. The use of the behavioral questions

is important given the study's timeline. Behaviors are more likely to change day to day, whereas general satisfaction with the relationship is rather stable in the short term (Neff & Karney, 2005; Pasch & Bradbury, 1998). As this study follows couples over a period of five to six weeks, the use of daily behaviors will be more beneficial to track change than a single general question of marital satisfaction. In conclusion, this study builds off past research but expands variables like exercise and marriage satisfaction and differentiates between most distressed partner to get an additional, and hopefully more helpful angle.

Research Questions

1. For males, is exercise on a given day related to a change in the perception of relationship satisfaction, as reported by each partner?
2. For females, is exercise on a given day related to a change in the perception of relationship satisfaction, as reported by each partner?
3. For males, is exercise on a given day related to a change in positive behaviors, as reported by each partner?
4. For females, is exercise on a given day related to a change in positive behaviors, as reported by each partner?
5. For males, is exercise on a given day related to a change in negative behaviors, as reported by each partner?
6. For females, is exercise on a given day related to a change in negative behaviors, as reported by each partner?

Methods

Study Participants

Data for this study were collected through the Changing Hearts and Minds in relationshiPS (CHAMPS) research project conducted through Brigham Young University (BYU). Although the CHAMPS project collects data from both therapists and client couples, only data from couples is used in this study. The research participants consisted of married couples seeking therapy at a university-based clinic. To be included in the study, couples needed to be English-speaking, married for at least one year, free from substance abuse problems, addiction, or severe mental disorders.

Participants were 20 married heterosexual couples who had an average age of 28.40 (*SD*=4.12; range=22-39). The majority of the sample was White, 78.95% (n=30), with 10.53% indicating they are more than one race (n=4), 7.89% Hispanic (n=3), and 2.63% Asian/Pacific Islander (n=1). The average family income was between $35,001 and $45,000 and couples had an average of 2.79 children (*SD*=1.60; range:1-6). Educational attainment of the sample varied; for 5.13% (n=2) the highest level of education was a GED or high school, 5.13% (n=2) attained an associate degree, 23.08% (n=9) a bachelor's degree, 5.13% (n=2) completed vocational or technical school, 43.59% (n=17) completed some college, and 15.38% (n=6) attained a master's or professional degree. It should be noted that demographic data was not available for one of the couples included in the study. Therapists for the study were second-year MFT masters-level or PhD interns from the BYU Comprehensive Clinic and clients were assigned based on availability.

Procedures for Data Collection

Data for this analysis were collected using daily dairy self-report measures to ascertain marital satisfaction and positive and negative behaviors, as well as accelerometer data to track physical activity. The self-report measures for marital satisfaction and relationship behaviors were given daily, and the accelerometer data provided around the clock information on physiological processes such as movement and changes in heart rate.

Measures

Marital Satisfaction

Marital satisfaction was operationalized by daily impressions of the marriage relationship/spouse (McNulty & Karney, 2001). The daily impressions scale was modified from McNulty and Karney (2001) and asked about satisfaction within seven domains: household chores, general support, time spent together, disagreement resolution, conversations, affection, and dependability. Respondents rated their satisfaction daily on a scale of 1 (very unsatisfied) to 7 (very satisfied) for each domain. The original scale, which was made up of nine domains, had daily adequate coefficient alpha for each item, ranging from .82 to .93 for husbands and from .87 to .94 for wives. Face validity for this measure is good, as couples who are satisfied in a variety of domains such as emotional closeness, sexual intimacy, communication, and decision-making would most likely be satisfied in their marriage overall.

Relationship Behaviors

Relationship behaviors were measured using daily perceptions of supportive and negative behaviors of spouse (Neff & Karney, 2005). A modified version of the "Daily perceptions of spousal support" and "Daily perceptions of negative spousal behaviors" scales by Neff and Karney was used to measure relationship behaviors (2005). This scale is made up of 12, yes-no

items assessing eight positive and four behaviors of the spouse, such as shared physical intimacy with spouse/partner, enjoyed a leisure activity with spouse/partner, criticized by spouse/partner, and had an argument with spouse/partner. Every day, spouses indicate which events did or did not happen (1 = Yes and 0 = No). All positive event questions are summed to produce a positive behaviors variable, and all negative behaviors are summed to produce a negative behaviors variable for each day, for each spouse.

