Relationships Between Physical and Mental Health in Rural, Low-Income Adolescents

by

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[anxiety; depression; health education; health policy; sport and physical activity; stress]

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Abstract

Studies have consistently reported that environment (i.e., rural vs. urban) and socioeconomic status (SES) are moderating factors of physical health (i.e., obesity and/or physical activity) and mental health (i.e., stress, anxiety, and depressive symptoms) in adolescents and adults. Additionally, relationships between physical and mental health have been shown in adolescents; however, research has not addressed these relationships in those from low-income or rural backgrounds. The present program of research aims to: (1) characterize physical and mental health in rural, low SES adolescents, (2) investigate the relationships between physical and mental health in this population, and (3) investigate longitudinal changes in mental and physical health.

We hypothesized that (1) elevated rates of obesity, stress, anxiety, and depressive symptoms would be observed and would be influenced by sex, (2) body composition and self-esteem/body image would be related to anxiety, depression, and stress and that these relationships would be influenced by sex, and (3) longitudinal increases in stress, anxiety symptoms, depressive symptoms, and obesity would be observed. To address these aims, students in 10^{th} and 11^{th} grade at Title I schools in the rural, southeastern U.S. participated in a wellness fair program, during which mental health measures (i.e., stress, depression, anxiety), self-esteem, body image, physical health characteristics (i.e., physical activity level, body fat percentage, BMI, blood pressure, resting heart rate, number of sports), and physical fitness measures (i.e., push-ups, curl-ups, PACER) were collected. Relationships were assessed using stepwise linear models and Pearson correlations. Due to logistical issues, longitudinal analyses were not able to be evaluated.

The first hypothesis was supported. The rates of obesity, anxiety, and depressive symptoms observed were higher than previous state- and national-level estimates, and females exhibited increased anxiety, depressive, and stress symptoms compared to males. Additionally, males reported greater physical activity and sport participation than females. The second hypothesis was partially supported. As expected, bivariate correlations demonstrated positive relationships between body composition and mental health symptoms and negative relationships between body image and mental health and body composition. However, linear analyses with physical activity, sport participation, and demographics (sex and race) as factors, showed that physical activity was negatively related to anxiety symptoms in females and depressive symptoms in female athletes. These analyses also demonstrated that sport participation was associated with lower depressive and psychological stress symptoms, but only among Caucasian/White adolescents. Additionally, these analyses revealed positive influences of physical activity and sport participation on physical fitness.

These studies suggest that efforts must be made towards reducing both mental and physical health burdens among rural, low-income adolescents. The relationships observed between body composition, body image, and mental health suggest that mental health programs may benefit from the discussion of these topics. In particular, school-based programs that integrate physical and mental health education may be important to reduce these health burdens.

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List of Abbreviations

SES	Socioeconomic Status
NSCH	National Survey of Children's Health
YRBSS	Youth Risk Behavior Surveillance Survey
MVPA	Moderate-to-Vigorous Physical Activity
PROMIS	Patient Reported Outcome Measurement Information System
NIMH	National Institute of Mental Health
BSS	Body Shape Satisfaction Scale
RSES	Rosenberg Self-Esteem Scale
BMI	Body Mass Index
PACER	Progressive Aerobic Cardiovascular Endurance Run
SBP	Systolic Blood Pressure
DBP	Diastolic Blood Pressure
RHR	Resting Heart Rate
HFZ	Healthy Fitness Zone
NI	Needs Improvement
NI – HR	Needs Improvement – Health Risk

Chapter 1 – General Introduction

Adolescence represents a critical period during which problems in physical health (e.g., lower physical activity levels, increased obesity) (Gordon-Larsen, McMurray, & Popkin, 2000) and mental health (e.g., increased symptoms of depression, anxiety, stress) (Das et al., 2016) emerge and may lead to long-term health burdens (Das et al., 2016; Hallal, Victora, Azevedo, & Wells, 2006). It is estimated that 31.9% of adolescents ages 13- to 18-years have been or are currently diagnosed with an anxiety disorder (Merikangas et al., 2010) and 31.5% have experienced depressive symptoms (Center for Disease Control, 2017). Moreover, the estimated prevalence of these disorders has increased by as much as 37% from 2005 to 2014 (Mojtabai, Olfson, & Han, 2016). These internalizing disorders are commonly linked to suicide risk, which is the second leading cause of death among teens and young adults ages 10-24 years (Center for Disease Control, 2016).

Given the high comorbidity amongst anxiety, depression, and stress disorders (Kessler, Chiu, Demler, & Walters, 2005; Merikangas et al., 2010), symptoms of one disorder may be predictive of concurrent or future development of other internalizing mental health disorders. Indeed, adolescent depressive and anxiety symptoms predict later levels of stress symptoms (Shapero, Hankin, & Barrocas, 2013). Specifically, baseline anxiety and depressive symptoms predicted achievement stress and interpersonal stress, even after controlling for age and sex. Furthermore, a similar reciprocal relationship was found as baseline stress, achievement and interpersonal stress, predicted depressive symptom levels (Shapero et al., 2013). Therefore, it is important to examine these disorders together in order to understand the profile of internalizing symptoms in these populations.

In addition to the emergence of mental health issues during this period of development, adolescents are also at risk for physical health issues, particularly obesity and low physical activity levels. National surveys suggest that only 26.1% of high school students self-report meeting physical activity guidelines (i.e., 60 minutes of physical activity every day) with more males (35.3%) meeting physical activity guidelines than females (17.5%) (Kann et al., 2018). However, quantitative measurement via accelerometers report that far fewer adolescents actually meet these physical activity guidelines (i.e., 7.5% of 12- to 15-year-olds and 5.1% of 16- to 19-year-olds) (Katzmarzyk et al., 2016; National Center for Health Statistics, 2006). Elevated rates of obesity have also been reported with 14.8% of adolescents reporting being obese and 15.6% reporting being overweight (Kann et al., 2018). In Alabama, these rates are even higher with 18.2% of adolescents reporting being obese (Kann et al., 2018). Recent changes in in physical activity and obesity (Federal Interagency Forum on Child and Family Statistics, 2017) may be partially due to decreases in sport participation and increases in sedentary behaviors (Hu, Ramachandran, Bhattacharya, & Nunna, 2018).

As both mental and physical health issues are present in adolescents, recent research has begun to examine the relationships between these two domains. Indeed, research suggests physical and mental health are inter-related across development and adulthood (Biddle & Asare, 2011; Lubans & Morgan, 2008; Ströhle, 2009). For example, a longitudinal cohort study of Norwegian adolescents found an inverse relationship between physical activity and depression and anxiety in male adolescents ages 13-19 (Fløtnes, Nilsen, & Augestad, 2011). This study also found that body image may contribute to anxiety and depressive symptoms as well, particularly among

female adolescents (Fløtnes et al., 2011). More recently, results from another large European cohort study found that both greater physical activity levels and sport participation were associated with lower levels of depression and anxiety and better overall well-being for both male and female adolescents ages 14-16 (McMahon et al., 2017). Furthermore, Jewett et al. (2014) demonstrated that these effects are long-lasting such that sport participation during adolescence was associated with lower levels of depressive and stress symptoms in early adulthood. Although these studies provide support for the interrelation between physical and mental health outcomes in adolescents, these European and Canadian cohorts may not be representative of all adolescents such as those with limited access to medical care, lower socioeconomic status (SES), or countries with different education and health policies.

Environment (rural vs. urban), SES, and to a lesser extent race/ethnicity are moderating factors of physical health outcomes (i.e., obesity and/or physical activity) in adolescents. Specifically, adolescents from rural areas (Johnson & Johnson, 2015) and those from families with lower SES (Hanson & Chen, 2007) report lower physical activity levels and are more likely to be overweight or obese compared with those from urban areas or families with higher SES, respectively. Environmental barriers, such as lack of access to transportation, which may be common in rural areas are negatively associated with physical activity levels among adolescents (Kahn et al., 2008). Common barriers to participating in physical activity reported by rural adolescents include lack of opportunities outside of the school environment and physical distance/transportation (Edwards, Theriault, Shores, & Melton, 2014; Moore et al., 2010). Recent national data found that the prevalence of obesity was higher among both Black and Hispanic adolescents than White adolescents, regardless of sex (Kann et al., 2018). However, the influence

of race as a moderator of physical activity is less clear, as results differ between studies (National Physical Activity Plan Alliance, 2018). For example, the 2016 National Survey of Children's Health (NSCH) report found that a greater percentage of Black adolescents participated in 60 minutes of physical activity every day compared to White adolescents (Child and Adolescent Health Measurement Initiative & Data Resource Center for Child and Adolescent Health, 2017), while the 2017 Youth Risk Behavioral Surveillance System (YRBSS) found that more White adolescents reported being physically active for at least 60 minutes on 5 or more days than Black or Hispanic adolescents (Kann et al., 2018). While physical health disparities have been established among, rural, low SES, and minority adolescents, additional research is needed to understand how these factors individually, as well as cumulatively, influence physical health.

Evidence regarding the impact of SES and race on mental health status has also been mixed. A literature review found that low SES was associated with greater self-reported mental health difficulties among adolescents (Reiss, 2013), however data from a national survey found no relationship between SES and mental health diagnoses (Merikangas et al., 2010). These divergent findings may be related to the way in which mental health problems were operationalized (i.e., self-reported symptoms vs. clinical diagnoses). With regard to race, White children and adolescents ages 9-17 from families with low SES were more likely to be diagnosed with depression or anxiety than Black children and adolescents from families with low SES (Costello, Keeler, & Angold, 2001). More recent studies have shown that White and Black adolescents report depressive symptoms at similar rates, however this study did not examine SES and/or its interaction with race (Center for Disease Control, 2017). Despite these inconsistencies in the literature regarding race, greater stigma surrounding mental health has been reported in

Black communities compared with White communities (Gary, 2005), which may result in lower utilization of mental health care services (De Luca, Blosnich, Hentschel, King, & Amen, 2016). Additionally, studies investigating the impact of environmental (rural vs. urban) on mental health, suggest that there are greater barriers for receiving mental health services in rural environments including negative cultural perception, inability to travel to/from services, and reduced quality of care (Douthit, Kiv, Dwolatzky, & Biswas, 2015; Priester et al., 2016). Although mental health disparities and lack of access to mental health care have been established among low SES, rural, and minority populations, further research must be conducted to understand these risk factors and their influence on the prevalence of mental health problems and their treatment in greater depth, particularly in adolescents.

Collectively, these studies suggest that minority adolescents, particularly Black adolescents, from rural areas and low SES backgrounds are at the greatest risk for cumulative physical and mental health burden and that these problems may underlie health disparities exhibited during adulthood (i.e., greater incidence of metabolic disease, cardiovascular disease, and mental health disorders). Moreover, despite the relationship between physical and mental health outcomes, no studies have examined this relationship in rural, low-income, predominantly Black communities. Therefore, the overarching purpose of this program of research is to investigate the factors that influence and relationships among mental and physical health outcomes in adolescents from this population. Study 1 examined the influences of demographics, sport participation, and physical activity on mental health as well as physical health and fitness outcomes. Study 2 examined profiles of physical and mental health using traditional and data-driven analytic approaches to identify those with mental and physical health burdens. Taken together, these studies add to the

extant literature regarding the prevalence of mental and physical health problems in adolescents from rural, low-income backgrounds and the relationships between physical and mental health in this population. Additionally, these studies support health and education policies to target and reduce health burdens in this population.

