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Physical Activity, Motivation, and Depression in College Students

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Abstract

Depression is a major mental health concern. There is an established relationship between physical activity and depression, where greater levels of physical activity are related to (and may even predict) lower depression status. The current study set out to explore how three different types of physical activity and three different motivational factors for physical activity were related to depression in college students. Overall physical activity was not related to depression. However, strength training predicted lower depression, while body-related motivation predicted greater depression. Strength training was a significant predictor of lower depression in men, but not women. There was also a trend towards body-related motivation as a predictor for greater depression in both men and women. These findings suggest that (1) to decrease depression, men should look towards strength training exercises, and (2) that engaging in physical activity for body-related reasons can be related to greater depression in both men and women.

Physical Activity, Motivation, and Depression in College Students

Depression is a major mental health disorder that effects how a person feels, acts and thinks. Depression can cause changes in sleep patterns, energy levels, motivation, concentration, and feelings of worth (NIMH, 2012). College is a time when young adults need to be at their peak mental state; however, a 2012 report by the American College Health Association (ACHA) found that 11% of students had been diagnosed with depression in the previous 12 months, while 30% felt that they had been depressed to the point where it was difficult to complete daily tasks (American College Health Association, 2012). Depression also increases the risk of suicide (NIMH, 2012). In 2011, about 6% of students reported having seriously considered suicide, while about 1% reported having attempted suicide (NIMH, 2012). While these numbers seem somewhat small, suicide is the third leading causes of death for those ages 15-24, so it is imperative that college students remain aware of its symptoms, ways to prevent it, and know how to access various treatment options (NIMH, 2012).

Depression can manifest itself in different ways, ranging from minor depression which is less severe and short term, to persistent depressive disorder, to major depressive disorder which can be disabling to a normal lifestyle (NIMH, 2012). Depression can also be seasonal, such as with seasonal affective disorder, where the symptoms usually occur throughout the winter and cease during the spring (NIMH, 2012). Depression can lead to dangerous behaviors such as substance abuse, smoking, and engagement in unprotected sex, which can all ultimately undermine a student's academic and social achievement (Cranford, Eisenberg, & Serras, 2009; Weitzman, 2004).

Criteria for major depressive disorder as laid out in the Diagnostic and Statistical Manual of Mental Disorders, (DSM-V) include depressed mood, impaired function, and at least five of nine specific symptoms including depressed mood or irritability nearly every day, decreased

interest in daily activities, 5% weight change or appetite change, change in sleep, change in activity, loss of energy, feelings of guilt or worthlessness, diminished concentration, and thoughts of suicide (American Psychiatric Association, 2013). Substance abuse, medical illness, bereavement, and other psychiatric disorders can mimic or coexist with Major Depressive Disorder (American Psychiatric Association, 2013). Lifetime prevalence of Major Depressive Disorder classified based on DSM-IV criteria, was shown to be between 10-15% (Lepine & Briley, 2011). In 2010, the prevalence of current depression in the United States was found to be 9% while the rate of current major depression in the United States was found to be about 3 % (Center for Disease Control and Prevention, 2010).

Treatment for depression comes in many different forms. Medication and psychotherapy are common forms of treatment, however they can differ based on type of depression (NIMH, 2013). Antidepressants are a form of medication used to treat depression that are usually beneficial, but they can also have unwanted side effects such as nausea, headaches, sleeping problems, agitation, or sexual difficulty (NIMH, 2013). Children, teens, and young adults are at a higher risk for more harmful side effects, including suicidal thoughts or suicide attempts (NIMH, 2013). Therapy can be as beneficial in treating depression as antidepressants by engaging patients in new methods of thinking and behaving (NIMH, 2013). However, this form of treatment is only beneficial if the patient is cooperative and persistent in forming these new habits (NIMH, 2013). Additionally, despite their effectiveness, only about 25% of people have access to such treatments as antidepressant medications and psychotherapy (Halliwell, Richardson, McCulloch, & Ryrie, 2005). According to DSM recommendations, patients with major depressive disorder should be monitored and assessed for possibility of relapse, with pharmacotherapy and psychotherapy as recommendations to reduce risk of relapse (American

Psychiatric Association, 2013). However, the risks associated with antidepressant drug use in young adults' demands that alternative treatments be available and accessible to college students.

Association between Depression and Physical Activity

Multiple studies have found negative correlations between physical activity and depression in adult populations of wide age ranges (Galper, Trivedi, Barlow, Dunn, & Kampert, 2006; Goodwin, 2003; Morris et al., 1992; Mutrie, 2000; Ruuskanen & Ruoppile, 1995; Stephens, 1988; Steptoe et al., 1997). For instance, Goodwin (2003) used data from the National Comorbidity Survey to compare those who reported physical activity and those who did not. This survey was taken by 8,098 individuals across the country between the ages of 15 and 54. Goodwin found a significantly strong negative correlation between physical activity and current major depression (Goodwin, 2003). Likewise, a similar study found that higher levels of physical activity measured using both the treadmill test and self-report measures were related to lower depression scores on the CES-D for 5451 men and 1277 women ages 20-88 (Galper, Trivedi, Barlow, Dunn, & Kampert, 2006).

Various prospective studies have shown a clear relationship between physical activity and future depressive symptoms later in life, exhibiting a protective effect of physical activity on risk for depression (Aberg et al., 2012; Strawbridge, Deleger, Roberts, & Kaplan, 2002; Suija, et al., 2013; Taliaferro, Rienzo, Pigg, Miller, & Dodd, 2010). One study compared groups who had some physical activity versus none (Taliaferro et al., 2010) while others examined general cardiovascular and muscular physical fitness (Aberg et al., 2012; Suija et al., 2013). Strawbridge and colleagues (2002) explored this effect in older adults and found significant results.

Taliaferro and colleagues (2010) compared the depression levels of college participants who reported some type of physical activity to those who did not. Their data came from the 2005

National College Health Assessment by the American College Health Association and included 43,499 male and female college students between the ages of 18 to 25 (Taliaferro et al., 2010). Physical activity was assessed using a self-report measure of weekly frequency of vigorous aerobic physical activity, as well as strength or toning activity (Taliaferro et al., 2010). Results showed that in both male and female college students, performing some type of weekly physical activity was related to lower depression risk compared to performing no physical activity at all (Taliaferro et al., 2010). Although the results differed in which types of activity were more strongly related to the reduced depression status, the fundamental message was that is important for college students to at least be engaged in some form of physical activity.

Aberg and colleagues (2012) explored how physical activity at age 18 was related to depression at later times in life. They followed 1,117,292 Swedish male participants starting at age 18 for 3 to 40 years. At age 18, they measured participants' cardiovascular fitness and depression level, and then measured depression level at the follow-up (Aberg et al., 2012). The researchers found that low cardiovascular fitness at age 18 was related to increased depression risk at the follow up compared to baseline measurements of depression (Aberg et al., 2012). Even though this study only included men, it provides evidence of the importance for college students to engage in physical activity not only for their current mental health but also to ensure their future mental health. However, it is possible that there is some other factor at play in this relationship, such as those who are not initially depressed tend to exercise more and therefore show lower levels of depression at a future time.

Suija and colleagues (2013) looked at a sample of data from the Northern Finland 1966 birth cohort follow up study, and were able to collect data on adults physical activity and depression levels at age 18 and 31. Researchers also looked at cardiorespiratory measurements

and a self-report measure of physical activity, as well as a muscular fitness measurement (Suija et al., 2013). Suija and colleagues (2013) found that lower muscular strength and lower self-reported physical activity level were related to higher levels of depression in both men and women. This supports the results found by Aberg and colleagues that greater physical activity and physical fitness at a younger age are related to lower levels of future depression.

Data from the Alameda County Study was used by Strawbridge and colleagues (2002) to compare depression levels of 1,974 adults between the ages of 50 and 94 from a baseline measurement through 5 years of follow-up measurements. They found that higher physical activity levels were related to lower prevalent and incident depression over the 5 year time span among older adults (Strawbridge et al., 2002). These four prospective studies used different methods of assessing physical activity; nevertheless they provide convergent results indicating that those who engage in physical activity report better future mental health.

Despite these findings, there seems to be countless other factors to consider in this association such as age, gender, ethnicity, or other mental disorders such as anxiety. For example, Taliaferro and colleagues (2010) found that greater physical activity was related to lower levels of depression; however, men and women differed in amounts of aerobic and toning exercises and rates of depression. Additionally, although both men and women who participated in aerobic activity had lower incidence of depression, they differed in their relationships between toning exercise and depression. High levels of toning exercise were related to greater depression in men, while high levels of low and moderate toning exercise were related to lower depression in women (Taliaferro et al., 2010). This indicates that there may be a discrepancy in how different genders respond to physical activity and how different types of physical activity are related to depression in different genders.

Furthermore, Dakwar and colleagues (2012) collected data from the 2001 and 2005 National Epidemiologic Survey on Alcohol and Related Conditions to explore the relationship between physical activity and a broad range of psychiatric disorders in 23,505 adults ages 18-65. There was evidence that higher self-reported physical activity level, as measured by the International Physical Activity Questionnaire, was indeed related to lower levels depression in individuals with dysthymia; however, higher physical activity level was not related to lower depression in individuals with major depressive disorder (Dakwar et al., 2012). Additionally, higher levels of vigorous physical activity were related to bipolar disorder and alcohol dependence (Dakwar et al., 2012). These unexpected findings suggest that the relationship between physical activity and depression may vary among those with different types and severities of mental illness.

