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Implementing an Exercise Referral Scheme for Promoting Physical Activity in University Mental Health Care

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Implementing an Exercise Referral Scheme for Promoting Physical Activity in University Mental Health Care

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Abstract

Introduction. Mental health symptoms and conditions are prevalent and increasing on college campuses with anxiety and depression having the highest increases in prevalence. Many college students are also physically inactive which is problematic as physical activity benefits mental health. Exercise referral schemes (ERS) can promote physical activity, though no studies have investigated the implementation of an ERS within a college counseling center. **Purpose.** The purpose of this dissertation was to investigate the implementation of an ERS for promoting physical activity in university mental health care. **Methods**. Study 1 used a qualitative descriptive design of 14 certified counselors to explore perceptions of counselors using physical activity in their therapeutic works. Study 2 utilized a cross-sectional design of 237 undergraduate students to examine relationships between personality traits, high school sports participation with physical activity to assist a physical activity specialist. Study 3 used a randomized controlled trial of 20 college students to assess the implementation and effectiveness of an exercise referral scheme (ERS) in a college's counseling and psychological services (CAPS) on physical activity (PA) and health outcomes. **Results.** Study 1 demonstrated counselors recognized physical activity is important for treatment of mental health needs of their patients. Counselors also had supportive attitudes and presented specific barriers to both prescribing physical activity to patients and towards referring patients to a physical activity specialist. Study 2 showed Conscientiousness was positively related to all physical activity measures except for active transport, and High school sports participation was positively related to vigorous physical activity and leisure time physical activity. Conscientiousness was also the best predictor for physical inactivity, overall. Study 3 found the ERS had low reach within CAPS but generated more interest in the broader campus. Participants of the treatment group were supportive of the intervention and showed high adherence. There was no group and time interaction effect on

device-based physical activity for the treatment group. However, there were significant and beneficial group and time interaction effects on percent body fat, VO2max, and mental health scores. **Conclusion.** Barriers of the implementation included low counselor buy-in and low buy-in of patients. The intervention that was originally planned to be within the ERS was still tested with the broader population of campus outside the counseling center. MI showed to have positive effects on fitness and mental health but did not demonstrate changes in objectively measured physical activity. Incorporating behavioral change techniques that promotes long term internal accountability and self-regulation may be more effective for increasing device-base physical activity over time. Future studies should continue to investigate the implementation of physical activity interventions within student mental health care to continue to promote positive physical activity habits to ultimately improve both physical and mental health on college campuses.

Acknowledgment

I would like to acknowledge I made a huge life mistake doing a PhD…. I'm kidding! LET'S FREAKING GO!!!!!! I write these on the day before Easter, a fitting time to recognize the mighty works of God and to acknowledge the blessings and gifts that He graciously bestowed upon me. To my family and friends that have invested in me spiritually, academically, scientifically, socially, and financially (I owe a lot of people money/meals, I guess 9.5 years is the limit for using the poor college student excuse LOL), I love y'all so much…. so so much! To Mike, Tricia, Brannon, Summer, Canyon, Brock, Michelle, Missy, Ricky, and Lathan, there's no way I persevere without y'all. Thank you for being the epoxy that is holding this dissertation together. Life is a lot of fun with y'all as my family. To Josh, Katie, Nicole, Seong, and Whitley, my co-hort and academic family, I couldn't have done it without y'all. I will cherish the laughs, the smiles, the grind, and problem solving we shared over the years forever. I wish I could list all my friends, but that be another 100 pages on top of this and my fingers hurt.

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Dedication

I dedicate this to my grandfather and grandmother, Dr. Lathan Bernard Daniels and Jeanie Daniels. Paw-paw your fight with Parkinson's disease inspires the family and me more than you will ever know. I didn't think there was a chance that you would see me finish this PhD. However, I've learned to never bet against you because as Babe Ruth once said, "It's tough to beat a person who never gives up." You never give up on life and you never quit making people smile, regardless of your circumstances. Just know I will always continue to "hang in there" and will strive to be a fair and righteous leader of people as you are.

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I. Introduction

Young adults are a critical age group because of the transition to adulthood. College students are a unique population as many are experiencing complete autonomy over their daily routines for the first time in their lives. This autonomy can form positive or negative health habits that can be carried with them throughout their adult lives. Evidence suggests ranges of 46% to 72% of college students are not getting sufficient physical activity (American College Health Association, 2018; Arias-Palencia et al., 2015; Dinger et al., 2014; Ghrouz et al., 2019; Kwan et al., 2013). Moreover, high rates of anxiety and depression prevalence are common among college students too, especially females (Auerbach et al., 2016). Uniquely, physical activity demonstrates both acute and chronic benefits to mental health (2018 Physical Activity Guidelines Advisory Committee, 2018). Evidence suggest physical activity may be just as effective as standard medications and psychotherapy for treating anxiety (Bartley et al., 2013) and depression (Josefsson et al., 2014). Thus, to combat physical inactivity and poor mental health, it is imperative that universities effectively promote physical activity.

In 2007, The American College of Sports Medicine commenced the Exercise is Medicine® global health initiative with the goal of assessing and promoting physical activity in clinical healthcare settings. Health care professionals recommending more physical activity with an exercise prescription and referral to an exercise professional may improve physical activity and health (Thompson et al., 2020). With many universities offering healthcare services, the Exercise is Medicine initiative is being promoted on university campuses. Exercise is Medicine supports using exercise referral schemes (ERS) as a way for universities to promote physical activity. ERS have been recognized as one of the four most common methods to increase poor physical activity (NICE, 2014). ERS typically consist of a health professional determining a

patient to be physically inactive, referring the patient to a physical activity specialist, and then consulting with the patient about how to increase physical activity (NICE, 2014). ERS have been trialed in primary care for community adults and have shown to increase physical activity (Martín-Borràs et al., 2018; Pavey et al., 2011; Rowley et al., 2018a) and cardiovascular fitness (Buckley et al., 2020). Though, the ERS definition is broad allowing for many different healthcare providers to refer patients to a physical activity specialist and allowing the physical activity specialist to implement different strategies to improve the patient's physical activity.

Counselors are health care providers who have the potential to promote physical activity to their patients. However, no studies have qualitatively investigated individual factors, environmental factors, and behavioral factors of college counselors when trying to implement physical activity into their therapeutic work, particularly for prescribing physical activity to patients or referring patients to a physical activity counselor. This study is necessary to better understand how counselors can implement physical activity as part of patient care or therapeutic practices. Counselors may be supportive of either prescribing physical activity to patients or referring patients to a physical activity specialist and they may bring up important barriers that would need to be addressed before prescribing physical activity or referring to a physical activity specialist. Consequently, this study can guide future work for designing effective and feasible programs for college counselors to include physical activity in their therapeutic works such as implementing an ERS.

Next, physical activity specialist are tasked with improving physical activity of patients in an ERS. Previous research has investigated correlates of physical activity or factors associated with physical activity including age, sex, self-efficacy, health status, and previous physical activity are individual level correlates of physical activity behavior (Bauman et al., 2012). For

college students especially, one study found fruit consumption, nonsmoking, and perceptions of body weight as correlates of physical activity (Seo et al., 2007). Another study found enjoyment and self-management strategies (e.g. self-monitoring, goal setting, time management, overcoming perceived barriers, and self-reinforcement) were strong correlates of college students physical activity (McArthur & Raedeke, 2009). Understanding correlates of physical activity allow scientists or physical activity specialists to target specific variables to intervene on when trying to increase physical activity. Establishing Identifying more specific correlates in college students could be beneficial to a physical activity specialist. Previously, a systematic review and meta-analysis showed Extraversion, Neuroticism, Conscientiousness, and Openness are associated with physical activity (Wilson & Dishman, 2015). However, the relationships between personality traits and domains of physical activity remain unknown in college students. Also, the relationship between high school sports participation and domains of physical activity remains unknown in college. Understanding these relationships could help a physical activity specialist tailor a more individualized physical activity program for a patient.

Lastly, beyond just identifying correlates of physical activity, a physical activity specialist within an ERS may benefit from implementing a specific behavior strategy based on behavior change theory. Motivational Interviewing (MI) is a behavior change counseling method that aligns with the constructs of Social Cognitive Theory (Bandura, 1986), by targeting and supporting a participant's self-efficacy (Hettema et al., 2005) and recognizing and shifting the participant's inner values and goals to kindle behavior change (self-regulation) (Rubak et al., 2005). In a systematic review (n = 10 studies), MI showed to increase physical activity with both device-based measurements and self-reported measures with patients diagnosed with chronic health diseases (e.g. hypertension, hyperlipidemia, multiple sclerosis, etc.) (O'Halloran et al.,

2014). However, few ERS have utilized motivational interviewing (MI) to attempt to improve physical activity and improve mental health outcomes for patients of seeking mental health treatment and results remain unclear (Chalder et al., 2012; Duda et al., 2014; Littlecott et al., 2014; Murphy et al., 2012). Primary limitations of previous studies on MI ERS with mental health patients has been the utilization of self-reported physical activity measures, utilization of very broad age ranges in their samples, and participants being almost exclusively form the UK. Stronger evidence, with device-based measures of physical activity and more diverse populations outside the UK are needed to determine the effects of ERS for improving mental health. Importantly, the effects of an ERS through mental health services on college students, a population in high need to improve mental health, has yet to be studied. An effective MI ERS within a university counseling center may improve the physical activity and mental health of physically inactive college students struggling with poor mental health and be deemed an effective strategy to promote physical activity on college campuses.

Therefore, the overall purposes of this dissertation includes the following:

1. To investigate individual, environmental, and behavioral factors that affect counselors when trying to implement exercise into their therapeutic work
2. To evaluate the relationships between physical activity and personality and high school sports participation to assist physical activity specialist in designing interventions.
3. To assess the effectiveness and implementation measures of an exercise referral scheme utilizing motivational interviewing on college students' physical activity and mental health.

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II. A Review of Literature

Origins of Physical Activity and Health Research

Today, it is well established physical activity, any bodily movement caused by skeletal muscles resulting in energy expenditure (Caspersen et al., 1985), is related to lower risk of premature mortality and lower risk for chronic diseases including cardiovascular disease, type II diabetes, obesity, and cancers (2018 Physical Activity Guidelines Advisory Committee, 2018; Warburton & Bredin, 2017). The origins of physical activity and health epidemiology research started in the 1950s when physically active workers (e.g. conductors and postmen) were found to experience lower rates of coronary heart disease compared to physically inactive workers (e.g. bus drivers and telephonists) (Morris & Crawford, 1958). These findings were reconfirmed in a cohort of longshoremen workers where more physically active longshoremen were less likely to suffer from cardiovascular disease compared to more sedentary longshoremen (Paffenbarger Jr et al., 1970). By the late 1980s, research evidence supporting the benefits of physical activity had expanded beyond cardiovascular health as higher levels of physical fitness, an indicator of physical activity, was associated to less risk of all-cause mortality by reducing rates of cardiovascular disease and cancers (Blair et al., 1989). These studies were foundational in recognizing the importance of physical activity on health and prompted the creation of national physical activity public health guidelines to promote physical activity standards for public health.

As physical activity research continues to evolve, the national physical activity guidelines have also evolved throughout the years. In 1995, the Center for Disease Control Centers (CDC) and American College of Sports Medicine (ACSM) released guidelines for physical activity performance detailing every American adult should acquire 30 minutes or more of moderate intensity physical activity on most, preferably all, days of the week using intermittent bouts of at

least 10 minutes to receive positive health benefits (Pate et al., 1995). In 2008, as more physical activity research had been conducted, the Physical Activity Guideline Committee updated the recommendations reporting American adults should achieve at least 150 minutes of moderate intensity aerobic activity, or 75 minutes of vigorous aerobic activity, or an equivalent combination, with aerobic activity bouts needing to last at least 10 minutes, as well as two days per week of full body strength training to elicit positive health benefits (Health & Services, 2008). In 2018, the recommendations were updated to reflect the most current physical activity literature, leading to the deletion of having to perform 10-minute bouts. Today, it is recommended that American adults achieve at least 150 minutes of moderate intensity aerobic activity, or 75 minutes of vigorous aerobic activity, or an equivalent combination, as well as two days per week of full body strength training to elicit positive health benefits (2018 Physical Activity Guidelines Advisory Committee, 2018). Adolescents (ages 6-17 years) should achieve at least 60 minutes of moderate-vigorous physical activity daily, which includes time for muscle strengthening activities to be performed for at least 3 days a week (2018 Physical Activity Guidelines Advisory Committee, 2018). With recommendations in place, there was an epidemiological need to establish how many people are adhering to these guidelines.

Physical Activity Surveillance

Multiple physical activity surveillance monitoring tools have been developed to estimate population physical activity performance. The United States monitors physical activity using three major surveillance surveys: National Health Interview Survey (NHIS) (Centers for Disease Control and Prevention, n.d.-a), National Health and Nutrition Survey (NHANES) (Centers for Disease Control and Prevention, n.d.-b), and Behavior Risk Factor Surveillance Survey (BRFSS) (Centers for Disease Control and Prevention, 2017). All three questionnaires ask for self-reported

measures for physical activity, but the questions are not standardized. NHANES and BRFSS inquire about physical activity performed in the last 30 day whereas NHIS inquire of physical activity performed over the last 12 months. BRFSS is typically used more for state level surveillance of physical activity seeking representative samples from each state to make an overall national estimate. NHANES, has incorporated device-based measures of physical activity into 4 cycles, including during the NHANES 2013-2014 cycle, however, this data has yet to be released due to methodological uncertainty in processing the data.

Current estimates of US physical activity, using NHIS data, estimates only 21% of women and 28% of men are satisfying the physical activity guideline (National Center for Health Statistics, 2021). Similarly, BRFSS data estimates 24% of US adults were achieving the physical activity guidelines (Bennie et al., 2019). However, these surveillance estimates contain research limitations. For example, the 2018 NHIS sample of adults included only 25,417 adults who were a part of four defined geographical regions of the United States. Using sample clusters across these four regions may not be truly representative of the US civilian noninstitutionalized population especially with a relatively small sample size within each state compared to the overall US population. Looking at age ranges, NHIS data also shows ages 18-24 years to have the highest percentage of the sample to meet the physical activity guidelines (34%) though the sample of size of each age group was not reported (National Center for Health Statistics, 2021). The BRFSS did have a much larger initial sample size of 414,456 adults, however, 13.5% (n = 30,528) did not report physical activity measures. It may be the BRFSS sample is a more conservative estimate as the 13.5% were probably physically inactive due to social desirability bias - where participants refrain from reporting unfavorable conduct to avoid admittance to socially undesired behaviors (Johnson & Richter, 2004). Looking at age groups specifically, ages

18-24 years (*n* = 20,516) had the highest percentage of the sample (29.7%) of meeting the physical activity guidelines compared to ages 25-34 years (*n* = 36,500, 23.3%*n*), ages 35-44 years (*n* = 44,203, 19.9% *n*), ages 45-54 (*n* = 62,629, 18.5% *n*), ages 55-64 (*n* = 86,515, 16.8 % *n*), ages 65-74 years (*n* =78, 429, 17.8%*n*), and ages >75 years (*n* = 55,316, 15.4 %*n*) (Bennie et al., 2019). However, the sample sizes of each age range are not equally distributed and therefore some age groups sample may be less representative of the population of that age range than others. Though even with these limitations, it is clear adherence to the physical activity guidelines across the nation are low and specific age groups may need more representative surveillance.

BFRSS data samples were the smallest for the young adults (ages 18-30) and the sample of young adults of NHIS survey were unreported. Young adults are a critical age group because of the transition to adulthood. College students are a unique population as many are experiencing complete autonomy over their daily routines for the first time in their lives. This autonomy can form positive or negative health habits that can be carried with them throughout their adult lives. Longitudinal data has shown decreases in physical activity from adolescents to young adults. In a 5 year longitudinal Minnesota cohort observing changes from mid adolescents (ages 14-18 years) to young adulthood (ages 18-23) (*n* =1710), self-reported hours of moderate to vigorous physical activity significantly decreased from mid adolescents to young adulthood in both females (5.1 hr/wk to 3.5 hr/wk) and males (6.5 hr/wk to 5.1 hr/wk) (Nelson et al., 2006). More evidence from a longitudinal cohort data of US adolescents (ages ranged from 11 to 21 years in 1994-1995 and then were followed up with in 2001 (ages 18 to 26 years) found 33.6% were initially performing at least 5 sessions of moderate to vigorous physical activity each week followed by only 12.7% were meeting physical activity recommendations (Gordon-Larsen et al., 2004).

However, these longitudinal data are limited by self-reporting measures of physical activity and may be considered dated as the physical activity guidelines have changes since the early 2000s. One study evaluated 2003-2006 NHANES objective measures of PA suggests total physical activity is actually higher in early adult years (18-30) compared to the rest of the life span (Varma et al., 2017). Though, like NHIS and BRFSS, NHANES do not utilize repeated measures of the same participants from adolescents to young adulthood. It could be that particular sample had more active young adults compared to adolescents or older adults explaining the discrepancy in the data. Longitudinal data studying the physical activity of adolescents to young adulthood using objective is needed.

Research among college students, a specific population of young adults, have found rates of 46% to 72% of college students not getting sufficient physical activity (American College Health Association, 2018; Arias-Palencia et al., 2015; Dinger et al., 2014; Ghrouz et al., 2019; Kwan et al., 2013). However, these studies present some limitations including limited sample sizes and generalizability. For example, one study was done on Canadian campuses (Kwan et al., 2013), one study had a sample of just Indian college students (Ghrouz et al., 2019), and another study took place in a university in Spain with a 70% female sample (Arias-Palencia et al., 2015). These results may not be generalizable to a sample on a US college campus where many students live on campus creating more social opportunities and other international differences in higher education. Two studies had large sample of US college students, 94, 806 (American College Health Association, 2018) and 67, 861 (Dinger et al., 2014), but the data came from the Spring of 2006 and the academic year of 2008-2009, respectively. Lastly, only one study in these college physical activity surveillance studies used an objective measure of physical activity, which happened to be the lowest estimate (46%) (Arias-Palencia et al., 2015). More recent, device-

measured data is necessary for a more current physical activity estimate in US college students as the physical activity guidelines changed in 2018. This information is critical to better measure change and effectiveness of physical activity interventions and to also better identify populations who may be at the most risk for being physically inactive. Though despite the limitations of current research, evidence suggests many college students are currently not meeting the physical activity guidelines and interventions are needed to improve physical activity among college students.

Correlates of Physical Activity

There are many factors associated with physical activity, identifying and understanding these correlates can assist in efforts to increase physical activity. Understanding correlates of physical activity allow scientist to target specific variables to intervene on when trying to increase physical activity. A systematic review in the Lancet, which included reviewing 16 systematic reviews of adults 18 year and older and 7 systematic reviews of children (ages 5-13 years) and adolescents (ages 12-18 years), reported: age, sex, self-efficacy, health status, and previous physical activity are individual level correlates of physical activity behavior and introduced more novel determinants of physical activity including genetics, evolutionary biology, and variation of physical activity throughout life to be correlates of physical activity across the life span (Bauman et al., 2012). While less research has focused on college students, one cross sectional study using a convenience sample 1,134 students across 4 universities in the Midwest identified fruit consumption, nonsmoking, and perceptions of body weight as correlates of physical activity (Seo et al., 2007). Another study of 636 undergraduate students (62% female) enrolled in a physical activity and fitness course at a midwest university found enjoyment and self-management strategies (e.g. self-monitoring, goal setting, time management,

overcoming perceived barriers, and self-reinforcement) were strong correlates of college students physical activity (McArthur & Raedeke, 2009). More studies with more representative samples across different college campuses are needed to explore and confirm other potential correlates of college students' physical activity.

One factor shown to correlate with other health behaviors has been personality. Previously, personality traits demonstrate to influence health behaviors such as wellness behaviors, accident prevention, substance-abuse taking, and traffic risk taking (Booth-Kewley & Vickers Jr, 1994). A systematic review and meta-analysis reporting Extraversion, Neuroticism, Conscientiousness, and Openness are associated specifically with physical activity (Wilson & Dishman, 2015), though these findings are limited by self-reported measures and cross-sectional designs. One study using device-measured physical activity found that neuroticism may be the only key personality trait associated with physical activity (Smith, 2017). It is possible personality traits may be differentially associated with different contexts (e.g., intensity, modalities, etc.) of physical activity. Identifying these relationships in a college students may help researchers develop more effective physical interventions.

In addition to personality traits, previous physical activity experience of college students is another understudied potential correlate of physical activity. As mentioned, previous physical activity is associated with past physical activity levels (Bauman et al., 2012) and high school sports participation may influence college physical activity, however, this relationship has not thoroughly investigated. Research suggests physical activity declines between high school and college. For example, 4,760 students (47.6%) of a national college sample (n =10,000 students) reported meeting the physical activity guidelines for vigorous-intensity physical activity, however 7,070 students of the sample met the recommendations in high school (Nelson et al.,

2007). Furthermore, a study found 66.2% of the sample of Canadian college freshmen were meeting the physical activity guidelines their last two months of high school versus only 44.1% of the sample during their first 2 months of college (Bray & Born, 2004). High school sports may explain some of this decline. In 2017, it was estimated that 63% of 8th graders, 59% of 10th graders, and 55% of 12th graders were participating in high school sports (Participation in School Athletics, n.d.). However, many high school athletes do not go on to play sports in college sports and therefore these new college students may not be continuing leisure time sport or physical activity. One study found that high school sports participation was positively related to number of times per week participants worked up a sweat doing vigorous physical activity in college and this relationship was mediated by body image, physical competence and instrumentality (Greenleaf et al., 2009). Also, the MET hr/wk measure of physical activity did not have a significant relationship with high school sports participation and was not included in the model. The study's sample was not very generalizable by including only first semester female undergrad students (n = 260) and the number of times per week participants sweated doing vigorous may not be consistent with meeting the physical activity guidelines as time was not used as a measure. Another study found students who participated in high school sports showed a significant decrease of participants meeting the vigorous physical activity guidelines in high school (81.3%) compared to college (65.8%) (Downs & Ashton, 2011). This was conducted across two universities. But, the sample included mostly females (*n* = 286/395) and self-reported measures of only vigorous physical activity was only used. Only measuring vigorous physical activity measure may be too conservative for determining if students were meeting the physical activity guidelines since moderate physical activity was not measured. More research is needed on the relationships between high school sports participation and the different contexts of

physical activity (outside of vigorous physical activity) to design more effective interventions. Also, more research is needed to establish the likelihood of high school sports participants and non-high school sport participants meeting the current physical activity guidelines in college to identify students who may be at risk for being physically inactive in college. For example, non-high school sports participation may be a potential warning sign for low physical activity in college, and students who did not participate in high school sports may need additional physical activity opportunities.

Identifying strong physical activity correlates allows interventions to target these specific factors to improve physical activity more efficiently. Critical components of physical activity interventions can include the intervention's theoretical framework, setting, and implementation and effectiveness measures.