We hypothesized that the prevalence of obesity, anxiety symptoms, and depressive symptoms would be greater in the rural, low-income adolescents compared to national samples and that obesity prevalence would be similar to that reported for the state of Alabama. Second, we hypothesized that sport participation and physical activity would be inversely related to anxiety, depressive, and stress symptoms and that these relationships would be influenced by sex and race. Third we hypothesized that body composition, body image, and self-esteem would be related to anxiety, depression, and stress and that these relationships would be influenced by sex. Fourth, we hypothesized that longitudinal increases in stress, anxiety symptoms, depressive symptoms, and obesity would be observed from 10^{th} to 11^{th} grade. Lastly, we hypothesized clustering of variables of similar types (i.e., physical fitness/activity, body composition, and mental health) and participant clusters that reflected combinations of physical and mental health (i.e., good physical and mental health, poor physical and mental health, good physical and poor mental health, and poor physical and good mental health). The participant clustering would be useful for identifying individuals with the greatest physical and mental health burdens that would benefit from future intervention.

Measures

Parent Demographic Survey. The parent demographic survey consisted of four questions to determine the ethnicity/race of the parent, their household income, their level of education, and their relationship to the child.

Student Demographic Survey. The student demographic survey was a 9-item questionnaire used to determine the participant's age, sex, ethnicity/race, family structure (i.e., single vs. two-parent household), number of siblings, extracurricular/sport participation, and the typical number of hours per week worked. Participants were categorized as athletes if they participated in at least one sport and non-athletes if they did not report participating in a sport. The total number of sports was determined from the number of different sports reported by the participant.

PROMIS Pediatric Item Bank v1.0 – Physical Activity – Short Form 8a. This questionnaire is an 8-item measure of the frequency of moderate-to-vigorous physical activity (MVPA) per week. The conceptual framework and item development were a part of the National Institute of Health's Patient Reported Outcome Measurement Information System (Cella, Yount, et al., 2010; Forrest et al., 2012; Tucker et al., 2014a, 2014b) and the measure is appropriate for use in the general population (Tucker et al., 2014a, 2014b). Scores from each question were summed to form a composite score ranging from 8 (didn't exercise at all) to 40 (participated in MVPA 6 or 7 days per week).

PROMIS Pediatric Item Bank v2.0 – Anxiety – Short Form 8a. This questionnaire is an 8-item measure of anxiety symptoms (e.g., focusing on worrying, nervousness, and fear) and is recommended for use in the general population (Irwin et al., 2010). Participants are asked to rate the frequency of their symptoms from 1 (Never) to 5 (Almost Always) over the previous week.

Scores from each question were summed to calculate a composite score ranging from 8 to 40, with higher scores representing higher levels of anxiety symptoms.

PROMIS Pediatric Item Bank v2.0 – Depressive Symptoms – Short Form 8a. This questionnaire is an 8-item measure of depressive symptoms, focusing on common depressive symptoms among children and adolescents (National Institute of Mental Health [NIMH]) (i.e., negative mood, negative self-views, disinterest, and negative social cognition) and is appropriate for use in the general population (Irwin et al., 2010). Participants are asked to rate the frequency of their symptoms from 1 (Never) to 5 (Almost Always) over the previous week. Scores from each question were summed to calculate a composite score ranging from 8 to 40, with higher scores representing higher levels of depressive symptoms.

PROMIS Pediatric Item Bank v1.0 – Psychological Stress Experiences – Short Form 8a. This questionnaire is an 8-item measure of psychological symptoms commonly associated with stress (i.e., feeling overwhelmed or under pressure) and is recommended for use in the general population (Bevans et al., 2018; Bevans, Gardner, Pajer, Riley, & Forrest, 2013). Participants are asked to rate the frequency of their symptoms from 1 (Never) to 5 (Almost Always) over the previous week. Scores from each question were summed to calculate a composite score ranging from 8 to 40, with higher scores representing higher levels of psychological stress symptoms.

PROMIS Pediatric Item Bank v1.0 – Physical Stress Experiences – Short Form 8a. This questionnaire is an 8-item measure of physical symptoms commonly associated with stress (i.e., fast heart beat when not exercising or muscle tension) and is recommended for use in the general population (Bevans et al., 2018, 2013). Participants are asked to rate the frequency of their symptoms from 1 (Never) to 5 (Almost Always) over the previous week. Scores from each

question were summed to calculate a composite score ranging from 8 to 40, with higher scores representing higher levels of physical stress symptoms.

Body Shape Satisfaction Scale (BSS). A modified version of the Body Shape Satisfaction Scale (Pingitore, Spring, & Garfield, 1997) was used to assess body satisfaction/dissatisfaction. This 13-item questionnaire has been used with both male and female adolescents (Neumark-Sztainer et al., 2012). For each item, participants rated their satisfaction with a body part or feature (e.g., height, stomach, muscles) from 1 (Very Dissatisfied) to 7 (Very Satisfied). Scores from each item were summed to calculate a composite score ranging from 13 to 91, with higher scores representing greater body satisfaction.

Rosenberg Self-Esteem Scale (RSES). The Rosenberg Self-Esteem Scale short form (Rosenberg, 1965) was used to assess global self-esteem. This 6-item questionnaire has been used with adolescents with varying demographic backgrounds (Van Den Berg, Mond, Eisenberg, Ackard, & Neumark-Sztainer, 2010). For each item (e.g., "On the whole, I am satisfied with myself", "At times I think I am no good at all") participants were asked to rate their agreement with the statement from 1 (Strongly Disagree) to 4 (Strongly Agree). Scores from each item were summed to calculate a composite score ranging from 6 to 24, with higher scores representing greater self-esteem.

Functional Fitness and Health Testing. FITNESSGRAM® physical fitness testing consists of anthropometrics (i.e., height, weight, body mass index [BMI]), body composition (% fat mass, % lean mass), resting heart rate, blood pressure, muscular strength and endurance (i.e., push-ups, curl-ups), and aerobic capacity (i.e., 15m Progressive Aerobic Cardiovascular Endurance Run [PACER]). Body composition was measured using a TANITA total body composition analyzer (SC-331S Total Body Composition Analyzer, TANITA) and blood pressure and heart rate were

measured via an Omron® automatic blood pressure monitor (5 Series Upper Arm Blood Pressure Monitor BP742N, Omron Healthcare)**.**

Procedure

Wellness fair programs were conducted at three Title 1 high schools (Dadeville High School, Lanett High School, and Reeltown High School) in the fall of 2018 and four Title 1 high schools (Dadeville High School, Lanett High School, Horseshoe Bend High School, and Loachapoka High School) in the fall of 2019. During the wellness fair programs, physical health and mental health measures were obtained. The fairs held in 2018 were open to 10^{th} grade students and the fairs held in 2019 were open to both 10^{th} and 11^{th} grade students to allow for an analysis of longitudinal changes in physical and mental health for previous program participants. Prior to the wellness fair program, parents completed the informed consent to allow their child to participate in the program and the parent demographic survey. Students completed the student demographic survey, PROMIS Pediatric Physical Activity, PROMIS Pediatric Anxiety, and PROMIS Pediatric Depression questionnaires prior to the program. During the wellness fair program, students attended small group sessions discussing different aspects of mental health (i.e., depression, anxiety, stress, self-harm, peer support, help-seeking behaviors) and completed the PROMIS Psychological Stress, PROMIS Physical Stress questionnaires, and the functional fitness and health assessment. Same-sex groups of 4-8 students completed the functional fitness and health assessment as a circuit.

Table 1.
School Information

School	Number of Students	City/School District	Median Income (City)	% of Students on Free or Reduced Lunch
Dadeville High School	494	Dadeville/Tallapoosa County	$30,690	74%
Horseshoe Bend High School	130	New Site/Tallapoosa County	$51,597	57%
Lanett High School	227	Lanett/Lanett City	$31,925	99%
Loachapoka High School	229	Loachapoka/Lee County	$40,227	86%
Reeltown High School	403	Reeltown/Tallapoosa County	$51,645	56%

Limitations and Delimitations

The first study limitation is related to the longitudinal aim. The initial hypotheses and analysis plan included longitudinal analyses using a subset of participants that attended the fair in both 2018 as a 10th grade student and 2019 as an 11th grade student. However, due to Reeltown High School not offering the program in 2019, Lanett High School limiting the 2019 fair to 10th grade students, and limited participation from 11th grade students at Dadeville High School, we were unable to conduct these analyses. A second limitation was the possible confounding of race and household income. Due to the unequal distribution of race across the income categories, we were unable to determine how household income uniquely influenced sport participation, physical activity, and physical/mental health measures. The last limitation involved the format and type of physical fitness testing conducted (i.e., field-based measured intended for use in physical education). It Is well-known that the motivation of the participants influences their performance. To address this limitation, research assistants provided encouragement during the fitness testing to motivate the students, but this may not have been effective for all students.

One delimitation was the inclusion of only Title 1 schools in Southeastern Alabama. Title I schools receive supplemental federal funding due to a high concentration of students (i.e., at least

40% of students) from low-income families (i.e., families with a household income less than 185% of the federal poverty line). This delimitation allowed for greater access to the target population of rural, low-income adolescents; however, it may also have limited the generalization of the present results. A second delimitation was the choice not to examine the influence of different characteristics of sport and sport participation on physical and mental health. There are many interesting research questions in this line. For example, examining differences between team sports and individual sports, competitive and recreational sports, and year-round and seasonal participation on physical and mental health or how coach-athlete relationships or team cohesion may influence mental health outcomes for athletes. However, these questions were beyond the scope of the present study and would be difficult to conduct given the small sample size.

Chapter 2 –Study 1: Physical activity and sport participation affect mental and physical health in adolescents from low-income, rural backgrounds

Introduction

Over the last three decades, the prevalence of obesity among adolescents in the U.S. has increased dramatically (Federal Interagency Forum on Child and Family Statistics, 2017). Current estimates of adolescent obesity (i.e., having a BMI in the 95th percentile) range from 14.8% (Kann et al., 2018) to 20.6% (Hales, Carroll, Fryar, & Ogden, 2017). This increase in obesity is partially due to decreases in sport participation and increases in sedentary behaviors (Hu et al., 2018). Physical activity and sport participation during adolescence has been shown to have a positive influence on physical health during adolescence (Turner, Perrin, Coyne-Beasley, Peterson, & Skinner, 2015) and into adulthood (Hallal et al., 2006; Tammelin, Näyhä, Hills, & Järvelin, 2003). Indeed, a review by Hallal et al. (2006) found that participation in sports and/or regular physical activity during adolescence is associated with greater physical activity and physical fitness in adulthood. Sport participation in adolescence, particularly sports that encourage diversified sports skills (e.g., soccer, running, track and field) was related to greater physical activity and sport participation in adulthood (Tammelin et al., 2003).

In school and out of school sports participation during adolescence is associated with greater physical activity, including moderate-to-vigorous level (Machado-Rodrigues et al., 2012; Nelson et al., 2011; Pate, Trost, Levin, & Dowda, 2000; Shull, Dowda, Saunders, Mciver, & Pate, 2020). Sport participation may also be related to decreased obesity; however, this finding has been mixed as the relationship may depend on the type of sport (Nelson et al., 2011). Although sport participation may enable adolescents to increase physical activity levels and may decrease their

risk for obesity (Nelson et al., 2011), the direct effect of sport participation and physical health warrants further investigation. Moreover, few studies have examined how sport participation impacts other aspects of physical health (e.g., physical fitness, blood pressure, cardiovascular health).

