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## **Exercise and Mental Health Over the Course of a Semester**

Jamie Alexis Whitney

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EXERCISE AND MENTAL HEALTH OVER THE COURSE OF A SEMESTER

by

Jamie Alexis Whitney

Bachelor of Science  
Heidelberg University, 2021

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Submitted in Partial Fulfillment of the Requirements

For the Degree of Master of Science in

Exercise Science

Arnold School of Public Health

University of South Carolina

2023

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## ABSTRACT

**Introduction and purpose:** Anxiety and depression are two of the most common mental health struggles in the United States each year. There has been promising research noting the positive effects of exercise on lowering symptoms of both anxiety and depression. Anxiety and depression are highly prevalent on college campuses, especially during high stress portions of the semester. The purpose of this study was to observe the changes in mental health over the course of the semester and if exercise level mediated any of these changes in the university population. **Methods:** Participants scanned a QR code or followed a link to the first survey via flyers in Campus Recreation facilities. They were then taken to the informed consent document and after agreeing, participants filled out basic sociodemographic information, the PROMIS Anxiety short form, the PROMIS Depression short form, and the Godin-Shepherd Leisure Time Activity form. Those who filled out the first survey and consented to a follow up email received the second survey in late November with the same three validated surveys along with questions regarding Campus Recreation and more sociodemographic information. **Results:** Twenty-two participants completed the first survey and seven completed the follow up survey. At the first time point, there was a moderate correlation between the amount of exercise score with anxiety (Spearman's  $Rho = -0.5117$ ,  $p < 0.03$ ) and depression scores respectively (Spearman's  $Rho = -0.6530$ ,  $p < 0.01$ ). Correlations were not as strong at the second time point (Spearman's  $Rho = -0.2571$ ,  $p = 0.63$ ; Spearman's  $Rho = -0.3947$ ,  $p = 0.44$ ), though only 6 participants completed the follow-up survey. There was no significant difference

between anxiety or depression scores and Group Exercise or Intramural program use versus facility users only ( $p=0.2765$ ,  $p=0.2342$ ). **Conclusions:** There was a significant negative correlation between higher levels of exercise and depression and anxiety scores. There was no significant difference between campus recreation program use and mental health scores, so this could mean that different types of activities might have similar associations with mental health scores. Future studies with larger sample sizes have the potential to describe more generalizable relationships between exercise and anxiety and depression scores over time.

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## LIST OF ABBREVIATIONS

BDNF	Brain Derived Neurotrophic Factor
CBT	Cognitive Behavioral Therapy
CDC	Center for Disease Control
GAD	Generalized Anxiety Disorder
HPA	Hypothalamic-Pituitary-Adrenal
PA	Physical Activity
PROMIS	Patient-Reported Outcomes Measurement Information System
SAD	Social Anxiety Disorder
SSRI	Selective Serotonin Reuptake Inhibitor
US	United States

# CHAPTER 1

## LITERATURE REVIEW

Anxiety and depression are two of the most common mental health concerns in the US.<sup>1-6</sup> Approximately one third of all US adults are diagnosed with some form of anxiety in their lifetime and roughly 15% of adults are diagnosed with depression.<sup>4,7</sup> These rates, however, do not include the large number of adults who either do not seek a diagnosis or who experience subthreshold symptoms. There tends to be higher rates of depression and anxiety symptoms in those of lower socioeconomic status, those of marginalized groups in the US, and those with little to no social interaction or extracurricular participation.<sup>1,8</sup> Women also tend to be more likely than men to be diagnosed with, or experience symptoms of, anxiety and depression.<sup>9-11</sup> A significant amount of research has been conducted involving the association between exercise and mental health and how exercise can positively influence symptoms of anxiety and depression.<sup>3,4,10,12-22</sup> This research mainly focuses on adults in the US, but more research is being published about younger adults and those in the university setting.<sup>1,8,23-29</sup> This research has the potential to influence university planning and programming to promote physical and mental well-being among students, faculty, and staff.

Anxiety is broadly defined as the anticipation or fear of a future threat characterized by excessive feelings of worry or fear.<sup>29,30</sup> The prevalence of anxiety tends to be based on the rates of those with trait anxiety and generally includes all anxiety disorders. Trait anxiety is referred to as anxiety as a personality trait that affects people

during their everyday life, whereas state anxiety refers to symptoms of anxiety felt during a specific situation or in response to a certain stressor.<sup>30,31</sup> State anxiety is normal and is experienced by everyone at some point in their lives due to the nature of different stressors and situations people encounter.<sup>31</sup> When diagnosing an anxiety disorder, trait anxiety symptoms are usually measured. Two of the more common forms of anxiety disorders are social anxiety disorder (SAD) and generalized anxiety disorder (GAD).<sup>2</sup> These disorders are characterized by feelings of anxiety that become overwhelming in response to stressors occurring in everyday life.<sup>2</sup> While the prevalence of these diagnoses is relatively high, the presence of subthreshold symptoms is also common and can be seen in conjunction with symptoms or a diagnosis of depression.<sup>2,30,32</sup>

There is not necessarily a direct definition of depression, but the disorder is typically characterized by a multitude of symptoms of varying severity.<sup>6,12</sup> Some of the more common symptoms of depression include sadness, fatigue, hopelessness, irritability, and a lack of interest in usual activities.<sup>1,6,7,12,21,32,33</sup> This is only a handful of the many symptoms individuals can experience in response to depression. Sadness is a natural emotion and reaction to loss and other life events, but its differentiation from depression is important.<sup>6</sup> Depression is characterized by symptoms of sadness that are disproportionate to the context of the situation and usually lasts for extended periods of time.<sup>12</sup> There are also different severity levels of depression, typically categorized into mild, moderate, and severe, and there is also a form of depression that is considered treatment resistant.<sup>12</sup> Treatment resistant depression is a form of depression that does not respond to psychotherapy or medicinal treatment, so the implementation of other avenues of treatment could be beneficial.<sup>12,21</sup> Depression has also been shown to be a leading

cause of disability and disease burden in the US.<sup>6</sup> In comparison to anxiety, it may be less prevalent overall, but it causes more burden on the individual than anxiety does in a typical case.<sup>1,9,34</sup>

When it comes to the treatment of anxiety and depression, there are multiple avenues that may be utilized. The most common first line treatment is psychotherapy, with more chronic cases relying on cognitive behavioral therapy.<sup>4,12,21,35</sup> Medications such as selective serotonin reuptake inhibitors (SSRIs) and tricyclic antidepressants are common in the treatment of depression and of late are being utilized more in the treatment of anxiety.<sup>4,21</sup> Unfortunately, treatment for anxiety and depression is not always accessible and can be quite expensive.<sup>1,5-7,30,35</sup> This barrier causes a large divide in the amount of people diagnosed with either depression or anxiety and the amount of people who get treatment. One article in 2018 noted that less than half of individuals who have been diagnosed with depression receive treatment and only about 20% receive treatment that is adequate.<sup>7</sup> This lack of effective treatment is a potential factor in depression continuing to be a leading cause of disease burden in the US since such a large number of people do not receive adequate treatment.