Exercise

Daily exercise was tracked using both individual daily diary entries and an accelerometer. The accelerometer was utilized to measure daily minutes of exercise, based on intensity. Minutes of exercise were broken down into four intensity categories: light, moderate, vigorous, and very vigorous based on Freedson adult cut points (Freedson et al., 1998). These cut points are based on metabolic equivalent of task (MET) which can be described as the amount of oxygen consumed per kilogram of body weight per minute (Jetté et al., 1990). More simply put, a MET value signifies the energy expenditure of different types of activity. The MET categories are as follows: light exercise (≤ 2.99 METs), moderate exercise (3.0-5.99 METs), vigorous exercise (6.0-8.99 METs), and very vigorous exercise (≥ 9.0 METs) (Freedson et al., 1998). Studies have shown that most mental health benefits from exercise come when a person is in the moderate to very vigorous range (Gerber et al., 2014; Nakagawa et al., 2020). Therefore, minutes spent in moderate, vigorous, and very vigorous activity were summed for each participant for each day. Accelerometer data has proven to be a good daily measure for physical and sedentary activity because it is more objective than self-report data (Reilly et al., 2008).

Analysis

Analysis of the data was completed using Stata/SE 17.0 statistical analysis software. To run an actor partner interdependence model as a multilevel model data were stacked or double coded. Next, actor and partner variables were created as interaction variables in Stata, prior to entering them into the multilevel models. Once the interaction variables were created, three multilevel models were fit to the data to consider how daily exercise impacted individuals as well as their partners in terms of each of the dependent relationship variables: marital satisfaction, positive behaviors, and negative behaviors. Multilevel models were chosen because the data contains individual information nested within couple relationships, as well as longitudinal data over several days (Leyland & Groenewegen, 2020).

Results

Three multilevel models were fit to the data and explored the three different dependent variables of marital satisfaction, positive behaviors, and negative behaviors and how they interacted with daily minutes of moderate, vigorous, and very vigorous exercise. On average, males in the study engaged in 62.3 minutes (SD = 2.6) of moderate, vigorous, or very vigorous exercise each day, while women averaged 48.4 minutes (SD = 2.4). Full results for each model are displayed in Tables 1-3.

Table 1

Summary of Multilevel Model Analyses for Exercise Predicting Marital Satisfaction

Predictor	Coef.	SE	95% CI [LL, UL]	z	p
Male	4.74	.11	[4.53, 4.96]	43.28	< .001***
Female	4.31	.11	[4.09, 4.53]	38.12	< .001***
Male actor	-.001	.001	[-.003, .001]	-.78	.435
Male partner	-.004	.001	[-.007, -.002]	-3.37	.001***
Female actor	-.003	.001	[-.005, .000]	-1.95	.051*
Female partner	.005	.001	[.003, .007]	4.12	< .001***

***$p \leq .001$, **$p \leq .01$, *$p \leq .05$

Table 2

Summary of Multilevel Model Analyses for Exercise Predicting Positive Relationship Behaviors

Predictor	Coef.	SE	95% CI [LL, UL]	z	p
Male	3.83	.18	[3.46, 4.19]	20.78	< .001***
Female	3.02	.19	[2.65, 3.40]	15.85	< .001***
Male actor	-.001	.002	[-.005, .003]	-.71	.481
Male partner	-.005	.002	[-.009, .-001]	-2.21	.027*
Female actor	-.005	.002	[-.010, -.001]	-2.39	.017*
Female partner	.003	.002	[-.001, .007]	1.57	.117