With respect to mental health, there is growing evidence that physical activity is associated with decreased mental health burdens (Biddle, Ciaccioni, Thomas, & Vergeer, 2019; Fløtnes et al., 2011; Fox, 1999; McMahon et al., 2017). Gore et al. (2001) found that females in the top quintile of depressed mood had lower levels of sport participation than all other females. Males in the lowest quintile of depressed mood had greater levels of sport participation compared with all other males. Adolescents that participate in sports or engaged in high levels of physical activity have lower symptoms of depression (Donaldson & Ronan, 2006; Jewett et al., 2014; McMahon et al., 2017) and anxiety (Fløtnes et al., 2011; Hallal et al., 2006; McMahon et al., 2017), as well as lower levels of perceived stress (Jewett et al., 2014) compared to non-athletes or less active adolescents. However, Fløtnes et al. (2011) only found this relationship among male adolescents, while both Jewett et al. (2014) and McMahon et al. (2017) observed significant relationships in males and females. Taken together, these results suggest that greater sport participation and/or physical activity in adolescence are negatively associated with mental health problems.

Adolescents from low-income backgrounds may be particularly at risk for mental and physical health disparities (Gordon-Larsen et al., 2000; Hanson & Chen, 2007; Ogden et al., 2016; Reiss, 2013). The review by Reiss (2013) found that children from low SES families are two to three times more likely to develop mental health problems than children from high SES families.

Furthermore, children from low SES families may be at risk for decreased physical activity (Gordon-Larsen et al., 2000; Hanson & Chen, 2007) and increased obesity (Ogden et al., 2016) compared to their high SES counterparts. Adolescents from rural areas have an increased risk of obesity and report engaging in less physical activity than adolescents from urban areas (Johnson & Johnson, 2015). While there are no studies examining the prevalence of mental health symptoms in adolescents from rural areas, greater barriers to accessing mental health services in rural communities have been reported (Douthit et al., 2015).

Given the increased risk of physical and mental health burdens among rural and low-SES adolescents, it is critically important to determine factors that reduce these health disparities. To our knowledge, no studies have assessed the relationships between physical activity, sport participation, and physical or mental health among rural, low-income adolescents. Further, while there is evidence that sport participation and physical activity levels influence body composition and multiple aspects of mental health, to our knowledge, few studies have assessed the relationships between sport participation and/or physical activity and other components of physical fitness (e.g., muscular strength/endurance, aerobic capacity, etc.). Therefore, the purpose of this study is to examine the relationships between sport participation, physical activity, physical fitness (i.e., aerobic capacity, muscular strength/endurance), physical health (i.e., body composition, blood pressure), and mental health symptoms (i.e., anxiety, depressive, and stress symptoms) among rural, low-SES adolescents in the U.S.

We hypothesize that adolescents participating in sports and/or reporting higher levels of physical activity will have lower mental health burdens (i.e., report lower anxiety, depressive, and

psychological stress symptoms) than adolescents not participating in sports and/or reporting lower levels of physical activity. Further, we hypothesize adolescents participating in sports and/or reporting higher levels of physical activity will have greater physical fitness and better physical health than adolescents not participating in sports and/or reporting lower levels of physical activity.

Methods

All procedures were approved by the Institutional Review Board at Auburn University (Protocol 18-109 MR 1803).

Participants

Tenth and eleventh grade students were recruited from four Title I high schools in rural Alabama. Title I schools receive supplemental federal funding due to a high concentration of students (i.e., at least 40% of students) from low-income families (i.e., families with a household income less than 185% of the federal poverty line). A total of 253 adolescents ages 15- to 18-years participated in the program. Participant demographics are presented in Table 1. Race was consolidated into 2 categories: Caucasian/White (45.1%) and Non-White (52.2%). Race information was missing from 6.3% of participants.

Table 2.
Participant demographics

Demographic Variables	Number of Participants (%), N=253
Sex	
Male	114 (45.1%)
Female	139 (54.9%)
Age	
15	151 (59.7%)
16	80 (31.6%)
17	15 (5.9%)
18	1 (0.4%)
Not Reported	6 (2.4%)
Ethnicity	
Caucasian/White	105 (41.5%)
African American/Black	114 (45.1%)
Hispanic/Latino	4 (1.6%)
Asian/Pacific Islander	2 (0.8%)
Native American	1 (0.4%)
Mixed Race	11 (4.3%)
Not Reported	16 (6.3%)
Household Income	
< $30,000	109 (43.1%)
$30,000-$49,999	40 (15.8%)
$50,000-$99,999	53 (20.9%)
$100,000+	20 (7.9%)
Not Reported	31 (12.3%)
Parental Education	
Did Not Finish HS	39 (15.4%)
HS Diploma/GED	74 (29.2%)
Some College	44 (17.4%)
Trade, Technical, or Vocational Training	11 (4.3%)
Associate degree	26 (10.3%)
Bachelor's Degree	26 (10.3%)
Master's Degree	10 (4.0%)
Professional Degree	4 (1.6%)
Doctoral Degree	0 (0.0%)
Multiple Degrees Selected	4 (1.6%)
Not Reported	15 (5.9%)

With respect to household income, 43.1% of participants came from families making less than $30,000. It is important to note that of the 109 participants who were categorized as low income (i.e., < $30,000), 61.5% identified as Black, while only 25.7% of those in the higher income

categories identified as Black. Given the unequal distribution of race across these income categories, household income was not included as a variable in the analyses to avoid the potential confound of race and income. With respect to parent education, nearly half the sample (44.6%) did not complete post-secondary education (i.e., some high school or GED, high school diploma). Of the participants who did not complete post-secondary education, 58.4% identified as Black.

Measures

Parent Demographic Survey. The parent demographic survey consisted of four questions to determine the ethnicity/race of the parent, their household income, their level of education, and their relationship to the child.

Student Demographic Survey. The student demographic survey was a 9-item questionnaire used to determine the participant's age, sex, ethnicity/race, family structure (single vs. two-parent household), number of siblings, extracurricular/sport participation, and the typical number of hours per week worked. Participants were categorized as athletes if they participated in at least one sport and non-athletes if they did not report participating in a sport. The total number of sports was determined from the different sports the participant reported.

PROMIS Pediatric Item Bank v1.0 – Physical Activity – Short Form 8a. This questionnaire is an 8-item measure of the frequency of moderate-to-vigorous physical activity (MVPA) per week. The conceptual framework and item development were a part of the National Institute of Health's Patient Reported Outcome Measurement Information System (Cella, Yount, et al., 2010; Forrest et al., 2012; Tucker et al., 2014a, 2014b) and the measure is appropriate for use in the general population (Tucker et al., 2014a, 2014b). Scores from each question are summed to

form a composite score ranging from 8 (didn't exercise at all) to 40 (participated in MVPA 6 or 7 days per week).

PROMIS Pediatric Item Bank v2.0 – Anxiety – Short Form 8a. This questionnaire is an 8-item measure of anxiety symptoms (e.g., focusing on worrying, nervousness, and fear) and is recommended for use in the general population (Irwin et al., 2010). Participants are asked to rate the frequency of their symptoms from 1 (Never) to 5 (Almost Always) over the previous week. Scores from each question are summed to calculate a composite score ranging from 8 to 40, with higher scores representing higher levels of anxiety symptoms.

PROMIS Pediatric Item Bank v2.0 – Depressive Symptoms – Short Form 8a. This questionnaire is an 8-item measure of depressive symptoms, focusing on common depressive symptoms among children and adolescents (National Institute of Mental Health) (i.e., negative mood, negative self-views, disinterest, and negative social cognition) and is appropriate for use in the general population (Irwin et al., 2010). Participants are asked to rate the frequency of their symptoms from 1 (Never) to 5 (Almost Always) over the previous week. Scores from each question are summed to calculate a composite score ranging from 8 to 40, with higher scores representing higher levels of depressive symptoms.

PROMIS Pediatric Item Bank v1.0 – Psychological Stress Experiences – Short Form 8a. This questionnaire is an 8-item measure of psychological symptoms commonly associated with stress (i.e., feeling overwhelmed or under pressure) and is recommended for use in the general population (Bevans et al., 2018, 2013). Participants are asked to rate the frequency of their symptoms from 1 (Never) to 5 (Almost Always) over the previous week. Scores from each question are summed to calculate a composite score ranging from 8 to 40, with higher scores representing higher levels of psychological stress symptoms.

PROMIS Pediatric Item Bank v1.0 – Physical Stress Experiences – Short Form 8a. This questionnaire is an 8-item measure of physical symptoms commonly associated with stress (i.e., fast heart beat when not exercising or muscle tension) and is recommended for use in the general population (Bevans et al., 2018, 2013). Participants are asked to rate the frequency of their symptoms from 1 (Never) to 5 (Almost Always) over the previous week. Scores from each question are summed to calculate a composite score ranging from 8 to 40, with higher scores representing higher levels of physical stress symptoms.

Functional Fitness and Health Testing. FITNESSGRAM® physical fitness testing consists of anthropometrics (height, weight, body mass index [BMI]), body composition (% fat mass, % lean mass), resting heart rate, blood pressure, muscular strength and endurance (push-ups, curl-ups), and aerobic capacity (15m Progressive Aerobic Cardiovascular Endurance Run [PACER]). Body composition was measured using a TANITA total body composition analyzer (SC-331S Total Body Composition Analyzer, TANITA) and blood pressure and heart rate were measured via an Omron® automatic blood pressure monitor (5 Series Upper Arm Blood Pressure Monitor BP742N, Omron Healthcare)**.**

Procedure

Wellness programs were conducted at each of the four high schools, during which physical health and mental health measures were obtained. Prior to the program, parents completed the informed consent to allow their child to participate in the program and the parent demographic survey. Students completed the student demographic survey and the PROMIS Pediatric Physical Activity questionnaire prior to the program. During the wellness program, students attended small group sessions discussing different aspects of mental health (i.e., depression, anxiety,

stress, self-harm, peer support, help-seeking behaviors), as well as completed the mental health questionnaires and the functional fitness and health assessment. Groups of 4-8 students of the same sex rotated through a circuit of the tasks that comprised the functional fitness and health assessment.

Statistical Analyses

Anxiety, depression, and physical activity scores were standardized and categorized into normal, mild, moderate, and severe according to the PROMIS norms (Cella, Riley, et al., 2010; Rothrock et al., 2010). Physical and psychological stress scores were standardized into low, average, above average, and high according to the PROMIS norms (Cella, Riley, et al., 2010; Rothrock et al., 2010). MATLAB version R2018a (MathWorks Inc., Natick, MA, USA) was used to conduct stepwise linear regressions using an integrated forward and backward selection procedure to examine the influence of demographics (i.e., Sex and Race) on sport participation and physical activity. Additional subsequent stepwise linear regressions were conducted to examine the influence of Sex, Race, Physical Activity, and Number of Sports on mental health (anxiety, depression, psychological stress, physical stress) and physical health measures (body composition, blood pressure, heart rate, muscular strength/endurance, aerobic capacity). Outliers were removed via a threshold based on Cook's distance as a measure of leverage. One-way analysis of variance (ANOVA) was used to evaluate any significant effects. The level of significance was set to $p < .05$ for all analyses.

Results

Sport Participation Details

Overall, 147 participants reported being involved in sports as an extracurricular activity with 75 participating in one sport and 72 participating in multiple sports. Baseball, boys' and girls' basketball, cheerleading, football, and marching band were available at all 5 schools in the study. Softball, track and field, and volleyball were offered at 4 schools, cross country was offered at 2 schools, and dance, fishing, tennis, wrestling, and soccer were offered at only one school. Participants reported participating in a total of 19 different sports including both school-based and non-school sports (e.g., participation in recreational leagues, non-organized sports, specialty programs, etc.). The most popular sports were basketball (n=59), football (n=42), and track and field (n=36) (See Figure 1). As expected, given the lack of availability of school-based individual sports, the vast majority of athletes participated in at least one team sport (See Table 3). However, it is important to note that sport participation was self-reported and that school rosters were not checked to verify competitive sport participation (e.g., junior varsity or varsity levels).