Many of these statistics on anxiety and depression apply to the general US adult population and do not focus primarily on the college/university population. The transition from high school to college is a stressful time due to the changing pressures put on students.<sup>1,8,23,36</sup> From learning how to be financially independent from their parents to learning how to form new relationships with people they have never met all while experiencing the academic pressure that is prevalent in college, there is a lot of stress put on college students.<sup>1,8,23,36</sup> These kinds of stressors, if not handled properly, can lead to a

number of adverse outcomes including hypertension, high levels of muscle tension, anxiety, depression, and ineffective cognitive processes.<sup>23</sup> As of 2019, approximately 30% of college students screened positive for some form of mental health disorder.<sup>35</sup> College students in 2017 had a prevalence rate of depression of about 16%, greater than the general adult population.<sup>7</sup> Even though there are notably high levels of stress and mental health concerns in the college student population, treatment options are still slim and not always accessible to all students. University health centers are not always prepared with effective mental health services on top of the multitude of other services they provide.<sup>7</sup> A study investigating university healthcare centers found many barriers to screening students for depression including a lack of mental health professionals available, concerns about how to accommodate more referrals, and some administrative concerns.<sup>7</sup> As university health care centers tend to be hesitant to screen students for depression due in large part to staffing shortages, there is an opportunity and motive for universities to find other evidence-based ways to improve students' mental health.

Since the treatment of anxiety and depression is not always easily accessible, introducing exercise as a treatment could be a way to improve the lives of people experiencing anxiety and depression symptoms.<sup>3,10,12,13,37</sup> Exercise is a subset of physical activity (PA) that is planned and structured with the goal of improving or maintaining different components of fitness.<sup>16</sup> The physical effects of exercise are well known and include decreased risk of cardiovascular disease, diabetes, hypertension, obesity, and many other common health issues in the US.<sup>34</sup> Exercise also exerts positive effects on different aspects of mental well-being, including increased self-efficacy, improved self-image, and improved utilization of coping strategies during stressful events.<sup>34</sup> This

increase in positive thoughts of oneself is a factor in how exercise improves overall mental well-being and shows the importance of encouraging exercise to those struggling with mental health issues.<sup>19,37,38</sup>

One potential mechanism for improvements in anxiety and depression symptoms in response to exercise is due to the hypothalamic-pituitary-adrenal (HPA) axis.<sup>19,33</sup> The HPA axis is responsible for adaptive responses to different physical or psychological stressors and controls levels of cortisol in the blood.<sup>19,33</sup> In those with anxiety and depression the HPA axis can be dysfunctional causing heightened or reduced levels of circulating cortisol. This change in cortisol levels is closely associated with increases of feelings of stress and anxiety.<sup>33</sup> Depression has also been associated with heightened levels of cortisol in the bloodstream. Exercise has been shown to positively influence the levels of cortisol in the bloodstream via the HPA axis, with aerobic exercise promoting a greater amount of stabilization of cortisol levels.<sup>19,25,33</sup> This stabilization of cortisol levels has the potential to have a positive impact on symptoms of depression, anxiety, and stress.

Another hypothesized mechanism of how exercise improves mood is the role of different neurotrophic factors on the neuroplasticity of neurons.<sup>34,39,40</sup> The most well studied neurotrophic factor is brain derived neurotrophic factor (BDNF) and how exercise upregulates it and its effects on the nervous system.<sup>39,40</sup> Other neurotrophic factors such as vascular endothelial growth factor, insulin like growth factor, and glial derived neurotrophic factor are also potential mechanisms, but less is known about their effects on mental health.<sup>41</sup> It is hypothesized that increased levels of BDNF are associated with decreases in anxiety and depression symptoms.<sup>34,39,40</sup> Exercise has been shown to

increase circulating BDNF levels, causing an increase in hippocampal neurogenesis and an increase in neuroplasticity.<sup>39</sup> These increases are the proposed mechanisms by which anxiety and depressive symptoms are improved in response to exercise.<sup>39,40</sup> This topic is hard to directly study so most studies have small sample sizes, but a majority of the studies have come to similar conclusions that overall increases in BDNF and increases due to exercise have positive impacts on mental health.<sup>39,40</sup>

A lack of physical activity has been shown to be detrimental to mental and physical health and is a leading risk factor for mortality in the US.<sup>10</sup> Physical activity has been consistently shown to decrease risks of cardiovascular disease, obesity, hypertension, and diabetes among many other serious health conditions.<sup>10,15,18,21,22,42</sup> When physical activity is lacking, the risk for these diseases increases and thus increases individuals' risk for mortality. Unfortunately, the number of adults in the US that meet the recommended physical activity levels is low. The US Department of Health and Human Services has released the second edition of Physical Activity Guidelines for Americans noting that adults should be engaging in at least 150 to 300 minutes of moderate to vigorous physical activity each week.<sup>43</sup> According to the CDC, as of 2020 46.3% of US adults did not meet the recommended physical activity guidelines for adults.<sup>44</sup> While this number represents all adults in the US, those aged 18-34 were more likely to meet the guidelines, but still only about half of the sample met the guidelines.<sup>44</sup> These numbers also vary based on gender with women being less likely than men to meet the guidelines in any age group.<sup>43,44</sup>

Campus recreation has a unique connection with the university population and has the potential to encourage students to be more physically active on a day-to-day basis and



in turn have a positive impact on student's mental health. Both exercise and socialization have positive impacts on mental health and campus recreation has the potential to influence both factors.<sup>25,28,45,46</sup> Campus recreation facilities and programming can provide support for the development of relationships among students, helping them create a support system and ideally promote an increase in their overall well-being on campus. Different structured campus recreation programs and facilities may also provide a way to improve students' symptoms of anxiety and depression.<sup>46</sup> One study also saw greater improvements in mental health symptoms in those who participated in organized sports, so encouraging participation in programs like intramural and club sports could help encourage students to be more physically active.<sup>33,42,46,47</sup> Since exercise has been shown to have a positive impact on anxiety and depressive symptoms, campus recreation programming can provide a large number of students with access to a low cost avenue for decreasing their symptoms.<sup>24,25,42,46,47</sup> Not only are participants getting the benefits of physical activity, but they are also benefiting from the social aspect of physical activity within campus recreation facilities and programs.<sup>46,48</sup> Ideally, participation in different activities could increase students psychological well-being in multiple ways including increasing self-image, increasing self-efficacy, and improving their overall perception of life.<sup>46</sup>

Overall, there is a significant amount of research on the association between exercise and its potential to improve both physical and mental health. Exercise has been shown to improve overall quality of life, decrease risk of all-cause mortality, and increase physical fitness.<sup>4,14</sup> In addition to these physical improvements, exercise has been shown to decrease anxiety and depressive symptoms.<sup>4,33</sup> While a large amount of the current

research applies to the general adult population, a less robust body of research that focuses on the university population has shown similar results. Campus recreation, a unique physical exercise and social offering in university settings, has the potential to influence students' mental health by encouraging participation in physical activities and providing a space to create new relationships among peers.

## CHAPTER 2

### AIMS AND HYPOTHESES

There were two primary aims of this study:

- I. Compare indices of mental health at the beginning and end of the semester.
- II. Evaluate the associations of exercise volume and Campus Recreation program participation on changes in mental health during the semester.

It was hypothesized that anxiety and depressive symptoms would increase, representing a decline in mental health over the course of the semester, but greater exercise volume and Campus Rec participation will be inversely associated with this decline. It was also hypothesized that a greater use of Campus Rec facilities and programs will be inversely associated with the decline in mental health.