Finally, when discussing physical activity it is important to take into consideration the measurement tools researchers are using, whether a self-report analysis or a fitness test is used. For example, the Finland cohort study by Suija and colleagues (2013) mentioned previously, found a negative relationship between self-reported physical activity and depression, as was expected, but no relationship between cardiorespiratory fitness and depression. They did, however, find that women with lower trunk extension strength and men with lower handgrip strength had the highest levels of depression (Suija et al., 2013). In this particular study, a self-report measure and a strength fitness assessment showed relationships with depression, while a cardiovascular fitness assessment did not. This indicates that various types and measurements of physical activity can be related to depression in different ways, and that it may be the person's perception of their physical activity or fitness that is important; their actual level of fitness may

not matter (which is an important message for those who are not in shape—fitness is not necessary to reap the mental health benefits of physical activity).

Because of this discrepancy, it is necessary to consider which type of assessment is the most beneficial to use in such research. For instance, Lindwall and colleagues (2011) found that self-reported light to moderate physical activity was related to lower depression level, while aerobic fitness level, as measured using the Astrand bicycle test, revealed no such relationship. When assessing physical fitness, a participant is only being evaluated for their current strength, which does not necessarily indicate how often they are participating in physical activity. Some people have more natural strength or cardiovascular fitness than others through gene inheritance, while others may have athletic backgrounds that have lasting effects on their physical status. This may give an inaccurate estimate of physical activity for those individuals, or for individuals who participate in physical activity often but have not reached a level of fitness comparable to those who are naturally stronger. Self-report measures may obtain a better estimate of physical activity because they allow one to report how often they are exercising on average rather than how strong they may be on any one occasion. However, self-report measures can also have their downfalls as some people may lie in order to seem socially agreeable.

Finally, in a meta-analysis, Dunn and colleagues (2001) explored the literature of dose response effects of physical activity on depression. They found that overall, occupational and leisure time physical activity, light, moderate and vigorous physical activity, and both resistance training and aerobic physical activity were consistently related to decreased depression symptoms (Dunn, Trivedi, & O'Neal, 2001). This is inconsistent with the results from Suija and colleagues' (2013) study previously discussed; however, many of the studies discussed in the

meta-analysis were purely observational and do not take into account frequency and duration of activity (Dunn et al., 2001).

All of these examples of inconsistencies in the expansive amount of data on physical activity and depression promote the need for further research into the relationship between these variables, while taking into account the variety of ways to define and measure them. It also suggests the need to explore how people of differing backgrounds respond to such variables.

Physical Activity as Treatment for Depression

When exploring alternative treatments for depression, it is necessary to understand the mechanisms by which these treatments help decrease depression so that they can be compared to currently available antidepressant drugs. For example, neurological changes in the brain resulting from exercise, such as increased neurotransmitter release, neurotropic factor and neuro genesis, and alteration of cerebral blood flow, are suggested to be the link between physical activity and mental health (Deslandes et al., 2009). These neurological processes reduce the effects of stressors such as mental illness and the harmful effects of aging (Deslandes et al., 2009). Studies in rats and even humans have shown that exercise can increase brain-derived neurotropic factor (BDNF), which is generally decreased due to depression (Russo-Neustadt, Beard, & Cotman, 1999; Winter et al., 2007); increasing BDNF is the mechanism of many antidepressant drugs. Similarly, according to Kempermann (2002), major depression is a result of reduced neuroplasticity which can be reversed through neurogenesis. Exercise was shown to increase neurogenesis in mice (Van Pragg, Kempermann, & Gage, 1999). Based on this evidence, it is proposed that the resulting mechanisms in the brain by which exercise influences psychological well-being reflect those of antidepressants, and thus, by means of exercise, individuals can

increase generation of neurons and neurotropic expression to reduce their depression (Deslandes et al., 2009).

Evidence for physical activity as a form of therapy for depression is growing. A study by Martinsen (2008) explored various research investigations of exercise as a treatment for depression. For example, investigations of the use of behavioral activation as an antidepressant showed that it was just as effective in reducing major depression as antidepressants. Behavioral activation was also shown to be more effective in reducing major depression than cognitive therapy (Dimidjian, 2006). Depressed individuals often spend a lot of time in inactive behaviors that do not involve much reward. In order to reverse these behaviors, engagement in activities that provide feelings of reward or accomplishment and spending less time in passive activities is required. Exercise is an example of one such behavior that provides a pleasurable feeling of accomplishment, and thus could influence depression status in a beneficial way (Martinsen, 2008).

Mata and colleagues (2011) explored how self-initiated physical activity led to positive affect in 53 individuals with major depressive disorder. Over a seven day time span, participants were prompted at eight random times per day to do some physical activity and answer questions (Mata et al., 2011). Participants were asked to report the length of their activity and answer questions regarding their positive and negative affect before and after the prompts (Mata et al., 2011). The sample group of individuals with major depression did not differ in level or frequency of physical activity than the control group, and results showed that positive affect was higher in both groups after prompts in which participants reported engaging in physical activity (Mata et al., 2011). Results also showed that for depressed participants, positive affect was higher for the days in which they participated in physical activity than on the days they did not

(Mata et al., 2011). Finally, researchers found that higher intensity and duration of physical activity was related to higher positive affect in depressed participants (Mata et al., 2011).

This evidence supports a dose-response relationship of physical activity on depression, including, specifically, an increase in positive affect after physical activity in patients with Major Depressive Disorder. Although there was no difference in the increase in positive affect between depressed patients and the control group for any specific instance of physical activity, there was a greater increase in positive affect between non-active and active days for participants with Major Depression than for the control group (Mata et al., 2011). The experience sampling method used in this study was useful because it allowed researchers to access information from the participants in their daily life environments. Nevertheless, this method can be problematic because participants could exaggerate or minimize their level of activity or affect, or may have problems with recalling such information.

Brown and colleagues (1976) looked specifically at a younger population sample including high school and college students. In two different phases, subjects chose an exercise plan and were given various psychological tests before and after a 10-week period of engagement in the activity (Brown, Ramirez, & Taub, 1976). For both depressed and non-depressed samples, depression scores were reduced after a 10 week period of wrestling, mixed exercises, tennis and jogging three or five days per week; however, depression scores did not decrease for individuals who chose to participate in softball or those who did not participate in an activity (Brown et al., 1976). This suggests that greater frequency, intensity and duration of exercise could be related to greater reduction in depression status (Brown et al., 1976).

Mailey and colleagues (2010) explored an interesting approach to physical activity as an intervention for mental health disorders in college students. The study used an internet based

intervention system over a 10-week time period for 47 college students receiving health counseling (Mailey et al., 2010). Interestingly, depression declined more during the 10 week time span in the control group than in the intervention group, and there was not a significant effect of physical activity on depression (Mailey et al., 2010). However, they did find a correlation between increases in physical activity and decreases in depression over the 10-week time span (Mailey et al., 2010). This unique intervention study sheds some light on how different approaches to interventions may have effective results in reducing depression symptoms. The internet approach may be a useful tool for counseling college students because of the ease of access of information and encouraging activity outside of the traditional counseling setting.

In a meta-analysis, Silveira and colleagues (2013) explored 10 diverse studies on physical activity and depression, including studies that used either aerobic or strength training types of activity as interventions for depression individuals (Silveira et al., 2013). Results showed that both aerobic and strength training activities were repeatedly shown to help reduce patients' depression symptoms (Silveira et al., 2013). Additionally, there was no significant difference between the two types of physical activity in reduction of depression symptoms (Silveira et al., 2013). Overall, physical activity was found to promote a 49% increase in patients' response to depression treatment (Silveira et al., 2013). However, it was the elderly and the patients diagnosed with mild depression that reported the greatest improvement in depressive symptoms (Silveira et al., 2013).

Overall, it seems that exercise is an effective possible alternative for treatment of depression; however it is important to take into consideration the individual's age, severity of depression, the type, frequency, and level of physical activity, and the method of intervention. In the studies discussed, these factors played a role in how well participants responded to treatment.

Types of Physical Activity as it Relates to Depression

The ACHA found that less than half of students are achieving the recommended guidelines established by the American College of Sports Medicine and the American Heart Association for moderate and vigorous intensity physical activity (American College Health Association, 2012). These guidelines propose at least five days per week of moderate physical activity for 30 minutes or more, and at least three days per week of vigorous physical activity for 20 minutes or more (American Heart Association, 2007). Furthermore, physical activity tends to decrease over the course of the four years a student spends in college (Johnston et al., 2010). Seniors spend less time walking than freshmen, and there is a consistent decrease in moderate forms of physical activity regardless of year (Johnston at al., 2010). Throughout those four years, vigorous physical activity decreases, while time spent doing sedentary activities increases along with BMI (Johnston et al., 2010).