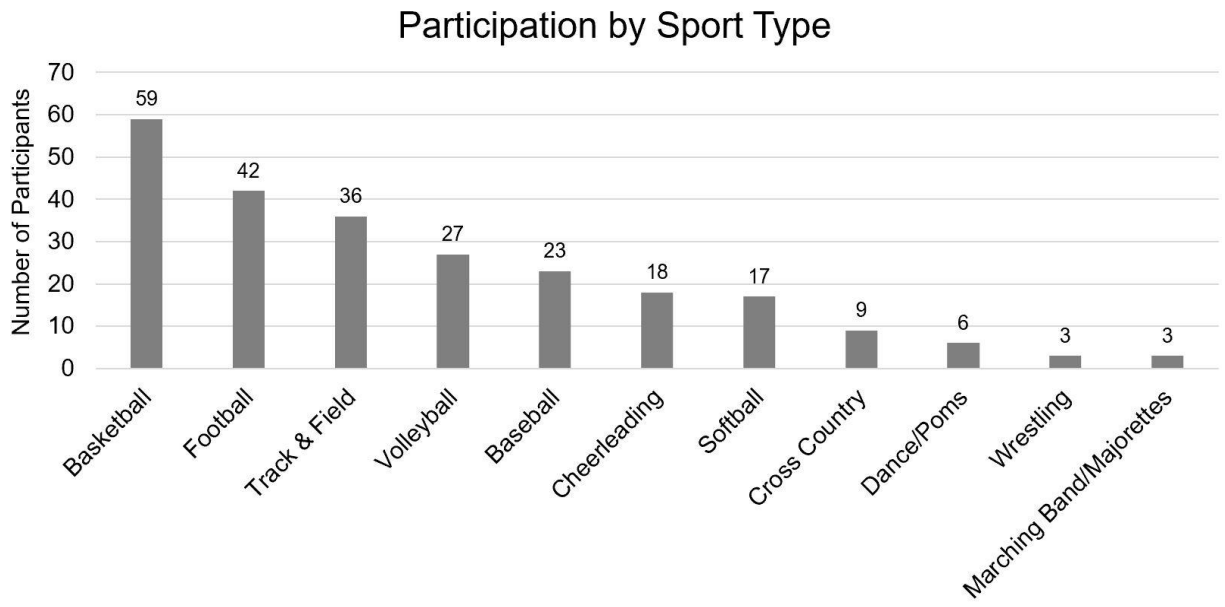

Figure 1. Sport participation histogram. The following sports were reported by one participant each: eSports, fishing, golf, hockey, mascot, soccer, tennis, and traffic.

Table 3.
Participation in individual or team sport environment

Environment	Number of Participants (%), N=147
Individual Sports	3 (2.04%)
Team Sports	140 (95.24%)
Combination	4 (2.72%)

Note: Individual sports included: eSports, fishing, golf, tennis, and wrestling; Team sports included: baseball, basketball, cheerleading, cross country, dance, football, marching band/majorette, soccer, softball, track & field, and volleyball.

Demographics, Sport Participation, and Physical Activity

Stepwise linear regressions and follow-up one-way ANOVAs revealed main effects of Sex ($F(1,223) = 8.47$, $p < .01$) for Number of Sports, where males participated in more sports than females. Main effects of Sex ($F(1,212) = 15.57$, $p < .001$), Race ($F(1,212) = 20.28$, $p < .001$), and Number of Sports ($F(1,212) = 49.25$, $p < .001$) were observed for physical activity. Males reported being more physically active than females. Caucasian/White adolescents reported being

more physically active than Non-White adolescents. Lastly, the number of sports was positively related to physical activity levels.

Sport Participation and Mental Health

Anxiety Symptoms. A stepwise linear regression revealed a Sex x Physical Activity interaction for anxiety symptoms ($F(1,204) = 4.15$, $p = .04$), such that there was a positive relationship between anxiety symptoms and physical activity for females ($F(1,115) = 5.47$, $p = .02$), but no relationship for males ($F(1,97) = 0.04$, $p = .84$) (see Figure 2). Significant sex differences were also observed ($F(1,204) = 35.73$, $p < .001$), such that females had higher anxiety scores than males.

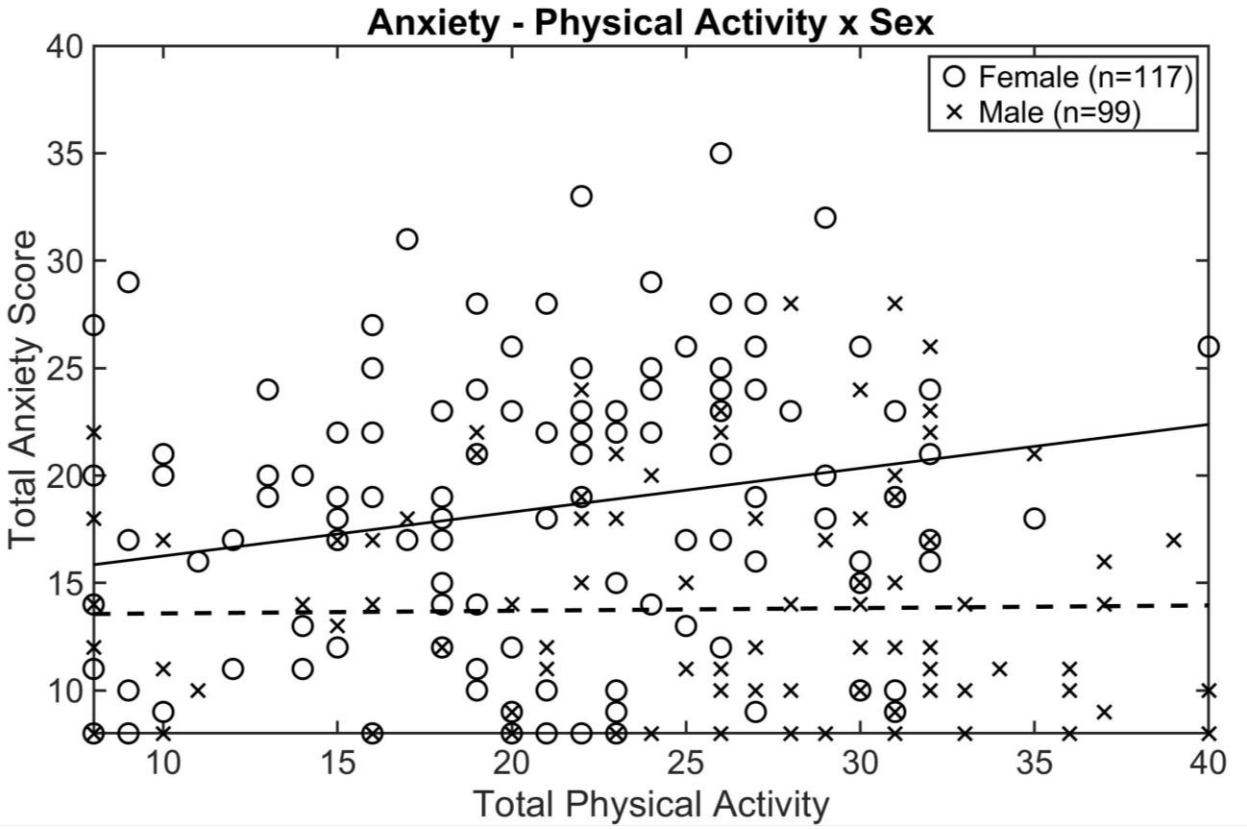

Figure 2. The interaction between sex and physical activity for anxiety symptoms; female data are depicted as circles and a solid trendline and male data are depicted as Xs and a dashed trendline. The number of participants in each subgroup is included in the legend.

Depressive Symptoms. A Sex x Physical Activity x Number of Sports interaction was observed for depressive symptoms ($F(1,198) = 5.71$, $p = .02$). This interaction was driven by the positive relationships between depressive symptoms and physical activity for one-sport ($F(1,37) = 7.38$, $p < .01$) and multisport ($F(1,25) = 12.83$, $p < .01$) females; these relationships were not present for one-sport ($F(1,30) = 0.01$, $p = .94$) or multisport ($F(1,34) = 0.01$, $p = .91$) males or for non-athlete males ($F(1,23) = 2.61$, $p = .12$) or females ($F(1,48) = 0.40$, $p = .53$) (see Figure 3). Additionally, there was a Race x Number of Sports interaction for depressive symptoms ($F(1,198) = 4.01$, $p < .05$), where there was a slightly negative relationship between number of

sports and depressive symptoms for Caucasian/White adolescents, but a slightly positive relationship for Non-White adolescents ($t(198) = 2.00$, $p < .05$) (see Figure 4).

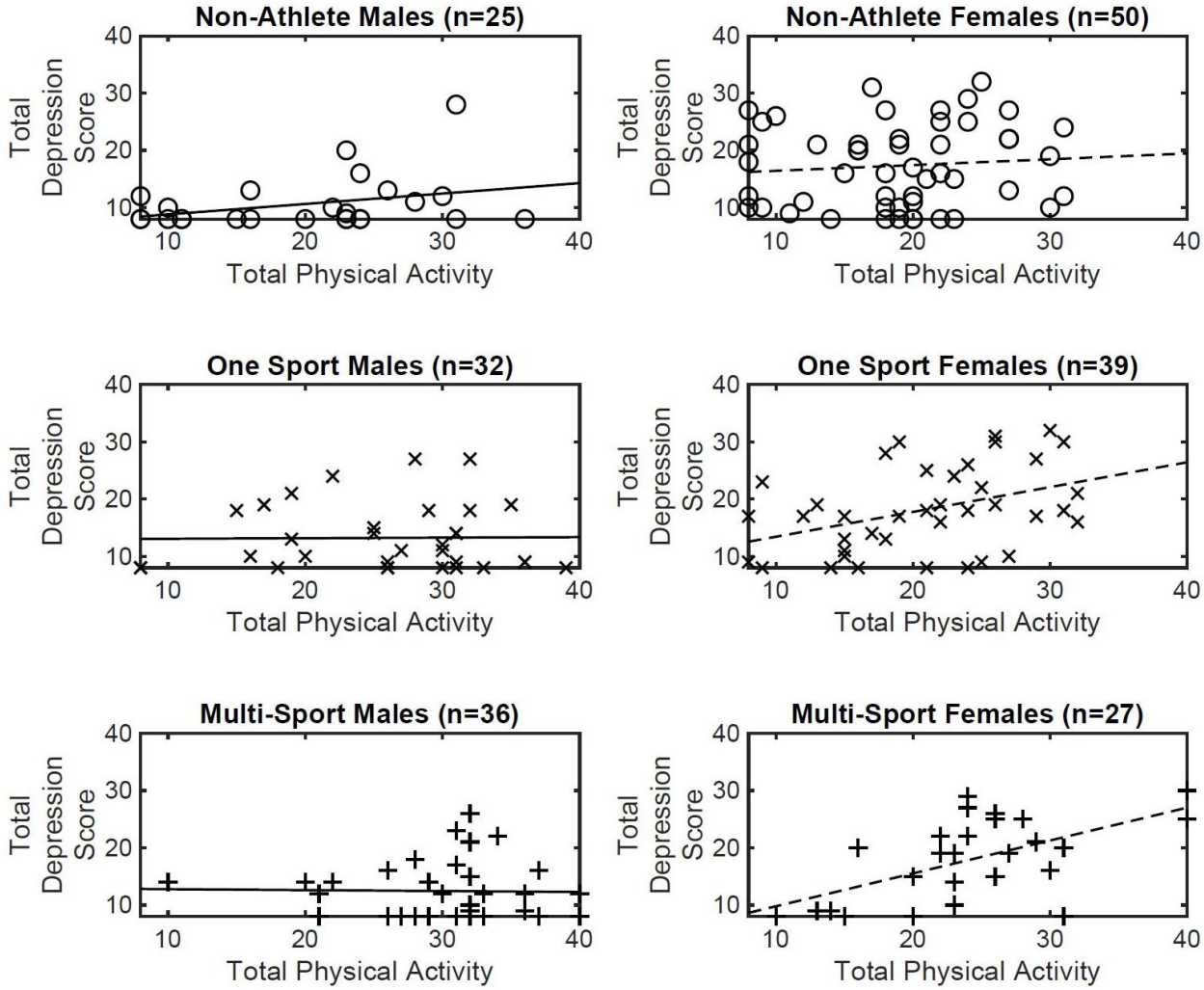

Figure 3. The interaction between sex, physical activity, and number of sports for depressive symptoms; each plot depicts physical activity plotted against depressive symptoms, the plots are separated by sex and athlete status with males on the left (solid trendlines), and females on the right (dashed trendlines). Data from non-athletes are depicted in the first row as circles, data from one-sport athletes are depicted in the second row as Xs, and data from multisport athletes are depicted in the third row as crosses. The number of participants in each subgroup is included in the figure title.