## CHAPTER 3

### METHODS

#### 3.1 Study Design

This study consisted of a total of two surveys, one completed at the beginning of the semester (prior to the end of October) and the other completed towards the end of the semester (roughly during or after Thanksgiving break). This is visually depicted in figure 3.1. Each survey inquired about exercise volume, anxiety symptoms and depressive symptoms over the previous seven days. Participants were recruited via flyer, email, and word of mouth. Flyers were posted in all Campus Recreation facilities on both campuses with QR codes and links to the first survey. Copies of the flyer were also emailed to students who were interested in the study if they requested it be emailed to them. Anyone 18 years or older using campus recreation facilities were welcome to participate in the study. After scanning the QR code or clicking the link to the survey, participants were taken to the informed consent where they could either consent to the study and move forward with the survey or deny consent and the survey would end. Those who consented were then prompted to fill out a short list of sociodemographic information, the Godin-Shepard Leisure-Time Activity Questionnaire, the PROMIS anxiety short form, and the PROMIS depression short form. The Godin-Shepard Leisure-Time Activity Questionnaire is comprised of four questions regarding the participants exercise over the past seven days. The questionnaire has questions about how many times the participant

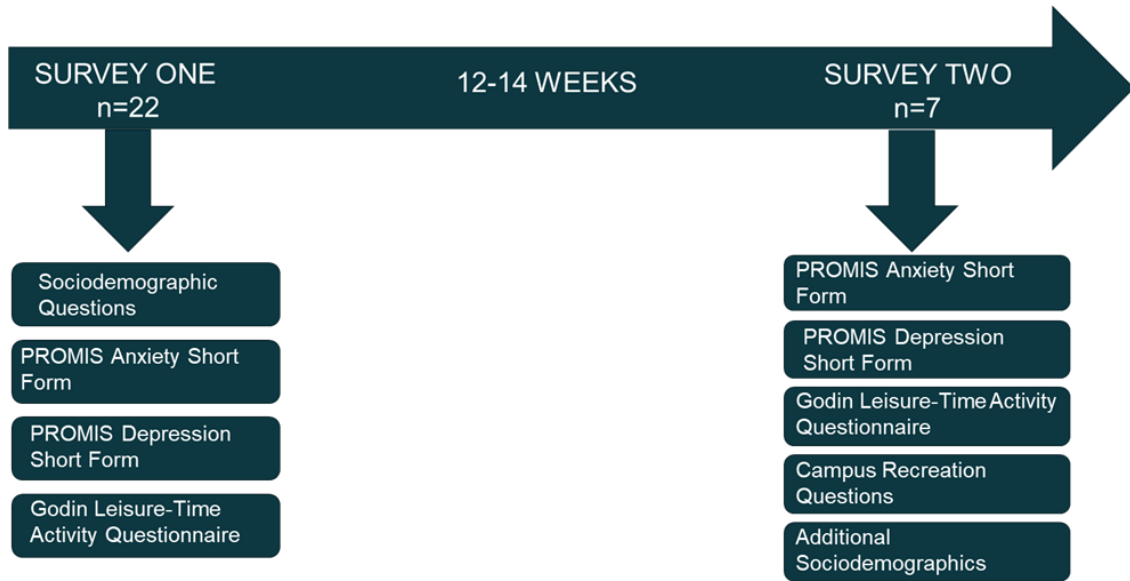
engaged in fifteen minutes or more of light, moderate, or strenuous activity and how often they exercised long enough to break a sweat.<sup>49</sup> This questionnaire was scored by multiplying the number of times per week the participant engaged in each level of activity by a preset multiplier, then added together. The higher the score, the more the participant exercised. The PROMIS anxiety short form is comprised of eight questions regarding their anxiety symptoms over the past seven days and they would check if they experienced this symptom never, rarely, sometimes, often, or always.<sup>50</sup> This form was scored by coding the answers from 1-5, then adding the values together. This total could then be interpreted as none to slight, mild, moderate, or severe after obtaining a T-score based on the raw score.<sup>51</sup> For the purposes of this study only the raw score was utilized in analyses. The PROMIS depression short form, much like the anxiety short form, is comprised of eight questions regarding the participants depressive symptoms over the past seven days.<sup>52</sup> This survey was scored in the same manner as the anxiety short form.<sup>53</sup> The sociodemographic information included was gender identity, race and ethnicity, university status, age group, email address, and exercise history. Those who filled out the full survey at the beginning of the semester and input their email to be re-contacted were sent the second survey at the end of the semester, around Thanksgiving break, which consisted of the same three questionnaires along with additional sociodemographic questions and campus recreation use questions. These questions included how many times they attended, why they attended, what they liked/disliked, year in school, current

living situation, athlete status, if they used group or individual exercise, medication use, and general personality type.

### 3.2 Statistical Analyses

Differences in anxiety, depression, and leisure-time activity scores between the first and second survey were evaluated using a (t-test or Mann-Whitney U test) based on the distribution of the data. The relationship between change in anxiety and depression scores and changes in leisure-time activity scores were evaluated using Spearman correlation coefficients. Since the sample size was small, there was not enough power to run hypothesis testing, so effect size calculations (Cohen's d) were completed to complement the tests of means or medians. A stratified analyses a priori test was used to test for any interactive effects from gender identity, race and ethnicity, or age. As the sample was homogenous in regards to age and university status, only race and ethnicity and gender identity were compared. The amount of Campus recreation programs utilized, and frequency of program use were compared to the changes in anxiety and depression scores using a Kruskal Wallis test. Any data point that was more than two standard deviations from the mean was to be removed from the analyses. The initial proposal was to evaluate associations of the changes in anxiety and depression with the number and frequency of campus recreation program use in separate multiple linear regression models that were adjusted for age group, gender identity, race and ethnicity, and university status. Since the sample was too small, regressions were not run due to a lack of power in the analyses. The question regarding which program participants engaged in was tallied and averaged. Free text fields were to be summarized with themes identified by two reviewers. A third reviewer was to review the themes for consistency and compile

a final list of emergent themes. No participants completed the free text fields, so there were no data to review or support these analyses.



**Figure 3.1** Visual depiction of study procedures.



## CHAPTER 4

### RESULTS

#### 4.1 Participants

Twenty-two participants completed the first survey in its entirety and seven of those completed the follow-up survey. Extreme outlying data points, defined as points that were greater than two standard deviations from the mean score, were removed from analysis (n=1). Participant demographics are tallied in Table 4.1. All the participants were students, mostly between the ages of 18-24 with a small minority between age 25-39. Most of the participants identified their race and ethnicity as either White or Black/African American. There were two participants who identified as male and the rest identified as female, but all the participants who completed the follow-up survey were female. A majority had a history of being active for at least 30 minutes per day on at least two days per week (n=20, 90.9%).