***$p \leq .001$, **$p \leq .01$, *$p \leq .05$

Table 3

Summary of Multilevel Model Analyses for Exercise Predicting Negative Relationship Behaviors

Predictor	Coef.	SE	95% CI [LL, UL]	z	p
Male	.81	.09	[.638, .986]	9.16	< .001***
Female	1.01	.09	[.832, 1.19]	11.06	< .001***
Male actor	.000	.001	[-.002, .002]	.34	.734
Male partner	-.000	.001	[-.003, .002]	-.45	.656
Female actor	-.001	.001	[-.003, .002]	-.53	.593
Female partner	-.002	.001	[-.004, -.000]	-1.97	.049*

***$p \leq .001$, **$p \leq .01$, *$p \leq .05$

Questions 1 and 2

The first two research questions explored how minutes of moderate, vigorous, and very vigorous daily exercise impact marital satisfaction for the individual, as well as their partner (see Table 1 for full results). The overall model for these questions was significant (Wald chi-square = 6581, $p \leq .001$). For males, there was no significant effect of time spent exercising on their self-reported marital satisfaction (b = -.001, p = .44), however male exercise was significantly related to female's marital satisfaction (b = -.005, $p \leq .001$). The magnitude of this finding is small, and in the negative direction, meaning for every additional 30-minutes spent exercising for males every day, female marital satisfaction would decrease by .15 points. For females, time spent exercising was significantly related to their own self-reported marital satisfaction (b = -.003, p = .05), as well as their partner's marital satisfaction (b = .005, $p \leq .001$). Female actor effects were negative, while female partner effects were positive, yet very small. For every 30-minute increase in time spent exercising for females, male marital satisfaction would increase by .15 points. To put this in perspective, according to this model if females exercised for 200

minutes (3 hours and 20 minutes) per day, male satisfaction would increase by only one point, but their own report of marital satisfaction would decrease by .6 points.

Questions 3 and 4

Questions 3 and 4 related to understanding how minutes of daily moderate, vigorous, and very vigorous exercise impact positive relationship behaviors for individuals and their partners (see Table 2 for full results). The overall model regarding questions 3 and 4 was significant (Wald chi-square = 1420 , $p \leq .001$). For men, minutes of daily exercise was not significantly related to their own report of positive behaviors ($b = -.001$, $p = .48$), but it was significantly related to their partner's report of positive behaviors ($b = -.005$, $p \leq .05$). The magnitude of this finding is small, and in the negative direction, meaning for every 30-minute increase in time spent exercising for males, female positive behaviors would decrease by .15 points. For females, time spent exercising impacted their own positive behaviors ($b = -.005$, $p \leq .05$) but did not significantly impact their partner's positive behaviors ($b = .003$, $p = .12$). Once again, the magnitude of these relationships is quite small. As women increase their time spent exercising, their positive behavior decreases by an amount of .005 units per minute of exercise.

Questions 5 and 6

The last two research questions explored how time spent exercising in moderate, vigorous, and very vigorous intensity levels impacts negative relationship behaviors of individuals and their partners (see Table 3 for full results). The overall model for these questions was significant (Wald chi-square = 351.9, $p \leq 001$). The only significant relationship found was that between minutes of female exercise and their partner's report of negative behaviors ($b = -.002$, $p \leq .05$). This means that as females minutes of exercise increase, male reports of negative behavior in the relationship decrease, albeit by a very small degree. Results of the relationship

between minutes of male exercise and male reports of negative behavior (b = .001, p = .73) as well as female negative behavior (b = .001, p = .66) were not significant. Female time spent exercising was negatively related (b = -.001, p = .59) but was also not significant.

Discussion

Many of the findings were unexpected. According to the window of tolerance theory, emotion regulation, and past research (Siegel, 2012; Thompson, 1994), we hypothesized that increased exercise would widen individuals window of tolerance and increase ability to emotionally regulate, and therefore lead to more positive relationship behaviors, fewer negative relationship behaviors, and higher marital satisfaction. However, increased exercise was associated with significant positive outcomes in only two instances. Female exercise predicted increases in male marital satisfaction as well as decreases in male reported negative relationship behaviors. It is important to note that while significant, the magnitude of the findings is so miniscule that these findings are not meaningful in a clinical sense.