Theoretical Frameworks for College Physical Activity Interventions

Theoretical frameworks are critical because they describe the relationships between constructs or factors that influence a phenomenon (i.e. behavior) which can explain why programs are effective or ineffective, and thus, help scientists create better interventions (Glanz, 1997). The Social Cognitive Theory (SCT) (Bandura, 1986) has been a popular and effective theory for increasing physical activity among diverse participants (Bagherniya et al., 2018; C. G. Lee et al., 2018; Shamizadeh et al., 2019). The main constructs of the Social Cognitive Theory include reciprocal determinism, self-efficacy, outcome expectations/expectancies, self-regulation/self-control (Bandura, 1987). Self-efficacy and Self-regulation are the two of the most critical factors of physical activity performance (Biddle & Nigg, 1970). As mentioned previously, self-efficacy is one of the most consistent correlates of performing physical activity (Bauman, 2012). Self-efficacy is defined as the confidence one has to successfully perform the

specific behavior (Bandura, 1987). Self-regulation is a construct pertaining to the ability to set goals, monitoring progress towards goals (self-monitoring), problem solving in the face barriers, and self-reward (Bandura, 1987). Interventions improving self-efficacy/self-regulation have shown to improve physical activity (Anderson-Bill et al., 2011; Olson & McAuley, 2015).

Cognitive based strategies, such as goal-setting and self-monitoring, have been critical components of physical activity interventions (Artinian et al., 2010) and have effectively increased physical activity (Dishman & Buckworth, 1996). Cognitive strategies that align with SCT constructs including enhancing self-efficacy, goal-setting, and self-monitoring have been especially successful at increasing physical activity (Artinian et al., 2010). A meta-analysis has demonstrated pairing self-monitoring with one of the techniques within self-regulation is the most effective to use during physical activity interventions (Michie et al., 2009). Interestingly, each of the cognitive strategies mention above can directly influence self-efficacy and self-regulation which then feeds into reciprocal determinism (individual, behavior, and environment will all impact one another) (Bandura, 1986), promoting physical activity performance. Self-efficacy is derived from four critical sources: mastery experience, vicarious experience, social persuasion, and physiologic and affective states. Thus, interventions may include tracking physical activity through the intervention to promote mastery experience, provide a physical activity specialist to serve as a role model to promote vicarious experiences, provide social support among peers to promote social persuasion, or have a health coach provide positive and encouraging feedback on physical activity throughout the intervention to promote positive physiological and affective states.

Physical activity counseling is a behavior change strategy using a physical activity specialist with behavioral change experience to support positive changes in physical activity

(Gagnon et al., 2018). Physical activity counseling can assist in promoting positive self-regulation by assisting in creating realistic goals and can also promote self-efficacy by confirming mastery experience of patients, being a role model for a health behavior, providing positive feedback on behavioral performance, and being a coping mechanism for negative physiologic and affective states. A systematic review and meta-analysis (n =66 studies) concluded physical activity counseling to be effective in promoting and regulating physical activity (Lin et al., 2010). However, of the 13 good quality interventions identified, only 3 interventions (Marcus et al., 2007; Martinson et al., 2008; Morey et al., 2009) mentioned the theoretical framework, though, all 3 included SCT. One of these studies included a sample of just elderly adults (Morey et al., 2009) while the other two used middle age adults (Marcus et al., 2007; Martinson et al., 2008). Interventions conducted on undergraduate students utilizing SCT and counseling as a behavior change strategy has been limited.

Counseling Based Physical Activity Interventions

As SCT has been popular theory for physical activity behavior change, limited physical activity interventions among college students have used counseling as the main behavior change technique, despite its alignment with SCT and effectiveness in other populations (Lin et al., 2010). From a systematic review of physical activity interventions on college campuses, 12 physical activity interventions used the SCT as a theoretical framework; Of the 12, only two interventions (Boyle et al., 2011; Mailey et al., 2010) employed counseling as a behavioral change strategy (Maselli et al., 2018). Boyle et al. (2011) compared the self-reported physical activity measure (frequency*duration/week based off NHIS question) and physical fitness changes between the intervention group (n = 86) - working with a peer educator, who provided vicarious experiences and verbal persuasion through exercise advice giving and encouragement-

versus the control group (n = 92) - participants tried to increase physical activity on their own. The results demonstrated women of the treatment group who were inactive at baseline significantly increased physical activity while women who were considered active at baseline significantly improved their waist to hip ratio and flexibility. The treatment had no significant effect on men, though. The study was limited to only self-reported measures and the intervention took place within a college course at university in New York. Interventions that are nested as a course can restrain the availability of intervention to participants because participants may not be able to fit the course in their academic schedule. Furthermore, Mailey et al. (2010) designed an intervention based on SCT to increase physical activity and improve mental health symptoms of college students with mental health disorders by piloting the effects of biweekly internet modules and two monthly advice-giving meetings with their physical activity counselor (n = 23) versus the control group (n = 24), who simply received their normal mental health treatment. The results indicated the treatment group significantly increased device-measured physical activity but showed no effects on mental health symptoms scores. The main limitations of this study included the intervention was only partly individualize for each patient with the standardized internet models and the sample included undergraduate and graduate students from a large public university in Illinois and had a broad age range of 18-52 years. Based on the SCT, more personalized treatment can better influence the individual's personal values and feelings which can influence the participant's behavior (Bandura, 1986). One intervention, used motivational interviewing (MI), a specific counseling technique, in the college setting (Martens et al., 2012). The study compared the effects of one motivational interviewing session (n = 34) versus giving the control group (n =36) an information sheet on physical activity found the MI group reported a significant difference in performing vigorous physical activity after one month of follow up.

The study was limited by a female dominant sample (females = 58, males = 12) and did not use device measured physical activity. Though, regardless of the limitations, motivational interviewing still shows promise to increase physical activity of college students

Motivational Interviewing

Motivational Interviewing (MI) is a behavior change counseling method characterized by being client centered and assists in settling feelings of ambivalence (Miller & Rollnick, 2012). MI aligns with the constructs of SCT, by targeting and supporting a participant's self-efficacy (Hettema et al., 2005) and recognizing and shifting the participant's inner values and goals to kindle behavior change (self-regulation*)* (Rubak et al., 2005). Motivational interviewing with a physical activity specialist can promote mastery experiences via tracking the physical activity performed between sessions, promote vicarious experience with the physical activity specialist serving as a model for performing physical activity, promote social persuasion via the specialist providing positive feedback to the participant during the session, and promote positive physiologic and affective states via the specialist helping the participant resolve feelings of ambivalence towards physical activity and overcoming barriers. In a systematic review (n = 10 studies), MI showed to increase physical activity with both device-based measurements and self-reported measures with patients diagnosed with chronic health diseases (e.g., hypertension, hyperlipidemia, multiple sclerosis, etc.) (O'Halloran et al., 2014). In randomized control trials comparing motivational interviewing versus a control (education only) group, modest effects of increases of physical activity have been seen in patients with cardiovascular disease (Reid et al., 2012), fibromyalgia (Ang et al., 2013), obesity (Hardcastle et al., 2013), and multiple sclerosis (Bombardier et al., 2008). Though the health conditions were mainly physical, one study found physical activity promotion through MI significantly decreased depression score of patients with

major depression in people with multiple sclerosis (Bombardier et al., 2013). However, more research is warranted for how MI can impact physical activity levels of people experiencing moderate depression and anxiety symptoms without multiple sclerosis. The lone MI study using both accelerometry and self-reported physical activity measures of fibromyalgia patients (ages 18-65 years) showed the MI group (n = 107) reported higher amounts of physical activity compared to the controls (n =109), but the accelerometer measures were not significantly different (Ang et al., 2013). However, the MI group walked significantly further in the six-minute walk test compared to the control. This discrepancy may be due to the bias of self-reporting measures creating imprecise estimates of physical activity. Another study using a pedometer and self-report measures similarly showed the MI group (n = 69) to have a larger effect on self-reported physical activity compared to the control (n = 72), but MI did have a significant increase on step count overall (Reid et al., 2012). MI shows modest effects in increasing physical activity in a variety of patients, but more research is necessary for the effectiveness MI can have on physical activity in college students especially those experiencing depressive and anxiety symptoms.

Physical Activity Intervention Settings

College campuses have increased research efforts into helping students increase physical activity and have explored different platforms for these interventions. In general, a systematic review and meta-analysis reviewed 28 controlled trails of physical activity interventions on college campuses finding the trials were mainly being conducted in an online setting or at least had an online component while others utilize in person setting (Maselli et al., 2018). No other literature outside from the systematic review could identify new physical activity interventions on a college campus. Unfortunately, many of the studies in the systematic review were at high

risk of bias. For example, many studies had high attrition or high differential attrition between groups limited effectiveness of the interventions. Also, intervention designs in general were limited with some not having any control groups. Furthermore, poor methodology such as imprecise PA measures, only measuring PA in part of the sample, not reporting PA data limited some of the interventions as well. Thus, there is a need for higher quality physical activity interventions on college campuses. The two-counseling based physical activity interventions were either nested in a college course or was conducted on the general campus. Mailey et al. (2010) targeted students suffering from mental health but did not utilize mental health care professionals as part of the intervention. Utilizing health care professionals to refer students to an exercise intervention can promote physical activity in a critical healthcare setting on campus, but translating research into practice is not a brief process in healthcare (Balas & Boren, 2000).

Implementation and Effectiveness Measures

Implementation science investigates the strategies and measures of incorporating evidence based practices into clinical settings to more efficiently translate research into actual clinical practice (Woolf, 2008). Reach and acceptability are two major implementation science measures. Reach is defined as the number, proportion, and representativeness of participants in an intervention (Glasgow et al., 2004). Reach can be measured by totaling the number of participants recruited, the number of participants who started the intervention, and the number of participants who completed and did not complete the intervention (including follow-up measures) (Sweet et al., 2014). Reach can show the adherence or the specific proportion of participants who complete the intervention, which is important for determining how well an evidence based practiced can translate to a clinical setting. For example, if an intervention has too low poor adherence, the intervention may not be worth the resource costs regardless of the

effectiveness. Moreover, acceptability is defined by the perceptions of how pleasurable or satisfying an intervention was to a participant (Proctor et al., 2011). If an intervention displays high effectiveness but low levels of acceptability, then again, the intervention may not be worth its resource costs to be fully implemented.

With the counseling based interventions of college students mentioned previously, all studies investigated the reach of their interventions, however, only one study did a process evaluation or acceptability measures of the intervention with only 24% of the sample completing the acceptability measures (Mailey et al., 2010). Currently, many physical activity interventions do not evaluate acceptability. Thus, the acceptability of counseling interventions in college students is unknown which may be hindering sustainable programming for evidence-based practices for increasing physical activity on college campuses.

For effectiveness measures, self-reported physical activity measures were mainly used. Physical fitness is a key indicator of physical activity (Blair et al., 1989) and can objectively show effects of improving physical activity. Boyle et al. (2011) is the only counseling-based intervention for college students that measured components of physical fitness. Physical fitness objective measures can assist in explaining the effectiveness of a physical activity intervention and help overcome shortcomings of physical activity measurement

Measurement of Physical Activity

As effectiveness of interventions are commonly defined by health outcome measures, it is important to explore how physical activity is typically assessed. Self-report measures of physical activity are a common physical activity measurement method (J. Sallis & Saelens, 2000). Self-reported measures are derived from either questionnaires or physical activity diaries. Questionnaires often rely on recalling physical activity which can lead to memory bias. Though

questionnaires can vary in structure to obtain important contexts of physical activity measures including frequency (e.g. days/week or days/month), intensity (e.g. vigorous, moderate, or light), type (e.g. cardiovascular, resistance training, leisure, or occupational), duration (minutes of cardiovascular physical activity or days of resistance training), and energy expenditure (e.g. MET*hr/week or calories) (Jacobs et al., 1993). Self-reported physical activity diaries or logs can offer the same context of physical activity as questionnaires, but are based on real time which can lead to more accurate details of physical activity compared to questionnaires (van der Ploeg et al., 2010). Though, participation adherence to filling out a physical activity log can be burdensome and physical can often not be done in real time which can also lead to memory bias (Sylvia et al., 2014).

Moreover, self-report is limited by bias which can include social desirability bias where participants naturally over or under estimate the degree to which they possess desirable traits or engage in desirable behavior (Johnson & Richter, 2004). Importantly, most college students felt an increase in feeling of guilt and shame associated with not being physically active (Ullrich-French et al., 2013). To avoid this perceived guilt and shame, college students may be more susceptible to overestimating PA levels. But self-report measures can also be limited by recall bias where participants make inaccurately recollect measures from the past. In recent years, researchers have adopted and widely accepted accelerometry as a feasible method of measuring physical activity (Bassett et al., 2012; Migueles et al., 2017; Rothney et al., 2010; Warren et al., 2010). Utilizing accelerometers, an objective measure of PA, for college students can more accurately measure patterns of physical activity and bring more clarity on the effectiveness of a physical activity intervention. Vector Magnitude of counts per minute (VM cpm) is a common objective measure of physical activity (Migueles et al., 2017). However, the measures of VM

cpm is still arbitrary because VM cpm alone does not inform the researcher of any context of the physical activity. Cut points have been developed to create time spent in various intensities (Freedson et al., 1998), however, these cut points were developed by different walking or running speeds on a treadmill. Thus, these cut point are not really transferable to other physical activity modalities such as cycling. A systematic review demonstrates that machine learning algorithms of accelerometers show high predictive accuracies of type, intensities of activities, energy expenditure in of laboratory models, but these high predictive accuracies are lost in free-living settings mainly due to momentary and obscured activities (Farrahi et al., 2019). A combination of self-reporting measures and accelerometers may provide the best representation of physical activity as the accelerometer can still provide an objective measure and self-report data can provide physical activity context.

Physical Activity and Mental Health

As previously mentioned, physical activity has substantial effects on physical health, but physical activity also has a positive impact on mental health (2018 Physical Activity Guidelines Advisory Committee, 2018). Meta-analyses demonstrate physical activity to decrease both state (Ensari et al., 2015) and trait anxiety (Wegner et al., 2014). Physical activity may be just as effective as standard medications and psychotherapy for anxiety treatment (Bartley et al., 2013). Aside from anxiety, greater physical activity is associated with the reduced risk of developing depression (Mammen & Faulkner, 2013) and may be just as effective for treating depression as standard medication or psychotherapy (Josefsson et al., 2014). Interestingly, as discussed, many college students convey to be physically inactive, but high rates of anxiety and depression prevalence are common among college students too (Auerbach et al., 2016). Moreover, from Fall 2007 to Spring 2013, one university's counseling and psychological service demonstrated a

173% increase in total clients with an overall diagnosis of anxiety and depression and a 231% increase in yearly visits (Beiter et al., 2015). Increasing physical activity of college students is not only pertinent for physical health, but mental health too.

Physiological Mechanisms of Exercise and Mental Health

There are multiple theories of the physiological mechanisms of exercise on mental health. This section looks to detail three popular mechanism theories for explaining how exercise can improve or treat mental health.

Exercise/PA Affects Neurotransmitters

Depression disrupts the normal balances for a special class of neurotransmitters called monoamines, which includes serotonin, dopamine, noradrenaline, and glutamate (Maletic et al., 2007). A serotonin imbalance presents as the leading monoamine disturbance in the onset of depression and, accordingly, is the most frequently treated (Mikkelsen, Stojanovska, Polenakovic, Bosevski, & Apostolopoulos, 2017). Serotonin is an important neurotransmitter for emotional processing (Harmer, 2008) and leads to negative emotional processing when depleted (Roiser, Müller, Clark, & Sahakian, 2007). Antidepressant medications commonly use serotonin reuptake inhibitors (SSRI) to synthetically inhibit the binding of serotonin back to the releasing neuron's transporter proteins, increasing serotonin's availability in the brain (Hood, Bell, & Nutt, 2005). Direct measurement of central serotonin in rats showed to increase after performing bouts of aerobic exercise (Chaouloff et al., 1985). Since direct measurement of central serotonin binding in the human brain is not possible, blood serotonin levels can be used as an indirect measure. In a randomized control trial of untrained humans (n = 73), the aerobic exercise (moderate intensity stationary cycling) group showed a larger percentage reduction in blood (indicating more serotonin uptake in the brain) compared to the control (stretching) group after a

7 week exercise intervention (Wipfli et al., 2011); this decrease in blood serotonin after a chronic exercise program is similar to the chronic SSRI effects of humans (Moreno et al., 2006). Increasing serotonin in the brain is associated with more positive processing and alleviating depression symptoms (Harmer, 2008). However, more research is needed on the link between blood serotonin levels and physiological changes in the central serotonin system in the brain.

Exercise/PA Affects Oxidative Stress

Aside from neurotransmitters imbalances, oxidative stress may also contribute to depression (Kandola et al., 2019). In a review paper, findings suggest oxidative stress occurs when reactive oxygen species (ROS) and reactive nitrogen species (RNS) begin to heavily outnumber the antioxidants, leading to injuries of lipids, proteins, DNA, and even cell death; the brain's high metabolic rates and low antioxidants levels makes the organ susceptible to oxidative stress (Maes, 2011). Chronic oxidative stress can weaken antioxidant defenses and increase inflammatory cytokines, impeding proper neuroplasticity, which can contribute to the structural deficiencies of a depressed person's brain (Kandola et al., 2019). In a study utilizing post mortem prefrontal cortex brain tissues, patients whom suffered from psychiatric disorders including bipolar disorder, major depression disorder, and schizophrenia contained decrease levels of glutathione compared to the non-psychiatric comparison controls which indicates these patient groups to be more susceptible to oxidative stress (Gawryluk et al., 2011). In an extensive meta-analysis of human participants (n =1,346), exercise, regardless of intensity, modality, volume, or type, was associated with less oxidative stress indicators and an increase of antioxidants (de Sousa et al., 2017). In another review article using mainly evidence from animal models, regular exercise stimulates a protective response against ROS by activating more antioxidant enzymes and enzymes that repair ROS damage (Radak et al., 2008). In conclusion, findings support

chronic and acute physical activity protects against chronic oxidative stress which has been associated with mental health disorders such as depression.

Exercise/PA Affects the Hypothalamic-Pituitary-Adrenal Axis (HPA)

Physical activity can also regulate cortisol through the HPA which can have a positive effect on mental health. The HPA axis is a critical endocrine regulator that responds to stressors; however, when overresponsive due to chronic stress, the HPA can become dysfunctional, as commonly seen in depression and anxiety (McEwen, 2008). Normally, the corticotrophin-releasing hormones (CRH) initiate pro-opiomelanocortin (POMC) gene transcription, which increases adrenocorticotropic hormones (ACTH) (Tafet & Nemeroff, 2015). ACTH is secreted into the bloodstream and is received by the adrenal cortex, where glucocorticoids, specially cortisol, are produced and released (Tafet & Nemeroff, 2015). Cortisol is then normally received by glucocorticoid receptors (GRs), where a hormone-receptor complex is regulated based on the amount of cortisol in the blood (de Kloet et al., 2005). Once the GRs signal there is enough cortisol uptake, the adrenal cortex typically decreases cortisol production (Reul & Holsboer, 2002). However, chronic stress can cause overstimulation of the HPA axis, causing GRs to lose cortisol sensitivity, harming negative feedback loops of cortisol production (Nikisch, 2009) and chronically elevating cortisol and CRH in the bloodstream (Pariante & Lightman, 2008). Evidence from review articles of human studies suggests heightened levels of cortisol in the blood is directly linked to the development of depression, anxiety, and other mood disorders (Dean & Keshavan, 2017; Tafet & Nemeroff, 2015). In mice models, aerobic exercise, acutely, promotes healthier regulation of the release of CRH from the hypothalamus and ACTH from the pituitary gland, decreasing cortisol blood levels as GRs become more cortisol sensitive post exercise (Droste et al., 2003; Salmon, 2001). Another review concluded exercising regularly also

promotes chronic reregulation of the HPA axis, allowing for healthier responses to stress and anxiety in humans (Anderson & Shivakumar, 2013). More work is needed in understanding how resistance training can the HPA.

Overall, these three mechanisms have laid a foundation understanding how physical activity impacts can treat or improve mental health. These mechanisms are still complex, and more research is needed to better understand the relationship especially when direct research on human is not always feasible. Therefore, researchers will continue to investigate these physiological mechanisms to better understand why physical activity is positive for mental health. Though, regardless, physical activity is justified in being used as a treatment for improving physical and mental health.

Exercise is Medicine

As physical activity's positive physical and mental health benefits have been well accepted, healthcare systems should begin to attempt to integrate more physical activity into their practices. In 2007, The American College of Sports Medicine commenced the Exercise is Medicine® global health initiative with the goal of assessing and promoting physical activity in clinical healthcare settings. Health care professionals recommending more physical activity with an exercise prescription and referral to an exercise professional may improve physical activity and health (Thompson et al., 2020). One randomized control trial found an intervention group (*n* = 135)- the physician wrote an exercise step prescription and meet with the patient 3-4 times over a 12-15 month period- had higher step counts at the end of the intervention when compared to a standard care group (n = 140) where the physician recommended the patients to be active daily for 30-60 minutes (Dasgupta et al., 2017). Though the study used device measured step counts, the intensity or speed of the steps captured were unknown. However, considering other

health outcomes improved such as A1C1 and insulin sensitivity, exercise prescription shows promise for positively impacting physical health of patients. Furthermore, a systematic review (*n* = 15) meta-analysis (*n* = 8745) investigated the effectiveness of physical activity promotion in primary care, which many of the interventions included health professionals recommending advice or counseling participants on multiple occasions, conveyed physical activity promotion in primary care to significantly increase self-reported physical activity measures after 12 months follow-up (Orrow et al., 2012). Within this review, four interventions implemented motivational interviewing into primary healthcare and all showed significant increases in physical activity (Elley et al., 2003; Harland et al., 1999; Hillsdon et al., 2002; Lawton et al., 2008). However, who delivered the motivational interviewing in the healthcare setting varied. Harland et al. (1999) utilized a "health visitor" to promote physical activity, though it was unknown how qualified the health visitor was to deliver physical activity. Hillsdon et al. (2002) used a health promotion specialist who was not specified as a physical activity specialist. Lawton et al. (2008) has nurses deliver MI sessions and prescribe a standard exercise routine while Ellie et al. (2003) did initial MI consultations between general physicians and patients then an exercise specialist conducted MI sessions later in the intervention. Health care professionals could be important personnel to promote physical activity, however, there may be many barriers for health care professionals to implement a physical activity intervention.

Health care professionals are commonly faced with barriers when trying to recommend and prescribe exercise. In a qualitative study investigating primary care provider's perspective on physical activity, providers recognized physical activity as a health issue and welcomed physical activity counseling as a routine part of care, however, barriers to implementation included a lack of knowledge for how to individualize plans to meet physical activity guidelines, assisting in

overcoming barriers patients face, and who should implement the counseling the physicians/nurse practitioners or the nurses (Easty, 2018). Another study noted a lack of organized education in PA counseling and lifestyle medicine during residency training is also a barrier for physical activity counseling from physicians (Hauer et al., 2012).

Furthermore, exercise education seems to be lacking in medical school curriculum (Cardinal et al., 2015; Rogers et al., 2002; Weiler et al., 2012). In a review of 118 doctor of medicine or doctor of osteopathic medicine institutions' websites, the majority of programs offered either no course (n = 61, 51.7%) or a single course (n = 25, 21.2%) related to physical activity content and 82.2% of the institutions did not require a single class on physical activity content (Cardinal et al., 2015). In a sample of 251 resident physicians, only 71 (28%) participants felt confident in prescribing exercise (Rogers et al., 2002). Another review of 109 studies found physical activity was the least addressed topic in health behavior counseling curricula for medical trainees when compared to smoking, nutrition, alcohol, and drug use (Nawaz et al., 2016). Hence, health care professionals referring patients to a physical activity specialist may be the best option as far blending physical activity into healthcare.