#### 4.2 Correlations

Associations between anxiety, depression, and exercise level were calculated at each time point separately and from beginning to end using Spearman's correlation coefficients. At the beginning of the semester, there was a significant correlation between exercise level and anxiety scores suggesting that anxiety scores were lower when exercise scores were higher (Spearman's  $Rho = -0.5117$ ,  $p < 0.03$ ). This correlation is shown in

Figure 4.1. This was also seen between depression scores and exercise level in the first survey in figure 4.2, but the correlation was stronger (Spearman's  $Rho = -0.6530$ ,  $p < 0.01$ ). A similar trend between higher exercise level and lower anxiety and depression scores was seen in the second survey, but this correlation was insignificant (Spearman's  $Rho = -0.2571$ ,  $p = 0.63$ ; Spearman's  $Rho = -0.3947$ ,  $p = 0.44$ ). This data is presented in figures 4.3 and 4.4. Data for average values at the first survey are depicted in table 4.2. There was no significant change in anxiety or depression symptom score from the beginning of the semester to the end (Cohen's  $d = 0.3399$  and  $0.2559$  respectively). The average anxiety and depression scores decreased slightly, but the change was not significant for either. There was a slight decrease in exercise level, but it was also insignificant (Cohen's  $d = 0.3833$ ). These changes are shown in table 4.3 only including those who completed both surveys. When comparing use of groupX fitness classes, intramural sport participation and no campus recreation program use, there was no significant difference in mental health scores, likely due to only having two participants in each group. This data is depicted in table 4.4.

#### 4.3 Time one vs Time two Comparisons

While seven participants completed both surveys, one had to be excluded from the analyses due to all three of their scores being two or more standard deviations larger than the mean. Of the remaining six who filled out both surveys, the average exercise score was 48.33 for the first survey and went up to 49 at the second survey with an average change value of 0.667. Individual changes are plotted in figure 4.5. Anxiety symptom scores decreased from an average symptom score of 23.67 to 20.33 from the first survey to the second. Individual changes are plotted in figure 4.6. Depression

symptom scores also decreased from the first survey to the second going from an average of 14.47 to 12.67. Individual changes are plotted in figure 4.7. Both anxiety and depression symptom scores decreased from the first survey to the second with average change values of -3.33 and -1.50 symptoms respectively. This data is outlined in table 4.3. With all twenty-two participants who filled out survey one, the average exercise score was 59.9, the average anxiety symptom score was 21, and the average depression symptom score was 14.56.

#### 4.4 Additional Participant Information

In the second survey, participants were asked about their university class level, living situations, personality type, medication use, athlete status, and if they participated in group or individual exercise. Of the six participants who completed the second survey, four were juniors and two were graduate students. One participant lived off campus without roommates and the five others lived off campus with roommates. Three identified as introverted, two identified as an ambivert, and one identified as extroverted. None of the participants reported using medications to treat anxiety or depression symptoms. There were no participants who were on a university team, only two participating on intramural teams. Four of the participants participated in group exercise, whether that was intramurals or groupX training and the other two individuals reported exercising individually.

**Table 4.1: Participant Demographics**

<b>Demographic Variable</b>	<b>Survey 1 (n, %)</b>	<b>Survey 2 (n, %)</b>
<b>Age</b>		
18-24	20, 90.9%	5, 83.3%
25-39	2, 9.10%	1, 16.7%
<b>Gender Identity</b>		
Male	2, 9.10%	0, 0%
Female	20, 90.9%	6, 100%
<b>Race/Ethnicity</b>		
Black and/or African American	10, 45.45%	1, 16.7%
White	10, 45.45%	4, 66.7%
Native Hawaiian/other Pacific Islander	1, 4.55%	1, 16.7%
Prefer not to answer	1, 4.55%	0, 0%
<b>Exercise History</b>		
Yes	20, 90.9%	5, 83.3%
No	2, 9.10%	1, 16.7%
<b>Year in School</b>		
Junior	n/a	4, 66.7%
Graduate	n/a	2, 33.3%

Tallied number of demographics participants identified themselves as. Exercise history constitutes those who exercised for thirty minutes or more on two or more days per week. Survey one consisted of twenty-two participants and survey two consisted of six participants.

**Table 4.2: Average Questionnaire Values for Survey One**

---

	<b>Mean <math>\pm</math> SD</b>
<b>Godin Score</b>	59.9 $\pm$ 29.49
<b>Anxiety Score</b>	21 $\pm$ 6.57
<b>Depression Score</b>	14.56 $\pm$ 5.78

---

Mean  $\pm$  Standard deviation for scores for anxiety, depression, and exercise level for the twenty two participants in the first survey.

**Table 4.3: Average Questionnaire Scores from Survey One to Survey Two**

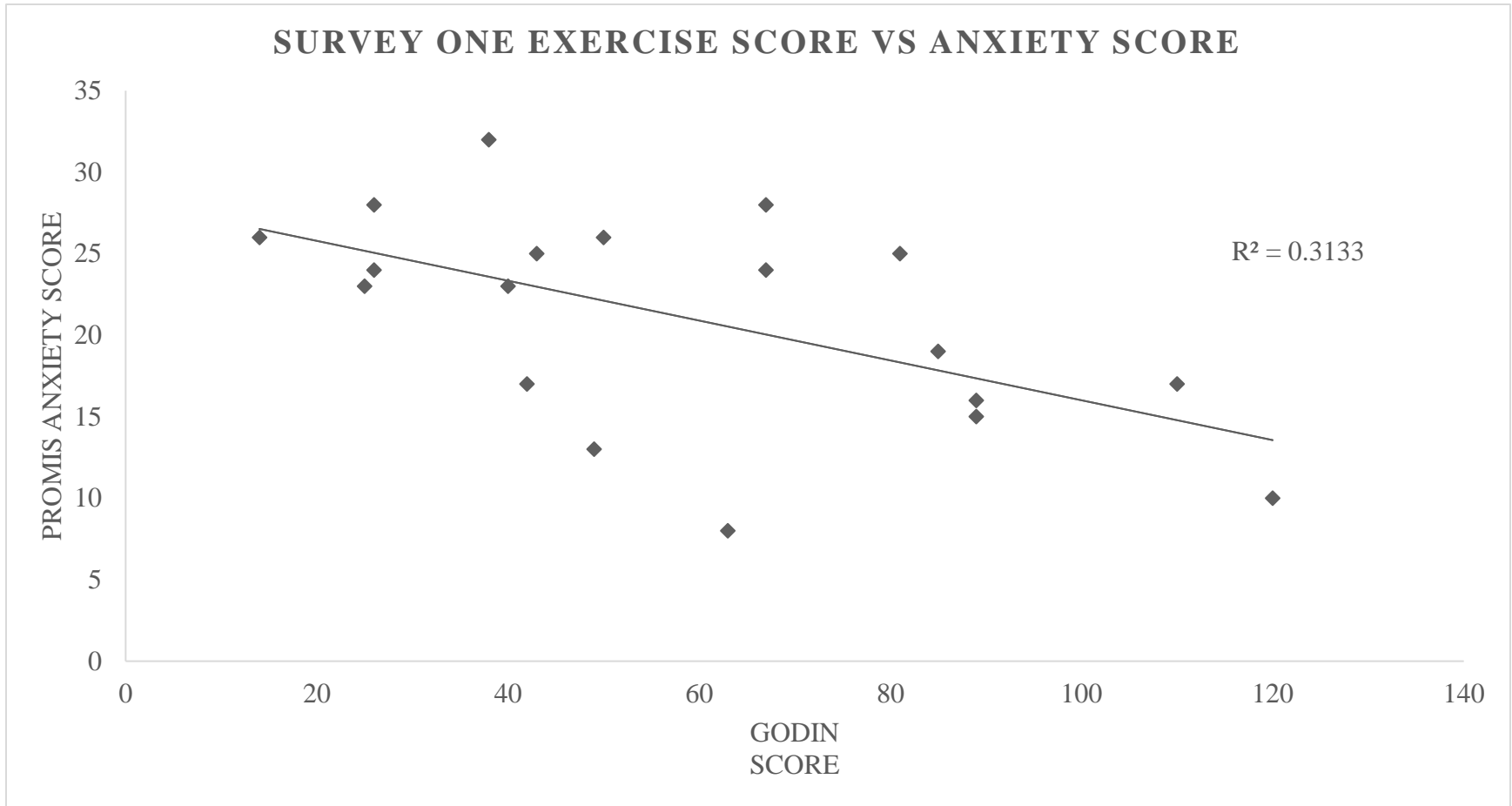
	<b>Initial Survey (n=6)</b>	<b>Follow-Up Survey (n=6)</b>	<b>Mean Change (n=6)</b>
Godin Score	48.33 ± 25.07	49 ± 27.62	0.667 ± 7.39
Anxiety Score	23.67 ± 4.80	20.33 ± 6.02	(-)3.33 ± 5.16
Depression Score	14.17 ± 4.36	12.67 ± 5.50	(-)1.5 ± 4.93