There were four instances of exercise being statistically significant for negative relationship outcomes. Increased exercise in males was associated with decreases in positive behaviors and marital satisfaction as reported by their partners. Increased exercise in females was associated with decreases in self-reported positive behaviors and marital satisfaction. Taking all the significant results of this study together, females seem to be more negatively impacted by not only their own time exercising, but their husband's exercise levels as well. These findings are surprising, especially given the extent of research on beneficial effects of exercise for individuals (Mikkelsen et al., 2017; Oaten & Cheng, 2006; Puterman et al., 2017; Zhang et al., 2019).

The results of this study also seem to contradict previous studies of its kind. For instance, one previous study found that for females, increased exercise was associated with more positive

interactions within their relationship, as well as increased external positive events for husbands (Johnson, Selland, et al., 2018). This is the exact opposite of what was found in the current study, where female exercise was associated with negative outcomes regarding positive behaviors and marital satisfaction as reported by females. This study also revealed significant partner effects for male exercise, which were not found in any of the similar studies that were examined (Johnson, Mennenga, et al., 2018; Johnson, Selland, et al., 2018; Yorgason et al., 2018). While other studies may have used slightly different variables and populations, one would think there would be more overlap given the major similarities between them. It appears all these studies are missing a crucial element when it comes to how exercise impacts couple functioning and satisfaction levels. One possibility is how exercise is both defined and measured.

Given that research supports the distinctive emotional regulatory benefits of moderate, vigorous, and very vigorous exercise (Childs & de Wit, 2014; Gerber et al., 2014; Nakagawa et al., 2020), which was specifically measured for this study, we were surprised we did not see positive outcomes in the results. One theory is, perhaps exercise is emotionally and cognitively beneficial up to a certain point, but in large amounts it begins to have a limited or even negative impact (Chang et al., 2014; Peluso & Andrade, 2005; Sarbadhikari & Saha, 2006). This would assume a curvilinear, bell-shaped relationship between exercise and the dependent variables, which was not tested in this study.

Another idea is that the moderate exercise category encompassed movement that reached the moderate MET category but was not intense enough to produce the needed effects. Moderate exercise (3.0-5.99 METs) includes activities such as sweeping, washing windows, briskly walking, or dancing which may explain the inflated exercise averages (MacIntosh et al., 2021). Because the accelerometers captured all movement over 3.0 METs, it is likely the accelerometers

captured any movement that reached the 3.0 METs threshold, even if it was not intentional exercise.

Looking into the data further strengthens this theory, as the average time spent in the moderate exercise category for both men and women was 56.41 minutes (*SD*=43.86) per day, while the average time spent in the vigorous exercise category was 11.04 minutes (*SD*=14.81). This means, on average, men and women in the study were engaged in moderate exercise for 394.87 minutes each week, far exceeding the national guidelines of 150 minutes of moderate exercise per week. According to 2019 data, only 23% of the U.S. population met the federal exercise guidelines of 150 minutes of moderate exercise or 75 minutes of vigorous exercise per week (United Health Foundation, 2021) . It seems unlikely that the average duration of moderate exercise in the study not only met the national guidelines but exceeded it by 163%. In conclusion, there were complexities in measuring movement and exercise that were unforeseen and may have impacted results. Because of the unexpected nature of the results, there are few clinical implications but several recommendations for further research that touch on some of the limitations of the current study.

Clinical Implications

Results revealed that while daily exercise may impact same day reports of individual and partner marital satisfaction and relationship behaviors, the magnitude of these relationships is extremely small. The largest dependent variable coefficient was .005, which means a person would need to exercise for 200 minutes to see a one-point change in the dependent variable. Clinically, according to this study, exercise on any given day is unlikely to have a meaningful positive *or* negative effect on marital satisfaction, positive behaviors, or negative behaviors during that same day.