Counselors are another health care professional who have the potential to promote physical activity and prescribe physical activity to patients, specifically to patients struggling from mental health. "Licensed Professional Counselors (LPCs) are master's degree mental health service providers, trained to serve individuals, families, and groups in treating mental, behavioral, and emotional problems and disorders" (American Counseling Association, 2011). It was argued in the 1980s exercise had a niche in counseling therapeutic work, creating more holistic treatment and also supporting collaboration and implementing expertise from professionals of other disciplines (Thoresen & Eagleston, 1985). However, with the lack of

literature on how or if exercise is being incorporated in the therapeutic work it seems Thoreson and Ealeston (1985) point remained stagnant. In a qualitative study investigating how counselors in the UK have used exercise in their therapeutic work and the experience of incorporating exercise into their practices, four of the eight counselors were assessing exercise at visits, most counselors felt they lacked competence to prescribe exercise (some were open to referring penitents to an exercise professional), and most counselors felt exercise was important (Gordon, 2014). However, these counselors in the UK may not have the same perceptions of incorporating exercise into their therapeutic work as counselors in the US or on college campuses. Thus, more work is necessary in exploring the perceptions of incorporating exercise into the therapeutic work of US counselors on college campuses. There are also no studies recognizing how much physical activity content is in a counselor's course curriculum. Counselors seem to face the same barriers as primary care health care professionals.

Exercise Referral Schemes

To overcome some of the barriers and limitations of directly promoting physical activity through health care professionals, health care professionals have begun referring patients to third party physical activity specialists through Exercise referral schemes (ERS). ERS have been recognized as one of the four most common methods to increase poor physical activity (NICE, 2014). Exercise referral schemes typically consist of a health professional determining a patient to be physically inactive, referring the patient to a physical activity specialist, and then consulting with the patient about how to increase physical activity (NICE, 2014). Exercise referral schemes have been trialed in primary care for community adults and have shown to increase physical activity (Martín-Borràs et al., 2018; Pavey et al., 2011; Rowley et al., 2018a) and cardiovascular fitness (Buckley et al., 2020). ERS have also targeted specific populations

including mental health patients. Rowely et al. (2018) reviewed key characteristics of these ERS scheme studies for mental health patients including the findings on the study; the table was adapted and updated and been divided into two tables. Table 1 defines the study design, participant information, and information on who made the referrals. Table 2 summarizes the prescription, measures, and outcomes of the studies. Despite its effectiveness at increasing PA as previously discussed, few ERS have utilized motivational interviewing to attempt to improve physical activity and improve mental health outcomes for patients of seeking mental health treatment (Chalder et al., 2012; Duda et al., 2014; Littlecott et al., 2014; Murphy et al., 2012). However, findings have been conflicting on the effects of MI in ERS on physical activity and mental health. One study demonstrated MI to have positive effects on both physical and mental health. Duda et al. (2014) compared an ERS with a social determinism theoretical framework using MI techniques (n = 184) versus a standard ERS (n = 163), a standard check in with a counselor of previous medical history, current state of health, and a prescribed physical activity program, found significant improvements in physical activity and anxiety/depression scores both 3 months and 6 months after baseline for the intervention group. Two other studies found MI to have positive effects on physical activity, but not mental health. Chalder et al. (2012) compared the effects of ERS using MI (n = 133) compared to usual care (n = 124), how patients normally treat mental health symptoms (i.e. medication, counseling, etc.), and found self-reported increased physical activity was sustained after a year but did not improve depression outcomes or decrease the use of antidepressants. Littlecott et al. (2014) found significant intervention effects for autonomous motivation and social support on exercise compared to a control group that did not utilize an ERS with MI, but the authors admitted MI techniques were “weakly” delivered and mental health outcomes were not measured. Lastly, one study found MI to have positive effects

on only mental health outcomes. Murphy et al. (2012) compared Mental Health patients in an ERS using MI (n = 41) to usual care (n = 38) (including a leaflet overviewing the benefits of physical activity) and found significant lower levels of anxiety/depression in the intervention group, but no effect on self-reported physical activity. Though, all studies used self-reported measures of physical activity and used a wide age range for the samples. Interestingly, all studies included participants from the UK. One study used participants who were diagnosed with depression (Chalder et al., 2012). Other studies used similar patients who were at risk for cardiovascular disease ((Duda et al., 2014; Littlecott et al., 2014; Murphy et al., 2012). Duda et al. (2014) the only study for MI in ERS to have a positive effect on physical activity and mental health but had a female dominant sample (72.9%). Studying the effects of MI within ERS on physical activity and mental health in a different population outside of UK adults, with different healthcare systems, could add clarity to these conflicting results. The effects of an ERS using MI on college students getting mental health treatment has yet to be researched, despite the potential for an MI counseling intervention to improve physical activity and mental health among college students.

EIM-OC suggests university health care providers to use a referral system for exercise prescription. In a recent analytic review of Exercise is Medicine®, Exercise is Medicine- On Campus (EIM-OC) includes a network of over 275 college and university campuses initiating EIM-OC around the world (Thompson et al., 2020). Many of the EIM-OC campuses, however, have not instituted an exercise referral scheme in student healthcare. There is a need for identifying and understanding barriers in student healthcare including counseling and psychological services for implementing exercise referral schemes. Due to the positive effects of physical activity on mental health (Mikkelsen et al., 2017), an exercise referral program utilizing

MI -an evidenced based behavior technique (Miller & Rollnick, 2012) that can enhance physical activity (O'Halloran et al., 2014) and aligns constructs of SCT (Hettema et al., 2005; Rubak et al., 2005)-within mental health services has the potential to greatly improve the mental and physical health of young adults in higher education. As many universities have counseling and psychological services or similar programs, implementing an exercise referral scheme has the potential for a larger reach of university students. However, currently many universities across America, including the author's current university, have never initiated an exercise referral scheme and the reach and acceptability of mental health patients from a university population who use an exercise referral scheme to increase physical activity and mental health outcomes is unknown.

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Appendix

Table 1. *A Summary of ERS Interventions Designs of Mental Health Patients*

Study	Design	Comparison	Time Points	Health Condition of Patients	Referred By
(Anokye et al., 2011)	Decision analytic model, Quantitative	Retrospective	Completion	Mental health, Cardiovascular	Primary care professional
(Chalder et al., 2012)	RCT, Quantitative	ERS vs. usual care	Baseline 4 months 8 months 12 months	Mental health	General Practitioner
(Duda et al., 2014)	RCT, Quantitative	ERS SDT ($N = 184$) vs. Standard ERS ($N = 163$)	Baseline 3 months 6 months	Mental health, Cardiovascular	Primary care professionals
(Edwards et al., 2013)	RCT, Quantitative	Between time points	Baseline 6 months 12 months	Mental health, Cardiovascular	Primary care professionals
(Littlecott et al., 2014)	RCT, Quantitative	ERS ($N = 1080$) vs. control ($N = 1080$)	Baseline 6 months 12 months	Mental health, Cardiovascular	Health professionals
(Murphy et al., 2012)	RCT, Quantitative	ERS vs. usual care	12 months	Mental Health ($N = 522$) Cardiovascular ($N = 1559$)	Clinicians
(Rouse et al., 2011)	Exploratory, Quantitative	SDT theory based program	Baseline	Mental Health Cardiovascular	Physician or practice nurse
(Tobi et al., 2017)	Retrospective, Quantitative	Adherers vs. non-adherers	13 weeks Completion	Mental health ($n = 141$) Musculoskeletal (orthopaedic $n = 164$), Cardiovascular ($n = 111$) *Respiratory (n = 34) Other*	General Practitioner
(Shay et al., 2018)	Exploratory, Mixed Methods	ERS only	Pre and Post	Mental health	General Practitioner

Table 2. *A Summary of Effects and Outcomes of ERS for Mental Health Patients*

Study	Sample, age (mean,sd)	Length	Prescription	Measures	Effects	Outcomes
(Anokye et al., 2011)	*N* = 701 40–60 years Mean age = 50 SD = n/a	12	Gym based exercise, 2× weekly	QLAY	⇑ 51–88% cost-effective	ERS is associated with modest increase in lifetime costs and benefits. Cost-effectiveness of ERS is highly sensitive to small changes in the effectiveness. ERS cost is subject to significant uncertainty mainly due to limitations in clinical effectiveness evidence base.
(Chalder et al., 2012)	*N* = 361 18–69 years Mean = 40.9 SD = 12.5	8	Group aerobic exercise classes, 1-4× weekly	BDI 7D PAR	⇓[a, b] -0.54 $p = 0.68$ ⇑[a, b] $p = 0.08$	Increased PA, improved mood. No reduction in antidepressant use in ERS group. A mean 7.2 (SD 4.1) sessions were completed. More people reported increased PA at the follow up in ERS, than those in usual care.
Duda et al., 2014)	*N* = 347 30–65+ Mean = n/a SD = n/a	10–12	Gym based exercise, 2× weekly	7D PAR BP (mmHg) BMI (kg/m^2) Weight (kg) HADS anxiety HADS depression	⇑[a] 120 *** ⇔[a] ⇓[a] – 0.24* ⇓[a] -0.77* ⇓[a] -0.24 ⇓[a]-0.47*	Standard ERS: No sig. Changes in BP, but reductions in weight and BMI (reduced sig. at 6 months compared to baseline). 3 months' follow-up: increase of 187 min (from baseline) in self-reported moderate/vigorous PA. 6 months' follow-up: increase of 120 min. Sig. reduction in HADS depression scores, no sig. Diff. in anxiety. SDT-ERS: 3 months' follow-up: increase of 196 min in self-reported moderate/vigorous PA compared to baseline. Sig. improvements in HADS anxiety and depression scores. 6 months' follow-up: No sig. Diff. from baseline to 6 months' in BP, BMI or weight. Increase of 114 min in self-reported moderate/vigorous PA. Sig reduction in HADs anxiety and depression.
(Edwards et al., 2013)	*N* = 798 16+ years Mean = n/a SD = n/a	16	Gym based & exercise classes, 1–2 x weekly	EQ-5D Adherence	⇑[a] ⇑[a]	Participants with risk of CHD, were more likely to adhere to the full program than those with mental health conditions/combination of mental health and risk of CHD. Those living in areas of high deprivation were more likely to complete the program. Results of cost-effectiveness analyses suggest NERS is cost saving in fully adherent participants. Adherence at 16 weeks was 62%.
(Littlecott et al., 2014)	*N* = 2160 16–88 years Mean = n/a SD = n/a	16	Group aerobic exercise sessions, 2× weekly	Adherence BREQ	⇑[a, ⇓[b] ⇑[a]	Improved adherence and improved psychosocial outcomes. Significant intervention effects were found for autonomous motivation and social support for exercise at 6 months. No intervention effect was observed for self-efficacy. Greatest improvements in autonomous motivation observed among patients who were least active at baseline. Individuals with CHD risk in the control group participated in more PA per week than those in the intervention group with CHD risk factors.
(Murphy et al., 2012)	*N* = 2160 16–88 years Mean = 52 SD = 14.7	16	1-to-1, aerobic and resistance exercise, 1–2 x weekly	7D PAR Adherence HADS depression HADS anxiety	⇑[b] 1.19* ⇑[a, b] 1.46* ⇓[a] – 0.71* ⇓[a] – 0.54	Increase PA observed among those randomized to ERS intervention compared to usual care, and those referred with CHD only. For those referred for MH alone, or in combination with CHD, there were sig. Lower levels of anxiety/depression, but no effect on PA.

Table 2. *Continued*.

(Rouse et al., 2011)	*N* = 347 Mean = 50.4 SD = 13.51	12	Gym based exercise sessions, 1× weekly	IOCQ BREQ-2 SVS HADS	⇑[a] ⇑[a] 0.24 ** ⇑[a] 0.17 * ⇓[a] **	Autonomy support increased intrinsic motivation. Autonomous motivation was positively associated with vitality and PA intentions. Those who scored high on HADS, had high scores for PA intentions. Regression analyses revealed that the effects of autonomy support on mental health and PA intentions differed as a function of who provided the support (offspring, partner, or physician), with the offspring having the weakest effects. Autonomy support and more autonomous regulations led to positive mental health outcomes.
(Tobi et al., 2017)	*N* = 701 Mean = 46.4 SD = 13.85	20–26	1-to-1, aerobic and resistance exercise, 1–2 x weekly	Adherence (DV) BMI (kg/m^2) BP (mmHg)	⇑[b] ** - -	Longer term schemes increased adherence. Longer-term adherence was found for increasing age and medical condition. For every 10-year increase in age, the odds of people continuing exercise increased by 21.8%. Participants referred with metabolic conditions were more likely to adhere than those with orthopaedic, CV and other disorders. Longer-term schemes offer the opportunity to maintain adherence to exercise.
(Shay et al., 2018)	*N* = 30 Male prisoners Age- 22-52	12	Aerobic and Resistane Training	DASS-42 Novaco Anger Rosenburg Self Esteem Zung Self-Rated Anxiety Scale	⇑[a] ** ⇑[a] ** ⇑[a] ** ⇑[a] **	The Exercise Referral program significantly improved mental health outcomes of Irish male prisoners experience poor mental health symptoms.

CVD cardiovascular disease, *CHD* coronary heart disease, *BDI* Beck depression inventory, *QALY* quality adjusted life-year, *7D PAR* 7-day physical activity recall scale, *IPAQ* international physical activity questionnaire, *GPPAQ* general practice physical activity questionnaire, *BMI* body mass index, *BP* blood pressure, *HADS* hospital anxiety and depression scale, *EQ-5D* EuroQol 5 dimension, *GLTEQ* Godin leisure-time exercise questionnaire, *BREQ*-behavioural regulation in exercise questionnaire, *SVS* subjective vitality scale, *IOCQ* important other climate questionnaire

⇓= reductions in scores, ⇑ = increase in scores, ⇔ no change

[a]all comparisons are with baseline value

[b]all comparisons are with control

-not available in the results

***$p < 0.001$, ** $p < 0.01$, * $p < 0.05$

III. Manuscript #1: Physical Activity as Medicine in Therapeutic Works of Counselors

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Abstract

Yearly visits of students to college counseling centers have increased as prevalence of diagnosed anxiety and depression has increased on college campuses. Physical activity shows to have positive benefits for mental health. However, it is currently unknown if or how college counselors are implementing physical activity as part of their therapeutic practices. Using a qualitative descriptive design, 14 certified counselors, across 7 southern universities, participated in semi-structured virtual interviews to explore perceptions of prescribing physical activity to patients and referring patients to a physical activity specialist. Thematic analysis revealed physical activity is perceived to be important for mental health, counselors support prescribing physical activity to patients, barriers of counselors prescribing physical activity, counselors support referring patients to a physical activity specialist, and barriers of counselors referring to a physical activity specialist. We discuss the main findings and the implications of the findings for college counselors' training and therapeutic practices.

Keywords: physical activity, mental health, university, counseling, implementation

Introduction

Mental health symptoms and conditions are prevalent and increasing on college campuses with anxiety and depression having the highest increases in prevalence from 2009 to 2015 (Oswalt et al., 2020). From fall 2007 to spring 2013, one university's counseling and psychological service demonstrated a 173% increase in total clients with an overall diagnosis of anxiety and depression and a 231% increase in yearly visits (Beiter et al., 2015). Another study found 20.3% of college students had a diagnosed mental disorder and 83.1% of these cases had pre-matriculation onsets (Auerbach et al., 2016). As mental health conditions continue to rise on college campuses and with incoming students, remedies to combat deleterious psychological symptoms are necessary.

Mental health is positively influenced by physical activity (PA) (2018 Physical Activity Guidelines Advisory Committee, 2018). Meta-analyses demonstrate PA to decrease both state (Ensari et al., 2015) and trait anxiety (Wegner et al., 2014). Evidence supports PA to have positive effects on key physiological mechanisms of mental health including neurotransmitter balance (Wipfli et al., 2011), combating oxidative stress (de Sousa et al., 2017), and regulation of the Hypothalmic-Pituitary-Adrenal Axis (Anderson & Shivakumar, 2013). Thus, PA may have similar efficacy to standard medications with reduced chances of side effects for anxiety treatment (Bartley et al., 2013). Additionally, greater PA is associated with the reduced risk of developing depression (Mammen & Faulkner, 2013) and may also have similar efficacy for treating depression as standard medication with reduced likelihood of experiencing negative side effects (Josefsson et al., 2014). However, many college students struggle to be physically active.

It is recommended that American adults achieve at least 150 minutes of moderate intensity aerobic activity, or 75 minutes of vigorous aerobic activity, or an equivalent

combination, as well as two days per week of full body strength training to elicit positive health benefits including decreased risks of chronic diseases (2018 Physical Activity Guidelines Advisory Committee, 2018). Current estimates of US physical activity, using National Health Interview Survey (NHIS) data, show only 19% of women and 26% of men are meeting physical activity guidelines (Piercy et al., 2018). Similarly, Behavioral Risk Factor Surveillance System (BRFSS) data estimates 24% of US adults were satisfying these physical activity guidelines (Bennie et al., 2019). Alarmingly, studies demonstrate a range between 46% to 72% of college students not getting sufficient physical activity (American College Health Association, 2018; Arias-Palencia et al., 2015; Dinger et al., 2014; Ghrouz et al., 2019; Kwan et al., 2013). Consequently, it is necessary to increase PA among college students as many are missing critical physical and mental health benefits. Thus, initiatives or programming has been developed to promote physical activity on college campuses, but the effectiveness of these initiatives remain unclear (Leslie et al., 2001).

In 2007, The American College of Sports Medicine commenced the Exercise is Medicine- On Campus® initiative which is a global health initiative with the goal of assessing and promoting PA in student health care settings by incorporating PA as a preventive and treatment option for students on college campuses. Importantly, health care professionals recommending more PA with an exercise prescription and referral to an exercise professional may improve PA and health (Thompson et al., 2020). Though, college counselors seem to be an understudied heath care professional population when it comes to incorporation of physical activity into therapeutic practices. This is concerning as these individuals are positioned within the college community as a source to support positive mental health. Considering the drastic increase in therapy administered and received on college campuses and benefits of PA for mental

health, counselors effectively promoting physical activity to patients could significantly combat poor mental health on campus. A qualitative study investigated how counselors in the UK have used exercise in their therapeutic work and their experiences of incorporating exercise into their practices (Gordon, 2014). It was reported that four of the eight counselors were assessing exercise at visits, most counselors felt they lacked competence to prescribe exercise (some were open to referring patients to an exercise professional), and most counselors felt exercise was important (Gordon, 2014). The perceptions of counselors promoting physical activity in therapeutic work at universities in the US has not been studied which is problematic as perceptual factors serve as antecedents and reinforces of individual behavior (Bandura, 1986).

To better understand influences of individual behavior, behavioral theory is advantageous for organizing and conceptualizing perceptual and social factors that determine behavior (Ajzen, 2011; Bandura, 1986; Lewin, 2016). The Social Cognitive Theory, one of the most frequently applied theories of health behavior (Baranowski et al., 2002), includes individual, environmental, and behaviors factors which are the key constructs for explaining behavior (Bandura, 1986). Specific individual, environmental, and behavioral factors among college counselors governing the prescribing of PA or referring to a PA specialist, however, has not been investigated. Understanding factors that serve to facilitate or act as barriers to prevent the incorporation of PA as a treatment option in student mental healthcare in the United States will allow researchers to plan for and effectively navigate these barriers to incorporate physical activity as a treatment option in student psychological healthcare, thereby, improving the mental and physical health of college students.

The purpose of this study is to explore individual, environmental, and behavioral factors among practicing mental health college counselors related to both prescribing PA to patients as well as referring patients to third-party specialists for such PA prescribing.

Methods

Interpretivist Framework

The interpretivist paradigm was selected to allow for the comprehension of personal experiences of a phenomenon through exploring thoughts, feelings, and emotions (Kivunja & Kuyini, 2017). Considering the interpretivist theoretical lens is founded on the belief that individuals experience an independent and justifiable reality that is created by their own daily life experiences (Kivunja & Kuyini, 2017), the descriptions provided by counselors can effectively depict individual, environmental, and behavioral factors when including physical activity into therapeutic work, prescribing physical activity to patients, and referring counselors to a physical activity specialist.

Research Design

The study employed a qualitative descriptive design (Sandelowski, 2000), which has been used frequently in qualitative health care professional studies (Polit & Beck, 2014) and is congruent with the interpretivist paradigm (Kahlke, 2014). Admittedly, it has been argued qualitative description is less theory driven than traditional methodologies (Kahlke, 2014; Sandelowski, 2000). However, a qualitative descriptive study allows for researchers to interpret findings more generally and with less inference without being restrained by rigid traditional methodologies, thus revealing more straightforward and comprehensive perception of a participant's experience (Sandelowski, 2010). The qualitative description is therefore appropriate

for the research questions as the aims of the study is to gain an enhanced comprehension of counselors' perceptions of including PA into therapeutic work.

Participants

A convenience sample consisting of certified counseling professionals who are active counselors of college students within student health care at large southern universities in the United States were recruited through calling or emailing university counseling centers. Certified counseling professionals were defined as professionals who had one of the following licenses to work with patients in a clinical setting: professional counselor license, clinical social worker license, mental health counselor license, psychologist license, and provisional registered art therapist license. Participants were eligible if they were actively licensed with one of the licenses mentioned previously and were currently working with college students within their respective university healthcare system. Participation was voluntary with participants providing written informed consent prior to the interview. Counselors remained anonymous were giving a unique, random participant ID for reporting (e.g., C1). The study was approved by the university's Institutional Review Board.

Data Collection Procedures

Eligible participants completed semi-structured interviews through Zoom videoconferencing software. Semi-structured interviews were conducted by the first author, a PhD candidate in Health, Sport, and Exercise Science, who researches physical activity promotion and physical activity benefits for physical and mental health. The researcher has 6 years of experience working to improve physical activity of people across the life span and various demographics but has no previous experience working in a university counseling clinic. Interviews were transcribed and sent back to participants to ensure accuracy on the transcript and

to confirm the answers indeed capture the true essence of their thoughts, feelings, and beliefs when answering the questions.

Interview Scripts

Semi-structured interview questions explored the individual, environmental, and behavioral factors of including physical activity into therapeutic work, counselors prescribing physical activity, and counselors referring to a physical activity specialist. Semi-structured interviews are a commonly used in qualitative studies and can meaningfully explore perceptions of participants that serve to guide their behavior (Longhurst, 2003). The semi-structured interviews allowed a sense of standardization of the interview process to ensure each counselor explores key topics such their attitudes on incorporating physical activity into therapeutic work, but also allow the freedom within the interview to let the counselors expand on their overall personal experience or tendencies. Development of specific interview questions were guided by principles of The Social Cognitive Theory (SCT) (Bandura, 1986). Social Cognitive Theory assumes that individual factors (e.g. attitudes, knowledge, self-efficacy, etc.), environmental factors (e.g. barriers, facilitators, resources), and behavioral factors (e.g. reinforcement from overt actions, behavioral skills, and behavioral intentions) reciprocally influence one another and provides a framework for explaining the observance of specific behavioral phenomena (Bandura, 1987).