Mean scores for exercise level, anxiety symptoms, and depression symptoms and mean change values for the those who completed both surveys.

**Table 4.4: Anxiety and Depression Scores by Campus Rec Programming**

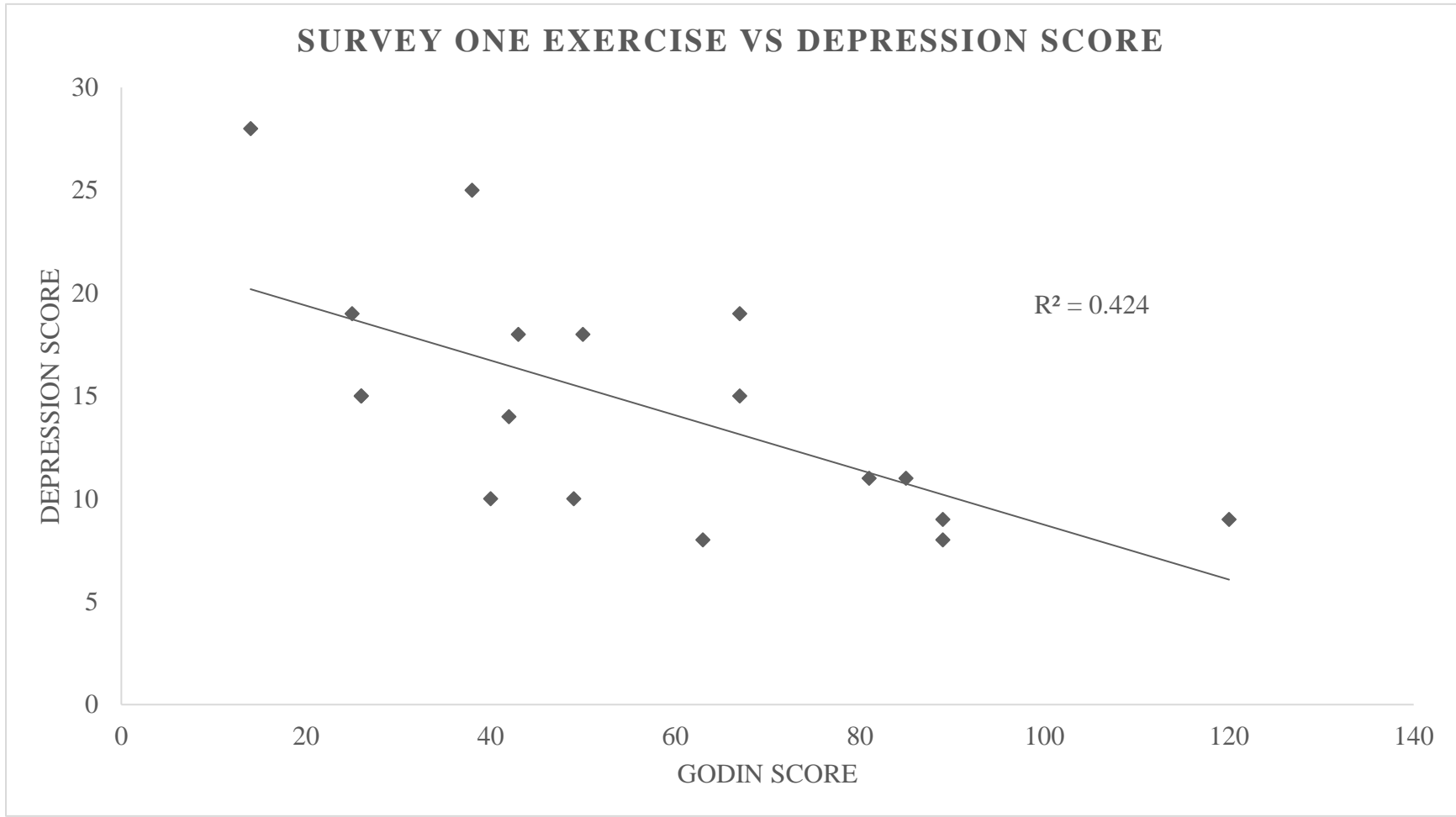
	Mean $\pm$ SD	Chi square w/ ties	p-value
Anxiety	n=6		
no program	15.5 $\pm$ 3.53		
GroupX	21.5 $\pm$ 7.78	2.571	0.2765
Intramurals	24 $\pm$ 5.66		
Depression			
no program	8 $\pm$ 0		
GroupX	12 $\pm$ 5.66	2.903	0.2342
Intramurals	18 $\pm$ 4.24		

Mean  $\pm$  standard deviation of anxiety and depression scores for each type of programming utilized for six participants who completed the second survey.