The evidence for physical activity as a correlate of lower depression is exhaustive, but there is a discrepancy regarding whether low, moderate or high levels of physical activity are the most beneficial. Some research suggests that physical activity is important to reduce depression, but that increasing the level of physical activity does not necessarily have greater beneficial effects (Calder et al., 2012; Song, Lee, Baek, & Miller, 2011). Other research shows that higher level of intensity of physical activity is related to greater decreases in depression (Gerber et al., 2014; Vallance et al., 2011). Physical inactivity, on the other hand, has been established as a risk factor for depressive symptoms (Farmer et al., 1988); However, when assessing physical activity levels in adults with depression, Song and colleagues (2011) found that although depressed participants had significantly lower levels of low and moderate physical activity than non-depressed individuals, they had no difference in level of sedentary behavior or vigorous physical

activity. Furthermore, a randomized control trial of facilitated physical activity as treatment for depressed patients found no difference in depression scores between patients who did and did not receive facilitation for physical activity after 4, 8 and 12 month trial intervals, even though participants receiving facilitation reported more physical activity during those time periods (Calder et al., 2012).

In contrast, an odds ratio analysis of moderate and vigorous physical activity revealed that increasing moderate to vigorous physical activity lowered depression risk by around 40-50% compared to those who engaged in lower levels of physical activity (Vallance et al., 2011). A recent study found similar results after assessing the health benefits of objectively measured vigorous physical activity compared to moderate physical activity in young adults (Gerber et al., 2014). Gerber and colleagues (2014) found that vigorous physical activity was more greatly associated with decreases in stress, pain, sleep complaints, and depression than moderate physical activity.

The discrepancy between level of physical activity and decreasing depression is also related to whether the physical activity is current or in the past. When exploring the longitudinal associations of physical activity and sports involvement, Brunet and colleagues (2012) found that past moderate to vigorous physical activity was not related to depression status while current moderate to vigorous physical activity was negatively related to depression in young adults. They also found that both past and current sports involvement was negatively associated with depression (Brunet et al., 2012). This reinforces the importance of considering if physical activity is current or past, involvement in sports, and intensity of physical activity when attempting to decrease depression. Past moderate or vigorous physical activity is

inconsequential; one must be currently participating in the activity in order to reap the benefit of decreased depression.

Intensity, duration, and length of training are other factors that can affect the psychological benefits of physical activity and are important to account for when prescribing physical activity as an antidepressant (O'Neal, Dunn, & Martinsen, 2000). Intensity of a specific activity does not necessarily determine the beneficial effects, as every individual will have different fitness and tolerance levels for exercise (O'Neal et al., 2000). There is a minimum duration that is recommended to receive beneficial effects of exercise (i.e., 20 minutes or more of an activity), but there is no evidence to suggest that more than 20 minutes of exercise will provide greater benefits (O'Neal et al., 2000). Longer training programs (20 weeks or longer) show greater antidepressant effects, likely due to frequent enhancement of mood (O'Neal et al., 2000).

As previously mentioned, it is important to consider the type of activity when judging its effectiveness in reducing depression symptoms. While aerobic exercise has evidently been consistently correlated with decreased depression status, there is the question about whether or not other forms of exercise might be just as, or more, beneficial. The research regarding aerobic and strength training is abundant, showing that both are consistently related to lower depression (Blumenthal et al., 2007; Dimeo, Bauer, Varahram, Proest, & Halter, 2001; Dunn, Trivedi, Kampert, Clark, & Chambliss, 2005; McCann & Holmes, 1984; Taliaferro et al., 2009). Furthermore, the research suggests that there is no significant difference between the beneficial effects of aerobic exercise and strength training in reduction of depression (Krogh, Saltin, Gluud, & Nordentoft, 2009; Martinsen, Hoffart, & Solberg, 1989; Silveira et al., 2013).

Dimeo and colleagues (2001) explored the effect of an aerobic training program on 12 adults with major depression. After 10 days of 30 minutes of aerobic exercise, participants experienced a significant change in depression status. Similarly, McCann and Holmes (1984) found that participation in aerobic exercise for a 10 week period of time was related to a significant decrease in depression in undergraduate students. Dunn and colleagues (2005) explored how varying levels of aerobic exercise affected depression status in 80 adults with mild to moderate major depressive disorder. They found that participants who were prescribed aerobic exercise consistent with the public health dose of 17.5-kilocalories per kilogram of body weight per week had a 47% reduction in depression level after 12 weeks (Dunn et al., 2005).

Blumenthal and colleagues (2007) compared the effectiveness of aerobic exercise to that of antidepressants as treatment for depression in 202 adults with major depression over a 4 month period. After 4 months, the supervised and at-home exercise groups had 45% and 47% reduction in depression symptoms respectively, and the antidepressant group had 47% reduction in depression (Blumenthal et al., 2007). The exercise groups also had significantly greater reductions in depression than the placebo group (Blumenthal et al., 2007). These results suggest that aerobic activity is not only related to lower depression but is also comparable to antidepressants in treatment for depression (Blumenthal et al., 2007).

Stein and Motta (1992) compared the effects of aerobic and non-aerobic exercise on 89 undergraduate students' level of depression and self-concept. The aerobic exercise group participated in swimming, while the non-aerobic exercise group participated in weight training (Stein & Motta, 1992). Depression and self-concept were measured before and after the intervention (Stein & Motta, 1992). Results showed that both the aerobic and non-aerobics training groups had reductions in depression scores, with no significant difference between the

two (Stein & Motta, 1992). Interestingly, the non-aerobic group had a greater enhancement of self-concept than did the aerobic training group (Stein & Motta, 1992). This may be because non-aerobic strength training results in different, more noticeable changes in body shape or because those that strength train experience a more noticeable change in strength and ability. This raises the question again about whether physical activity is best measured based on fitness level or activity level.

A review and meta-analysis of the literature on strength-training found that is associated with reductions in anxiety and depression symptoms, along with various improvements in physical health (O'Connor, Herring, & Caravalho, 2010). However, Martinsen and colleagues (1989) found that there was no significant difference in the reduction of depression scores in patients with unipolar depressive disorders who completed aerobic training versus resistance training. Similarly, a randomized control trial that measured depression levels after a four month period of strength-training, aerobic-training, or relaxation-training in patients with unipolar depression found no significant difference between changes in depression level between the three different types of exercise (Krogh et al., 2009). Likewise, a more recent review and meta-analysis of the literature on exercise interventions for patients with major depressive disorder revealed that there was no significant difference between aerobic exercise and strength-training exercise in reduction of depression symptoms (Silveira et al., 2013).

Another form of exercise, mind and body training, is important to consider as it has become a popular means of physical activity. In the present study, in addition to comparing aerobic and strength training activities, mind and body training will also be considered as well. Since mind and body training is typically a slower paced and more attention focused activity, it

may have different effects in reducing depression when compared to aerobic and strength training activities.

Research on mind and body training is growing, with evidence that it can have beneficial effects on mental health. For example, Deckro and colleagues (2010) explored the effects of a mind/body intervention program for 128 college students. Students' levels of distress, anxiety and perception of stress were measured before and after 6 weeks of 90 minute training sessions in relaxation and cognitive behavioral skills (Deckro et al., 2010). Those who participated in the mind/body training group were found to have significantly reduced psychological distress, anxiety and perceived stress (Deckro et al., 2010). This suggests that mind/body training could also be beneficial for other psychological problems, including depression. However, there is limited research on some types of mind/body exercises such as Tai Chi.

Several studies have shown beneficial effects of mind-body training for reduced depression or depressive symptoms. Research on yoga has been conducted in relation to various conditions in order to see its effectiveness in relieving symptoms associated with those conditions (Roberts, 2013). Examples of yoga research include its effects on patients with anxiety, depression, diabetes, epilepsy, cancer, aging, and childhood development (Roberts, 2013). Some factors regarding these conditions that were found to be related to yoga practice included reduced anxiety symptoms, improved sleep, decreased stress level, improved mood, increased energy, decreased aggression, increased glucose tolerance and insulin sensitivity in those with diabetes, and decreased seizures for patients with epilepsy (Roberts, 2013). In regards to depression, a 2010 review of several studies found that yoga was related to increased mindfulness, increased physical activity, decreased stress, and improved sleep (Uebelacker et al., 2010).

Participants of an intervention study at UCLA had significant decreases in depressive symptoms after 10 yoga classes over a five week period (Woolery, Myers, Sternlieb, & Zeltzer, 2004). A similar study showed that yoga was found to be an effective technique to alleviate depression symptoms in female students with severe depression (Khumar, Kaur, & Kaur, 1993). A meta-analysis also revealed mindfulness-type interventions to be moderately effective in improving mood symptoms (Hofmann, Sawyer, Witt, & Oh, 2010). Cramer and colleagues (2013) explored the effectiveness of yoga on depression, and found a moderate short term effect of yoga on decreased severity of depression. However, they were unable to explore the long term effects of yoga on depression based on 12 studies included in the meta-analysis (Cramer, Lauche, Langhorst, & Dobos, 2013).