Data Analysis

For data analysis, the study implemented thematic analysis to effectively analyze semi-structured interviews (Braun & Clarke, 2006). Thematic analysis was chosen mainly for the flexibility of the analysis and not being tied to a singular theory (Braun & Clarke, 2006). Data analysis began with the familiarization of data by reviewing all transcripts. Then meaningful and similar sentiments were developed into initial codes. Based on similarity between initial codes,

initial themes and sub-themes began to form. The data was thoroughly reviewed again to ensure these initial themes and sub-themes captured the data set as a whole. Then names and clear definitions for the themes were developed. To ensure reliability and validity of these themes, an independent research assistant, a master's level athletic training student who has exercise science experience but not in this specific area of research, separately reviewed and recoded the data based on the definition of the initial theme. Any conflicting codes within themes were reviewed and discussed until a clear inclusion or exclusion of the code was agreed upon by the researchers. Then final themes and sub-themes were established.

Trustworthiness

To ensure credibility of the findings, the researcher selected a common methodological approach with recognized methodological rigor to conduct the study. Using well established methods of a comparable research project allowed the researcher to have justification for their methods which creates more credibility for their research project (Shenton, 2004). This also allows the study to be replicated by other researchers. The first author also explained the rationale and objective of the study to explore individual, environmental, and behavioral factors of including physical activity into therapeutic works. Next, member checks were completed by participants reviewing transcripts to ensure the accuracy of the transcript and to confirm if the answers of the interview truly captured the essence of what the counselors were communicating on each question. Counselors were asked to return the transcripts through email and were asked to return the interview in 10 business days. To ensure dependability of the findings, the researcher kept an audit trail across the entire study, which included a bracketing journal and reflective statements and thoughts. The bracket journal was used to recognize bias and paired with the reflective statement and thoughts to minimize these biases when developing codes and

themes. As mentioned previously, a research assistant reviewed and recoded the data based on the definition of the initial themes. Once codes and themes were finalized, the final audit trail, codes, and themes were reviewed by an external auditor who has extensive qualitative research experience but was not involved with the research project.

Results

Fourteen different certified counseling professionals who were active counselors of college students at the time of the study from seven different universities across the south participated in this qualitative study. Among the clinicians, six practiced in Florida, two practiced in Arkansas, two in Texas, one in Georgia, one in Kentucky, one in Louisiana, and one in Mississippi. Of the participants, 12 self-identified as female, 1 male, and 1 non-binary. The average age of participants was 39 years, ranging from 26-67 years. The average number of years being a certified counseling professional was 10 years, ranging from 2-28 years. The average number of years being a certified counseling professional working specifically with college students was 7 years, ranging from 8 months to 28 years.

Table 1 displays thematic analysis of qualitative data which headlines the five themes identified: physical activity is important for mental health, counselors support prescribing physical activity to patients, barriers of counselors prescribing physical activity, counselors support referring patients to a physical activity specialist, and barriers of counselors referring to a physical activity specialist. Exemplar quotes are presented in the text and the table and percentages are presented.

Physical activity is important for mental health

Counselors interviewed in this study expressed that PA is important for mental health. The majority (93%) of counselors had positive beliefs that patients could benefit from physical activity. As an example, C6 expressed “I do. I talk with clients how increasing physical activity can increase physical health which can have positive effects on mental health and vice versa.” The majority of counselors (79%) could recite benefits of performing physical activity. C8 reported “I mean it's helpful for mood regulation and it's helpful for digestive issues, it's helpful for sleepy regularity, so I definitely highlight it from the jump.” The majority of counselors (86%) often discussed physical activity with their patients, signifying that physical activity is important to discuss. C7 stated, “Pretty consistently and pretty regularly that is one of the coping skills that I recommend because it does have such an impact on our mental health.” Many of the counselors (100%) mentioned encouraging physical activity but not prescribing physical activity. C14 expressed, “Right now yeah I don't prescribe physical activity routines just encourage exploring.”

Counselors support prescribing physical activity to patients

Counselors interviewed in this study expressed support for prescribing physical activity to patients. The majority of counselors (64%) had a supportive attitude towards prescribing PA to patients. As C10 reported,

> “I guess, my attitude is, we should all be doing, and so that's I guess my personal attitude is that I think that we're really ignoring an important piece of the puzzle for clients if we're not prescribing that if we're looking at everything else but exercise I see that as one of those basic self-care things that we all should be

doing and some way for ourselves, so I feel like it's a necessity for therapists to be including that."

Outcome expectations of counselors without having proper training to prescribe PA reported patients would attempt the PA prescription, demonstrating the perception that patients trust their counselor's advice. C3 iterated, "I definitely think some of them would follow through. You do have to kind of be careful because some of them will do anything you tell them." An outcome expectation of counselors prescribing PA to patients after being properly trained included increased confidence of the counselor. C7 expressed, "If I was properly trained and I have a licensure to back up my ability to quote unquote prescribe physical activity, then I would feel much more confident." An outcome expectation the counselors expressed was that if all counselors across the US were prescribing PA, then PA of patients would increase. C5 stated, "Whereas if we're properly trained, and we're bringing it up in conversation, whether people do it or not talking about it more, I would imagine would yield more results in that area [increasing physical activity]." All counselors (100%) expressed a high sense of locus of control demonstrating autonomy in their practices to treat a patient how they see fit within their scope of practice. C9 reported, "Every clinician does. It's up to us, it's up to me. I am the expert with my client." All counselors expressed to be currently encouraging but not prescribing physical activity to patients.

Barriers of counselors prescribing physical activity

Counselors interviewed in this study expressed factors that prevent counselors from prescribing PA to patients. Prevalent outcome expectations discussed included counselors being liable for practicing outside their certification and patients being injured because of their prescription. C11 iterated,

> "Yeah, I think my hesitancy with liability is the primary barrier. I'm like if a student gets hurt and that comes back to me like I'm practicing outside of my scope and legally that can be a really big issue."

Counselors reported a lack self-efficacy in prescribing PA to patients. C7 responded, "A specific physical routine, not very confident just because, again, I am not trained in that. That is not what I'm here for. But I do always strongly encourage exercise." Importantly, the majority of counselors (71%) were uncertain of the physical activity guidelines and felt they lacked competency to prescribe physical activity to patients. C3 stated, "I don't. I am aware that something like that does exist, but I'm not super aware of what it is." C6 mentioned, "I would think the only barrier would be just my competency. Like I said, it's not something that I feel that I could do that I have a breadth of understanding about." The majority of counselors (86%) noted they had received no formal training in prescribing PA to their patients in their graduate programs or continued education. C3 said, "Zero. It was just not brought up you know it was just a general sense that "Hey, this is a good thing." but more than that, not really."

Counselors support referring patients to a physical activity specialist

Counselors expressed support for referring patient to a physical activity specialist. Almost all counselors (92%) expressed a supportive attitude to referring patients to a PA specialist. C1 expressed,

> "I think I'd be open to that, especially if I was able to learn more of what that person does or what the specialist would recommend and again, maybe, just like ideas of what their treatment plans or whatever they might call it, so that I have a better understanding of what that person might recommend to the client."

Counselors perceived referring to a PA specialist would help increase the physical activity of patients. Counselors perceived if all counselors across the US referred patients to a physical activity specialist, then physical activity of patients would also increase. C11 stated, “I think it could, I think if the students are motivated it has potential to help them increase their activity.” The counselors felt their counseling center would be open to working with a PA specialist expressing institutional support. C4 responded,

> “I see the openness being there. Yeah, just because we do know that physical health is really important to all of the areas of wellness. We use a public health model here and so physical wellness is a significant part of that public health model.”

The counselors reported knowledge of resources to recommend to patients to help increase PA which included the campus recreation center. All counselors (100%) expressed high self-efficacy to be able to make a referral. C7 reported, “I’ve done it, so pretty confident.” Again, all counselors (100%) felt autonomy in their practices to treat a patient how they see fit within their scope of practice. Counselors believed referring to a physical activity specialist to be the most feasible behavior right now compared to counselors prescribing physical activity or a hybrid model of both behaviors. C9 expressed, “I will say referring someone out to a third party specialist. Again, for me, is because it's just not my area of training and expertise it's outside the scope of my training.” Most counselors (86%) iterated making referrals in the past. C6 iterated, “I think so. I mean when we think about third party people we collaborate with the campus all the time.”

Barriers of counselors referring to a physical activity specialist

Counselors expressed factors that prevent counselors from referring patients to a PA specialist. Counselors mentioned a possible negative outcome including patients would not be motivated to follow through with the referral. C11 mentioned,

> "If a student who's really focused on instant gratification I want to get better now, I want to feel better today. They might not stick with it, so I think it could be a mixed bag, like anything like it would have to be like a carefully thought out referral."

Counselors reported a financial barrier for patients or the university to fund a physical activity specialist. C10 expressed,

> "And I guess to the other piece might be financial I haven't talked about that too much, but yeah just financially. You know, one of the benefits of having someone in house to the university is that a lot of our services are covered, or at least partially covered or healthy, so if it was someone in the Community might be a little more challenging if there wasn't an affordable place for that person to go."

Another barrier included the lack of having a PA specialist on staff. C9 stated, "You know what, no. No, I don't know anybody."

Discussion

The findings of this study show the majority of counselors interviewed who practice in university settings expressed that PA is important for treatment of the mental health needs of their patients. Counselors had supportive attitudes and presented specific barriers to both

prescribing physical activity to patients and towards referring patients to a physical activity specialist.

The counselors expressed that PA is important for mental health and recognize the wide range of PA benefits including physical, mental, and emotional health. Therefore, the counselors mention discussion of physical activity frequently in sessions with patients and offer general encouragement but not a specific exercise prescription of physical activity. This finding is similar to a study in the UK, where the majority of the counselors in the sample felt physical activity or exercise was important and would generally encourage exercise, but not provide a prescription (Gordon, 2014). The effectiveness of general encouragement of physical activity remains unknown for counseling patients' physical activity levels. In primary healthcare, a systematic review (n = 15) meta-analysis (n = 8745) investigated the effectiveness of physical activity promotion in primary care (Orrow et al., 2012). Many of the interventions included health professionals advising or counseling participants on multiple occasions. The review found physical activity promotion in primary care to significantly increase self-reported physical activity measures after 12 months follow-up, which supports general encouragement of physical activity. Although, within the interventions there was variability on giving individualized physical advice, general recommendations based on guidelines, and general encouragement of physical activity. Written prescriptions may be more effective for increasing physical activity of patients. For example, in a randomized control trial found an intervention group (n = 135), the physician wrote an exercise step prescription and meet with the patient 3-4 times over a 12-15 month period- had higher step counts at the end of the intervention when compared to a standard care group (n = 140) where the physician recommended the patients to be active daily for 30-60 minutes (Dasgupta et al., 2017). The current practice of counselors offering general or vague

encouragement of physical activity may not be the most effective therapeutic practice to increase physical activity of mental health patients.

Counselors supported the idea of prescribing PA to patients, but a lack of perceived competency of in prescribing PA, low self-efficacy in prescribing PA to patients, and fears of client injury and subsequent injury liability are barriers to address before counselors felt they could be qualified for prescribing PA. The counselors' knowledge of the physical activity guidelines compared similarly to the general American population as only 33% of Americans knew the dose recommendations for physical activity (Piercy et al., 2020) and only 29% of the counselors in the current study could recite the guidelines. This lack of knowledge of physical activity is similar to other health care providers. In a qualitative study investigating primary care provider's perspective on PA barriers to implementation of PA counseling included a lack of knowledge for how to individualize plans to meet physical activity guidelines, assisting in overcoming barriers patients face, and who should implement the counseling the physicians/nurse practitioners or the nurses (Easty, 2018). Another study noted a lack of organized education in PA counseling and lifestyle medicine during residency training is also a barrier for physical activity counseling from physicians (Hauer et al., 2012). Despite recognizing the importance of PA, many counselors are not receiving formal education about physical activity and as such lack specific confidence to carry out the behavior.

Formally educating counselors on PA including the benefits, modalities, prescription, and ethics of physical activity may be the best strategy to overcome the mentioned barriers. Training is recognized as a critical strategy to enhance intervention uptake and implementation (Powell et al., 2015). As counselors are required to obtain continued education credits to renew their license, developing a continued education approved training could help increase the general

capacity of physical activity for counselors. The training could be designed with evidence-based practices including Interactive Learning Education (Snell, 1999), audit and feedback (Powell et al., 2015), Collective Efficacy (Sampson et al., 1997), and Discussion and Application (Powell et al., 2015) to increase general capacity. The continuing education credit could serve as a micro-credential (i.e., a non-traditional learning path to gain a skillset in a shorter amount of time (Fribance, 2020) and a certificate, a necessary tangible outcome (Ramalingam et al., 2019) to represent completion of the training and serve as a representation of individual competence. These strategies can all help increase the competencies of PA and potentially the self-efficacy necessary for prescribing PA. Although, the barrier of liability and client injury still remains, prescribing PA may be similar to prescribing medication. For example, as a medical doctor does not act outside of negligence or unethically, doctors are not held liable for the patient's mishandling of medical prescriptions. If counselors were appropriately trained and certified, then they may also not be liable for client injury. Regardless, counselors promoting the National Physical Activity Guidelines to patients may be more effective than general encouragement and more feasible then becoming certified to provide PA prescriptions for now. As mentioned previously many Americans are unaware of the physical activity guidelines. Counselors iterating specific benefits of physical activity, adequate dosages and intensities of physical activity, and encouraging different modalities to achieve the National Physical Activity guidelines may be more likely to get patients to increase physical activity levels.

While overcoming barriers to PA prescription may be one strategy to incorporating PA into counseling practice, more counselors reported comfort with referring patients to PA specialists. A physical activity specialist was described as a licensed professional including (certified strength and conditioning coaches, personal trainers, etc.) who understands the benefits

of physical activity or exercise and can prescribe individually tailored physical activity programs to students. University counseling centers may look to address these barriers through designing and implementing an exercise referral scheme (ERS). ERS have been recognized as one of the four most common methods to increase poor physical activity (NICE, 2014), given the current nature of counselor education which lacks PA components. Exercise referral schemes typically consist of a health professional determining a patient to be physically inactive, referring the patient to a physical activity specialist, and then consulting with the patient about how to increase physical activity (NICE, 2014). Despite its effectiveness at increasing PA (Martín-Borràs et al., 2018; Pavey et al., 2011; Rowley et al., 2018a), few ERS have attempted to improve physical activity and improve mental health outcomes for patients seeking mental health treatment (Chalder et al., 2012; Murphy et al., 2012). Chalder et al. (2012) compared the effects of ERS (n = 133) compared to usual care (n = 124), how patients normally treat mental health symptoms (i.e. medication, counseling, etc.), and found self-reported increased physical activity was sustained after a year but did not improve depression outcomes or decrease the use of antidepressants. General care physician referred the patients, used "physical activity facilitators" (no mention of credentials) and the sample included UK adults with depression which is different from the current study. Murphy et al. (2012) compared Mental Health patients in an ERS using MI (n = 41) to usual care (n = 38) (including a leaflet overviewing the benefits of physical activity) and found significant lower levels of anxiety/depression in the intervention group, but no effect on self-reported physical activity. The study mentioned a "range of health care professionals" referred patients to "exercise professionals" (no mention of credentials) and the sample included patients 16 years or older who were physically inactive and suffered mild anxiety, depression, or stress symptoms. However, there is no current literature on the

implementation or effectiveness of an ERS within a college counseling center. This, combined with the previously mentioned mixed findings from existing study, necessitates further investigation of ERS implementation.

Counselors could be a novel health care provider to refer to an ERS scheme on university campuses. More studies are needed to evaluate the ERS within an American college counseling center in an effort to improve the physical activity and mental health of college students. As counselors discussed their major current resource to help increase students' PA would be the campus recreation department, developing a partnership between campus recreation or exercise science programs and the counseling center may allow for design and implementation of low cost, accessible exercise referral scheme for patients. As patient motivation still presents a concern, quantitative analysis is needed to see how many patients who are referred actually follow through an ERS. Thus, a quantitative study is necessary to test the implementation or the effects of an ERS in a university mental healthcare system on mental health and physical activity of patients. Implementation measures such as reach of patients, feasibility, and acceptability (Ramalingam et al., 2019) of the scheme from the patient and counselor perspective can provide universities important data for what it takes to implement an ERS on campus.

Limitations

One limitation of the study includes the use of a convenience sample limiting transferability of findings to other samples including counselors who serve non-university populations or counselors not located in the southern US. Self-identified females made up nearly the entire sample (85%). This is just slightly higher than a national estimate of 71% of mental health therapist are women (Zippia, 2021). Also, participants were only recruited if they were actively counseling at large southern universities. Therefore, practitioners from smaller

universities with lesser resources may not share similar perceptions related to benefits and barriers to prescribing and referrals for physical activity. This inclusion criteria was implemented to increase internal validity by having a more homogenous sample. Next, the lack of direct observation of participants with patients is also a limitation. For example, counselors were never observed during appointments to see physical activity was currently included into therapeutic works. Though counselors were encouraged to be transparent and honest for each question. Finally, with qualitative research, themes can be influenced by a researcher's bias and experiences. Therefore, necessary trustworthiness methods including a bracketing journal, member checks and auditing, were used in an attempt to limit these biases.

Conclusion

Overall, the study explored individual, environmental, and behavioral factors that influence university counselors' inclusion of PA into therapeutic work, prescribing PA to patients, and referring patients to a PA specialist. Counselors agreed PA was important for mental health and expressed referring to a PA specialist would be the most feasible strategy to incorporate PA as part of their therapeutic work for patients struggling with physical inactivity and mental health. This finding is novel in expressing openness to develop ERS for assisting counselors in implementing PA in therapeutic works. Future studies are necessary to investigate the implementation or reach of an ERS within a college counseling center as well as the effects of an ERS can have on mental health and PA of college students seeking mental health treatment. As physical inactivity (American College Health Association, 2018; Arias-Palencia et al., 2015; Dinger et al., 2014; Ghrouz et al., 2019; Kwan et al., 2013) and poor mental health (Oswalt et al., 2020) are highly prevalent on university campuses, incorporating PA in

therapeutic works of counselors may be a critical strategy for university to promote PA and mental health of a vulnerable population.

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Appendix

Table 1. *A summary of the major theme's SCT Factors (i.e. individual, environmental, and behavioral), SCT constructs, most prevalent subthemes, supporting quotes, and percentage of sample who expressed the subtheme.*

Theme- Physical activity is important for mental health				
SCT Factor	SCT Construct	Most Prevalent Subtheme	Supporting Quote Example	n (%)
Individual	Beliefs patients could benefit from increasing physical activity	*Positive beliefs*	"Yeah, I think so. And not even just for your physical health, but I think it can really have a positive impact on that mental and emotional health."	13 (93%)
Individual	Knowledge	*Knows benefits of physical activity*	"Physical activity has been shown to be very helpful with folks for a combination different reasons-- the cardiovascular benefits, the benefits of getting out in the fresh air, getting moving a lot of times they can make it a social activity as well which tends to help with the isolation."	11 (79%)
Behavioral	Overt Behaviors	*Often discussed with patients*	"Pretty often I think for most of my clients, if not every session then every month."	12 (86%)
Behavioral	Overt Behaviors	*Encourage but not prescribe physical activity*	"We don't prescribe per se, but we highly recommend and encourage…"	12/12* (100%)

Table 2. *A summary of the counselors prescribing physical activity major themes' SCT Factors (i.e. individual, environmental, and behavioral), SCT constructs, most prevalent subthemes, and supporting quotes.*

Theme- Counselor support prescribing physical activity to patients				
SCT Factor	SCT Construct	Most Prevalent Subtheme	Supporting Quote Example	n (%)
Individual	Attitude	*Open Attitude*	"I think it would be really helpful…"	9 (64%)
Individual	Outcome Expectations with no proper training	*Attempt the prescription*	"I think if I did, I think they would likely do it because we have the rapport, and they trust me. So they would at least attempt it, you know, I think they would attempt it because of our therapeutic relationship…"	5 (37%)
Individual	Outcome Expectations with proper training	*Increased confidence*	"Yeah I think if I could get some training on it, I think I would definitely feel more confident."	6/12* (50%)
Individual	Outcome Expectations if all counselors prescribed	*Increases physical activity*	"Yes, it would increase "buy in" which is needed for a client to do anything so yes."	11 (79%)
Individual	Locus of Control	*Counselors practice with autonomy*	"We have the autonomy to treat the patient as we see needed."	14 (100%)
Behavioral	Overt Behaviors	*Encourage but not prescribe physical activity*	"We don't prescribe per se, but we highly recommend and encourage…"	12/12* (100%)
Theme- Barriers of counselors prescribing physical activity				
Individual	Negative Outcome Expectations- with proper training	*Liability*	"I don't think I would do that without medical clearance. I think they would need to sign some type of waiver..."	7 (50%)
Individual	Negative Outcome Expectations- with proper training	*Client injury*	"I'd also become scared that they go out and hurt themselves if I prescribe specific exercises…"	7 (50%)
Individual	Self-Efficacy	*Lack of Confidence*	"Not very, not a very specific routine."	12 (85%)
Individual	Knowledge of physical activity guidelines	*Uncertainty*	"I think its 30 minutes of moderate exercise at least three times a week"	10 (71%)
Environmental	Barriers	*Lack of competency*	"Things that would prevent me from prescribing physical activity one would be the lack of training in exercise prescription."	10 (71%)
Behavioral	Formal Training	*No formal training*	"Besides learning that physical exercise is an emotional regulation skill, no. I had no training whatsoever, other than that."	12 (86%)

Table 3. *A summary of the counselors referring to physical specialist major themes' SCT Factors (i.e. individual, environmental, and behavioral), SCT constructs, most prevalent subthemes, and supporting quotes.*

Theme- Counselors support referring to physical activity specialist				
SCT Factor	SCT Construct	Most Prevalent Subtheme	Supporting Quote Example	n (%)
Individual	Attitude	*Open Attitude*	"I would be very supportive of it so like I said for the majority of my clients."	13 (92%)
Individual	Outcome Expectations	*Helpful increasing physical activity*	"I think if, like this was part of their goal plan, then yeah I think it could be helpful and then mental health and increasing physical activity and finding an individualized plan for them."	11 (79%)
Individual	Outcome Expectations if all counselors referred	*Helpful increasing physical activity*	"I would think so yeah if they had that buy in and they were ready to make those changes and kind of support."	13 (93%)
Individual	Perceived Institutional Support	*Counseling center would be open to working with a physical activity specialist*	"I see the openness being there. Yeah, just because we do know that physical health is really important to, you know, all of the areas of wellness…"	12 (86%)
Individual	Knowledge	*Counselors would recommend students to campus recreation center to increase physical activity*	"I would definitely recommend our student rec center."	13 (93%)
Individual	Self-Efficacy	*Very confident in my ability to make a referral*	"I mean making a referral is no problem mean that's easy."	14 (100%)
Individual	Locus of Control	*Counselors practice with autonomy*	"We have the autonomy to treat the patient as we see needed."	14 (100%)
Individual	Beliefs	*Referring Most Feasible*	"As a current scope of practice, it might be better to refer to the specialist because then that leaves session time to maybe deal with some of the emotional issues or cognitive issues that might be going on, or other coping strategies that will be needed."	7 (50%)
Behavioral	Overt Behaviors	*Made referrals to third party in the past*	"We work a lot with Community providers already. I'm referring students out in the Community if we can best serve their needs…"	12 (86%)

Table 3. *Continued.*

Theme- Barriers of referral to a physical activity specialist				
Individual	Negative Outcome Expectations	*Patients may not be motivated*	The follow through, I have several clients, I mean this is, I think it goes both ways though. It's if you follow through I think it's great. If you're not again we can't force people.	7/13 (54%)
Environmental	Barrier	*Financial Barrier*	"For most of our students, that financial piece is huge and so having a service that's free it's really, really helpful."	7 (50%)
Environmental	Barrier	*Lack of Physical Activity Specialist on staff*	"No, I know we have a psychologist who is trained in sports psychology which is maybe a little similar."	14 (100%)
Environmental	Barrier	*Patient Motivation*	"I think it could. I think if the students are motivated it has potential to help them increase their activity."	7/14 (50%)

Semi Structured Interview Questions

General Background

1. What is your gender?
2. What is your age?
3. What is your race?
4. How long have you been working as a certified counselor?
5. How long have you been working with college students?
6. Describe the demographics of your patient population?
7. What are some general health behaviors, if any, do you see your patient population struggle with?
    a. Probe further with more specific questions about health risk and health promoting behaviors based on the response eventually ask about physical activity habits

Current Practices/Situation Related to Physical Activity in the Counseling Setting

1. How often does physical activity come up in your appointments?

Attitudes/Knowledge towards physical activity in general

2. Do you feel many patients could benefit from increasing physical activity? Why or why not?
    a. Probe if counselors know the benefits of physical activity based on their response

Prescribing Physical Activity to Patients

Knowledge

3. What are the current physical activity guidelines?

Attitudes towards counselors prescribing physical activity

4. In general, what is your attitude towards counselors prescribing physical activity as part of their therapeutic works?