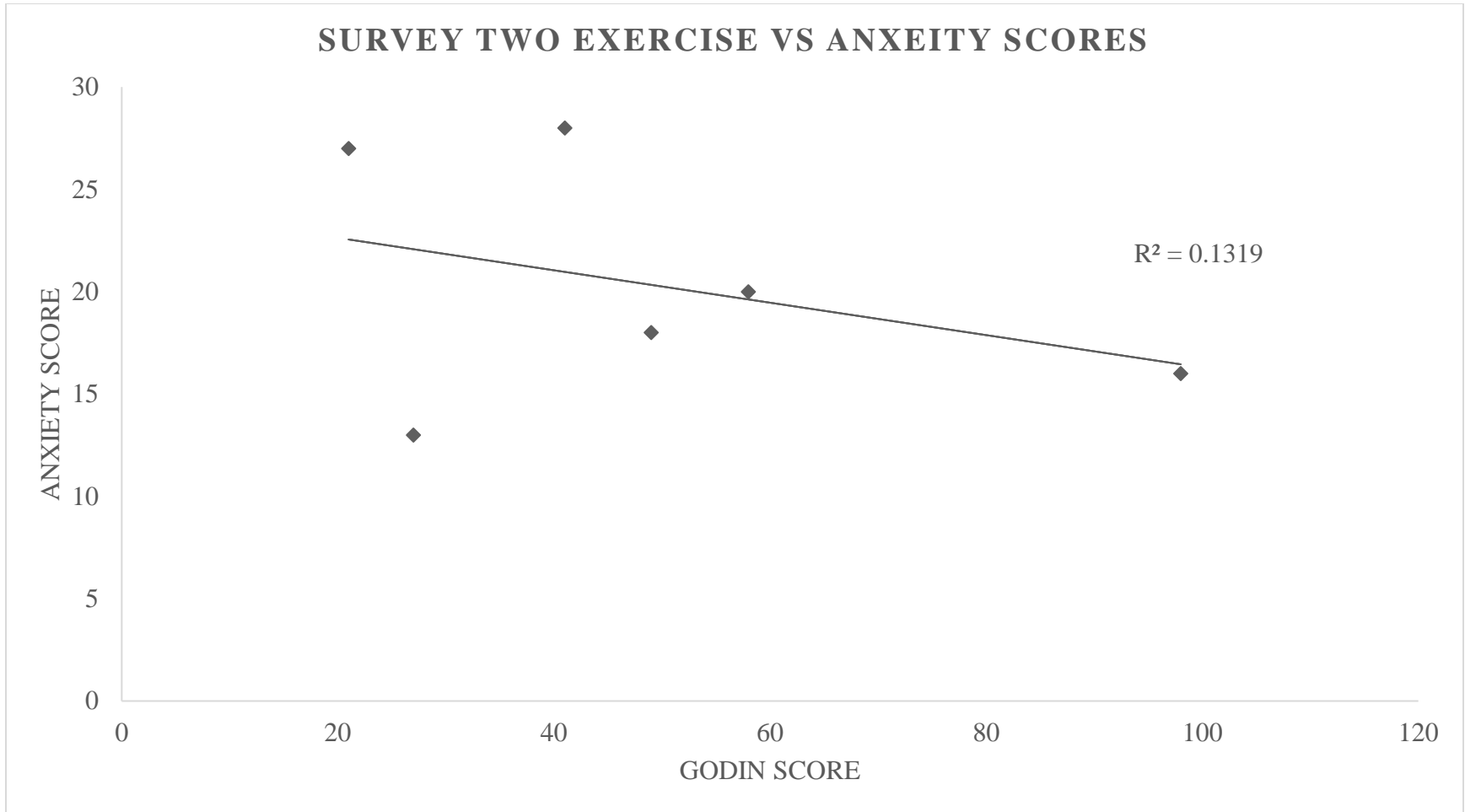


**Figure 4.1** Survey One Exercise Score vs Anxiety Score: Data points collected from initial survey.

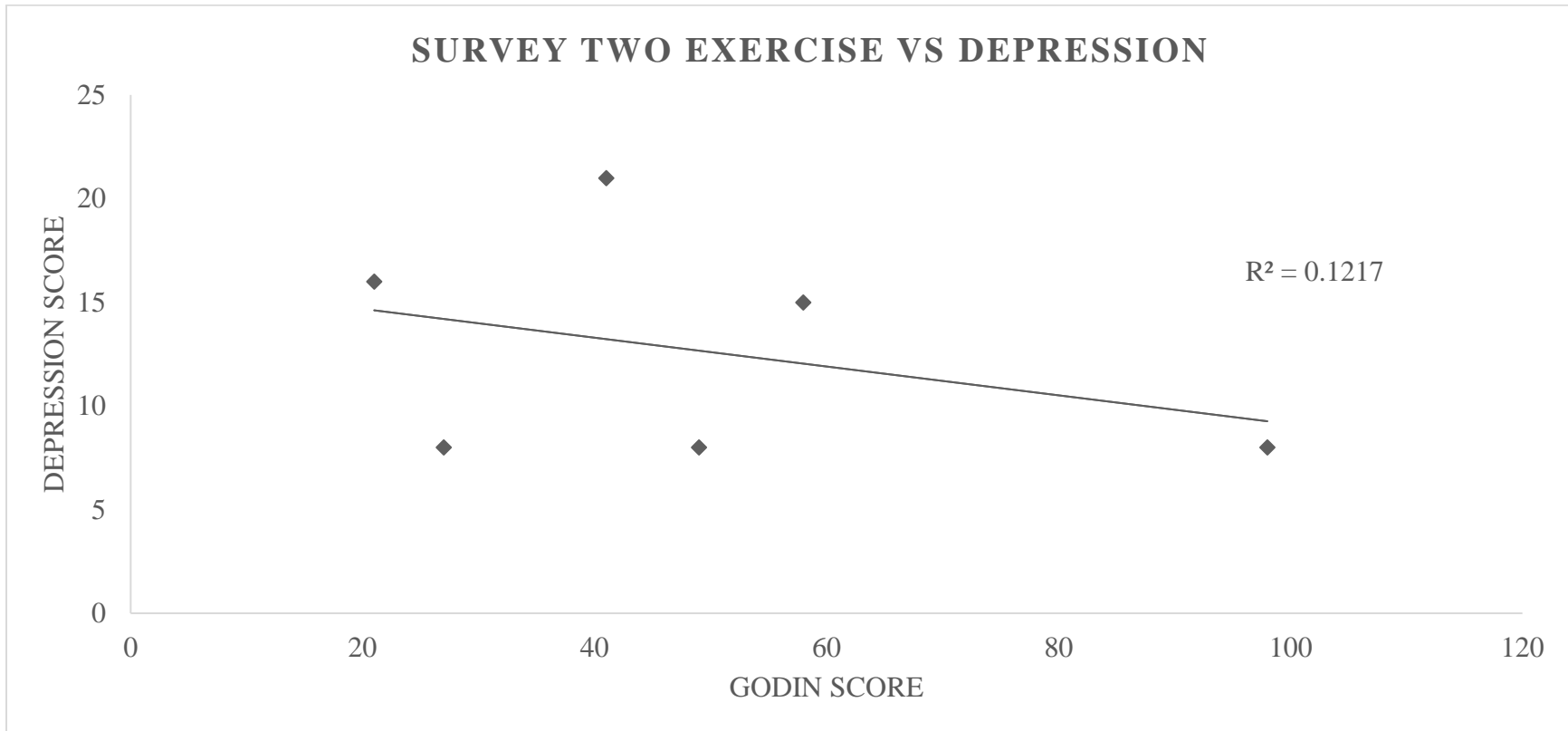




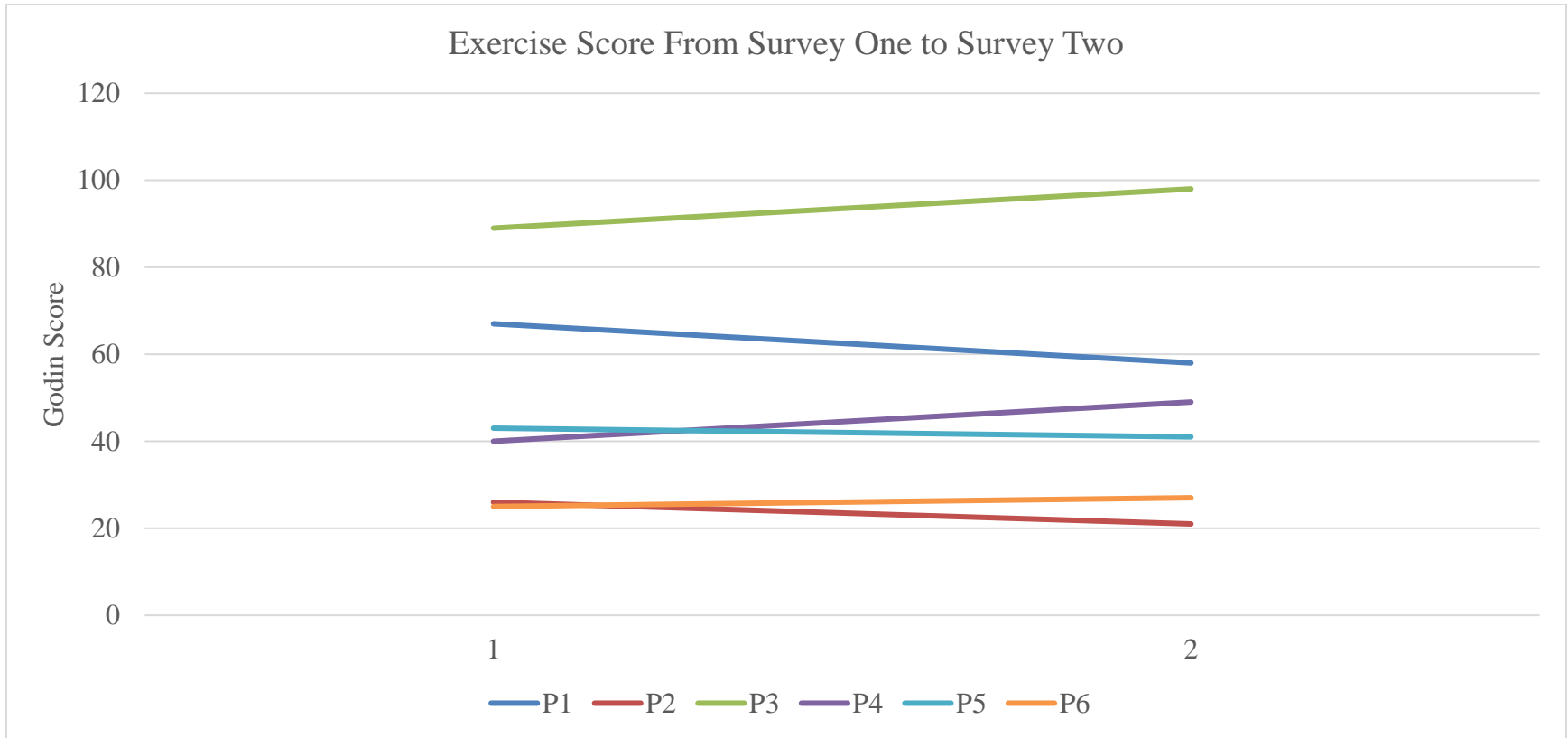