An intervention study compared the effects of yoga on depression using three different treatment methods: a yoga only group, a yoga and antidepressant drug group, and an antidepressant drug only group (Navheen et al., 2013). Results indicated that the two groups with the inclusion of yoga had greater reduction in depression scores than the group using the antidepressant drug only (Navheen et al., 2013). In addition to the relationship found between yoga and decreased depression scores, researchers also found a correlation between decreased depression and increase in BDNF levels—a protein in the brain that supports the growth and differentiation of neurons—in the yoga-only group (Navheen et al., 2013). This indicates that yoga is related to slight changes in the chemistry of the brain in ways that correlate with lower depression. Similarly, in a sample of college students, yoga was found to be related to significant reduction in perceived stress, worry, depression and improvement of mindfulness-based skills (Eastman-Mueller, Wilson, Jung, Kimura, & Tarrant, 2013).

Other forms of mind-body type training, such as Tai Chi are less well researched. A meta-analysis of the effects of Tai Chi on psychological well-being revealed that Tai Chi is related to reduction of stress and depression, and improvement of mood (Wang et al., 2010). Tai Chi is often recommended to older adults as an appropriate form of physical activity due to its low impact qualities, and thus most of the research on the beneficial mental health effects of Tai Chi is focused on the older population. For example, Chou and colleagues (2004) explored the effects of 36 sessions of Tai Chi on depressed adults 60 years and older. Results revealed that Tai Chi was significantly related to reduced depressive symptoms (Chou et al., 2004). A similar study was completed to determine the effects of Tai Chi on physical and mental health of college students. Mental and physical health measurements were taken of 30 college students before and after a three month intervention of hour long Tai Chi exercise twice per week (Wang, Taylor, Pearl, & Chang, 2004). Students who participated in the Tai Chi intervention showed significantly improved role mental/emotional function, vitality, and perceptions of mental health, along with increased multidimensional mental health scores as measured by the SF-36v2 health survey questionnaire (Wang et al., 2004). Although this study did not measure depression directly, it suggests that Tai Chi could be beneficial in improving overall mental health in college students (Wang et al., 2004).

Regardless of the findings of the beneficial effects of Tai Chi on mental health, much of the research varies in design and methodology. Summaries of the data on mind-body training and mental health have found that there is a lot of variation in the evidence based on different types of practices and depression classifications, leading to uncertainty about whether or not the evidence is sufficient enough to use these practices as treatments for depression (Bussing, Michalsen, Khalsa, Telles, & Sherman, 2012). Furthermore, it is still unclear whether mind-body

training practices have any different effect compared to aerobic forms of physical activity (Wang et al., 2010).

Motivators of Physical Activity

There is a large body of evidence regarding the relationship between physical activity and depression; however, when looking specifically at different types of physical activity, there seems to be slightly mixed results and many confounding variables. While it would be very difficult to consider one's risk for depression based on all of these dynamic factors, one important influence that is often overlooked is what is motivating people to exercise in the first place.

Consequently, when examining how physical activity and depression are related we must acknowledge the motives behind the activity. Motivation can depend on various factors including wanting to improve body image, increasing physical strength or ability, and sometimes even just for fun (Blatt, D'Afflitti, & Quinlan, 1976; Frederick & Ryan, 1993; Teixeira, Carraca, Markland, Silva, & Ryan, 2012; Wankel, 1993). Additionally, when considering physical activity as a treatment for depression, it is important that the individual feels that it is an autonomous choice made for the interest and enjoyment of the activity.

Zuroff and colleagues (2007) explored how autonomous motivation was related to remission from depression. In accordance with self-determination theory, autonomous motivation involves the performance of an activity based on its interesting or exciting values, not because of external rewards (Zuroff et al., 2007). Researchers assigned 95 patients with depression to three different treatment groups including manualized interpersonal therapy, cognitive-behavioral therapy, and pharmacotherapy (Zuroff et al., 2007). After assessing autonomous motivation in all three groups, Zuroff and colleagues (2007) found that autonomous

motivation for treatment was related to higher probability of remission and decrease in post-treatment depression.

Early studies on exercise motivation in adults found that common reasons for beginning an exercise training program included: to challenge oneself; to achieve a goal, to improve fitness and health, and to relieve tension (Biddle & Bailey, 1985; Summers, Machin, & Sargent, 1983; Summers, Sargent, Levey, & Murray, 1982). However, Wankel (1993) found that 50% of people who adhere to a physical activity program end up quitting before they reach their goals. While exploring how to enhance the effects of physical activity on psychological health, Wankel (1993) found that intrinsic value, or enjoyment of an activity, was an important motivating element in maximizing the beneficial psychological effects of physical activity. Enjoyment of an exercise activity was found to be important not only for adherence to the program, but also for dealing with stress and other possible psychological health factors (i.e., depression, anxiety) (Wankel, 1993).

In addition to interest/enjoyment motivational factors, competence related factors and body related factors also exist. These factors have been categorized in the self-determination theory in two ways: intrinsic and extrinsic motivation. A systematic review of the research on self-determination theory shows that it affects physical activity by providing a person with either an intrinsic or extrinsic motivation system (Teixeira et al., 2012). Self-determination theory relates intrinsic motivation with enjoyment of an activity, and extrinsic motivation with gaining a specific outcome from an activity (Teixeira et al., 2012). Teixeira and colleagues (2012) found that, overall, extrinsic motivation was important in the initial adoption of an activity, while intrinsic motivation was important in maintaining such activity. This study supported the idea

that having a goal is an important factor in starting an exercise activity, but having fun in the process of reaching that goal is equally important.

Frederick and colleagues (1996) examined how intrinsic and extrinsic motivations were related to adherence of an activity, perceived confidence, and perceived satisfaction. Surveys of motivation for physical activity and sport enjoyment were completed by 130 college students (Frederick, Morrison, & Manning, 1996). These surveys revealed intrinsic motivation as being related to increased positive affect and increased perceived competence and perceived satisfaction of an activity in both men and women (Frederick et al., 1996). Extrinsic motivation showed to be related to adherence to an activity in men (Frederick et al., 1996). This study provides evidence that it is essential for a physical activity program to spark intrinsic motivation in order for a patient to obtain positive emotional benefits.

Frederick and Ryan (1993) explored the relationships between different motives for physical activity, level of physical activity and psychological outcomes. They defined three specific types of motivation: interest/enjoyment, competence, and body-related motivation (Frederick & Ryan, 1993). These three factors were not derived specifically from self-determination theory; however, the researchers felt that each could be closely related to either intrinsic or extrinsic motivation. Frederick and Ryan (1993) categorized interest/enjoyment, and competence factors as forms of intrinsic motivation, and body-related factor as a type of extrinsic motivation due to the external relationship that exists between the goal of the activity and the actual activity itself.

After defining these motivational factors, Frederick and Ryan (1993) explored interest/enjoyment factors, body-related factors and competence factors specifically in adults' motivation to exercise. Competence factors included wanting to improve a certain set of skills or

competition, while body-related factors included wanting to become more attractive, improve body image, or attain a higher self-esteem (Frederick & Ryan, 1993). They categorized the adults by whether they participated in a sport or in a fitness class (Frederick & Ryan, 1993).

For the sports participation group, Frederick and Ryan (1993) found that interest/enjoyment factors were related to higher levels of physical activity in terms of number of hours and energy expenditure in the activity, while body related factors were related only to days per week of exercise and competence factors were not related at all to level of physical activity. For the fitness exercise group, they found that both interest/enjoyment and competence motivation were related to all three measures of physical activity—number of hours, number of days per week, and energy expenditure, while body related factors were only related to days per week of activity (Frederick & Ryan, 1993). Although there is discrepancy in how competence and body-related factors are related to physical activity between the different types of participation, there is agreement that interest and enjoyment of an activity is a positive correlate of overall physical activity level.

Finally, Frederick and Ryan (1993) explored how motivation was related to mental health. They found that in the sports participation group, interest/enjoyment and competence factors of motivation were not related to mental health (Frederick & Ryan, 1993). This was not the case for body-related factors of motivation—greater body-related motivation correlated with greater depression (Frederick & Ryan, 1993). Similarly, for the fitness exercise group, neither the interest/enjoyment or competence factors of motivation were related to mental health (Frederick & Ryan, 1993). However, unlike the sports participation group, there was no correlation between body-related motivation and depression for the fitness exercise group (Frederick & Ryan, 1993). These results indicate that there is no relationship between intrinsic

motivation and depression, but there is the possibility of a positive relationship between extrinsic motivation and depression, especially in sports participation.

While enjoyment is shown to be a significant correlate with adherence to an exercise program, body image factors have been shown to have a different effect. Blatt and colleagues (1976) explored correlates of depression in college students. After surveying 500 women and 160 men, they found that self-criticism and dependency were strongly correlated with depression (Blatt et al., 1976). This suggests that those who perform physical activity in order to improve some part of themselves due to high self-criticism, may not experience the same effects for treatment of depression symptoms as those who perform the activity based on its intrinsic value.

A significant research study on this topic of self-criticism motivation was completed by students from seven different schools around the United Kingdom who surveyed undergraduate students about their physical activity, depression, and body image perception. They found that poor body image perception down regulates the relationship between physical activity and depression (Ansari et al., 2011). Body image concern has been shown to be positively correlated with depressive symptoms in both male and female undergraduate students (El Ansari, Dibba, Labeeb, & Stock, 2014). Forrest and Stuhldreher (2007) reported that depression is a significant correlate of body image dissatisfaction, and that body image distortion and dissatisfaction are becoming more common in male and female college students. However, in contrast to Ansari and colleagues (2011), they also found that those with body image dissatisfaction were more likely to perform physical activity in order to become more satisfied with their image (Forrest & Struhdreher, 2007).