While possibly beneficial, therapists and clients may want to focus their time and energy on more direct means of emotional regulation such as meditation or mindfulness (Tang et al., 2015) or cognitive reappraisal (Gross & John, 2003). This does not mean that therapists should stop prescribing exercise to clients, but instead temper their expectations of just how much exercise will support or detract from relevant couple issues.

Limitations and Future Research

We acknowledge the imperfections of this study and outline possible strategies to produce greater insights into how exercise impacts couple functioning. Limitations include sample size and makeup, specific measures used, analysis type, and possible missing variables. This study lacked a large and varied sample population. The sample size was small and lacking in ethnic diversity, as 79% of the sample indicated they were white. Although the number of level one variable observations were satisfactory (232 days of data), the level two variable, couples, was smaller than we would have liked. Ideally, the sample size would be at least 50 couples to strengthen the statistical power of the, but this study only included 20 couples (Maas & Hox, 2005). With a larger and more representative couple population, statistical analysis can have more conclusion validity, and results may be more generalizable.

Secondly, the negative relationship behaviors scale only included four items. This lack of range may have impacted the significance of results. For future research a scale such as the Positive-Negative Relationship Quality Scale (PN-RQ) may be more beneficial, as it contains eight items for both positive and negative relationship quality. The positive relationship behavior scale included eight items, which allows for a larger range. The unequal number of questions on the “Daily perceptions of spousal support” and “Daily perceptions of negative spousal behaviors” may have skewed the results (Neff & Karney, 2005).

The type of analysis used may have made a difference in the results. The multilevel model used in this study assumes the relationship between exercise and relationship outcomes are linear. Based on the supporting theoretical research such as window of tolerance and emotional regulation, assuming a linear relationship was not unfounded. However, due to the extremely small magnitude of the finding, it may be more likely that the relationship between exercise and relationship outcomes is more curvilinear in nature. Future research could be done to fit a more nuanced curvilinear model to the data to better explain the variations in effects of exercise.

Similar to using a more nuanced model in the future, researchers may also want to look into altering the time lag of the study. Perhaps exercise *does* have an impact on marital satisfaction and relationship behaviors, but the impact is not immediate. If lagged by one or two days, findings may show a more significant relationship between the variables. There is also the possibility that consistent exercise produces improvements incrementally over weeks or even months.

Lastly, another limitation was the omission of a possible third variable. Based off the supporting literature, exercise should have had a stronger impact on the dependent variables, therefore it seems as though there may be an important variable we are not considering. Previous studies looking at similar variables have found conflicting results, which strengthens the argument that we are missing a fundamental aspect of the relationship between exercise and beneficial couple outcomes. Possible variables to include in further research are stress levels of each individual (Stults-Kolehmainen & Sinha, 2014), motivation for exercise, and the possibility that exercise influences variables related to emotional regulation which then influence relationship variables.

Conclusion

The purpose of this study was to explore how daily exercise impacts marriage satisfaction, positive behaviors, and negative behaviors in clinical couples, utilizing exercise data from accelerometers. Results of the study reinforce the notion that there is indeed a connection between exercise, marriage satisfaction, and positive and negative behaviors, although the magnitude of the findings from this study are small. Females seem to be impacted more negatively than men when it comes to exercise and relationship outcomes. Specific results include decreased marital satisfaction and fewer positive relationship behaviors for females as their time spent exercising increases. Additionally, females experience similar decreases in positive relationship behaviors and marital satisfaction when their *partners* exercise, possibly exacerbating negative outcomes. Two positive relationships were found: increases in female exercise were associated with increases in male marital satisfaction and decreases in male negative behaviors. More research needs to be done on exercise and couple functioning to better understand the dearth of corroborating studies. Recommendations for further research include utilizing a larger sample size, altering measures used, and adding in mediating variables such as stress levels or exercise motivation.

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