**Figure 4.2** Survey One Exercise Score vs Depression Score: Data points collected from the initial survey.



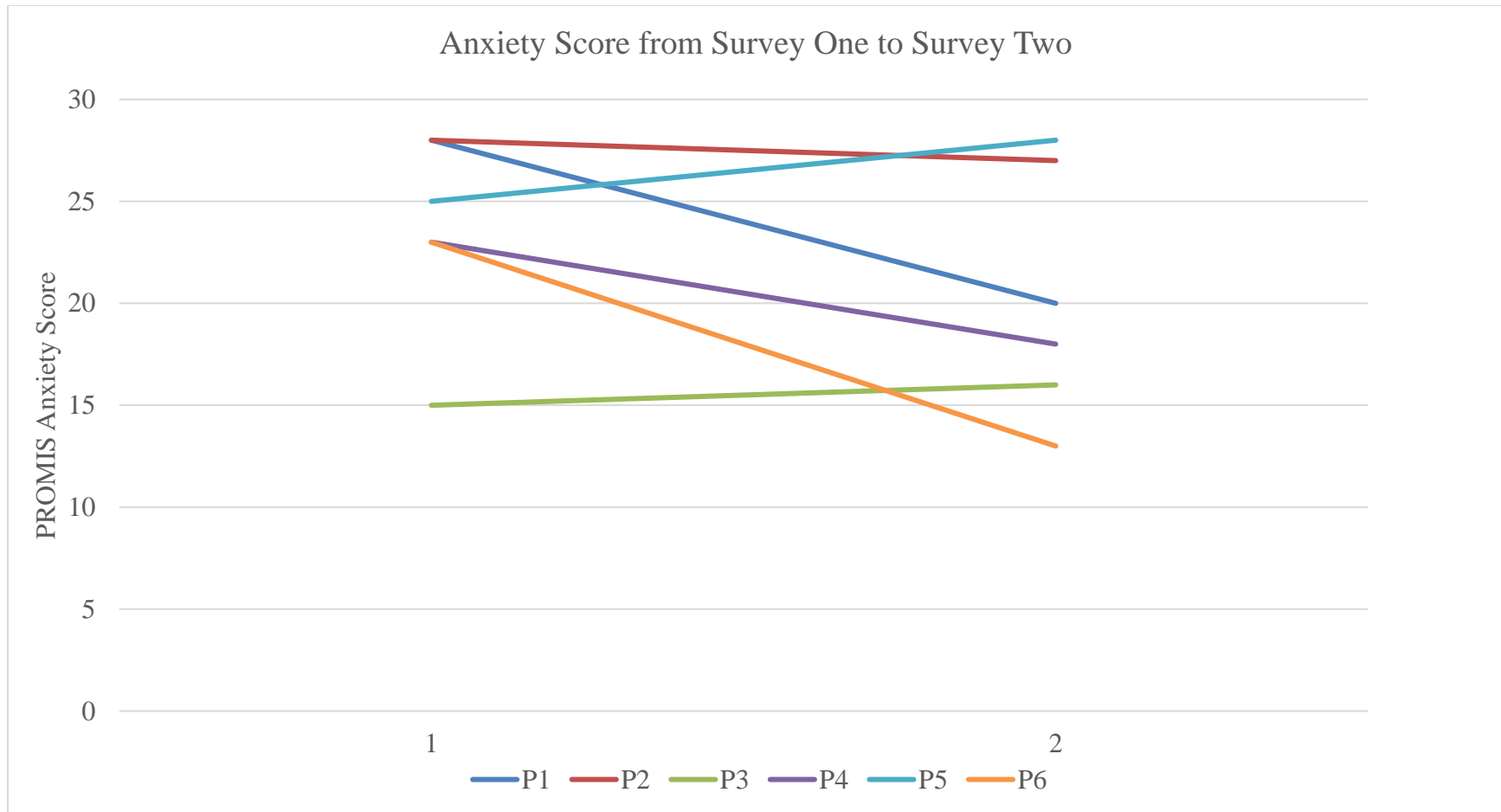
**Figure 4.3** Survey Two Exercise Score vs Anxiety Score: Data points collected from follow-up survey.