It is also important to consider the difference in motivation based on age. A study by Brunet and Sabiston (2011) explored the relationship between motivation and physical activity of

three different age groups, and compared the results of each. The three groups consisted of 18-24 year olds, 25-44 year olds, and 45-64 year olds (Brunet & Sabiston, 2011). They used self-determination theory as the guidelines for their motivation variables (Brunet & Sabiston, 2011). In all three age groups, greater intrinsic motivation was related to higher physical activity. This is evidence for the importance of enjoyment of an activity in promoting physical activity, regardless of age.

Furthermore, Brunet and Sabiston (2011) found that greater external regulation, a type of extrinsic motivation in which an individual performs an activity in order to fulfill a demand or receive a reward, was related to lower physical activity levels in the young adult (18-24) age group. However, greater introjected regulation, a type of extrinsic motivation in which an individual performs an activity in order to maintain their own feelings of self-worth, was related to higher levels of physical activity in the young adult age group. Neither of these findings was true for the adult (25-44) or middle age adult (45-64) groups (Brunet & Sabiston, 2011). This is intriguing because although introjected regulation and external regulation are both forms of extrinsic motivation, they differ in the ways they affect physical activity level in young adults, but not in those older than this age group.

General Aim of the Present Study

The general aim of the present study is to explore the relations of PA, type of physical activity, motivation, and depression among college students at the University of Redlands. Based on the available research on physical activity and depression, it is anticipated that higher levels of overall physical activity will be related to lower depression scores. Additionally, when examining specifically the different types of physical activity, we predict that higher frequency of cardio, mind/body, and strength training will all be related to lower depression scores, with

cardio and strength training showing similarly strong relationships, followed by mind and body training. Finally, when exploring the different motivating factors for physical activity, we hypothesize that higher intrinsic and competence motivation scores will be related to lower depression scores, while lower body-related motivation scores will be related to lower depression scores.

Method

Participants

Participants were recruited from the students enrolled in Introduction to Psychology class at the University of Redlands who received research participation credit for participating. Two hundred and fifty-four students completed the survey; however, three were excluded due to not meeting the age requirement, and 11 were excluded because of incomplete or irregular responses. Of the 240 remaining participants, 34.2% were men (*n*=82) and 65.8% were women (*n*=158). Participants' age ranged from 18-22 years of age (*M*=18.67, *SD*= 0.98). Sixty three percent of participants identified as Caucasian, 15.8% as Hispanic, 6.3% as Asian, 4.6% as multiracial, 3.8% as Latino, 2.9% as African American, 2.1% as Middle Eastern, 0.8% as Arab, and 0.8% as Native American. Freshman made up the majority of participants (67.1%), followed by sophomores (24.2%), juniors (6.3%), and seniors (2.5%).

Materials

Demographics. Participants completed a demographic survey regarding age, gender, ethnicity, and year in school.

Center for Epidemiological Studies- Short Depression Scale (CES-D; Irwin, Artin & Oxman, 1999; Radloff, 1977). The CES-D is a 10-item scale where participants indicated the frequency of depressive symptoms that they felt during the last week on a 4-point Likert scale, with 0 indicating rarely or none of time, and 3 indicating most or all of the time.

Participants' depression scores were totaled based on the sum of scores from 0-3 for each question, with 0 being the lowest total possible score and 30 being the highest. Higher scores represented greater depressive symptoms.

Radloff (1977) reported alpha coefficients for the original 20-item CES-D of 0.85 for the general population and 0.90 for a patient sample. Internal consistency of the 10-item CES-D (n=83) was reported as 0.92 and test-retest reliability as 0.83 (Irwin, 1999). The Cronbach's alpha was calculated for the present sample (n=240) as 0.58.

Godin Leisure-Time Exercise Questionnaire (Godin & Shepard, 1985). Participants completed the first three questions from the Godin Leisure-Time Exercise Questionnaire which asked about frequency of strenuous, moderate, and mild physical activity. Frequency was reported in number of times per week that the participants completed 15 minutes or more of the activity. They then completed three additional questions regarding frequency of cardio training, mind/body training, and strength training. Frequency was reported in times per week of the activity. Participants received a score for level of physical activity using the first three questions of the Godin Leisure-Time Physical Activity questionnaire by multiplying the frequencies (times/week) of strenuous exercise by 9, moderate exercise by 5, and mild exercise by 3, and adding the three quantities together for a single total. Separate scores were found for each type of exercise (cardio, strength training, mind/body) based on participants' responses for frequency of each activity (times/week). Godin and Shephard (1985) reported significant test-retest reliability for light (r=.48), moderate (r=.46), strenuous (r=.94), and total activity (r=.74).

Motivation for Physical Activity Measure (MPAM; Frederick & Ryan, 1993). Participants completed a modified version of the Motivation for Physical Activity Measure which contained six statements for each of three categories of motivation: body-related,

competence, and intrinsic. Participants indicated the degree to which they felt each statement applied to their own motives for their primary physical activity on a 5-point Likert scale with 1 indicating that the statement was not true, and 5 indicating that the statement was very true. Participants received three separate average motivation factor scores, one for each of the categories—body-related motivation, competence motivation, and intrinsic motivation—with a total possible score from 0-4 in each category (1 on the Likert scale received a score of 0, while 5 received a score of 4; scores were calculated for each type of motivation by taking the average of the responses for the 6 items in each category). Higher scores in each motivation category indicated greater motivation of that type. All three measures of motivation have been shown to have high reliability, with internal consistency ranging from 0.69-0.90 (Plonczynski, 2000). Alpha coefficients were found for the current study to be 0.89 for body related motivation, 0.94 for competence motivation, and 0.97 for intrinsic motivation.

Procedure

After signing up for the study online, participants received an email containing a link to the Survey Monkey site with the research materials. Utilizing the online Survey Monkey service, participants completed the demographic survey as well as the three questionnaires. The process of completing all four questionnaires took approximately 20 minutes.

Results

Means and standard deviations for depression, overall level of physical activity, the three types of physical activity (cardio, strength training, and mind/body training), and the three types of motivation (body-related, competence, and intrinsic) for the overall dataset and for men and women are shown in Table 1.

A hierarchical multiple regression analysis was conducted to explore the effects of overall level of physical activity, frequency of different types of physical activity, and motivation for physical activity as predictors of depression score. Overall physical activity level was entered in Step 1; types of physical activity (frequencies of cardio, strength, and mind/body training) were entered in Step 2; and finally, types of motivation (intrinsic, competence, and body-related) were entered in Step 3. Results of this analysis are shown in Table 2.

On step 1, inspection of the standard regression coefficients (βs) reveals that overall physical activity was not significant (p=.31) in predicting depression. On Step 2, inspection of the betas indicates that strength training was a significant predictor, whereas cardio and mind/body training were not significant (p=.15; p=.33) in predicting depression. The effect of strength training indicates that those who reported higher frequencies of strength training exercise scored lower on the depression measure. On Step 3, inspection of the betas reveals that only body-related motivation was a significant predictor, while intrinsic and competence motivations were not significant (p=.66; p=.25) in predicting depression. The effect of body-related motivation indicates that those who scored higher in body-related motivation also scored higher on the depression measure. To further examine the effects of strength training and body related motivation on depression a follow-up regression analysis was conducted on the effects of physical activity, type of physical activity, and motivation for men and women separately.

Effects of Overall Physical Activity Level, Type of Physical Activity and Motivation for Men

A follow-up hierarchical regression analysis was conducted to explore the predictors of depression for men, with overall physical activity level entered in Step 1; types of physical activity (frequencies of cardio, strength training, and mind/body training) entered in Step 2; and

types of motivation (intrinsic, competence, and body-related) entered in Step 3. Results from this analysis are shown in Table 3.

On Step 1, an inspection of the betas indicates that overall physical activity level was not significant (p=.63) in predicting depression. On Step 2, frequency of strength training was a significant predictor, while frequencies of cardio and mind/body training were not significant (p=.29; p=.59) in predicting depression. The effect of strength training indicates that men who reported higher frequencies of strength training scored lower on the depression measure. On Step 3, there was a trend for body-related motivation as a predictor, while intrinsic and competence motivation were not significant (p=.85; p=.11) in predicting depression. The trend for body-related motivation indicates that men who scored higher in body-related motivation also scored higher on the depression measure.

Effects of Overall Physical Activity Level, Type of Physical Activity and Motivation for Women

A follow-up hierarchical regression analysis was conducted to explore the predictors of depression for women, with overall physical activity level entered in Step 1; types of physical activity (frequencies of cardio, strength training, and mind/body training) entered in Step 2; and types of motivation (intrinsic, competence, and body-related) entered in Step 3. Results from this analysis are shown in Table 4.

On Step 1, an inspection of the betas reveals that overall physical activity level was significant in predicting depression. The effect of physical activity indicates that women who reported higher levels of physical activity also scored higher on the depression measure. On Step 2, none of the three types of physical activity were significant predictors of women's depression when entered separately into this model. On Step 3, there was a trend for body-related

motivation as a predictor, while intrinsic and competence motivation were not significant (p=.29; p=.94) in predicting depression. The trend for body-related motivation indicates that women who scored higher in body-related motivation also scored higher on the depression measure.