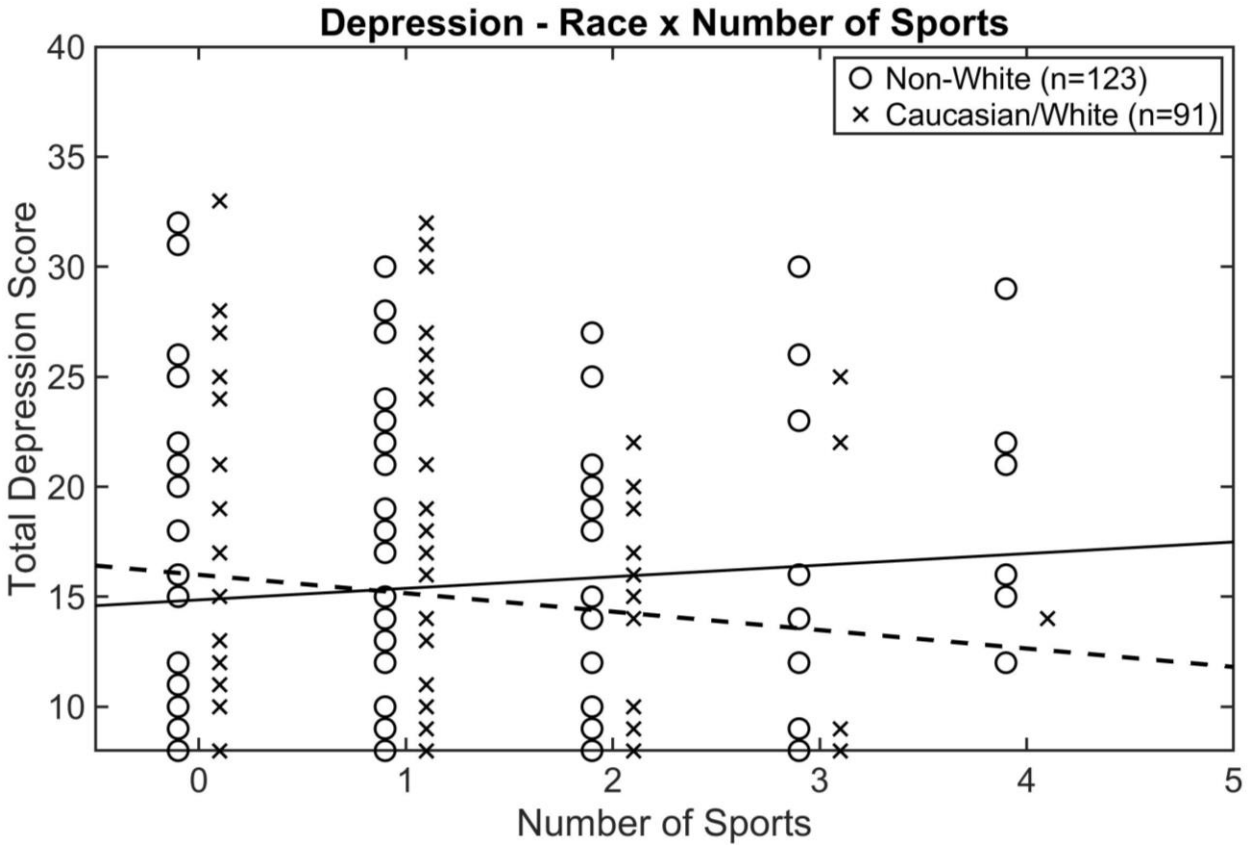

Figure 4. The interaction between race and number of sports for depressive symptoms; data for Non-White adolescents are depicted as circles and a solid trendline and data for White/Caucasian adolescents are depicted as Xs and a dashed trendline. The number of participants in each subgroup is included in the legend.

Psychological Stress Symptoms. A Race x Number of Sports interaction was observed for psychological stress symptoms ($F(1,158) = 4.13$, $p = .04$), such that there was a negative relationship between psychological stress symptoms and number of sports for Caucasian/White adolescents ($F(1,57) = 9.76$, $p < .01$), but no relationship for Non-White adolescents ($F(1,102) = 2.02$, $p = .16$) (see Figure 5). There was also a significant sex difference ($F(1,158) = 41.43$, $p < .001$), such that females had higher psychological stress scores than males.

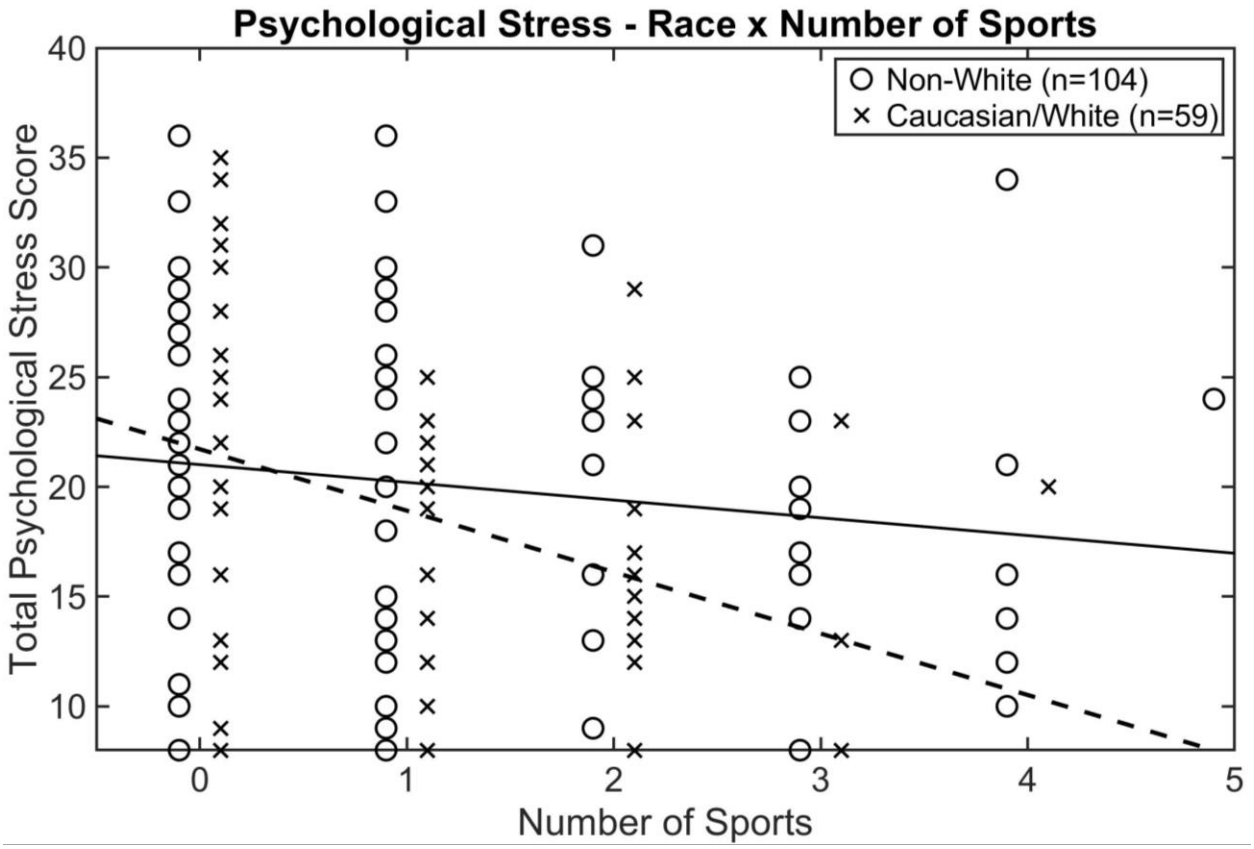

Figure 5. The interaction between race and number of sports for psychological stress symptoms; data for Non-White adolescents are depicted as circles and a solid trendline and data for White/Caucasian adolescents are depicted as Xs and a dashed trendline. The number of participants in each subgroup is included in the legend.

Physical Stress Symptoms. A significant Sex x Race x Number of Sports x Physical Activity ($F(1,140) = 4.24$, $p = .04$) interaction was observed for physical stress symptoms. This interaction was driven by the significant positive relationship between physical activity and physical stress symptoms for Caucasian/White male adolescents that do not participate in sports ($F(1,5) = 7.20$, $p = .04$) and Non-White female adolescents participating in one sport ($F(1,15) = 9.44$, $p < .01$); this relationship was not present any of the other subgroups (See Figure 6).