Behavioral Capability:

5. Did you have any formal training related to physical activity as therapy for mental health?
    a. What kind of training?
    b. Do you think that your training was adequate to be able to prescribe physical activity to patients? Explain.
        i. Would you want to learn how to prescribe physical activity to patients? Why or why not?

Self-Efficacy

6. How confident would you feel in prescribing a patient a physical activity routine?

Outcome Expectations

7. Right now, what do you think do you think might happen if prescribed physical activity to your patients?

a. Follow up with "What if you were properly trained?"
b. If they only discussed good things you might probe with "what about negative or bad things that could happen?

Social Comparisons

8. In general, if counselors across the US were trained in prescribed physical activity, do you think this would help patients increase their physical activity? Why or why not?

Environment

Barriers to Prescribing Physical Activity in Counseling Appointments

9. What, if any, barriers prevent you from prescribing physical activity as a treatment option for mental health within counseling appointments?

Facilitators to Prescribing Physical Activity in Counseling Appointments

10. What would help or facilitate your ability to prescribe physical activity to a patient during an appointment?

11. Does your practice have someone trained in physical activity counseling or prescribing?
    a. If you a patient were to ask you for campus resources to help increase their physical activity, could you recommend resources?
    b. What resources would you recommend?

Referring Patient to a Physical Activity Specialist

Attitude toward referral:

1. What do you think do you think might happen if you referred patients to a third-party physical activity specialist?
    a. If they only discussed good things, you might probe with "what about negative or bad things that could happen?" and vice versa.
    b. What are some reasons that you might recommend patients to a physical activity specialist?
    c. What are some reasons that you might not recommend patients to a physical activity specialist?
    d. In general, how would you describe your attitude toward referral to a physical activity specialist?
    e. In general, if counselors referred patients to a third-party referral physical activity specialist do you think this would help patients would increase their physical activity? Why or why not?

Self-Efficacy toward referral:

2. Hypothetically if you knew or know a third-party physical specialist, how confident are you that you could connect a patient to the third party physical activity specialist?

Environment

Locus of control

3. Who decides what therapies are appropriate/possible at your practice?
4. Do you, as the counselor, have the ability to decide what therapies are recommended to clients visiting your counseling center?
5. Would the counseling center be open to working with a third-party physical activity specialist? Why or why not?

Barriers to Referral to Third Party Physical Activity Specialist

6. What, if any, barriers prevent you from recommending patients to a third party to help increase physical activity of patients?

Facilitators to Referral to Third Party Physical Activity Specialist

7. What would help or facilitate your ability to recommend patients to a third-party physical activity specialist?

Beliefs on feasibility when comparing the behaviors

8. Overall, which do you believe would be more feasible for counselors: prescribing physical activity during appointments or referring patients to a third-party physical specialist? Why?

UNIVERSITY OF ARKANSAS

To:	Bryce T Daniels BELL 4188
From:	Douglas J Adams, Chair IRB Expedited Review
Date:	05/27/2021
Action:	**Expedited Approval**
Action Date:	05/27/2021
Protocol #:	2105332800
Study Title:	Physical Activity as Medicine in Therapeutic Works of Counselors
Expiration Date:	05/13/2022
Last Approval Date:	

The above-referenced protocol has been approved following expedited review by the IRB Committee that oversees research with human subjects.

If the research involves collaboration with another institution then the research cannot commence until the Committee receives written notification of approval from the collaborating institution's IRB.

It is the Principal Investigator's responsibility to obtain review and continued approval before the expiration date.

Protocols are approved for a maximum period of one year. You may not continue any research activity beyond the expiration date without Committee approval. Please submit continuation requests early enough to allow sufficient time for review. Failure to receive approval for continuation before the expiration date will result in the automatic suspension of the approval of this protocol. Information collected following suspension is unapproved research and cannot be reported or published as research data. If you do not wish continued approval, please notify the Committee of the study closure.

Adverse Events: Any serious or unexpected adverse event must be reported to the IRB Committee within 48 hours. All other adverse events should be reported within 10 working days.

Amendments: If you wish to change any aspect of this study, such as the procedures, the consent forms, study personnel, or number of participants, please submit an amendment to the IRB. All changes must be approved by the IRB Committee before they can be initiated.

You must maintain a research file for at least 3 years after completion of the study. This file should include all correspondence with the IRB Committee, original signed consent forms, and study data.

cc: Erin K Hickey, Investigator
Michelle Gray, Key Personnel
Kaitlin M Gallagher, Key Personnel
Robert E Davis, Key Personnel
Amanda L Sullivan, Key Personnel
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IV. Manuscript #2: Relationships between Personality Traits, High School Sports Participation, and Physical Activity in University Students

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Abstract

Objective: 1) Examine the relationships between contexts of physical activity (PA), personality traits, and high school sports participation (sports) 2) determine significant PA correlates in a college population. **Participants:** 237 undergraduate students from a large, southern university participated between September 2020 and May 2021. **Methods:** Participants completed an electronic survey evaluating PA, personality traits, sports, and demographic variables. Pearson partial correlations evaluated correlations between different PA domains, personality traits, and sports. A conditional inference tree model established variable significance for predicting physical inactivity. **Results:** Conscientiousness was positively associated with all PA measures except for active transport. Neuroticism was positively associated to walk and work PA. Sports was related to vigorous and leisure PA. Conscientiousness was the only significant predictor of physical inactivity. **Conclusions:** Conscientiousness is related to PA measures and a significant correlate of PA, but more research is necessary in understanding if leisure time PA can enhance Conscientiousness.

Keywords: physical activity, personality, high school sports participation

Introduction

Being physical active is an established health behavior to prevent non-communicable diseases (2018 Physical Activity Guidelines Advisory Committee, 2018; Haskell et al., 2007; Piercy et al., 2018). College is recognized as an important time in the lifespan where young adults are establishing habits carried on into adulthood (Sparling & Snow, 2002). Unfortunately, studies evaluating the physical activity of college students demonstrate a range between 46% to 72% of college students not getting sufficient physical activity (American College Health Association, 2018; Arias-Palencia et al., 2015; Dinger et al., 2014; Ghrouz et al., 2019; Kwan et al., 2013). Consequently, there is a critical need to increase physical activity among college students. However, current interventions in this population are few and ineffective (Plotnikoff et al., 2015). One reason for the ineffectiveness, may be a misunderstanding or limited knowledge of factors that influence physical activity in this specific population group. Therefore, a better understanding of the correlates of PA among college students is needed.

Few studies have evaluated correlates of physical activity specifically for college students. One cross sectional study using a convenience sample of 1,134 students across 4 universities in the Midwest of America identified fruit consumption, smoking behavior, and perceptions of body weight as correlates of physical inactivity (Seo et al., 2007). Another cross sectional study of 636 undergraduate students enrolled in a physical activity and fitness course at a Midwest university in America found enjoyment and self-management strategies (i.e., self-monitoring, goal setting, time management, overcoming perceived barriers, and self-reinforcement) were strong correlates of college students' physical activity (McArthur & Raedeke, 2009). However, only a small amount of behavior has been explained by previous correlates, highlighting a need to investigate more diverse correlates as well as understanding

which correlates are the strongest in predicting being physically active. More research has been conducted on the correlates of physical activity in the general population. A systematic review reported age, sex, self-efficacy, health status, and previous physical activity as individual level correlates of physical activity behavior and introduced more novel determinants of physical inactivity including genetics, evolutionary biology, and variation in physical activity behavior throughout life (Bauman et al., 2012). Uniquely, evidence suggests that personality can influence physical activity participation (Rhodes & Smith, 2006) and may explain genetic influence on physical activity (Stubbe et al., 2006). Also, as previous physical activity is an important correlate for general physical activity, past high school sports participation may be an important correlate of physical activity specific to college students. Thus, investigating more correlates of college students in general with a specific focus on personality and high school sport participation of college students may assist in developing more effective physical activity interventions on a university campus.

Personality traits have shown to be related to physical activity with a systemic review and meta-analysis reporting Extraversion, Neuroticism, Conscientiousness, and Openness are associated with physical activity, but these findings are not specific to college students and are limited by the majority of the studies (64%) using un-validated self-reported measures of physical activity (Wilson & Dishman, 2015). One study using objective measures of physical activity found that neuroticism may be the only key personality trait associated with physical activity (Smith, 2017). When investigating the relationship of personality traits and physical activity of college females, personality traits were again related to physical activity, however, personality traits had different associations with self-reported physical activity compared to objective physical activity (Wilson & Dishman, 2015). More research in a more diverse sample

of college students is necessary to continue to investigate the relationship between personality and physical activity while also investigating if personality types may have different risk factors for being physically inactive.

As mentioned, previous physical activity is associated with current physical activity levels (Bauman et al., 2012). Yet, observational studies suggest physical activity declines between high school and college (Bray & Born, 2004; Nelson et al., 2006). The discontinuation of high school sports may explain some of this decline. In 2017, it was estimated that 63% of 8th graders, 59% of 10th graders, and 55% of 12th graders were participating in high school sports (*Participation in School Athletics*, n.d.). However, many high school athletes do not go on to participate in college athletics and therefore these new college students may not be continuing leisure time sport or physical activity. Evidence suggests high school sports participation is positively related to vigorous physical activity (Greenleaf et al., 2009) and there is a significant decrease of vigorous physical from high school to college for those who played high school sports (Downs & Ashton, 2011). However, only measuring vigorous physical activity may be too conservative for determining if students were meeting the physical activity guidelines since moderate physical activity was not measured. Thus, more research is necessary to evaluate the associations between high school sports participation and different contexts (i.e., intensity and domain) of physical activity. Also, more research is necessary in establishing the likelihood of meeting the physical activity guidelines when participating or not participating in high school sports as high school sports participation may be an important risk factor for being physically inactive.

Participation in different domains of physical activity (e.g. leisure time, active transport, occupational etc) have demonstrated varied physical health effects, with leisure time physical

activity inducing more positive health benefits compared to occupational or work physical activity (White et al., 2017). A meta-analysis found that domains of physical activity can have a critical effect on the association between physical activity and mental health; specifically, leisure time and active transport physical activity were positively related to better mental health, but work physical activity was negatively related to mental health (White et al., 2017). Aside from physical activity intensities in the International Physical Activity Questionnaire – Short Form (IPAQ-SF) short form, a widely used self-report instrument, the IPAQ – Long Form (IPAQ-LF) separately assesses four contexts including job-related physical activity, transportation physical activity, housework/maintenance physical activity, leisure time physical activity, and time spent sitting (Craig et al., 2003). Different personality traits may be associated more with a certain physical activity intensity or domain and high school sport participation may impact the type of physical activity one does. Understanding the relationship between the different domains of physical activity and personality traits plus past physical activity performance (two important correlates of physical activity that have not been thoroughly researched in college students) could be beneficial in determining the best methods for enhancing physical activity interventions on a college campus.

The primary purposes of this study are to 1) determine the relationships between personality traits with different intensities and domains of physical activity, 2) examine the relationship between previous high school sport participation with different intensities and domains of physical activity, 3) investigate which factors of undergraduate students are the strongest correlates of physical inactivity. A secondary objective includes assessing the probability of meeting the physical activity guidelines based on personality traits and high school sports participation.

Methods

Participants

A convenience sample consisting of undergraduate students attending a large public university in the southern region of America was recruited by means of email newsletter, classroom announcements, social media, and word of mouth. Participants were eligible for the study if they were enrolled in undergraduate coursework at the respective university. Participation was voluntary, and participants were incentivized by being entered into a drawing for one of five $50 Amazon gift cards. All participants provided written, informed consent prior to the survey and the study received approval by the university's Institutional Review Board prior to recruitment and data collection.

Procedures

Eligible participants completed an electronic survey administered through Qualtrics (Qualtrics, 2020). The survey consisted of questions including basic demographics (i.e., sex, age, ethnicity, year in school), personality constructs, physical activity, high school sports participation, mental health, and quality of life. The survey was administered from September 2020 to May 2021.

Instrumentation

The BFI 10 is considered a valid and reliable instrument to measure personality (Rammstedt & John, 2007). This 10-question, Likert-style survey ranks participant's "Extraversion," "Agreeableness," "Conscientiousness," "Neuroticism," and "Openness" on a scale from 1 to 5 (Rammstedt & John, 2007). These personality traits acts as spectrum including Extraversion (e.g. outgoing–introverted), Agreeableness (e.g. courteous–antagonist), Conscientiousness (e.g. disciplined–undirected), and Openness (e.g. opened minded–closedness)

(Costa Jr, 1992) with a higher score meaning the person has more of one side of the spectrum and a lower score is the opposite trait (e.g. high score in Extraversion shows a person is more outgoing where a low score shows person is more introverted) for the respective personality trait. With scores for each trait ranging from 2-10, artificial categories were created where scores of 2-4 were considered low, 5-7 moderate, and 8-10 high. Previous high school sport participation was recorded using a dichotomous (yes/no) question, which read: "During high school, did you participate in organized sports (with your school or an organized league)?"

The International Physical Activity Questionnaire – Long Form (IPAQ-LF) is a 31-item questionnaire where participants self-report their time performed in the past 7 days in the domains of occupational physical activity, physical activity from self-powered transportation, household physical activity, recreation, sport and leisure physical activity, and time spent sitting (Craig et al., 2003). The IPAQ-LF has a criterion validity of $\rho = 0.30$ (Craig et al., 2003) when compared to an accelerometer, which is similar to the criterion validities of other self-reporting measures (J. F. Sallis & Saelens, 2000). Questions are asked on frequency and duration of walking, moderate, and vigorous levels of physical activity for each domain. The variables of specific interest included total Metabolic Minutes (a unit of energy expenditure) per week ($MET \cdot min \cdot wk^{-1}$) for each domain and intensity. $MET \cdot min \cdot wk^{-1}$ quantifies the minutes of energy expenditure from physical activity each week (Haskell et al., 2007). The MET values utilized for scoring included 3.3 METS for walking, 4 METS for moderate physical activity, and 8 METS for vigorous physical activity. For example, 30 minutes of walking equals 99 $MET \cdot min$. The appropriate MET values were multiplied by the minutes the activity was performed and then multiplied by days of the week for walking, moderate physical activity, and vigorous physical activity. These scores were summed within each domain and then summed across all domains for

the total physical activity. Achieving 1000 MET·min·wk^{-1} maximizes the health benefits of physical activity (2018 Physical Activity Guidelines Advisory Committee, 2018). Therefore, if the overall total score from cumulating each domain was below 1000 MET·min·wk^{-1} then the participant was considered inactive or not receiving the full benefits of physical activity.

Several other potential correlates were assessed, The DASS-21 is a valid and reliable measure for defining the severity of distress caused by depression, anxiety, and stress over the past week (Henry & Crawford, 2005). A score is totalled for depression, anxiety, and stress with higher scores indicating higher distress experienced. Overall health and happiness perceptions were assessed using singular items from the SF-12, a reliable and valid instrument for evaluating health related quality of life outcomes (Ware et al., 1996). Both overall health and happiness were evaluated on separate Likert scales ranging from "excellent" to "poor" for overall health and "all the time" to "very rarely" for happiness (Ware et al., 1996). The short grit scale (Grit-S) was validated in 2009 by Duckworth and Quinn. This 8-question, Likert-style survey ranks participant grit on a scale from 1 to 5 (Duckworth & Quinn, 2009) with a higher score meaning a "grittier" individual.

Data Analysis

Data was reviewed for missing data, normality, and outliers. Descriptive statistics were calculated for demographics, personality traits, and high school sport participation, and IPAQ data. To address any possible non-normality of physical activity and personality data, both non-parametric and parametric tests were conducted to check for equivalent results. When conclusions were equivalent, parametric results are reported for interpretation purposes. Analyses were conducted using R 4.1.1 (R Core Team, 2021) with statistical significance define at $p < .05$. Given the exploratory nature of this study, no adjustments or corrections were made

for multiple comparisons.

To assess the relationship between personality traits and general physical activity, Pearson partial correlation coefficients were evaluated between personality traits and physical activity while controlling for sex, age, and the other personality traits not being directly assessed and high school sports participation followed by Spearman correlations while controlling for sex, age, the other personality traits not being directly assessed and high school sports participation to confirm equivalency between parametric and non-parametric results. Pearson partial correlation coefficients were evaluated for each personality trait with Total MET·min·wk^{-1}. Then the partial correlation coefficients of each personality trait using total MET·min·wk^{-1} for each intensity (vigorous, moderate, and walking) and domain (leisure, occupational, domestic, and active transport) were also evaluated while again controlling for sex, age, the other personality traits not being assessed and high school sports participation. Spearman correlations were evaluated while controlling for sex, age, the other personality traits not being assessed, and high school sports participation were also conducted to confirm equivalency between the parametric and non-parametric results.

To assess the relationship between high school sports participation and general physical activity, Pearson partial correlation coefficients were evaluated between high school sports participation and Total MET·min·wk^{-1} while controlling for sex, age, and for personality traits. Spearman correlations were conducted while controlling for age, sex, and personality traits to confirm equivalency between parametric and non-parametric results. Pearson partial correlation coefficients were also evaluated between high school sport participation for each physical activity intensity (vigorous, moderate, and walking) and domain (leisure, occupational, domestic, and active transport) while controlling for age, sex, and personality traits. Spearman correlations

were conducted while controlling for age, sex, and personality traits to confirm equivalency between parametric and non-parametric results.

Another primary goal of this study was to examine which variables most influence students meeting physical activity guidelines. Conditional inference trees, a type of nonparametric supervised learning technique based upon recursive partitioning for multivariable analysis, were utilized to classify whether a student meets the physical activity guidelines using 26 potential variables of interest including demographic variables, each personality score, high school sports participation, each DASS-21 score, GPA, overall health score, and grit scores. Variable selection in the final tree-based model was determined by permutation-based significance testing, which avoids bias and results in a final model that utilizes only those variables exhibiting the strongest relationships with physical activity (Hothorn et al., 2006). To mitigate tree instability (Strobl et al., 2009) and provide a measure of variable importance, a random forest utilizing conditional inference tree base learners was also utilized. A random forest of 1,000 trees was used to assess the relative importance of each variable of interest in predicting whether or not a student meets physical activity guidelines. In addition to the above statistical techniques, observed rates of inactivity (those receiving < 1000 $MET \cdot min \cdot wk^{-1}$) for various participant subgroups were calculated to show how the rate of inactivity differs based upon variables of interest, specifically the big 5 personality traits and high school sports participation.

Results

Demographics

The sample consisted of 237 participants (females: n = 171 (72%) and males: n = 66 (28%)) and had an average age of 22 years (SD = 7.11), which ranged from 19 to 73 years. Data was considered missing if the personality questionnaire was not entirely completed, if the high school sports participation was unanswered, or if the reported total minutes of physical activity exceeded 960 minutes a day (as per standard IPAQ processing). The sample overall was 82% white and were predominantly (44%) college sophomores. Of the sample, 34 participants reported performing less than 1000 MET·min·wk^{-1} and 203 participants reported performing at least 1000 MET·min·wk^{-1}.

Personality, High School Sports Participation, and Physical Activity

The study investigated the relationships between each of the big five personality traits and high school sports participation with overall physical activity with different intensities and with domains of physical activity while controlling for sex, age, and high school sports participation and the big five personality traits when not being directly assessed. Partial correlation coefficients and p-values for each big five personality trait and each intensity and domain of physical activity are found in Table 1. Conscientiousness was positively and significantly related to Total MET·min·wk^{-1} (r = .30, p < .001), Vigorous MET·min·wk^{-1} (r = .14, p = .049), Moderate MET·min·wk^{-1} (r = .28, p < .001), Walking MET·min·wk^{-1} (r = .22 p = .001), Domestic MET·min·wk^{-1} (r = .22, p = .002), and Leisure MET·min·wk^{-1} (r = .23, p = .001). Neuroticism was positively and significantly related to and Working MET MET·min·wk^{-1} (r = .14, p = .042). High school sports participation was positively and significantly related to Vigorous MET·min·wk^{-1} (r = .18, p = .011) and Leisure MET·min·wk^{-1} (r = .17, p = .015).

Predicting Physical Inactivity

The study investigated which correlates of physical activity best predicted physical inactivity of undergraduate college students. The only statistically significant split in the conditional tree constructed from our sample included conscientiousness (p = .025), where participants were nearly five times more likely to be physically inactive if their Conscientiousness score was less than or equal to 4 compared participants that had a Conscientiousness score greater than 4. Furthermore, due to potential tree instability, importance ranks of all 26 variables in a random forest were evaluated and can be seen in Figure 1. Conscientiousness, grit, living situation, height, weight, and anxiety classification from the DASS-21 were the most important variables for predicting physical inactivity of college students. Out of the big five personality traits and high school sports participation the following were ranked from most important to least important when predicting physical inactivity: Conscientiousness, Neuroticism, high school sports participation, Openness, Extraversion, Agreeableness.