Discussion

It was hypothesized that depression status would be predicted by overall level of physical activity, types of physical activity, and types of motivation for physical activity, such that higher levels of overall physical activity, higher frequency of cardio, strength training and mind/body training, greater competence and intrinsic motivation, and lower body-related motivation would all predict lower levels of depression. Hierarchical regression analysis of the whole sample revealed that higher frequency of strength training and lower levels of body-related motivation predicted lower depression.

When analyzing just men, higher frequency of strength training was still a predictor of lower depression. There was also a trend toward body-related motivation as a significant predictor. When analyzing just women, strength training was no longer a significant predictor of depression; however, there was a trend for body-related motivation to predict depression. The trend for body-related motivation as a significant predictor of depression suggests that for both men and women, exercising for body-related reasons is not beneficial in reducing depression symptoms (and may even increase them). The attenuation of the results found in the male and female samples regarding body-related motivation as a predictor of depression is possibly due to limited sample size. The trend could only be explored in future studies utilizing a greater sample size. The absence of strength training as a predictor of depression in females (and its presence in males) suggests that strength training is more important for males than females in regards to reducing depression status.

Results of these analyses are consistent with the literature, with the following exceptions. First, the complete data sample did not reveal a relationship between physical activity level and depression. This finding is intriguing because it is contradictory to most of the research regarding these variables that have shown that greater physical activity is related to (and may predict) lower depression scores. Furthermore, neither frequency of cardio nor frequency of mind/body training showed the significant relationships with depression that are reported in the literature (Blumenthal et al., 2007; Dimeo et al., 2001; Dunn et al., 2005; McCann & Holmes, 1984; Taliaferro et al., 2009). The results are also in contrast to findings that show no difference between the relationships of strength training and cardio training with depression (Krogh et al., 2009; Martinsen et al., 1989; Silveira et al., 2013). Finally, the emergence of greater physical activity as a significant predictor of depression in women is in contrast to much of the research that supports the benefits of physical activity on depression. This finding may be the result of an interaction in the relationship between physical activity and depression that emerged when the data was analyzed separately for men and women. Future studies should explore this interaction in further detail.

The discrepancies between the present findings and the literature may be due to certain characteristics of the sample used in this study. For example, college students (specifically freshman—who made up the majority of the sample) are going through a transition period during which they are adjusting to new lifestyles that can be more stressful and intimidating than they are used to. Figuring out how to balance school, health, and social life can be challenging and it is possible that this may have influenced the rates of depression and frequencies of physical activity for the sample. Additionally, it is possible that the involvement in sports teams influenced the results, as there may exist a difference in the motivations and fulfillment of

physical activity when completed for a team sport versus physical activity that one participates in on their own. The difference between these two means of activity has been explored by Frederick and Ryan (1993) and would be interesting to investigate with the present sample.

The implications of these findings apply specifically to college students seeking to engage in some physical activity. Although the findings do not support the idea that physical activity can reduce depression symptoms (especially for females), they support the benefits of strength training for men. This study also sheds some insight into how different motivations for exercise can impact its' benefits. The trend towards a relationship between body-related motivation and depression implies that working out to improve body image will not lead to reductions in depression, and may possibly increase depression symptoms. Although intrinsic and competence motivations were not significant predictors of depression status, the negative aspects of body-related motivation suggest that students should try to find other motivating factors to engage in physical activity.

Although this study was conducted on university students, there may be questions about the generalizability of the results to all young adults of this age. This study's sample was primarily Caucasian, freshman at a private university in Southern California. Different results may have been found if the sample was more ethnically diverse, or included a greater diversity of students from different years in school. This study was also limited by its sample size, and the full range of interactions of the model could not be assessed. Future directions in the exploration of physical activity, its motivating factors, and their influence on depression should address the interactions of these variables. Such studies should obtain a greater sample of participants that is more ethnically diverse and represents each year of college equally.

A final important aspect of this study to note is the range of depression scores that was reported and the reliability of the depression measure used. The sample had a pretty wide range of depression scores, ranging from 2 to 28, with only 30% of participants scoring as not depressed (scores of 9 or less), and 70% scoring as depressed (scores of 10 or more). This seems like a large percentage of depressed students, however it is necessary to take into account the low reliability of the measure for this sample (*Cronbach alpha*=0.58). This low reliability may be due to the use of the 10-point scale rather than the 20-point scale, or because the measure was not designed primarily for college students. It is also important to consider the timing of the study—during the end of the first semester of college for many of the students (being that the majority were freshman), and the beginning of their second semester. Had the depression rates in the sample been more representative of the standard population, and the measure been more reliable, there might have been a different outcome. There is also the possibility that there may have been a different result if a clinical sample from the school had been chosen.

The importance of this study is its contribution to the growing volume of evidence on physical activity and depression, specifically for college students. There has been limited research regarding the role of motivation on depression status; however, this study provides a reference of the benefits of engaging in different exercises and how their motivations for doing so may affect mental health. As depression becomes an increasingly prevalent problem, especially among college students, it is necessary that students seek ways to reduce their symptoms of depression. Physical activity may be a beneficial way for some students to do so, (but not necessarily for females) as long as they know the implications of the type of exercise in which they are engaging and they have the right motivation for doing so.

References

Aberg, M. A. I., Waern, M., Nyberg, J., Pedersen, N. L., Bergh, Y., Aberg, N. D., Nilsson, M., Kuhn, H. G., & Tore´, K. (2012). Cardiovascular fitness in males at age 18 and risk of serious depression in adulthood: Swedish prospective population-based study. *The British Journal of Psychiatry, 201,*552-359.

American College Health Association. (2012). *American college health association-national college health assessment II: reference group executive summary. American College Health Association*

American Heart Association. (2007). Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation, 116*, 1081-1093.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5*. Washington, D.C: American Psychiatric Association.

Ansari, W. E., Stock, C., Phillips, C., Mabhala, A., Stoate, M., Adetunji, H., Deeny, P., John, J., Davies, S., Parke, S., Hu, X., & Snelgrove, S. (2011). Does the association between depressive symptomatology and physical activity depend on body image perception? A survey of students from seven universities in the UK. *Int. J. Environ. Res. Public Health, 8*, 281-299.

Biddle, S., & Bailey, C., (1985) Motives towards participation and attitudes toward physical activity of adult participants in fitness programs. *Perceptual and Motor Skills, 61*, 831-834.

Blatt, S. J., D'Afflitti, J. P., & Quinlan, D. M. (1976). Experiences of depression in normal young adults. *Journal of Abnormal Psychology, 85*(4), 383-389.

Blumenthal, J. A., Babyak, M. A., Doraiswamy, P. M., Watkins, L., Hoffman, B. M., Barbour, K. A., Herman, S., Craighead, W. E., Brosse, A. L., Waugh, R., Hinderliter, A., & Sherwood, A. (2007). Exercise and pharmacotherapy in the treatment of major depressive disorder. *Psychosomatic Medicine, 69*(7), 587-596.

Brown, R. S., Ramirez, D. E., & Taub, J. M. (1978) The prescription of exercise for depression. *The Physician and Sports Medicine,* 35-45.

Brunet, J., Sabiston, C. M. (2011) Exploring motivation for physical activity across the adult lifespan. *Psychology of Sport and Exercise, 12*(2), 99-106.

Brunet, J., Sabiston, C. M., Chaiton, M., Barnett, T. A., O'Loughlin, E., Low, N. C. P., & O'Loughlin, J. L. (2012). The association between past and current physical activity and depressive symptoms in young adults: a 10-year prospective study. *Annals of Epidemiology, 23*(1), 25-30.

Bussing, A., Michalsen, A., Khalsa, S. B. S., Telles, S., & Sherman, K. J. (2012). Effects of yoga on mental and physical health: A short summary of reviews. *Evidence-Based Complementary and Alternative Medicine, 2012*, 1-7.

Centers for Disease Control and Prevention. (2010). Current depression among adults – United States, 2006 and 2008. *Morb Mortal Wkly 59*, 1229–1235.

Chalder, M., Wiles, N. J., Campbell, J., Hollinghurst, S. P., Haase, A. M., Taylor, A. H., Fox, K. R., Costelloe, C., Searle, A., Baxter, H., Winder, R., Wright, C., Turner, K. M., Calnan, M., Lawlor, D. A., Peters, T. J., Sharp, D. J., Montgomery, A. A., & Lewis, G. (2012). Facilitated physical activity as a treatment for depressed adults: randomised controlled trial. *British Medical Journal, 344*: e2758.

Chou, K., Lee, P. W. H., Yu, E. C. S., Macfarlane, D., Cheng, Y., Chan, S. S. C., & Chi I. (2004). Effect of Tai Chi on depressive symptoms amongst Chinese older patients with depressive disorders: a randomized clinical trial. *International Journal of Geriatric Psychiatry, 19*(11), 1105-1107.

Cramer, H., Lauche, R., Langhorst, J., & Dobos, G. (2013). Yoga for depression: a systematic review and meta-analysis. *Depression and Anxiety, 30*(11), 1068-1083.