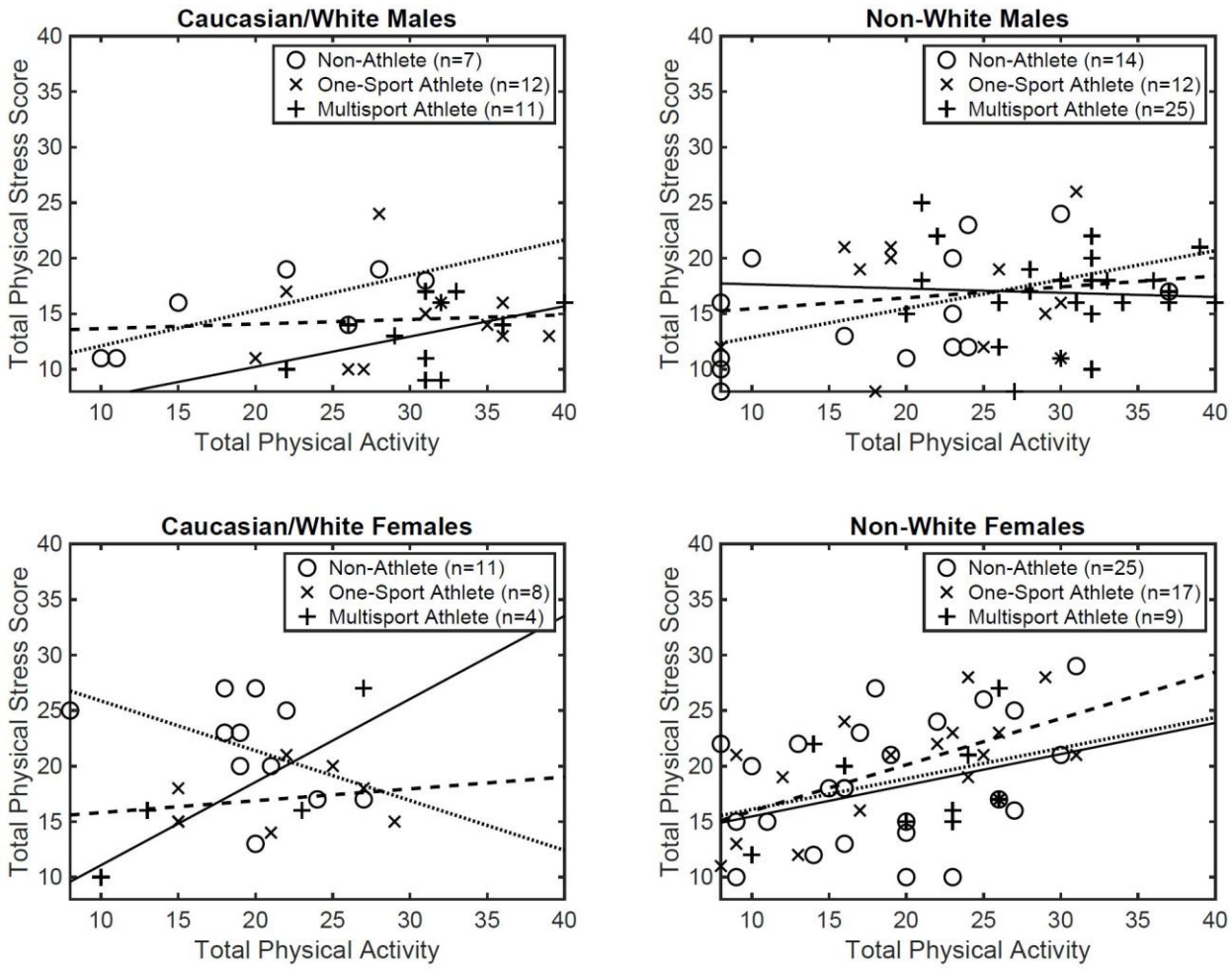

Figure 6. The interaction between sex, race, number of sports, and physical activity for physical stress symptoms; each plot depicts physical activity plotted against physical stress symptoms, the plots are separated by race and sex with Caucasian/White males on the top left, Non-White males on the top right, Caucasian/White females on the bottom left, and Non-White females on the bottom right. Data from non-athletes are depicted as circles and a dotted trendline, data from one-sport athletes are depicted as Xs and a dashed trendline, and data from multisport athletes are depicted as crosses and a solid trendline. The number of participants in each subgroup is included in the legend.

Sport Participation and Physical Health

Body Composition. Main effects of Sex ($F(1,192) = 105.63$, $p < .001$) and Race ($F(1,192) = 9.16$, $p < .01$), were observed for body fat percentage. Females had higher body fat percentages than males and Non-White adolescents had higher body fat percentages than Caucasian/White adolescents. For BMI, the most parsimonious model as revealed by the stepwise linear regression included a Sex x Number of Sports interaction but that term was not significant ($F(1,191) = 3.12$, $p = .08$), moreover the model itself was not significant ($F(1,191) = 1.8$, $p = .15$).

Blood Pressure and Heart Rate. A significant Sex x Number of Sports interaction was observed for systolic blood pressure (SBP) ($F(1,189) = 4.42$, $p = .04$), where there was a negative relationship between number of sports and SBP for females ($F(1,115) = 4.86$, $p = .03$), but no relationship for males ($F(1,77) = 1.90$, $p = .17$) (see Figure 7). There were also main effects of Sex ($F(1,189) = 98.37$, $p < .001$) and Race ($F(1,189) = 9.34$, $p < .01$), such that males had higher SPB than females and Non-White adolescents had higher SBP than Caucasian/White adolescents. Additionally, the Race x Sex interaction approached statistical significance ($F(1,188) = 3.65$, $p = .05$). This was driven by the significant difference in SBP between Caucasian/White and Non-White males ($t(79) = -3.56$, $p < .001$) that was not observed between Caucasian/White and Non-White females ($t(117) = -1.06$, $p = .29$).

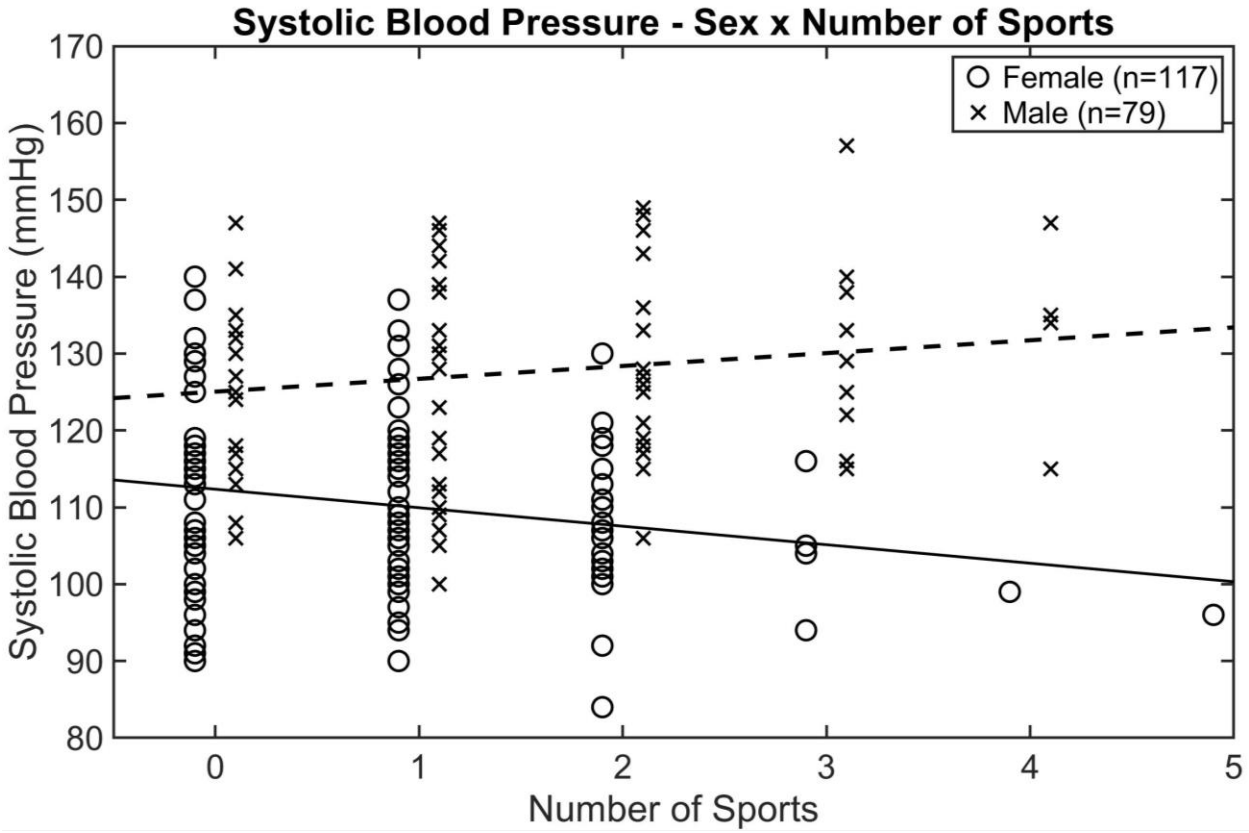

Figure 7. The interaction between sex and number of sports for systolic blood pressure; females are depicted as circles and a solid trendline and males are depicted as Xs and a dashed trendline. The number of participants in each subgroup is included in the legend.

For diastolic blood pressure (DBP), there was a significant Race x Physical Activity interaction ($F(1,187) = 20.07$, $p < .001$), such that there was a negative relationship between DBP and physical activity for Caucasian/White adolescents ($F(1,77) = 32.18$, $p < .001$) but no relationship for Non-White adolescents ($F(1,111) = 0.08$, $p = .78$) (see Figure 8).

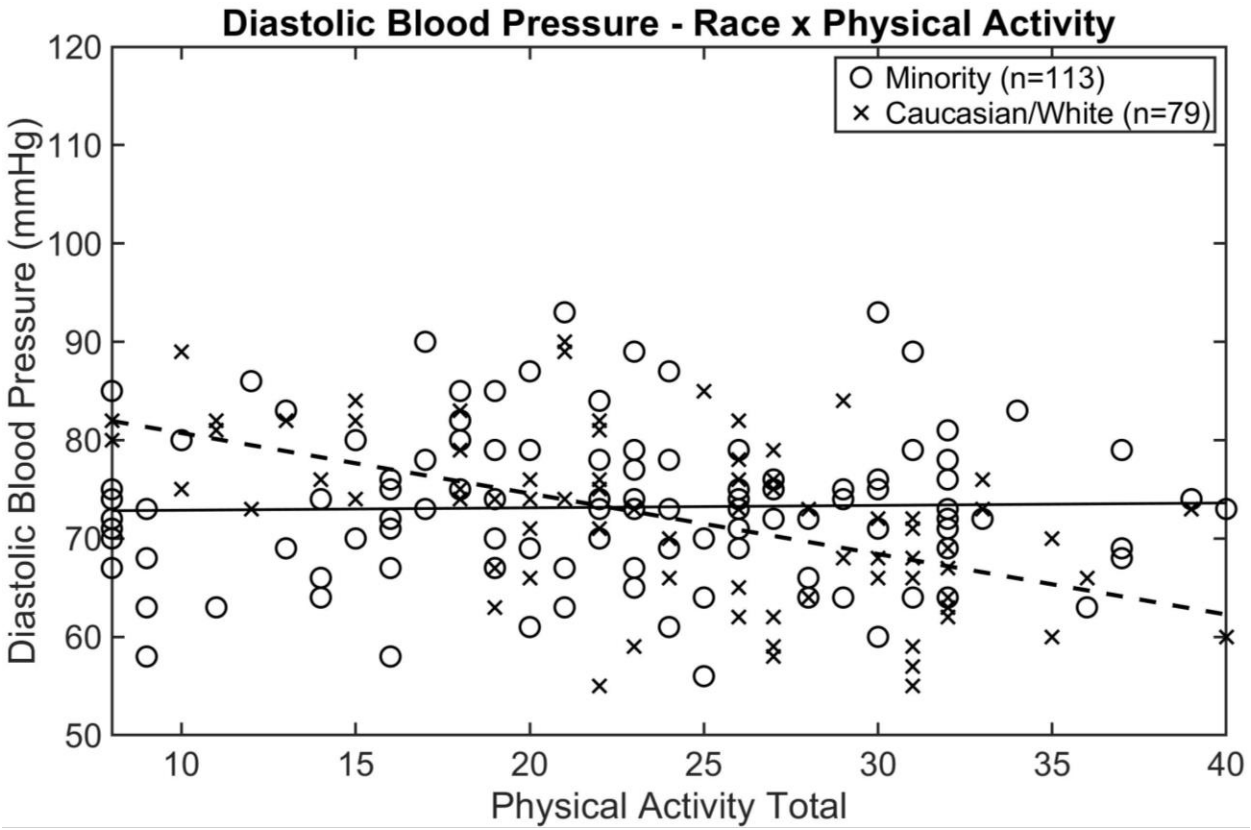

Figure 8. The interaction between race and physical activity for diastolic blood pressure; data for Non-White adolescents are depicted as circles and a solid trendline and data for Caucasian/White adolescents are depicted as Xs and a dashed trendline. The number of participants in each subgroup is included in the legend.