As a follow up analysis, conditional rates of inactivity were calculated to show how the risk of physical inactivity changes based upon the big five personality trait scores and the high school sports participation of study participants. Rates of physical inactivity were the lowest, indicative of higher rates of activity, at higher scores of agreeableness (13.9%), conscientiousness (10.4%), and neuroticism (11.3%) while moderate scores for extraversion (13.2%) and openness (13.8%) had the lowest rates of physical inactivity among the study participants. Of those who did not play high school sports, 25% were classified as inactive compared to only 13.4% of those that did play high school sports.

Discussion

The current study evaluated the relationships between personality traits and different intensities and domains of physical activity, examined the relationship between previous high school sport participation and different intensities and domains of physical activity, and investigated the strongest correlates of physical inactivity among undergraduate students. We found Conscientiousness was significantly related to all physical activity measures except for active transportation. Neuroticism was positively and significantly related to work physical activity. High school sports participation was positively and significantly related to vigorous and leisure physical activity. Conscientiousness was the only significant predictor of physical inactivity in the model. When investigating the conditional rates of personality traits and high school sports participation, moderate Extraversion, high Agreeableness, high Conscientiousness, high Neuroticism, moderate Openness, and participating in high school sports showed the lowest percentages of physically inactive students.

The current study found that Conscientiousness and Neuroticism were the only personality traits related to physical activity of this sample of undergraduate college students. Conscientiousness is defined as the dimension of personality relating to thoughtfulness, impulse control, and goal-directed behaviors while neuroticism relates to characteristics such as emotional instability and negative affectivity (Costa Jr, 1992). Our findings partly agree with previous work, which found Extraversion, Neuroticism, Conscientiousness, and Openness were all significantly associated with physical activity (Wilson & Dishman, 2015). This meta-analysis utilized 64 studies with mean ages ranging from 14.8 years to 92.9 years and only one studied utilized the IPAQ to get a total volume of physical activity. Our study found only Conscientiousness and Neuroticism was related to physical activity, but specifically targeted

undergraduate students, a vulnerable population for being physically inactive, and investigated personality traits with the different domains of physical activity. Assessing domains of physical activity is important as not all physical activity domains have equivalent relationships with personality traits and high school sports participation (e.g., Conscientiousness was only not related to active transport). This is useful knowledge for intervention design. For example, with Conscientiousness being related to leisure time physical activity, college campuses could incorporate behavior change strategies that promote qualities of Conscientiousness when developing physical activity interventions to specifically promote leisure time physical activity. The relationship of Conscientiousness and leisure time physical activity may be explained by leisure time physical activity being a voluntary decision. Choosing to preform leisure time physical activity can require organization, thoughtfulness, and attention to detail, which are connected to self-regulation (Zeidner et al., 2000). Self-regulation strategies (e.g. goal setting, self-monitoring) demonstrates to be related to physical activity (Umstattd et al., 2009). Self-regulation strategies may come more naturally to someone who is highly conscientious. Interestingly, we found Neuroticism was positively significantly related to work physical activity. Being highly neurotic (Liu & Lin, 2019) and performing high amounts of work physical activity (White et al., 2017) has been related to worse mental health. Although, personality traits show to stay relatively stable from young to middle adulthood (Atherton et al., 2021), leisure time physical activity may promote qualities of Conscientiousness (i.e. persistence and competitiveness) and promote emotional stability (Komarraju & Karau, 2005) and potentially improve the mental health of highly neurotic individuals. Future longitudinal studies are necessary to clarify the direction of the relationships between leisure physical activity and

Conscientiousness as well as investigate changes in poor mental health statuses of high neurotic individuals.

High school sports participation was positively related to vigorous physical activity and leisure physical activity, but not other domains, intensities, or overall physical activity. This finding is similar to previous work that found that high school sports participation was related to the frequency of participants who worked up a sweat from vigorous exercise in college (Greenleaf et al., 2009). However, the study used strictly first semester female freshmen whereas our study utilized both females and males across different years in school. Our study also used a more recognized measure of Total MET·min·wk-^{1} for each intensity and domain of physical activity. Another study showed a smaller decrease students in meeting the vigorous physical activity guidelines in college if students previously played high school sports (Downs & Ashton, 2011). Our study went beyond the relationship of vigorous physical activity and demonstrated high school sports participation to also be related to leisure time physical activity but no other physical activity domains. This relationship may be explained by the past physical activity performed in sports. For example, most high school sports off-season workouts, practices, and games can be considered vigorous physical activity. Former high school athletes may prefer continuing vigorous physical activity in their leisure time because they have higher self-efficacy or find the most enjoyment in vigorous physical activity which relates to individual constructs of the Social Cognitive Theory (Bandura, 1977). This relationship can also help universities target students who did not play high school sports and may be at risk for not performing leisure physical activity. As previous physical activity has been a recognized correlate of physical activity (Bauman et al., 2012), introducing physically inactive students who used to play high school sports to a physical activity intervention may be an important strategy to increase these

students physical activity. Future studies should evaluate the long-term effectiveness of increasing physical activity of physically inactive college students who used to play high school sports through a vigorous and leisure physical activity intervention.

Uniquely, Conscientiousness was the only statistically significant predictor of physical inactivity and was ranked the most important among 26 other correlates of physical inactivity of college students. Previous work has demonstrated other correlates of physical inactivity including fruit consumption, smoking behavior, and perceptions of body weight as correlates of physical inactivity for university students (Seo et al., 2007). Another cross sectional study demonstrated enjoyment and self-management strategies (e.g. self-monitoring, goal setting, time management, overcoming perceived barriers, and self-reinforcement) were strong correlates of college students' physical activity enrolled in a physical activity and fitness course (McArthur & Raedeke, 2009). These studies were conducted with students in the Midwest of America compared to the current sample which may differ demographically from students in the South as southern states are more prone to being physically inactive than Midwestern states (Centers for Disease Control and Prevention, 2020). The current study aimed to investigate a wider variety of correlates for college students and utilized factors similar to a highly cited systematic review (Bauman et al., 2012) of physical activity correlates including age, sex, health status (including mental health), and previous physical activity in addition to evaluating if personality traits are correlates of physical activity for college students. Conscientiousness was still the most important factor to predict physical inactivity. As conscientiousness qualities are similar to self-management strategies, universities or physical activity specialists may look to promote self-management strategies (Dishman et al., 2005) within physical activity interventions such as self-monitoring, time management, and goal setting to help combat physical inactivity. It may be

someone who is highly conscientious naturally uses self-management strategies verses someone who is lowly conscientious. However, someone who is lowly conscientious may be trained to effectively utilized these strategies to become more physically active.

Lastly, different levels of each personality trait and high school sports participation demonstrated different risks for physical inactivity. For example, scoring as moderately in Extraversion, highly in Agreeableness, highly in Conscientiousness, highly in Neuroticism, moderately in Openness, and participating in high school sports showed the lowest risks of being physically inactive in our sample. These findings can help in personalizing physical activity routines to combat physical inactivity. Future research should investigate matching personality types to different types of leisure physical activity to see the effects on promote physical activity adherence. For example, extraverted individuals may enjoy and participate in group exercise classes or students who score highly in openness may be more enjoy and participate in hiking or mountain biking. For students who used to play high school sports and are longer active recommending intramural sports may be a feasible channel for performing physical activity. Previous interventions have demonstrated individualized physical activity programs are more effective than untailored programs (Arrogi et al., 2017; Noormohammadpour et al., 2021). One study tailored individualized workout programs based on participants' goals, preferences for type of activities and current level of physical activity (Arrogi et al., 2017). It is possible that understanding the participant's personality may allow the physical activity specialist to assist the participant in creating better goals or perform new activities that cater to the participant's personality, thus, allowing for more individualization. Future studies should evaluate the effectiveness of using personality scores to help individualize physical activity programs on physical activity performance and adherence over time.

Limitations

The study's main limitations include the use of a convenience sample and a cross-sectional study design. The convenience sample included mostly females throughout the total sample (72%). The cross-sectional design limits data to only associations and not causations. Future longitudinal studies are necessary to clarify the direction of the relationships between leisure physical activity and Conscientiousness and Openness. Establishing if Conscientiousness and Openness causes an increase in physical activity or if physical activity causes an increase Conscientiousness and Openness is necessary to create enhanced interventions. Another limitation of the study includes using self-reported physical activity as opposed to device-based physical activity measurement. However, device-based measurement lacks context to the physical activity performed including the type or domain of physical activity. Also, the binary nature of the high school sports participation questions does not capture the full context of the sports performed or if they continued playing sports all through high school. Future research should investigate how different sports played or if students who played high school sports but stopped before graduation relate to physical activity in college.

Conclusions

Importantly, our study demonstrates personality traits and high school sports participation are related to physical activity among college students including different domains of physically and different risks of being physically inactive. Universities or physical activity specialists can use these findings to potentially target and help intervene with students who may be at risk for being physically inactive. More research is necessary to establish if behavior change strategies or modalities of physical activity tailored to personality types can produce effective interventions. As Conscientiousness demonstrated to be the most statistically important factor in predicting

physical inactivity, more research is necessary in understanding if leisure time physical activity can enhance Conscientiousness or qualities of Conscientiousness. Even if one does not become more conscientious, promoting conscientious behaviors (i.e., thoughtfulness, goal setting) may still help people become physically active. Understanding personality and past physical activity performance of college students may be useful for improving university students' physical activity and ultimately student health and success.

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Appendix

Table 1. *A summary of personality measures' and high school sports participation's relationships with physical activity.*

	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness	Played High School Sports
Total MET·min·wk^{-1}	.02 *p* = .745	.08 *p* = .233	.30 *p* < .001**	.14 *p* = .053	.02 *p* = .825	.07 *p* = .342
Vigorous MET·min·wk^{-1}	.03 *p* = .645	-.01 *p* = .931	.14 *p* = .049*	.08 *p* = .260	.02 *p* = .781	.18 *p* = .011*****
Moderate MET·min·wk^{-1}	-.02 *p* = .820	.12 *p* = .090	.28 *p* < .001**	.13 *p* = .069	.06 *p* = .377	-.00 *p* = .993
Walk MET·min·wk^{-1}	.04 *p* = .590	.06 *p* = .382	.22 *p* = .001*	.08 *p* = .261	-.06 *p* = .365	-.05 *p* = .477
Work MET·min·wk^{-1}	.06 *p* = .370	.01 *p* = .901	.14 *p* = .041*	.14 *p* = .042*	-.09 *p* = .201	-.02 *p* = .817
Active Transport MET·min·wk^{-1}	-.01 *p* = .906	.06 *p* = .430	.13 *p* = .064	.01 *p* = .880	.01 *p* = .884	.07 *p* = .294
Domestic MET·min·wk^{-1}	-.05 *p* = .447	.11 *p* = .116	.22 *p* = .002*	.04 *p* = .565	.09 *p* = .193	-.01 *p* = .839
Leisure MET·min·wk^{-1}	-.01 *p* = .930	.07 *p* = .355	.23 *p* = .001*	.04 *p* = .550	.12 *p* = .090	.17 *p* = .015*

Note. Values are expressed as partial correlation coefficients and p-values, **p < .001, *p < .05

Figure 1. *A summary of undergraduate physical inactivity correlates' importance*

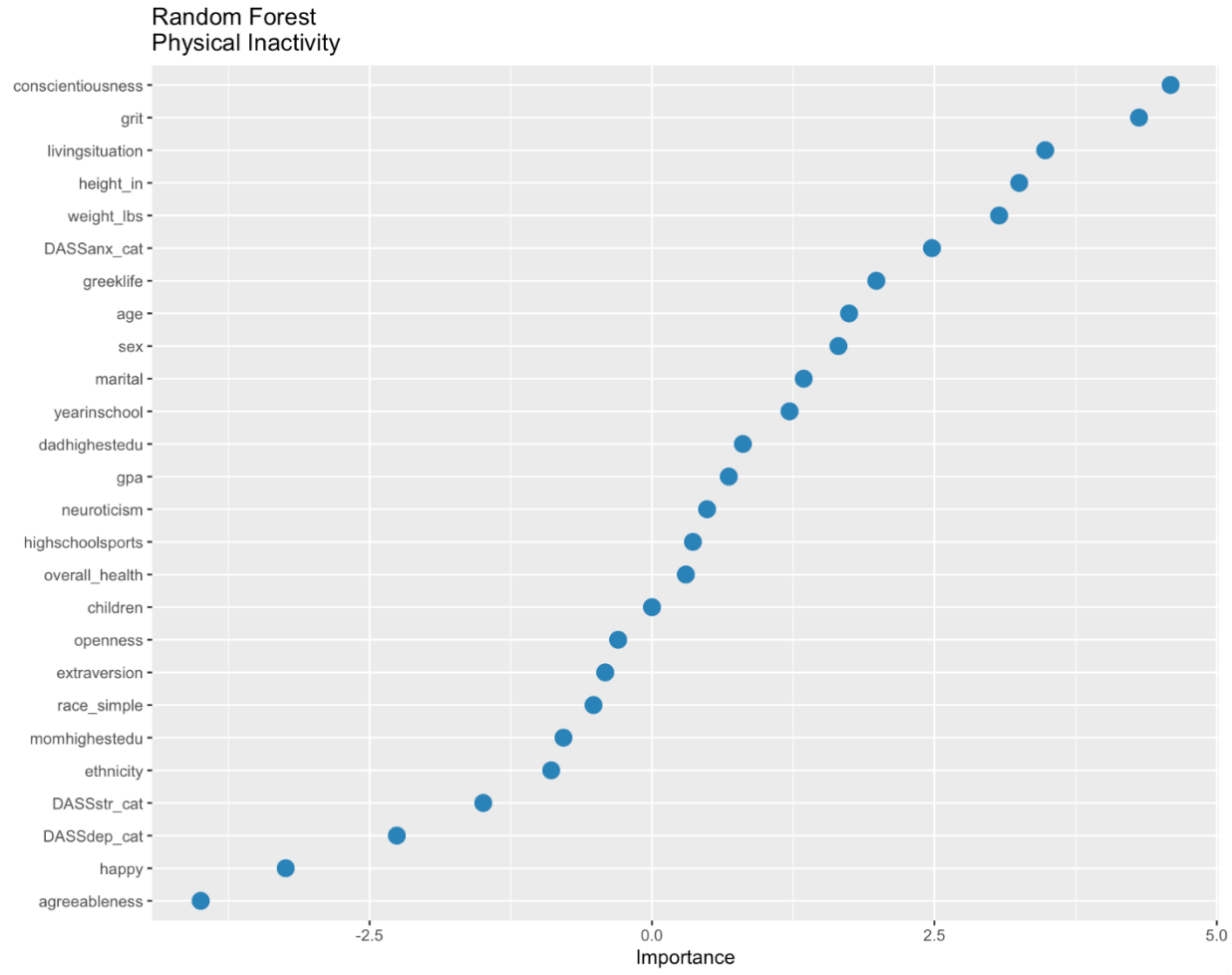

Table 2. *A summary of physical inactivity percentages based on variables of interest scores.*

Variable of Interest		**Physical Inactivity (%)**
Extraversion	Low	17.1 (n = 41)
	Moderate	13.2 (n = 91)
	High	17.1 (n = 76)
Agreeableness	Low	23.5 (n = 17)
	Moderate	15.7 (n = 83)
	High	13.9 (n = 108)
Conscientiousness	Low	60.0 (n = 10)
	Moderate	17.1 (n = 82)
	High	10.4 (n = 115)
Neuroticism	Low	17.5 (n = 63)
	Moderate	16.9 (n = 83)
	High	11.3 (n = 62)
Openness	Low	20.0 (n = 20)
	Moderate	13.8 (n = 109)
	High	16.5 (n = 79)
High School Sports Participation	No	25.0 (n = 32)
	Yes	13.4 (n = 179)

Note. Artificial categories were created where scores of 2-4 were considered low, 5-7 moderate, and 8-10 high. The sample sizes represent participants that did not have missing values.

UNIVERSITY OF ARKANSAS

To:	Erin K Hickey BELL 4188
From:	Douglas J Adams, Chair IRB Expedited Review
Date:	03/08/2021
Action:	**Expedited Approval**
Action Date:	03/05/2021
Protocol #:	1808138910A012
Study Title:	Exercise Is Medicine for Student, Faculty and Staff Success
Expiration Date:	09/09/2021
Last Approval Date:	03/05/2020

The above-referenced protocol has been approved following expedited review by the IRB Committee that oversees research with human subjects.

If the research involves collaboration with another institution then the research cannot commence until the Committee receives written notification of approval from the collaborating institution's IRB.

It is the Principal Investigator's responsibility to obtain review and continued approval before the expiration date.

Protocols are approved for a maximum period of one year. You may not continue any research activity beyond the expiration date without Committee approval. Please submit continuation requests early enough to allow sufficient time for review. Failure to receive approval for continuation before the expiration date will result in the automatic suspension of the approval of this protocol. Information collected following suspension is unapproved research and cannot be reported or published as research data. If you do not wish continued approval, please notify the Committee of the study closure.

Adverse Events: Any serious or unexpected adverse event must be reported to the IRB Committee within 48 hours. All other adverse events should be reported within 10 working days.

Amendments: If you wish to change any aspect of this study, such as the procedures, the consent forms, study personnel, or number of participants, please submit an amendment to the IRB. All changes must be approved by the IRB Committee before they can be initiated.

You must maintain a research file for at least 3 years after completion of the study. This file should include all correspondence with the IRB Committee, original signed consent forms, and study data.

cc: Bryce T Daniels, Investigator
Michelle Gray, Key Personnel
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V. Manuscript #3: Exercise is Medicine on Campus- The Implementation and Effects of an Exercise Referral Scheme Using Physical Activity Counseling

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Abstract

Objective: Assess the implementation and effectiveness of an exercise referral scheme (ERS) in a college's counseling and psychological services (CAPS) on physical activity (PA) and health outcomes. **Participants:** 20 enrolled students at a US university participated from January–April 2022. **Methods:** A randomized control trial utilized a treatment group (TG) receiving weekly motivational interviewing (MI) sessions across 4 weeks and a control group receiving a PA consultation. The primary outcome was device-based PA; secondary outcomes included fitness and mental health measures. Repeated measures ANCOVAs tested intervention effects. **Results:** 0/14 referred students via CAPS joined the ERS. The TG showed beneficial group by time effects for fitness and mental health measures but not device-based PA. **Conclusions:** Patients were not motivated to join the ERS and MI did not increase device-based PA. More work is needed to overcome ERS implementation barriers in CAPS and to develop effective PA interventions for college students.

Keywords: physical activity, mental health, university, counseling, implementation

Introduction

On college campuses, poor mental health symptoms are high and increasing (Oswalt et al., 2020). From fall 2007 to spring 2013, one university's counseling and psychological services (CAPS) demonstrated a 173% increase in total clients with an overall diagnosis of anxiety and depression and a 231% increase in yearly visits (Beiter et al., 2015). As high rates of anxiety and depression prevalence continue to rise in college students (Auerbach et al., 2016), several health behaviors, including physical activity, may have the potential to improve student mental health.

Physical activity consistently shows to have positive effects on mental health (2018 Physical Activity Guidelines Advisory Committee, 2018). Meta-analyses demonstrate physical activity to decrease both state (Ensari et al., 2015) and trait anxiety (Wegner et al., 2014). Evidence supports physical activity to have positive effects on key physiological mechanisms of mental health including neurotransmitter balance (Wipfli et al., 2011), combating oxidative stress (de Sousa et al., 2017), and regulation of the Hypothalmic-Pituitary-Adrenal Axis (Anderson & Shivakumar, 2013). Thus, physical activity may have similar efficacy to standard anxiety medications with reduced chances of side effects (Bartley et al., 2013). Aside from anxiety, greater physical activity is associated with the reduced risk of developing depression (Mammen & Faulkner, 2013) and can also have similar efficacy for treating depression as standard medication with reduced likelihood of experiencing negative side effects (Josefsson et al., 2014). However, studies suggest a range of 46% to 72% of college students are not getting sufficient physical activity (American College Health Association, 2018; Arias-Palencia et al., 2015; Dinger et al., 2014; Ghrouz et al., 2019; Kwan et al., 2013) As college students are seeking

remedies to alleviate poor mental health symptoms, increasing physical activity of college students may be a safe and effective treatment.

One initiative to utilize the clinical benefits of physical activity is Exercise is Medicine. In 2007, The American College of Sports Medicine commenced the Exercise is Medicine® global health initiative with the goal of assessing and promoting physical activity in clinical health care settings. Health care professionals recommending more physical activity with an exercise prescription and referral to an exercise professional may improve physical activity and health (Thompson et al., 2020). A systematic review and meta-analysis of 15 studies found physical activity promotion in primary care significantly increases the physical activity of patients (Orrow et al., 2012). Furthermore, in a qualitative study investigating primary care provider's perspective on physical activity, providers recognized physical activity as a health issue and welcomed physical activity counseling as a routine part of care; however, health care providers ranging from physicians, nurse practitioners, nurses, and mental health counselors have revealed lack of training or education in physical activity as a common barrier in a to prescribe physical activity to patients (Easty, 2018; Gordon, 2014). Thus, exercise referral schemes, where the expertise of exercise prescription is delegated to exercise professionals, may be an ideal and acceptable solution in incorporating physical activity into healthcare.

Exercise referral schemes (ERS) have been recognized by the National Institute of Health and Care (NICE) as one of the four common methods to increase poor physical activity (NICE, 2014). Exercise referral schemes typically consist of a health professional identifying physically inactive patients, referring the patient to a physical activity specialist, and then the physical activity specialist consults with the patient about how to increase physical activity (NICE, 2014). Exercise referral schemes have been trialed in primary care for community adults and have

shown to increase physical activity (Martín-Borràs et al., 2018; Pavey et al., 2011; Rowley et al., 2018a) and cardiovascular fitness (Buckley et al., 2020). However, the behavior change strategies utilized to increase physical activity within ERS have varied from assigning participants personal trainers to exercise specialists using counseling techniques, such as motivational interviewing (MI) (Rowley et al., 2018a). In a systematic review, MI has been shown to increase physical activity with both device-based and self-reported measures with patients diagnosed with chronic health diseases (i.e. hypertension, hyperlipidemia, multiple sclerosis, etc.) (O'Halloran et al., 2014). The effectiveness of ERS using MI for patients with mental health conditions on physical activity and mental health are conflicting. Duda et al. (2014) compared an ERS with a social determinism theoretical framework using MI techniques (n = 184) versus a standard ERS (n = 163) and found significant improvements in physical activity and anxiety depression scores both 3 months and 6 months after baseline for the intervention group. Two other studies found MI to have positive effects on physical activity, but not mental health (Chalder et al., 2012; Littlecott et al., 2014). Lastly, one studied only showed MI to only have positive effects on mental health (Murphy et al., 2012). Primary limitations of previous studies on MI ERS with patients undergoing mental health treatment has been the utilization of self-reported physical activity measures, utilization of very broad age ranges in their samples, and participants being almost exclusively from the UK. Stronger evidence, with device-based measures of physical activity and more diverse populations outside the UK are needed to determine the effects of ERS for improving mental health. Importantly, the effects of an ERS delivered through mental health services on college students, a population in high need to improve mental health, has yet to be studied.