Cranford, J. A., Eisenberg D., & Serras, A.M. (2009). Substance use behaviors, mental health problems, and use of mental health services in a probability sample of college students. *Addictive Behavior*. *34*(2), 134–145.

Dakwar, E., Blanco, C., Lin, K., Liu, S., Warden, D., Trivedi, M., & Nunes, E. V. (2012). Exercise and mental illness: results from the national epidemiologic survey on alcohol and related conditions (NESARC). *Journal of Clinical Psychiatry, 73*(7), 960-966.

Deckro, G. R., Ballinger, K. M., Hoyt, M., Wilcher, M., Dusek, J., Myers, P., Greenberg, B., Rosenthal, D. S., & Benson, H. (2010). The evaluation of a mind/body intervention to reduce psychological distress and perceived stress in college students. *Journal of American College Health, 50*(6), 281-287.

Deslandes, A., Moraes, H., Ferreira, C., Veiga, H., Silveira, H., Mouta, R., Pompeu, F. A. M. S., Coutinho, E. S. F., & Laks, J. (2009). Exercise and mental health: many reasons to move. *Neuropsychobiology, 59*(4), 191-198.

Dimeo, F., Bauer, M., Varahram, I., Proest, G., & Halter, U. (2001). Benefits from aerobic exercise in patients with major depression: a pilot study. *British Journal of Sports Medicine, 35*(2), 114-117.

Dimidjian, S., Hollon, S. D., Dobson, K. S., Schmaling, K. B., Kohlenberg, R. J., Addis, M. E., Gallop, R., McGlinchey, J. B., Markley, D. K., Gollan, J. K., Atkins, D. C., Dunner, D. L., & Jacobson, N. S. (2006). Randomized trial of behavioural activation, cognitive therapy, and antidepressant medication in the acute treatment of adults with major depression. *Journal of Consulting and Clinical Psychology, 74*(4), 658-670.

Dunn, A. L., Trivedi, M. H., & O'neal, H. A. (2001). Physical activity dose-response effects on outcomes of depression and anxiety. *Med. Sci. Sports Exerc., 33*(6), S587–S597.

Dunn, A. L., Trivedi, M. H., Kampert, J. B., Clark, C. G., & Chambliss, H. O. (2005). Exercise treatment for depression. *American Journal of Preventative Medicine, 28*(1), 1-8.

Eastman-Mueller, H.,Wilson, T., Jung, A., Kimura, A., & Tarrant, J. (2013). iRest yoga-nidra on the college campus: Changes in stress, depression, worry, and mindfulness. *International Journal of Yoga Therapy, 2*(2), 15-24.

El Ansair, W., Dibba, E., Labeeb, S., & Stock, C. (2014). Body image concern and its correlates among male and female undergraduate students at Assuit University in Egypt. *Global Journal of Health Science*, *6*(5), 105-117.

Farmer, M. A., Locke, B. Z., Moscicki, E. K., Dannenberg, A. L., Larson, D. B., & Radloff, L. S. (1988). Physical activity and depressive symptoms: The NHANES I epidemiologic follow-up study. *American Journal of Epidemiology, 128*(6), 1340-1351.

Forrest, K. Y. Z., & Stuhldreher, W. L. (2007). Patterns and correlates of body image dissatisfaction and distortion among college students. *American Journal of Health Studies, 22*(1), 18-25.

Frederick, C. M., Morrison, C., & Manning, T. (1996). Motivation to participate, exercise affect, and outcome behaviors toward physical activity. *Perceptual and Motor Skills, 82*(2), 691-701.

Frederick, C. M., & Ryan, R. M. (1993). Differences in motivation for sport and exercise and their relations with participation and mental health. *Journal of Sport Behavior, 16*(3), 124-146.

Galper, Trivedi, M. H., Barlow, C. E., Dunn, A. L., & Kampert, J. B. (2006). Inverse association between physical inactivity and mental health in men and women. *Medicine and Science in Sports and Exercise, 38*(1), 173-178.

Gerber, M., Brand, S., Hermann, C., Colledge, F., Holsboer-Trachsler, E., & Puhse, U. (2014). Increased objectively assessed vigorous-intensity exercise is associated with reduced stress, increased mental health and good objective and subjective sleep in young adults. *Physiology & Behavior, 136*, 17-24.

Godin, G., & Shephard, R. J. (1985). A simple method to assess exercise behavior in the community. *Canadian Journal of Applied Sports Science, 10*, 141-146.

Goodwin, R. (2003). Association between physical activity and mental disorders among adults in the United States. *Preventative Medicine, 36,* 698-703.

Halliwell, E., Richardson, C., McCulloch, A., & Ryrie, I. (2005). Up and running? Exercise therapy and the treatment of mild or moderate depression in primary care. *Mental Health Foundation,* 8-12.

Hofmann, S. G., Sawyer, A. T., Witt, A. A., & Oh, D. (2010). The effect of mindfulness-based therapy on anxiety and depression: A meta- analytic review. *Journal of Consulting and Clinical Psychology, 78*(2), 169-183.

Irwin, M., Artin, K. H., & Oxman, M. N. (1999). Screening for depression in the older adult: criterion validity of the 10-item Center for Epidemiological Studies Depression Scale (CES-D). *Arch Intern Med, 159*(15), 1701-1704.

Johnston, J. D., Thosar, S., Agley, J., Gassman, R., Middlestadt, S. E., Van Puymbroeck, M., & Youssefagha, A. (2010). Physical activity and sedentary patterns during college transition years. Peer reviewed oral presentation at the *American Public Health Association annual meeting, Denver, CO, November 6-10.*

Kempermann, G. (2002). Regulation of adult hippocampal neurogenesis—implications for novel theories of major depression. *Bipolar Disorders, 4*(1), 17-33.

Kessler, R. C., Berglund, P. B., Demler, O., Jin, R., Koretz, D., Merikangas, K. R., Rush, J., Walters, E. E., & Wang, P. S. (2003). The Epidemiology of Major Depressive Disorder: Results for the National Comorbidity Survey Replication (NCS-R). *Journal of American Medical Association, 289*(23), 3095-3105.

Khumar, S. S., Kaur, P., & Kaur, S. (1993). Effectiveness of Shavasana on depression among university students. *Indian Journal of Clinical Psychology, 20*(2), 82-87.

Krogh, J., Saltin, B., Gluud, C., & Nordentoft, M. (2009). The DEMO trial: a randomized, parallel-group, observer-blinded clinical trial of strength versus aerobic versus relaxation training for patients with mild to moderate depression. *The Journal of Clinical Psychiatry, 70*(6), 790-800.

Le´pine, J., & Briley, M. (2011). The increasing burden of depression. *Neuropsychiatric Disorder Treatment, 7*, 3–7.

Lindwall, M., Ljung, T., Hadzibajramovic, E., & Jonsdottir, I. H. (2011). Self-reported physical activity and aerobic fitness are differently related to mental health. *Mental Health and Physical Activity, 5*(1), 28-34.

Mailey, E. L., Wojcicki, T. R., Motl, R. W., Hu, L., Strauser, D. R., Collins, K. D., & McAuley, E. (2010). Internet-delivered physical activity intervention for college students with mental health disorders: A randomized pilot trial. *Psychology, Health & Medicine, 15*(6), 646-659.

Martinsen, E. W. (2008). Physical activity in the prevention and treatment of anxiety and depression. *Nordic Journal of Psychiatry, 62*(suppl 47), 25-29.

Martinsen, E. W., Hoffart, A., & Solberg, O. (1989). Comparing aerobic with nonaerobic forms of exercise in the treatment of clinical depression: a randomized trial. *Comprehensive Psychiatry, 30*(4), 324-331.

Mata, J., Thompson, R. J., Jaeggi, S. M., Buschkuehl, M., Jonides, J., & Gotlib, I. H. (2011). Walk on the bright side: physical activity and affect in major depressive disorder. *Journal of Abnormal Psychology*, *121*(2), 297-308.

McCann, L. I., & Holmes, D. S. (1984). Influence of aerobic exercise on depression. *Journal of Personality and Social Psychology, 46*(5), 1142-1147.

Morris M, Steinberg H, Sykes EA, & Salmon P (1990). Effects of temporary withdrawal from regular running. *J Psychosomat Res, (33*), 47–61.

Mutrie, N. The relationship between physical activity and clinically defined depression. In physical activity and psychological well-being. Routledge, London; 2000.

National Institute of Mental Health. (2012). Depression and College Students. *US Department of Health and Human Services.*

Navheen, G. H., Thirthalli, J., Rao, M. G., Varambally, S., Christopher, R., & Gangadhar, B. N. (2013). Positive therapeutic and neurotropic effects of yoga in depression: A comparative study. *Indian J Psychiatry*, *55*(Suppl 3), S400–S404.

National Institute of Mental Health. (2013). Men and Depression. *National Institutes of Health, Publication No. QF 11-5300.*

O'Connor, P. J., Herring, M. P., & Caravalho, A. (2010). Mental health benefits of strength training in adults. *American Journal of Lifestyle Medicine, 4*(5), 377-396.

O'Neal, H. A., Dunn, A. L., & Martinsen, E. W. (2000). Depression and exercise. *International Journal of Sport Psychology, 32*(2), 110-135.