Lastly, for resting heart rate (RHR) there were main effects of Sex ($F(1,184) = 23.40$, $p < .001$), Number of Sports ($F(1,184) = 13.77$, $p < .001$), and Physical Activity ($F(1,184) = 13.98$, $p < .001$). Females had higher RHR than males. Participants that participated in more sports or had higher physical activity levels had lower RHR.

Muscular Strength/Endurance. A Race x Physical Activity x Number of Sports interaction was observed for push up scores ($F(1,179) = 7.70$, $p < .01$). This was driven by significant positive

relationship between physical activity and push up scores for Non-White adolescents involved in multiple sports ($F(1,35) = 5.11$, $p = .03$) that was not observed for Caucasian/White adolescents involved in multiple sports ($F(1,19) = 0.05$, $p = .82$) (See Figure 9). Main effects of Sex ($F(1,179) = 14.52$, $p < .001$) were also observed for push-ups, where males had higher push-up scores than females.

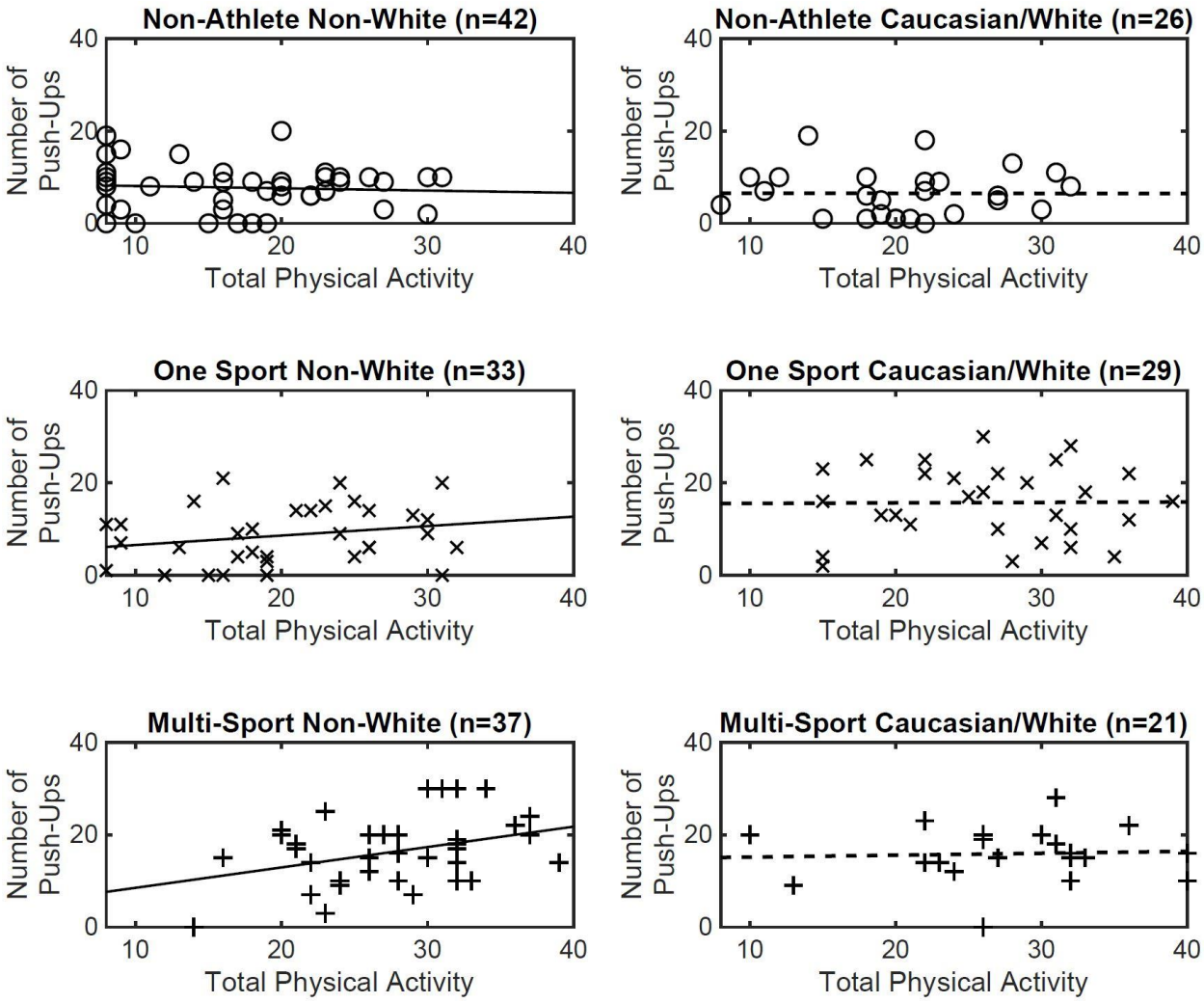

Figure 9. The interaction between race, physical activity, and number of sports for push-ups; each plot depicts physical activity plotted against depressive symptoms, the plots are separated by race and athlete status with Non-White adolescents on the left (solid trendlines), and Caucasian/White adolescents on the right (dashed trendlines). Data from non-athletes are

depicted in the first row as circles, data from one-sport athletes are depicted in the second row as Xs, and data from multisport athletes are depicted in the third row as crosses. The number of participants in each subgroup is included in the figure title.

For curl-ups there was a Sex x Race x Number of Sports interaction ($F(1,174) = 6.03$, $p = .02$). This was driven by the significant positive relationship between number of sports and curl-up scores for Non-White females ($F(1,66) = 8.67$, $p < .01$) and Caucasian/White females ($F(1,48) = 10.68$, $p < .01$); this relationship was not present for the other subgroups (See Figure 10). Additionally, a main effect of Physical Activity ($F(1,174) = 10.23$, $p < .01$) was found for curl-ups, where there was a positive relationship between physical activity and curl-up scores.

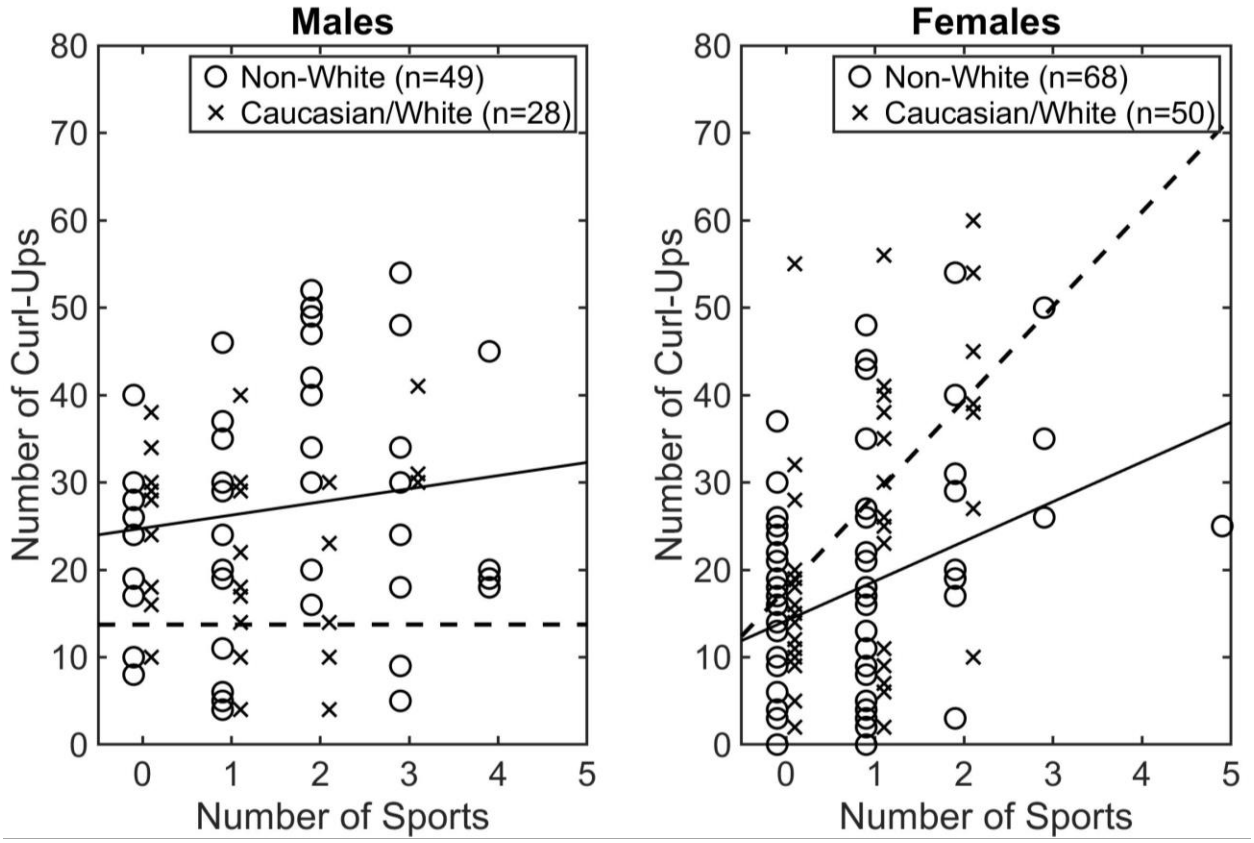

Figure 10. The interaction between sex, race and number of sports for curl-up scores; each plot depicts number of sports plotted against curl-up scores, the plots are separated by sex with males

on the left and females on the right. Data for Non-White adolescents are depicted as circles and a solid trendline and data for Caucasian/White adolescents are depicted as Xs and a dashed trendline. The number of participants in each subgroup is included in the figure legend.

Aerobic Capacity. A significant Sex x Number of Sports interaction was observed for the PACER test ($F(1,184) = 10.98$, $p < .01$). There was a positive relationship between number of sports and PACER test scores for both males and females; however, this relationship was stronger for males than females ($t(184) = 3.31$, $p < .001$) (See Figure 11).

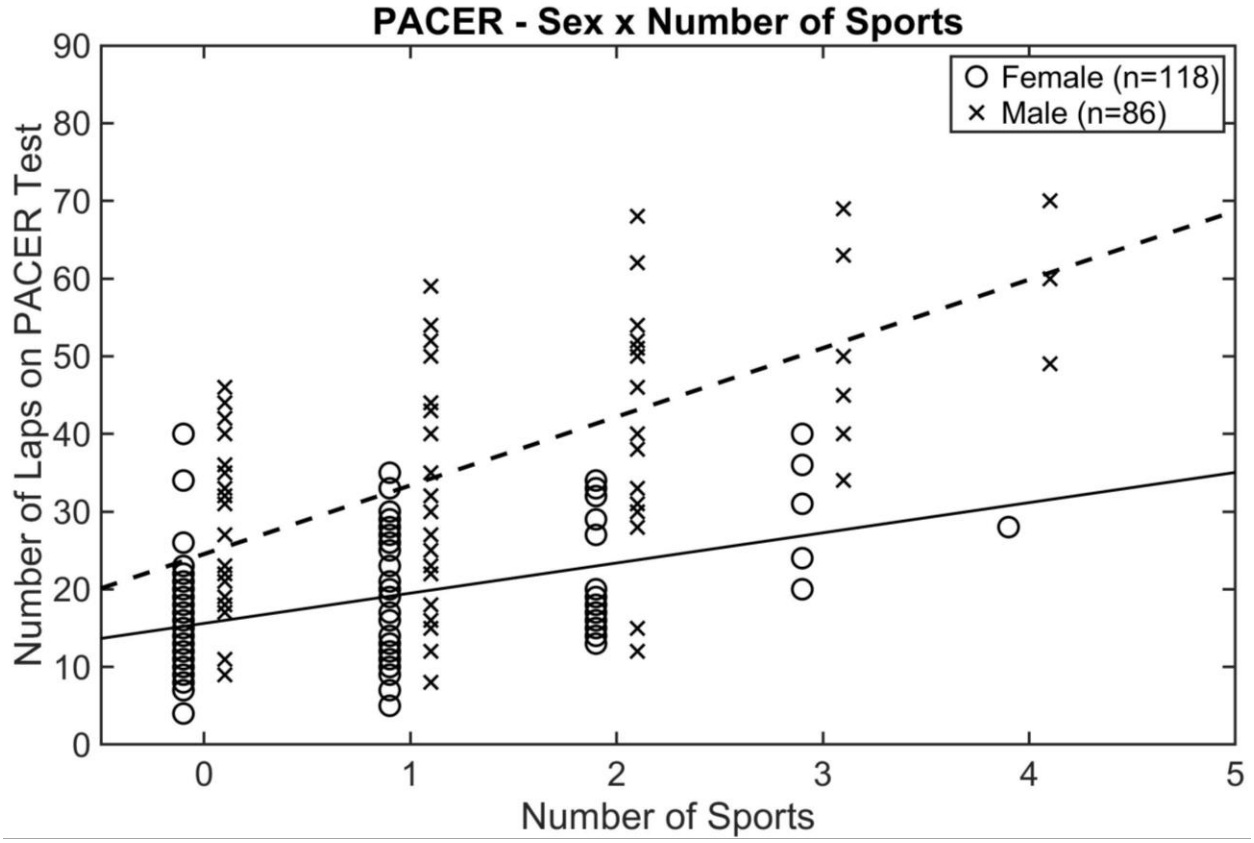

Figure 11. The interaction between sex and number of sports for the PACER test; female data are depicted as circles and a solid trendline and male data are depicted as Xs and a dashed trendline. The number of participants in each subgroup is included in the figure legend.