Despite a lack of research on the effectiveness of ERS in college students, Exercise is Medicine-On Campus (EIM-OC), a college specific EIM initiative, suggests university health care providers to use a referral system for exercise prescription. A recent analytic review of Exercise is Medicine®, highlighted a network of over 275 college and university campuses initiating EIM-OC around the world (Thompson et al., 2020), thus suggesting a high potential dissemination for ERS programs on college campuses. Despite an ultimate goal of EIM-OC to utilize ERS on college campuses, many of the EIM-OC campuses have not implemented an exercise referral scheme in student healthcare. To achieve this goal, there is a need to evaluate implementation measures including reach and acceptability, to better understand how to implement research into clinical settings. Reach is defined as the number, proportion, and representativeness of participants in an intervention (Glasgow et al., 2004) conveying adherence to the intervention. Acceptability can establish if participants are satisfied using an ERS and offer feedback on how to make the ERS more acceptable for other students.

An exercise referral program within mental health services has the potential to greatly improve the mental and physical health of young adults in higher education by increasing physical activity. All 14 universities in the Southeastern Conference universities have counseling and psychological services (CAPS) or similar programs (how many schools nationally have counselling services is unknown), meaning successfully implementing an exercise referral scheme has the potential for large reach of university students. Therefore, the purpose of this study is to assess the reach, acceptability, and feasibility of an exercise referral among undergraduate students seeking mental health services at a large public university and to determine the preliminary effectiveness of an exercise referral scheme on physical activity and health outcomes.

Methods

Study Design

The study design included a randomized control trial intervention comparing a MI counseling treatment group (MI group) versus a standard physical activity consultation (standard care group) from late January to early April of 2022.

Participants

A convenience sample of students referred by the counseling and psychological services of the University of Arkansas who were not currently meet the current physical activity guidelines were recruited for the study. Additionally, students from the general population of a large southern institution who were currently not meeting the physical activity guidelines were also recruited (via an emailed newsletter and word of mouth) for the study. Participants who were able to perform regular physical activity and who could read/speak English, and were free of severe mental disorders (e.g., severe bipolar disorder, severe major depression, personality disorder, etc.) qualified for the study. Counselors and the principle investigator (PI) had patients or potential participants complete the Physical Activity Vital Sign, a valid clinical screening tool of physical activity that on average takes 30 seconds or less to complete (Greenwood et al., 2010). A total of 21 participants were recruited and were randomized into 2 groups. All participation was voluntary, but participants were incentivized receiving a $50 Amazon gift card for completing the study. All participants granted informed consent prior to the survey and the study was approved by the university's Institutional Review Board.

Intervention Conditions

The control group received a consultation with a physical activity specialist and electronic flyer detailing the national physical activity guidelines, the 5 health related

components of fitness, benefits of physical activity, and tips for improving physical activity and the five components of fitness. The motivational interviewing group received an educational brochure, an individualized exercise program, and four approximately one-hour weekly face-to-face MI sessions over four weeks, which is similar to other MI interventions (Hettema et al., 2005). MI was selected as a counseling behavior change technique based on the Social Cognitive Theory (Bandura, 1986), a functional framework to explain physical activity behavior (Young et al., 2014). One component of personal behavior change includes one's self-efficacy of the behavior, which is strongly linked to behavior performance (J. F. Sallis et al., 1988). MI is known for elevating self-efficacy and has been effective in increasing regular physical activity (Hettema et al., 2005). The first MI session followed a similar to structure to a previous MI session used for college students (Martens et al., 2012). Figure 1 summarizes the standardization of the first session adapted from (Martens et al., 2012). The session started by greeting participants/establishing rapport, performing a decisional balance exercise for performing physical activity, receiving personalized feedback on physical activity level, discussing physical activity the participant enjoys and has performed in the past, designing an individualized physical activity program (based on the FITT principle (Riebe et al., 2018) and the physical activity guidelines (2018 Physical Activity Guidelines Advisory Committee, 2018)), participants talking through perceived barriers for performing the physical activity program, goal setting, tips for increasing physical activity (if necessary), and then recapping the session in general. The PI would send a follow up email with the individualized physical activity program. The first session took an average of about 45 minutes. The next three sessions followed a pattern of recapping what physical activity the participant performed the previous week, the participant exploring the positives of performing the physical activity and the negatives of performing the physical

activity, the participant would discuss barriers faced throughout the week and strategies to overcome the barriers for the following week, changes were made to the individualized physical activity programs based on request of the participant, the PI also assigned a short task such as measuring stress, depression, and anxiety on (0-10) scale before a workout and then re-measuring stress 15-30 minutes after each workout for weeks 2-4. The PI would email the individualized workout program to the participant after the sessions. These sessions for weeks 2-4 on average took 20 minutes. All MI sessions were conducted by the PI who holds a MI certification through Pyschotherapy.Net, an organization approved through the American Psychological Association. A visual summary of the study design along with a timeline of the measurements and intervention can be seen in Figure 2.

Measures

Primary Behavior Measures **(***all measures were performed pre and post intervention)*

Physical activity and sleep. Since self-reported physical activity is biased to sociability and recall bias, seven days of 24-hour activity (excluding water based activities) were objectively measured on the non-dominant wrist using Actigraph GT9x accelerometers where the vector magnitude of mean counts performed per day were the physical activity outcome (Jaeschke et al., 2020). Participants recorded non-wear time, “lights out” and wake-up times. To estimate in-bed and out-of bed times, two coders independently identified bedtimes using participant logs and visual inspection of the data. For times that differed by more than 15 minutes, data was re-examined, and a consensus was reached for total time asleep. Participants completed the Physical Activity Questionnaire (IPAQ-LF) (Craig et al., 2003) to capture the context of physical activity performed. The IPAQ-LF has a criterion validity of $\rho = 0.30$ (Craig et al., 2003) when compared to an accelerometer which is similar criterion of other self-reporting measures (J. F. Sallis &

Saelens, 2000). Each physical activity domain of the IPAQ-LF is broken down into frequency and duration of walking, moderate, and vigorous levels of physical activity. The variables of specific interest included total Metabolic Minutes (a unit of energy expenditure) per week ($MET \cdot min \cdot wk^{-1}$) for each domain and intensity. $MET \cdot min \cdot wk^{-1}$ quantifies the minutes of energy expenditure from physical activity each week (Haskell et al., 2007). The MET values utilized for scoring will include 3.3 METS for walking, 4 METS for moderate physical activity, and 8 METS for vigorous physical activity. For example, 30 minutes of walking equals 99 MET·min. The appropriate METS values were multiplied by minutes the activity was performed and then multiplied by days of the week for walking, moderate physical activity, and vigorous physical activity. These scores were summed with each domain and then summed across all domains for the total physical activity.

Secondary Behaviour Measures **(***all measures were performed pre and post intervention)*

Physical fitness. Participants completed a pre-intervention online questionnaire and then performed a fitness assessment that follows ACSM recommendations to measure the five components of physical fitness (Riebe et al., 2018). To assess cardiorespiratory fitness, participants completed the one mile walk test, a valid and reliable method to estimate a VO2 max (Kline et al., 1987). Validated equations were selected based on the age of participants to estimate VO2max (Dolgener et al., 1994; Kline et al., 1987).

Muscular grip strength was assessed using a hand grip dynameter (Takei T.K.K. 5401 GRIP-D handgrip dynamometer; Takei Scientific Instruments Co., Ltd, Tokyo, Japan) as a valid and reliable (Vanesa et al., 2008) indicator of muscular strength (de Vries, 1980). Dominant and non-dominant hand grip strength was assessed and the highest scores from each arm will be summed together to form a total isometric grip strength score (Riebe et al., 2018). Muscular

endurance was assessed from the maximum number of push-ups completed during the push-up test (Canadian Society for Exercise Physiology, 2013), a valid and reliable measure for muscular endurance (Hashim, 2012). Female participants used a modified procedure where the pivot point for the push-ups is at the participant's knees, males' pivot points were from the toes. Flexibility was assessed via the Canadian Trunk Forward Flexion Test (Riebe et al., 2018), a valid and reliable method for measuring hamstring flexibility (Jackson & Baker, 1986), after completing a standardized stretching routine before the test. The maximum reached distance defined the participant's flexibility score. Participants' height and weight were measured according to American College of Sports Medicine's standardized procedures (Riebe et al., 2018) and participants underwent a DXA scan to measure percent body fat, a valid and reliable method for defining body composition (Haarbo et al., 1991).

Other physical and mental health factors. Participants completed an online questionnaire inquiring on medical history, sleep (Buysse et al., 1989), self-efficacy of exercise (Resnick & Jenkins, 2000), and mental health constructs of quality of life including happiness and depression, anxiety and stress scale (DASS-21) (Henry & Crawford, 2005). Participants first completed The Pittsburg Sleep Quality Index (PSQI), a validated self-rated questionnaire that analyzes sleep disturbances and quality over a one-month time span (Buysse et al., 1989), a global score were generated from the seven component scores ranging from 0-21. A score below global score below 5 indicates a "good" sleeper while a global score of 5 or above indicates a "poor" sleeper (Buysse et al., 1989). The PSQI global score, and both average sleep duration on a weekday and weekend are main variables of interest for sleep. The self-efficacy of exercise questionnaire is a valid and reliable instrument (Resnick & Jenkins, 2000) where a higher score on a 0-90 scale represents higher self-efficacy of exercise. The DASS-21 is a valid and reliable

measure for defining the severity of distress caused by depression, anxiety, and stress over the past week (Henry & Crawford, 2005). A score is totaled for depression, anxiety, and stress with higher scores indicating greater severity or frequency of these negative emotional symptoms.

Demographic Measures. Participants reported their age, year in school, sex, and medications used, and medical history in the demographics section of the online survey.

Implementation Measures. *These measures will be concluded in the post intervention portion of the study.*

Reach. The total students referred by mental health counselors to the exercise referral system across the span of four weeks were recorded. Then the total number of students who actually joined the referral scheme and then completed the program were totaled and defined the reach of the intervention. Adherence will was also assessed by tracking the number of sessions each participant attends.

Acceptability. To assess acceptability, following the 4-week intervention, participants from the MI group completed a follow-up online questionnaire including open-ended questions on their favorite part of the intervention, if they would continue participating in the intervention, what they would change, and if they wanted to provide any additional comments. Thematic analysis (Braun & Clarke, 2006) of the open-ended responses was conducted to develop key themes.

Feasibility. To assess feasibility, post interviews were conducted with CAPS staff to explore the feasibility and sustainability of continuing an exercise referral system within CAPS. These interviews were analyzed using thematic analysis (Braun & Clarke, 2006) to develop key themes from the interviews.

Procedures

Counselors had patients complete the Physical Activity Vital Sign which consisted of two questions:

1. How many days during the past week have you performed physical activity where your heart beats faster and you're breathing is harder than normal for 30 minutes or more?
2. How many days in a typical week do you perform activity such as this?(Greenwood et al., 2010)

Scores ranged from 0/0 to 7/7 where scores less than 5 indicate being physically inactive. When a patient was determined not to be meeting the physical activity guidelines counselors encouraged patients to scan a QR code for more information on the study and providing permission to a physical activity specialist to reach out to the patient. While recruiting from the general campus population, the physical activity specialist administered a survey explaining the inclusion criteria of the study. If students were interested and reported their full name and email address, the physical activity specialist would then have the person complete the Physical Activity Vital Sign. After being deemed as physically inactive, the physical activity specialist then asked the patient to complete the online questionnaire that seeks information about topics including sleep (Buysse et al., 1989), self-efficacy of performing physical activity (Resnick & Jenkins, 2000), and mental health constructs of quality of life including happiness and depression, anxiety and stress scale (DASS-21) (Henry & Crawford, 2005), the international physical activity questionnaire- long form (IPAQ-LF) (Craig et al., 2003). Participants then visited the Exercise Science Research Center and completed a pre-intervention fitness assessment. Following the fitness measures, participants wore Actigraph, GT9x accelerometers for one week.

After completing the pre- measures, participants were randomized (via flipping a coin) and were evenly divided among the standard care group and the motivational interviewing group. The one time physical activity consultation for the standard care group was completed after the fitness assessment and participants were emailed the educational brochure. The motivational interviewing group received an educational brochure, an individualized exercise program, and four one-hour weekly face-to-face MI sessions over four weeks. After the four weeks the participants completed the post measures with the addition of completing a follow-up online questionnaire.

Data Analysis

A series of repeated measured ANCOVAs while controlling for age and sex determined differences between pre- and post-estimated VO_2 max, percent body fat, muscular strength and endurance scores, flexibility scores, IPAQ scores, self-efficacy scores, mean counts per minute, and DASS-21 scores with main effects of time and the group-by-time interaction was used. Both non-parametric and parametric tests were ran to check for equivalent results. If equivalent, parametric results are reported for interpretation. STATA 15.1 software (StataCorp, 2017) was used to conduct the analyses where a p-value less than or equal to 0.05 indicated statistical significance. It was hypothesized that the MI group show more positive changes for the pre to post measures. Reach was calculated by totaling the number of students who visited the counseling and psychological services across four weeks. Then the number of students who actually joined the referral scheme as well as the total number of students who completed the post measures was totaled. Acceptability and feasibility themes informed the researchers of next steps to take with the interventions such as adapting an aspect of the intervention to make the

intervention more acceptable or feasible so future studies can implement the intervention to a larger scale.

Results

Implementation

Reach

There are 22 clinicians within the respective CAPS. There is an average of 110 new intakes a month where most of the referring to resources takes place. Three counselors agreed to refer patients to the study. However, only one counselor ended up making actual referrals. The counselor on average sees 20 clients a month. In the month of referring for the study, the counselor referred 14 patients to the research study. Out of the 14 referrals, 1 patient expressed they wanted more information on the research study. The PI reached out to the patient via email, but the person never responded. When recruiting the broader campus, 157 initial inquiries were received, 21 participants were invited and completed baseline measures, but one participant withdrew prior to starting the physical activity counseling intervention due to time difficulties. One participant was unable to complete all post testing due to a lower limb injury unrelated to the physical activity intervention.

Adherence

The adherence of the MI Group included 100% as all counseling sessions were successfully attended.

Acceptability

Thematic analysis of open-ended survey responses exploring their favorite part of the intervention, if the participant would continue (why/why not), and what the participant would change of the intervention. Overall, participants demonstrated an overall theme of being Supportive of the Intervention. The most prevalent subthemes included Accountability (*n* =

6/10), Would Continue the Intervention- Helpful (*n* = 7/10), and Would Not Make Changes (*n* = 6/9). One participant noted that, “I loved the accountability and encouraging/cheering sessions. The fact that I was being held accountable spurred me to action.” Other participants expressed similar responses. For continuation of the intervention, one participant also reported, “I would [continue] because it has only brought positive aspects to my life.” Other participants expressed similar response. Lastly, many participants would not make changes to the physical activity counseling program. One participant’s response included, “Nothing! It had the desired effect -- do more physical activities!”

Feasibility

After interviewing the one counselor who made referrals, the major themes of the interview included the exercise referral scheme was feasible, there were barriers for students to follow-up on the referral, and there were also barriers and potential facilitators for making the exercise referral scheme more feasible. The counselor stated, “I’d say the process was feasible, having the handouts and visual representation was helpful for students.” The counselor mentioned, the difficulty with referrals in general for students “follow up for students seems to be the difficulty for referrals [in general]…. I would say probably comfortability a lot of students that come in tend to have some social anxiety of some type and so coming into CAPS alone is a feat for them, and so one more process can seem pretty daunting.” The counselor reported, a specific barrier to the exercise referral included some students faced “hesitation to use exercise as a mental health treatment” or some students “couldn’t add one more thing to their life.” The counselor also mentioned a barrier to get counselors to refer included “we just get really overwhelmed with a lot of referrals…” In order to facilitate more exercise scheme referrals, the counselor mentioned getting more counselors buy-in to refer. For example the counselor stated

"my hope is for the next step is to get more counselors referring and to be able to help with this process, so I think more papers or more referrals we hand out, the more people or students are going to follow up."

Demographics and Baseline Values

Twenty-one participants, (MI group: n = 10, n = 7 (70%) females; standard care group: n = 10, n = 8 (80%) females), began the intervention. Of the participants, 12 were undergraduate students while 8 were graduate students. The participants came from diverse colleges (4 out of 6 colleges). The majority of the sample was white (75%). The mean age was 26.15 (treatment: M = 29.2, SD = 13.5); standard care: (M = 23.1, SD = 4.3) and ranged from 18 to 64 years. Baseline values of female and male participants can be seen in Table 1. Baseline values of outcome groups can be seen in Tables 2 and 3.

Physical Activity and Sleep Outcomes

A summary of physical activity at baseline and post-intervention for both the MI and standard care groups is presented in Table 2. At baseline, there were no differences between groups in any of the physical activity or sleep variables. There was no significant group by time interactions for any of the physical activity or sleep variables.

Secondary Fitness and Health Outcomes

A summary of pre and post-secondary fitness and health outcomes for both the MI and standard care groups is presented in Table 3. At baseline there was no significant difference between groups in any of the fitness or health outcomes. There were beneficial and significant group by time interactions for VO2 max (change = 2.3 ml/kg/min), muscular strength (change = 3.1 kg), depression DASS-21 score (change = -1.7), stress DASS-21 score (change = -2.5), and

total DASS-21 score (change = -5.1), indicating the MI group had more beneficial changes in scores versus the standard care group.

Discussion

The study assessed the reach, acceptability, and feasibility of an exercise referral scheme among undergraduate students seeking mental health services at a large public university and determined the preliminary effectiveness of an exercise referral scheme on physical activity and health outcomes. Low reach was found within the counseling center despite the referral process being perceived by a counselor as feasible. Therefore, in order to still test the intervention, physically inactive students from the broader campus community were recruited as participants. The MI group participants were overall supportive of the intervention and demonstrated high adherence. There was no significant group by time changes in physical activity or sleep measures between the treatment and standard care group. However, the MI group demonstrated beneficial and significant changes in fitness and mental health scores.

The low reach of CAPS patients could be explained by only having one out of 22 CAPS clinicians making referrals to the study as well as low patient motivation to follow through with the referral. The one counselor who did refer patients perceived the referral process as feasible, but the counselor also mentioned high volume of referrals to other services and low counselor buy-in to refer were barriers for more counselors to make referrals to the exercise referral scheme. Educating counselors on the benefits of physical activity may promote counselor buy-in and allow counselors to better understand when to refer patients to physical activity specialists. Educating counselors can promote self-efficacy (Bandura, 1986) of referring to a physical activity specialist and help alleviate the ambivalence when choosing the proper referral. However, education or training for counselors is not emphasized in behavioral physical activity

(Dixon et al., 2003) which is similar to other medical professionals such as doctors as physical activity or exercise education seems to be lacking in medical school curriculum too (Cardinal et al., 2015). To increase the buy-in of patients, it may be important to target the counseling center as a whole. For example, The Social Ecological Model of Health Promotion (McLeroy et al., 1988) demonstrates that targeting organizations or counseling centers as a whole to promote physical activity and recognize an ERS as a normal treatment option, may positively influence the individual level or motivate patients to join the ERS scheme. More research is necessary to understand how to effectively navigate the mentioned barriers in implementing an ERS into a counseling center in a large university.

Despite having low reach of counseling patients, the study demonstrated both groups when including participants from the broader campus community there was no group by time interaction effects on device-based physical activity and sleep measures. When comparing the results of the current study to a comparable ERS, conflicting results were found. Murphy et al. (2012) compared patients with mental health conditions in an ERS using MI (n = 41) to usual care (n = 38) (including a leaflet overviewing the benefits of physical activity) and found no effect on self-reported physical activity. The current study did have increases in self-reported total physical activity in both groups. The current study did not utilize a sample of patients with mental health conditions, which may explain the disagreement in results. Other ERS that have seen intervention effects on self-reported physical activity (Chalder et al., 2012; Duda et al., 2014). However, there is a general consensus that self-report estimates of absolute physical are prone to biases (e.g. recall, social desirability, etc.) and inaccurate (J. F. Sallis & Saelens, 2000). Uniquely, the currently study utilized a device-base measure of physical activity and college students specifically, but no significant group by time interaction was observed. Objective

measures of activity did not detect a change in total daily mean physical activity. This may be due to potential washout of short bursts of physical activity, no changes in actual movement, or physical activity such as weight lifting, cycling, or swimming was not well captured by an accelerometer. College students in general show large amounts of sitting time or sedentary behavior, but have reported that studying accounts for the majority of the times spent sitting (Buckworth & Nigg, 2004). Thus, even increasing physical activity in a short burst of 30 minutes could get washed out due to the academics demands college students experience throughout the whole day. The MI group did show an increase in average steps per day over time whereas the standard care group's average steps decreased. This difference was not significant, but still demonstrates a positive trend. The current study also demonstrated no significant group by time interaction in device-based sleep duration. As physical activity does have positive effects on sleep (Kredlow et al., 2015), many factors beyond the control of the study can influence sleep duration including work demands, studying, social activities, and so forth. Future studies are necessary to continue to investigate the effects of MI on both objective measured physical activity (e.g. vector magnitude and step counts) and self-reported physical activity, but also cardiovascular fitness (another objective indicator of physical activity (Blair et al., 1989)) with a larger sample. Future works should also specifically target patients seeking mental health treatment in colleges in the US too as the effects of MI on this population's physical activity and physical fitness remains unknown.

Interestingly, without a significant increase in device-based physical activity, there were still significant group by time interaction effects for percent body fat, VO2max, muscular strength, depression DASS-21 scores, stress DASS-21 scores, and total DASS-21 scores. Though many ERS have not evaluated fitness measures, Buckely et al. (2020) found a similar change

(2.4 ml/kg/min) in cardiovascular fitness after 12 weeks in a counseling based ERS. Though the current study was a shorter intervention, increases of ≤1 ml/kg/min in cardiovascular fitness of at risk-populations demonstrates to have beneficial and significant changes in clustered cardiometabolic risk (Simmons et al., 2008), which indicates the MI group demonstrated a clinically significant change in cardiovascular fitness. Though, clinical significance has yet to be defined with percent body fat and muscular strength, these measures have shown to relate to all-cause mortality (Fitzgerald et al., 2004; C. D. Lee et al., 1999). Thus, the significant improvements demonstrated on percent body fat and muscular strength can have positive effects on overall health. This is the first study to evaluate the MI effects on fitness in an ERS scheme, which demonstrate promising results as fitness measures do not depend on self-report. Also, mental health demonstrated to improve in the MI group. The current results are again similar to Murphy et al. (2012) results, they found significant lower levels of anxiety/depression in the intervention group with patients with mental health conditions in the UK. Future studies should continue to investigate the effects of MI on physical fitness and mental health with longer follow-up measures to see if these positive changes are maintained or continue to improve over time. Also, patients seeking mental health care treatment should continue to be recruited to see if MI has the same positive effects on this specific population's physical fitness and mental health.