Plonczynski, D. J. (2000). Measurement of motivation for exercise, *Health Education Research , 15(*6), 695-705.

Radloff, L.S. (1977). The CES-D scale: a self-report depression scale for research in the general population. *Applied Psychological Measurement, 1,* 385-401.

Roberts, D. (2013). The benefits of yoga: a brief summary of evidence-based yoga research. *Yoga Australia:* Victoria, Australia.

Russo-Neustadt, A., Beard, R. C., & Cotman, C. W. (1999). Exercise, antidepressant medications, and enhanced brain derived neurotrophic factor expression. *Neurpsychopharmacology, 21*(5), 679-682.

Ruuskanen, J. M., Ruoppila, I. (1995). Physical activity and psychological well-being among people aged 65–84 years. *Age & Ageing, 24,* 292–296

Silveira, H., Moraes, H., Oliveira, N., Coutinho, E. S. F., Laks, J., & Deslandes, A. (2013). Physical exercise and clinically depress patients: A systematic review and meta-analysis. *Neuropsychobiology, 67*, 61-68.

Song, M. R., Lee, Y., Baek, J., & Miller, M. (2011). Physical activity status in adults with depression in the national nealth and nutrition examination survey, 2005–2006. *Public Health Nursing, 29*(3), 208-217.

Stein, P. N., & Motta, R. W. (1992). Effects of aerobic and nonaerobic exercise on depression and self-concept. *Perceptual and Motor Skills, 74*(1), 79-89.

Stephens, T. (1988). Physical activity and mental health in the United States and Canada: evidence from four popular surveys. *Prev Med, 17,* 35–47.

Steptoe, A., Wardle, J., Filler, R., Holte, A., Justo, J., Sanderman, R., & Wichstrom, L. (1997). Leisure-time physical exercise: prevalence, attitudinal correlates, and behavioral correlates among young Europeans from 21 countries. *Prev Med, 26*, 845–854.

Strawbridge, W. J., Deleger, S., Roberts, R. E. & Kaplan, G. A. (2002). Physical activity reduces the risk of subsequent depression for older adults. *American Journal of Epidemiology*, *156*(4), 328-334.

Suija, K., Timonen, M., Suviola, M., Jokelainen, J., Järvelin, M., & Tammelin, T. (2013). The association between physical fitness and depressive symptoms among young adults: results of the Northern Finland 1966 birth cohort study. *BMC Public Health, 13*, 535.

Summers, J., Machin, V., & Sargent, G. (1983). Psychosocial factors related to marathon running. *Journal of Sport Psychology, 5*, 314-331.

Summers, J., Sargent, G., Levey, A., & Murray, K. (1982). Middle-aged, non-elite marathon runners: A profile. *Perceptual and Motor Skills, 54*, 969-969.

Taliaferro, L. A., Rienzo, B. A., Pigg, R. M., Miller, M. D., & Dodd, V. J. (2010). Associations between physical activity and reduced rates of hopelessness, depression, and suicidal behavior among college students. *Journal of American College Health, 54*(4), 427-436.

Teixeira, P. J., Carraca, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 9*, 78.

Uebelacker, L. A., Epstein-Lubow, G., Gaudiano, B. A., Tremont, G., Battle, C. L., & Miller, I. W. (2010). Hatha yoga for depression: critical review of the evidence for efficacy, plausible mechanisms for action and directions for future research. *Journal of Psychiatric Practice, 16*(1), 22-33.

Vallance, J. K., Winkler, E. A. H., Gardiner, P. A., Healy, G. N., Lynch, B. M., & Owen, N. (2011). Associations of objectively-assessed physical activity and sedentary time with depression: NHANES (2005–2006). *Preventative Medicine, 53*(4-5), 284-288.

Van Praag, H., Kempermann, G., & Gage, F. H. (1999). Running increases cell proliferation and neurogenesis in the adult mouse dentate gyrus. *Nature Neuroscience, 2*(3), 266-270.

Wang, Y., Taylor, L., Pearl, M., & Chang, L. (2004). Effects of Tai Chi exercise on physical and mental health of college students. *The American Journal of Chinese Medicine, 32*(3), 453-459.

Wang, C., Bannuru, R., Ramel, J.,Kupelnick, B., Scott, T., & Schmid, C. H. (2010). Tai Chi on psychological well-being: systematic review and meta-analysis. *BMC Complementary and Alternative Medicine, 10*, 23.

Wankel, L. M. (1993). The importance of enjoyment to adherence and psychological benefits from physical activity. *International Journal of Sport Psychology, 24*(2), 151-169.

Weitzman, E. R. (2004). Poor mental health, depression, and associations with alcohol consumption, harm, and abuse in a national sample of young adults in college. *J Nerv Ment Dis*, *192*(4), 269–277.

Winter, B., Breitenstein, C., Mooren, F. C., Voelker, K., Fobker, M., Lechtermann, A., Krueger, K., Fromme, A., Korsukewitz, C., Floel, A., & Knecht, S. (2007). High impact running improves learning. *Neurobiology of learning and memory, 87*(4), 597-609.

Woolery, A., Myers, H., Sternlieb, B., & Zeltzer, L. (2004). A yoga intervention for young adults with elevated symptoms of depression. *Alternative Therapies in Health and Medicine, 10*(2), 60-63.

Zuroff, D. C., Koestner, R., Moskowitz, D. S., McBride, C., Marshall, M., & Bagby, M. R. (2007). Autonomous motivation for therapy: A new common factor in brief treatments for depression. *Psychotherapy Research, 17*(2), 137-147.

Table 1

Means and Standard Deviations for Depression, Level of Physical Activity, Types of Physical Activity, and Types of Motivation Overall, for Men, and for Women

Variable	Overall[a]		Men[b]		Women[c]	
	Mean	SD	Mean	SD	Mean	SD
Depression	12.07	4.05	11.18	4.18	12.53	3.92
Physical Activity Level	56.61	35.68	59.67	39.03	55.03	33.83
Cardio training	2.86	2.70	2.65	2.42	2.97	2.84
Strength training	1.98	2.02	2.73	2.13	1.59	1.85
Mind/body training	0.69	1.43	.329	0.817	0.87	1.63
Body-related motivation	2.44	1.06	2.28	0.92	2.53	1.11
Competence motivation	2.44	1.23	2.70	1.14	2.31	1.27
Intrinsic motivation	2.62	1.25	2.97	0.98	2.43	1.33

Note. [a]n=240, [b]n=82, [c]n=158. Depression measured using the 10-item Center for Epidemiologic Studies Depression Scale, with normative mean of 8.7 (ages 25-74) for the 20-point scale (Radloff, 1977). Physical activity level measured using the Godin-Leisure Time Exercise Questionnaire, with normative mean of 45.8 (for mean age of 30.7; Godin & Shephard, 1985). Cardio, strength and mind/body training reported in times per week. Body-related motivation, competence motivation, and intrinsic motivation measured using a modified version of the Motivation for Physical Activity Measure, with normative means for body-related, competence, and intrinsic motivation of 2.95, 2.54, and 3.65 respectively for males, and 3.50, 2.41, and 3.44 respectively for females.

Table 2

Hierarchical Regression Analysis Predicting Depression Status as a Function of Overall Physical Activity Level, Types of Physical Activity, and Types of Motivation

Step	Variable	*B*	*SE (B)*	β	ΔR^2
Step 1					.004
	Physical activity level	.008	.007	.066	
Step 2					.035*
	Type of physical activity				
	Cardio training	.178	.124	.118	
	Strength training	-.373	.145	-.186*	
	Mind/body training	.178	.182	.063	
Step 3					.044*
	Type of motivation				
	Body-related motivation	.659	.252	.171*	
	Competence motivation	-.381	.331	-.116	
	Intrinsic motivation	-.144	.330	-.044	

Note. n=240. *p<.05

Table 3

Hierarchical Regression Analysis Predicting Depression Status in Men as a Function of Overall Physical Activity Level, Types of Physical Activity, and Types of Motivation

Step	Variable	*B*	*SE (B)*	β	ΔR^2
Step 1					.003
	Overall physical activity level	-.006	.012	-.054	
Step 2					.101*
	Type of physical activity				
	Cardio training	.239	.222	.138	
	Strength training	-.684	.235	-.347**	
	Mind/body training	-.309	.577	-.060	
Step 3					.088
	Type of motivation				
	Body-related motivation	.876	.509	.193†	
	Competence motivation	-.848	.519	-.229	
	Intrinsic motivation	-.118	.609	-.028	

Note. n=82. *p<.05, **p<.01, †p=.09

Table 4

Hierarchical Regression Analysis Predicting Depression Status in Women as a Function of Overall Physical Activity Level, Types of Physical Activity, and Types of Motivation

Step	Variable	*B*	*SE (B)*	β	ΔR^2
Step 1					.026*
	Overall physical activity level	.019	.009	.162*	
Step 2					.004
	Type of physical activity				
	Cardio training	.029	.160	.021	
	Strength training	-.033	.198	-.016	
	Mind/body training	.152	.192	.063	
Step 3					.032
	Type of motivation				
	Body-related motivation	.446	.300	.126†	
	Competence motivation	-.034	.432	-.011	
	Intrinsic motivation	-.452	.402	-.144	

Note. n=158. *p<.05, †p=.139