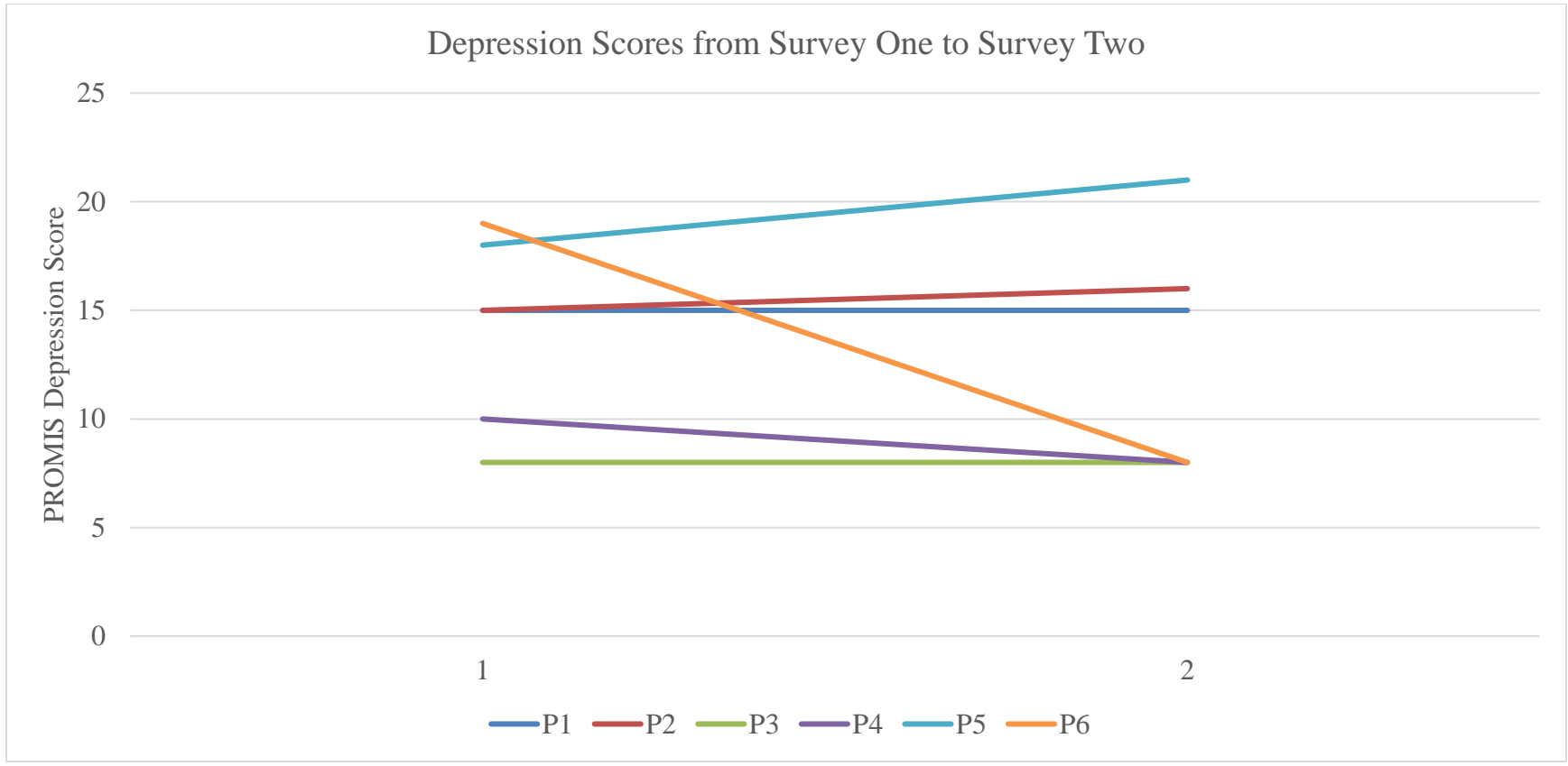
**Figure 4.4** Survey Two Exercise Score vs Depression Score: Data points collected from follow-up survey.



**Figure 4.5** Individual changes in exercise score from the first survey to the second.



**Figure 4.6** Individual changes in anxiety symptom score from the first survey to the second for each participant.



**Figure 4.7** Individual changes in depression scores from the first survey to the second.

## CHAPTER 5

### DISCUSSION

#### 5.1 Main findings and outcomes

The main findings of this study were derived from the initial survey showing data trending toward significant negative correlations between anxiety and depression scores and exercise levels in Campus Recreation users. Higher levels of exercise tended to be associated with decreased levels of anxiety and depression symptoms at single time points. Those who participated in Campus Recreation programming, either intramurals or GroupX training, did not have significantly different mental health scores than those who did not utilize campus recreation programming. This could suggest that no matter what kind of exercise one is participating in, the changes in their mental health scores should be similar, but since these differences are not significant, this deduction cannot be fully supported. A larger sample size would allow for stronger conclusions. For the participants who completed both surveys, there was a slight increase in exercise level from the first survey to the second and a slight decrease in both anxiety and depression symptom scores. The original hypothesis was that anxiety and depressive symptoms would increase from the first survey to the second, but in the six participants who completed both surveys, their scores decreased, meaning they experienced a decrease in anxiety and depression symptoms. Even though the original hypothesis was that mental health would decline from the beginning of the semester to the end, those who completed

both surveys reported exercising more at the second survey than the first, supporting the hypothesis that there would be an inverse relationship between anxiety and depression scores and exercise. However, since the sample size is so small, true hypothesis-based conclusions cannot be made on these changes from the first survey to the second. While these changes are small and the sample size is very small, this continues to support higher exercise levels being associated with lower anxiety and depression scores. Since the sample size is so small, further conclusions on the trends from the first survey to the second are hard to make.

This study included two universities, one larger institution and one smaller institution. With different access to different Campus Recreation facilities, the kinds of activity students participate in may differ. However, based on the data from this study, there was not a significant difference in mental health scores between those who used different campus recreation programming and those who did not use any programming (i.e., merely exercise in Campus Recreation facilities). The results comparing different program use to anxiety and depression scores at the second survey showed there were no significant differences between the groups, but there are only two values in each group. There is potential that with a larger sample size, there could be a significant difference between groups, or it could further support that any exercise can be beneficial for students mental health. While the findings of this study are hard to interpret due to the small sample size, there is potential for larger studies conducted in a similar way to achieve more significant results. Even with a small sample size, there are significant results showing higher levels of exercise correlate to lower anxiety and depression scores.

## 5.2 Limitations



The main limitation to this study was the sample size was small, especially the follow up sample size. With more participants there may have been more prevalent trends from the first survey to the second. Another limitation this study had was every measure was self-reported. While the questionnaires have all been previously validated, they are still subject to limitations due to self-reporting, mainly the leisure-time activity log. Another limitation was the follow up survey was not completed by many participants, only seven completed the second survey. This study was also only advertised in Campus Recreation facilities and by word of mouth, so participants may have been more likely to be habitual exercisers rather than a sample from the general university population.

### 5.3 Future directions

Future studies could utilize broader recruiting processes, ideally including a more representative sample of the university community. A more successful follow-up strategy to follow more participants from the beginning to the end of the study could also be beneficial. More information on what kinds of exercise each participant is participating in could be useful as well to compare differences between aerobic versus anaerobic training on mental health. From the first survey, there was a moderate correlation between anxiety and depression scores and exercise level showing an inverse relationship. This relationship was different than the original hypothesis in that the participants anxiety and depression symptom scores went down, but their exercise level increased, supporting the inverse relationship. It would be interesting to see if this trend continued towards significance in a larger sample of the university population. Another interesting direction this could go would be to investigate the differences between exercising individually or in group settings and how each affect mental health scores over time.

## 5.4 Conclusions

Even with a small number of participants, this study generated interesting and hypothesis-generating findings. Exercise level has the potential to be significantly and inversely correlated with anxiety scores and depression scores at a single time point, but more research needs to be completed regarding changes in exercise amounts and levels of anxiety and depression over time.

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