The overall inconsistent outcomes of the current study between physical activity, physical fitness, and mental health results within the current ERS may be explained by the MI group being physically active during the intervention but not on their own when wearing the accelerometer. Overall, participants were supportive of the intervention with the majority of the MI group's favorite part being the "accountability" for being physically active. Accountability can promote feelings of responsibility, fulfillment, and motivation, which supports positive self-

regulation of a behavior (Bandura, 1986). Through the accountability of the MI sessions, participants may have experience positive self-regulation for performing physical activity. However, there was less accountability during the post measurement of physical activity as there was no MI session during the post measurement week since the intervention was completed. Thus, the motivation and self-regulation to continue to be physically active may have decreased during the post measurement of physical activity. There was also no group by time effect on the self-efficacy of exercise scale scores. Though MI typically demonstrates to increase self-efficacy of a behavior (Hettema et al., 2005), participants in the MI group did not increase self-efficacy despite the intervention's attempt at promoting mastery experiences, social persuasion, and observations of psychological responses of exercise. This could also explain why objective measures of physical activity did not increase. MI did demonstrate to promote positive social-environmental factors (i.e. social support, accountability, etc.) that can positively influence mental health (Markland et al., 2005). Future studies should test whether it is MI sessions, in general, are improving mental health outcomes or if it is the physical activity itself during an intervention.

Limitations

The findings of this study are limited by the small convenience sample made up mostly of females (75%), which limits the generalizability of the results to other populations. Not all fitness measures were measured by gold standard methodology, however, the fitness tests used were valid measures of the respective measure. Also, the ERS was only 4 weeks, but 4 weeks has been previously shown to improve fitness (Saulicz et al., 2015). It is unknown if these changes or the intervention would be maintained during a longer term intervention. It is possible the MI group was more motivated to perform well on the fitness tests compared to the standard care

group. The principal investigator tried to alleviate this bias by not releasing results of either fitness test till after the study. The PI also did have standardized instructors to asking each participant to try their best on each fitness assessment. Overall, this is a novel pilot study that shows potential for improving fitness and mental health of college students within an ERS.

Conclusion

University counseling centers are a health care setting where patients may benefit from physical activity promotion. More work is necessary to develop effective strategies to overcome low buy-in of counselors to refer to an ERS. Also, effectively promoting physical activity as a treatment option at the organizational level through counseling centers may influence behavior at the individual level or improve patient motivation for joining an exercise referral scheme. MI sessions to increase physical activity did have positive effects on fitness and mental health scores in a broader student sample, but not the primary outcome, device-based physical activity. The MI group indicated they were supportive of the intervention. However, interventionists must continue to investigate effective behavioral change techniques for increasing device-based physical activity of college students. Incorporating a behavioral change technique that promotes long term accountability and self-regulation may be more effective for increasing physical activity over time. Future studies should continue to investigate physical activity interventions within student mental healthcare to continue to promote positive physical activity habits to ultimately improve both physical and mental health on college campuses.

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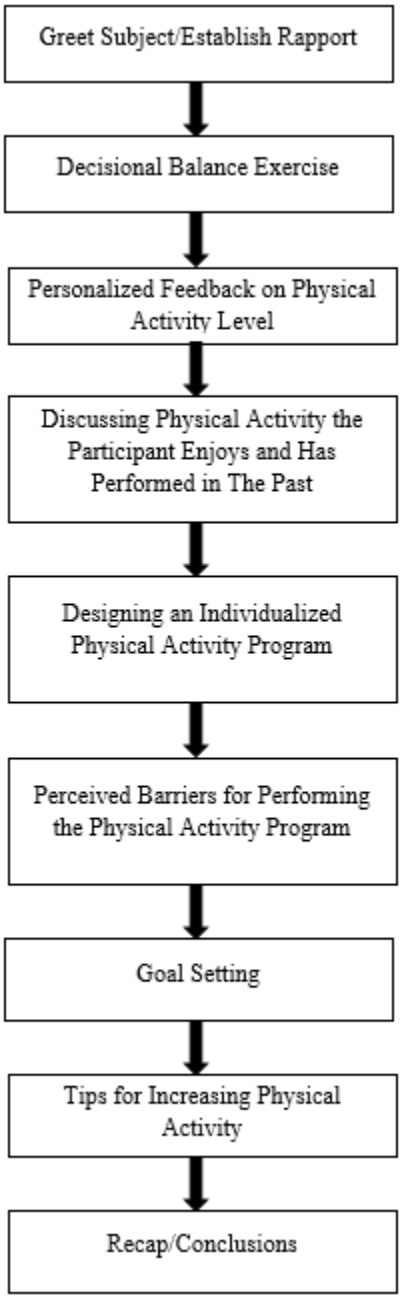
Appendix

Figure 1. *Outline of First Motivational Interviewing Session*



Adapted by (Martens et al. 2012)

Figure 2. *A Visual of the Study Design and Timeline*

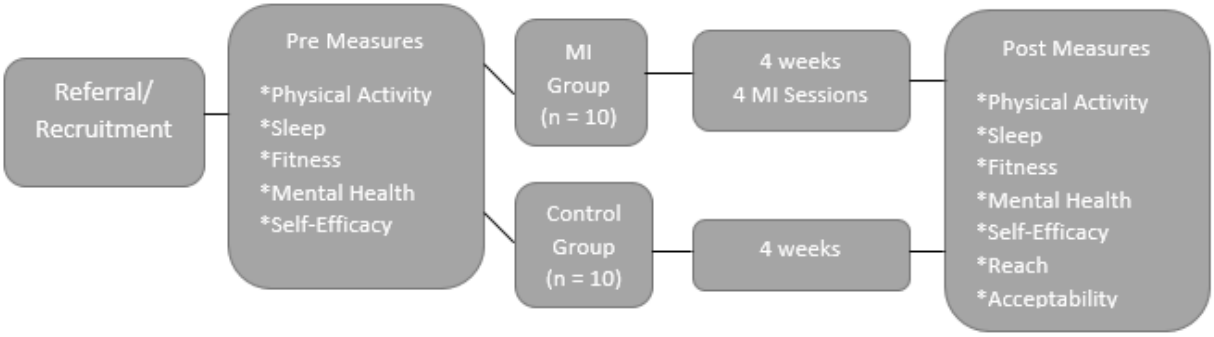


Table 1. *Baseline Measures of Male and Female Participants*

Measure	Female (n =15)	Males (n = 5)
Demographics		
Age (years)	26.8 (11.6)	24.2 (4.7)
Student Status	10 undergraduate, 5 graduate	2 undergraduate, 3 graduate
Physical Activity		
Leisure MET-min/Week	137.2 (199.4)	126.7 (189.3)
Sleep		
PSQI Score	6.9 (2.9)	6.2 (4.8)
Fitness		
BMI	25.9 (7.1)	25.2 (7.4)
% Body Fat	39.46 (8.6)	25.24 (15.2)
Relative VO2 (ml/kg/min)	33.2 (6.4)	41.12 (7.3)
Exercise Self-Efficacy	46.07 (22.6)	52.4 (24.9)
Mental Health		
Total DASS-21 score	15.2 (9.1)	16.6 (12.5)

Note. Values are shown as mean (SD)

Table 2: *Summary of Pre and Post Physical Activity and Sleep Outcomes for MI Group and Standard Care Groups*

	MI Group			**Standard Care Group**			
	Pre	Post	Change	Pre	Post	Change	Time*group (p-value)
Physical Activity							
Vigorous (min/day)	2.0 (2.7)	8.3 (2.8)	6.3 (3.8)	0 (2.8)	6.5 (2.8)	6.5 (3.9)	.960
Moderate (min/day)	17.4 (13.3)	69.0 (14.1)	51.6 (18.7)	24.0 (14.1)	42.1 (14.1)	18.1 (19.1)	.210
Walking (min/day)	36.3 (11.5)	44.9 (12.0)	8.6 (12.9)	31.7 (12.1)	48.2 (12.1)	16.5 (13.1)	.667
Total MET-min/Week	1000.0 (91.6)	2818.4 (91.6)	1818.4 (123.8)	1148.2 (96.5)	2089.3 (96.5)	941.1 (126.3)	.254
Leisure MET-min/Week	114.8 (227.6)	763.8 (240.3)	649 (319.3)	140.4 (239.6)	704.3 (239.6)	563.9 (326.3)	.852
Vector Magnitude (counts/min)	2221.5 (163.2)	2274.1 (111.5)	52.6 (141.0)	2176.8 (172.2)	2020.0 (172.2)	-156.8 (142.1)	.296
Steps/day	11419.5 (760.0)	12386.0 (787.3)	966.5 (682.0)	11382.1 (796.0)	10750.3 (796.0)	-85.0 (687.5)	.278
Sleep							
PSQI Score	7.6 (1.0)	6.7 (1.0)	-0.9 (0.72)	6.0 (1.0)	6.8 (1.0)	0.8 (0.72)	.110
Sleep Duration (min)	379.4 (18.3)	334.1 (19.1)	-45.3 (20.0)	408.0 (19.3)	408.4 (19.3)	0.4 (20.3)	.108

Note. Values are shown as mean (SE) or median (25^{th}-75^{th}). [a]Mixed ordered logistic regression. Bolded values indicate $p < 0.05$

Table 3. *Summary of Pre and Post-Secondary Fitness and Health Outcomes for MI and Standard Care Group*

	MI Group			**Standard Care Group**			Time*group (p-value)
	Pre	Post	Change	Pre	Post	Change	
Fitness							
Weight (lbs)	159.6 (15.4)	159.7 (15.4)	0.1 (0.89)	154.5 (16.2)	155.6 (16.2)	1.1 (0.91)	.426
% Body Fat	35.3 (3.4)	34.8 (3.4)	-0.50 (0.35)	35.9 (3.6)	36.8 (3.6)	0.90 (0.35)	**.006**
Relative VO2 (ml/kg/min)	34.0 (2.0)	36.3 (2.0)	2.3 (1.1)	37.0 (2.0)	35.0 (2.0)	-2.0 (1.0)	**.004**
Muscular Strength	59.6 (3.29)	62.7 (3.3)	3.1 (1.5)	59.1 (3.5)	55.0 (3.5)	-4.1 (1.5)	**.001**
Muscular Endurance	11.8 (3.0)	17.0 (3.1)	5.2 (1.4)	7.6 (3.2)	11.9 (3.2)	4.3 (1.4)	.683
Flexibility	25.7 (4.1)	27.8 (4.2)	2.1 (2.2)	29.9 (4.4)	33.0 (4.4)	3.1 (2.2)	.750
Exercise Self-Efficacy	55.0 (6.3)	47.5 (6.6)	-7.5 (6.0)	39.4 (6.7)	44.2 (6.7)	4.8 (6.1)	.153
Mental Health Scores							
Depression	4.3 (1.2)	2.6 (1.2)	-1.7 (0.50)	3.4 (1.3)	5.1 (1.2)	1.7 (0.50)	**< .001**
Anxiety	5.2 (1.2)	4.8 (1.3)	-0.4 (1.0)	3.5 (1.3)	3.3 (1.3)	0.2 (1.0)	.873
Stress	7.7 (1.4)	5.2 (1.5)	-2.5 (1.3)	5.4 (1.5)	7.7 (1.5)	0.7 (1.3)	**.007**
Total DASS-21 Score	19.1 (3.3)	14.0 (3.4)	-5.1 (1.9)	12.0 (3.3)	15.8 (3.3)	3.8 (1.9)	**.001**

Note. Values are shown as mean (SE). [a]Mixed ordered logistic regression. Bolded values indicate P < 0.05

Semi-Structured Interview Questions with Counselor

- Would you consider the referral process to the exercise referral scheme as feasible? Why?
- What, if any, barriers did you encounter in the referral process to refer clients to the physical activity specialist?
- What, if any, facilitators helped you in the referral process to refer patients to the physical activity specialist?
- Why do you think students chose not be reach out to the physical activity specialist?
- What, if anything, would you change about the program to make it more feasible for clinicians or CAPS? What would you change about the program to make it more feasible for students?
- Would you consider the exercise referral program to be a sustainable program for CAPS moving forward? Why?
- What do you believe could make the program more sustainable for CAPS and clinicians?

UNIVERSITY OF ARKANSAS

To:	Bryce T Daniels
From:	Douglas J AdamsJustin R Chimka, Chair IRB Expedited Review
Date:	01/10/2022
Action:	**Expedited Approval**
Action Date:	01/10/2022
Protocol #:	2107345696A002
Study Title:	Exercise is Medicine On Campus- the implementation and effects of an exercise referral scheme using physical activity counseling
Expiration Date:	08/11/2022
Last Approval Date:	01/10/2022

The above-referenced protocol has been approved following expedited review by the IRB Committee that oversees research with human subjects.

If the research involves collaboration with another institution then the research cannot commence until the Committee receives written notification of approval from the collaborating institution's IRB.

It is the Principal Investigator's responsibility to obtain review and continued approval before the expiration date.

Protocols are approved for a maximum period of one year. You may not continue any research activity beyond the expiration date without Committee approval. Please submit continuation requests early enough to allow sufficient time for review. Failure to receive approval for continuation before the expiration date will result in the automatic suspension of the approval of this protocol. Information collected following suspension is unapproved research and cannot be reported or published as research data. If you do not wish continued approval, please notify the Committee of the study closure.

Adverse Events: Any serious or unexpected adverse event must be reported to the IRB Committee within 48 hours. All other adverse events should be reported within 10 working days.

Amendments: If you wish to change any aspect of this study, such as the procedures, the consent forms, study personnel, or number of participants, please submit an amendment to the IRB. All changes must be approved by the IRB Committee before they can be initiated.

You must maintain a research file for at least 3 years after completion of the study. This file should include all correspondence with the IRB Committee, original signed consent forms, and study data.

cc: Erin K Hickey, Investigator
Michelle Gray, Key Personnel
Robert E Davis, Key Personnel
Kaitlin M Gallagher, Key Personnel
Andrew Wayne Shelley, Key Personnel
Savannah D. Hart, Key Personnel
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Lilli-Anna R Baca, Key Personnel

VI. Overall Conclusions

Exercise referral schemes (ERS) are comprised of a health professional identifying a patient to be physically inactive, referring the patient to a physical activity specialist, and then consulting with the patient about how to increase physical activity (NICE, 2014). Based on the definition of ERS, all three research studies in the current dissertation were related to the different components of an ERS. The first study (Study 1) investigated how to incorporate physical activity as possible treatment into college counseling clinics through either counselors (health care professional) prescribing physical activity or counselors referring to a physical activity specialist. The second study (Study 2) investigated correlates of physical activity of college students to assist physical activity specialists in understanding factors that increase are associated with higher levels of physical activity, which may lead to better consulting with patients. The third study (Study 3) assessed the implementation and effects of using MI in an exercise referral scheme within a college counseling center.

All three studies offered novel findings relating to an ERS within student mental health care. Study 1 demonstrated counselors recognized physical activity is important for treatment of mental health needs of their patients. Counselors also had supportive attitudes and presented specific barriers to both prescribing physical activity to patients and towards referring patients to a physical activity specialist. Study 2 found Conscientiousness was related to all physical activity measures except for active transport, and high school sports participation was related to vigorous physical activity and leisure time physical activity. Conscientiousness was also the best predictor for physical inactivity, overall. Study 3 found the ERS had low reach within the university counseling center, but generated more interest in the broader campus. Participants of the treatment group were supportive of the intervention and showed high adherence. There was no

significant improvements in the MI group on device-based physical activity. However, there were significant improvements for the MI group on percent body fat, VO2max, and mental health scores.

In addition to the unique, independent findings from each study, together this dissertation highlighted three overall findings. First, the three studies identified a common need to continue to promote physical activity on college campuses. The overarching problem on college campuses still remains as many students are physically inactive (American College Health Association, 2018; Arias-Palencia et al., 2015; Dinger et al., 2014; Ghrouz et al., 2019; Kwan et al., 2013) and mental health symptoms and conditions are prevalent (Oswalt et al., 2020). From Study 1, counselors identified that their student patient population needs to be performing physical activity as 86% of the counselors reported to often discuss physical activity with patients and 93% believed patients could benefit from increasing their physical activity. From Study 2, 15% of the sample self-reported to being physically inactive. Though, self-reported total physical activity is usually overestimated due to biases (e.g. social desirability or recall) (Sallis & Saelens, 2000). Thus, this is likely an overestimate of PA. Study 3 demonstrated that a counselor on average sees 20 patients a month, and when referring for the study, 14 patients were considered physically inactive. Future studies should continue to investigate implementing ERS into student mental healthcare in an effort to increase physical activity on college campuses.

Study 1 and Study 3 are foundational in better understanding the implementation of an ERS into a college counseling center, which no other studies to my knowledge have done before. Study 1 was conducted before Study 3 to understand factors to be aware of before implementing an ERS. Study 1 demonstrated that the majority of counselors perceived referring to a physical activity specialist (the start of an ERS) to be the most feasible method to include physical activity

as a treatment option for student mental health care. However, they also recognized barriers in referring to a physical activity specialist including patients having low motivation to follow through with the referral. When asking counselors to actually make referrals to a physical activity specialist in study 3, only 1 out of 22 clinicians made the referrals. The one counselor who did make the referral, however, found the process feasible; the counselor mentioned high volume of referral to other services and low counselor buy-in to refer were barriers for more counselors to make referrals to the exercise referral scheme. Interestingly, the perceived feasibility from the counselors in Study 1 was different than the actual feasibility evaluated in Study 3. Thus, to reconcile perceived barriers compared to actual barriers in future interventions it is important to assess the actual implementation of an ERS and qualitatively evaluate study personnel throughout the ERS. Similarly, Study 1 and Study 3 did show that patient motivation to follow through with the referral was a barrier with referring to a physical activity specialist. In study 1, 53% of counselors had a negative outcome expectation that patients may not be motivated. In Study 3, 0/14 referrals joined the ERS and in the follow up interview the counselor indicated patient motivation was a barrier along with patients showing hesitation towards physical activity as a treatment for mental health. Based on The Social Ecological Model of Health Promotion (McLeroy et al., 1988), targeting organizations or counseling centers as a whole to promote physical activity and recognize an ERS as a normal treatment option, may positively influence the organizational level, and therefore, the individual level for counselors to refer patients to a physical activity specialist or motivate patients to join the ERS scheme. More research is necessary to understand how effectively educating counselors and administrators on physical activity and how gaining organizational level support can influence the mentioned barriers in implementing an ERS into a counseling center in a large university.

After a health care provider refers to a physical activity specialist in an ERS, the physical activity specialist consults with the patient to increase physical activity. Many ERS have been theory-based (Buckley et al., 2020; Duda et al., 2014; Pavey et al., 2011; Rowley et al., 2018), but there is flexibility within each ERS to utilized different methods for increasing physical activity of patients including using group exercise classes (Chalder et al., 2012), personal training sessions (Murphy et al., 2012), and counseling techniques ((Duda et al., 2014). This dissertation identified and tested specific strategies and concepts connected to The Social Cognitive Theory (Bandura, 1986) to assist the physical activity specialist when trying to increase the physical activity of patients. First, when implementing an ERS in student mental health care, Study 1 identified the importance of utilizing a physical activity specialist as 71% felt they lacked the competency to prescribe physical activity. Study 2 demonstrated that in college students Conscientiousness is the strongest correlate of physical activity and may promote positive physical activity self-regulation (Bandura, 1986). Conscientiousness qualities align well with self-regulation strategies (e.g., goal setting, self-monitoring) which demonstrates to be related to physical activity (Umstattd et al., 2009). Study 3 promoted strategies that relate to Conscientiousness and self-regulation within the MI sessions including self-monitoring. The MI group showed significant improvements for key fitness measures and mental health: however, there was were no significant improvements for device-based physical activity. MI group participants noted the accountability of MI sessions was their favorite part of the intervention. There was no MI session the week of collecting post device-based physical activity, which means less external accountability. This may explain why device-based physical activity did not increase. Perhaps designing an intervention with MI paired with standardized self-regulation strategies may promote more conscientious qualities and more internal accountability

for the participants. Future studies should test interventions based on conscientious qualities (e.g. attention to detail, organization, and self-control) and self-regulation techniques and investigate if conscientious qualities can promote more internal accountability versus external accountability over time.

Limitations

The common limitation across all three studies includes convenience sampling with female dominant samples. The samples are unlikely to be represented representative of the intended populations, thus limiting the generalizability of the results of the dissertation as a whole. Also, participants across all studies may have had positive biases towards physical activity as opposed to people who did chose not to join the study. People who did not participate may have shown different results by potentially not being supportive in including physical activity into therapeutic works, their personalities could demonstrate weaker relationships to physical activity, and less willing to change their physical activity habits in Study 3. More limitations specific to Study 1 included the lack of direct observation of participants with patients. For example, counselors were never observed during appointments to see physical activity was currently included into therapeutic works. Counseling centers pose unique research barriers with confidentiality laws where observations of appointments are often not feasible. However, the counselors were encouraged to be transparent and honest for each question. Themes developed could also be limited by researcher bias. But, necessary trustworthiness methods including a bracketing journal, member checks and auditing, were used in an attempt to limit these biases. For study 2, the cross-sectional design limits data to only associations and not causation. More work is necessary to determine if Conscientiousness influences physical activity, if physical activity influences Conscientiousness, or Conscientiousness and physical

activity may be related to some other confounding factor and don't have a causal relationship. Self-reported physical activity as opposed to device-based physical activity measurement is also a limitation. However, device-based physical activity lacks the context or domains of the physical activity performed, which was found to be important in Study 2. Also, the binary nature of the high school sports participation question does not capture the full context of the sports performed or if they continued playing sports all through high school. Athletes that played high school sports all through high school may have a different relationship to physical activity verses athletes that did not play sports all the through high school. For study 3, the ERS was only 4 weeks, but 4 weeks has been previously shown to improve fitness (Saulicz et al., 2015). It is unknown if these changes would be maintained after more longitudinal follow up. However, this is a novel study that shows potential for improving fitness and mental health of college students within an ERS.o

Considerations for Future Research

The findings from this dissertation bring forth additional considerations for future studies. First, the ERS was not successful in student mental health care mainly due to low counselor buy-in and low patient motivation. This was despite the PI explaining the overall aims and procedures for referring to clinicians of the college counseling center. Also, the PI designed a QR code for patients to release contact information so the PI could reach out to the patient to inform them more on the study. Future studies could develop a formal physical activity training designed for counselors and administration with evidence-based practices including Interactive Learning Education (Snell, 1999), audit and feedback (Powell et al., 2015), Collective Efficacy (Sampson et al., 1997), and Discussion and Application (Powell et al., 2015) to increase physical activity general capacity of counselors. Educating counselors on the benefits of physical activity and

what physical activity specialist do may help overcome barriers counselors are facing with referring to a physical activity specialist. Next, future work can continue to design interventions that promote more self-regulation strategies and conscientious qualities that can promote long term physical activity on students with mental health symptoms because the dissertation only tested the effects of the intervention on college students who were interested in improving their physical activity. Future studies may also investigate the implementation of an ERS in a private practice mental health care clinic and aim for a more diverse sample of participants at a different stage in life to see what the effects of an ERS could be in mental health care beyond a college campus.

Conclusion

Overall, the dissertation aimed to investigate the implementation of an exercise referral scheme for promoting physical activity in university mental health care. The ERS was ineffective within the university counseling setting; zero patients were successfully referred to a physical activity specialist. The intervention that was originally planned to be within the ERS was still tested with the broader population of campus outside the counseling center. MI showed to have positive effects on fitness and mental health, but did not demonstrate changes in objectively measured physical activity. Incorporating behavioral change techniques that promote long term internal accountability and self-regulation may be more effective for increasing device-base physical activity over time. Future studies should continue to investigate the implementation of physical activity interventions within student mental health care in an effort to continue to promote positive physical activity habits to ultimately improve both physical and mental health on college campuses.

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