Discussion

Overall, sport participation and physical activity influenced physical fitness and mental health measures. Specifically, physical activity influenced anxiety, depressive, and physical stress symptoms but not psychological stress. However, the observed relationships were not in the hypothesized direction (i.e., greater physical activity was associated with greater mental health symptoms in females). Sport participation influenced depressive symptoms as well as psychological and physical stress symptoms but did not influence anxiety symptoms. Sport participation was also related to improved physical health and fitness measures including blood pressure, resting heart rate, push-ups, curl-ups, and PACER tests. In addition to evaluating these relationships, we also determined the influence of sex and race on physical activity and sports participation. Males participated in more sports and reported being more physically active than females. Additionally, Caucasian/White adolescents reported being more physically active than Non-White adolescents. Last, multi-sport athletes reported being more physically active than non-athletes. Overall, both sport participation and physical activity seem to improve physical health; however, their influence on mental health may differ by sex and race.

The finding that males reported being more physically active and participating in a greater number of sports than females is unsurprising and consistent with previous literature (McMahon et al., 2017). Additionally, Caucasian/White adolescents reported being more physically active than Non-White adolescents. These results are consistent with the findings from the Youth Risk Behavioral Surveillance System (YRBSS); White adolescents reported being more physically active than Black or Hispanic adolescents (Kann et al., 2018). However, the 2016 National Survey of Children's Health (NSCH) report found that a greater percentage of Black adolescents

participated in 60 minutes of physical activity every day than White adolescents (Child and Adolescent Health Measurement Initiative & Data Resource Center for Child and Adolescent Health, 2017). Therefore, future studies should continue to address race differences in physical activity levels.

Of the participants in the present study, 15.8% were overweight and 23.3% were obese. The obesity rate observed for this population is greater than the most recently reported rate for adolescents in the state of Alabama (18.2%; Kann et al., 2018). This discrepancy may be due to a greater risk of obesity for adolescents from rural and low-income areas (Johnson & Johnson, 2015). With that said, no studies have examined whether sports participation would affect the likelihood to be overweight or obese in adolescents from rural and low-income areas. A previous review by Nelson et al. (2011) found consistent evidence regarding the impact of sports participation on physical activity, but the evidence regarding the relationship between sports participation and weight status was less clear. Further, Turner et al. (2015) found that among female athletes, only those participating in running/track had lower obesity prevalence than non-athletes. In contrast, among male athletes except for those playing football, all other athlete groups had lower obesity prevalence than non-athletes. In the present study, although we observed a positive relationship between sports participation and reported physical activity levels, neither sport participation nor physical activity levels were associated with obesity. It is important to note it was not possible in the current study to evaluate the relationship between obesity and physical activity based on the sports played due to the small number of athletes playing only one sport.

The collection of physical fitness and cardiovascular health data was an important and unique aspect of the present study and the first, to our knowledge, in rural, low-income adolescents. The physical fitness and cardiovascular health data enabled us to determine the impact of physical activity and sports participation on a broad range of physical health outcomes. The results of the present study are in line with previous research (Christofaro, Andrade, Vanderlei, Fernandes, & Mota, 2018; Sarganas, Rosario, & Neuhauser, 2017; Vasconcellos et al., 2014), suggesting that higher physical activity levels and greater sport participation are associated with lower resting heart rate. In addition, females that participated in more sports had lower systolic blood pressure. This relationship was not observed in males, which may be due to the types of sports played by the male athletes (e.g., football), which may require larger body sizes and BMI associated with that sport. Indeed a positive association between BMI and systolic blood pressure has been observed in a national study among adolescents (Keefer, Caputo, & Tseh, 2013). Further, greater physical activity in Caucasian/White adolescents was associated with lower diastolic blood pressure, while this relationship was not observed in Non-White adolescents. These results are in line with findings from recent studies demonstrating the positive impact of physical activity on blood pressure in adolescents (Carson, Tremblay, Chaput, McGregor, & Chastin, 2019) and similar racial differences in this relationship among adults (Lakoski & Kozlitina, 2014). Taken together, these results suggest that greater sport participation and increased physical activity are associated with specific aspects of cardiovascular health, but other factors (e.g., sex, race, etc.) should be considered when examining these relationships.

With respect to the physical fitness outcomes, greater sports participation was associated with better muscular strength and endurance as well as aerobic capacity. Specifically, adolescents that

reported participation in more sports exhibited better push-up, curl-up, and PACER scores. The relationship between the number of sports and both push-up and curl-up scores diverged across demographic groups. For example, sports participation was positively associated with a greater number of push-ups, but this result may be driven by Non-White adolescents who reported participating in a greater number of sports. For females, there was a positive relationship between sports participation and curl-ups, but this relationship was not observed in males. Additionally, a positive relationship was observed between physical activity levels and curl-up scores (i.e., completed more curl-ups) regardless of sex or race. While there was a positive relationship between number of sports and PACER test scores for both males and females, this relationship was stronger in the males than the females. Taken together, although sport participation positively impacts physical fitness, similar to the cardiovascular health measures, demographic factors must be considered when examining these relationships.

With respect to the mental health outcomes, 36.4% of students in the present study reported moderate or severe anxiety symptoms, 36.0% reported moderate or severe depressive symptoms, and 28.1% reported high or very high psychological stress symptoms. Female participants reported higher anxiety, depressive, psychological stress, and physical stress scores than males. One surprising finding was that greater physical activity levels were associated with increased anxiety in females and depressive symptoms in female athletes. Previous literature reported negative relationships between sport participation and/or physical activity and depressive symptoms (Donaldson & Ronan, 2006; Jewett et al., 2014; McMahon et al., 2017) and anxiety symptoms (McMahon et al., 2017) among adolescent females. However, Fløtnes et al. (2011) reported these relationships were only present in males. The inconsistencies observed between

these studies and the current findings may be due to cultural differences in the populations examined; the previous studies used samples from New Zealand (Donaldson & Ronan, 2006), Canada (Jewett et al., 2014), and Europe (Fløtnes et al., 2011; McMahon et al., 2017). In contrast, present sample includes a large proportion of adolescents from low-income, minority backgrounds living in rural areas. It is possible that the level of participation physical activity and barriers for achieving additional physical activity participation outside of school (e.g., access to gyms, recreational sports, and other facilities) are not sufficient to reduce the elevated mental health symptoms experienced by females in this population. Further research addressing this relationship to determine if the present results are specific to the population or are also exhibited in other American adolescent populations (e.g., urban, other income categories).

Sport participation also influenced the mental health measures, such that greater participation in sports was associated with decreased depressive symptoms and psychological stress symptoms for Caucasian/White adolescents, while there was no relationship observed for Non-White adolescents. Previous studies have also found that sport participation was associated with decreased depressive and stress symptoms (Donaldson & Ronan, 2006; Jewett et al., 2014; McMahon et al., 2017) in primarily Caucasian/White samples. The present results are in line with a previous study assessing this relationship among female adolescents, which found a negative relationship between sport participation and depressive symptoms in Latino and White adolescents, but no relationship among Black adolescents (Duncan, Strycker, & Chaumeton, 2015). These racial differences may be due to cultural differences in the rationale for participating in sport or the experience of adolescent athletes (Duncan et al., 2015). For example, Black males reported that sport participation is viewed as an outlet to demonstrate their

masculinity or as a way out of unfavorable conditions (Faulk, Bennett III, & Moore III, 2017). Additionally, Black families may place more emphasis on sport participation than other activities compared to White families (Eitle & Eitle, 2002). Lastly, there was a four-way interaction between sex, race, number of sports, and physical activity for physical stress symptoms. A positive relationship was observed between physical activity and physical stress scores in Non-White female adolescents participating in one sport and in Caucasian/White male non-athletes. This result was not observed in other subgroups; however, the majority of the other subgroups did trend in this direction. Therefore, some of this interaction may have been due to the small number of participants in each of these subgroups. The positive relationship between physical activity and physical stress may be due to the number of physical stress symptoms that can be associated with high levels of physical activity (i.e., “I had pain that really bothered me”, “My muscles felt tight”, “My back hurt”). There is a positive relationship between physical activity and physical stress symptoms and this relationship appears to be influenced by sex, race, and level of sport participation. Future research should address how sex, race, and level of sport participation influence the relationship between physical activity and physical stress symptoms.

Future Research and Limitations

Although the present study is the first to evaluate the relationships between physical activity and sport participation on physical and mental health in adolescents from low-income, rural backgrounds, the main limitation is the small sample size. Previous studies examining these relationships utilized very large cohorts of predominately Caucasian/White adolescents from Europe (Fløtnes et al., 2011; McMahon et al., 2017). Thus, future studies are needed to replicate and extend the present findings examining larger populations of adolescents from health

disparate groups from the U.S. to address this limitation. Additionally, due to the homogeneity in SES in the present sample and the unequal distribution of race across the income categories, we were unable to compare how household income influenced sport participation, physical activity, and physical/mental health measures. Future studies may need a better parcellation of the lower SES category (i.e., <$15,000, $15,000-30,0000, etc.) as well as a larger number of individuals from middle and higher incomes living in rural areas. The present sample was selected specifically because they represented an under-studied population (i.e., students from low-income backgrounds), therefore future studies in this population should focus on better stratification of the lower SES category. Another limitation involves the format and type of physical activity measurement and physical fitness testing conducted (i.e., field-based measured intended for use in physical education). Given the tendency of adolescents to over-estimate their physical activity levels on self-report instruments, future studies, particularly intervention-based studies should consider the use of accelerometers to quantitatively measure physical activity in addition to or in place of a self-report physical activity measure. With regards to the physical fitness testing, the motivation of the participants influences their performance. To address this known limitation, research assistants provided encouragement during the fitness testing to motivate the students, but this may not have been effective for all students. Further, while the study addressed the influence of level of sport participation on physical and mental health, we did not examine characteristics of the sports and how they influenced these outcomes. For example, future studies could examine differences between team sports and individual sports, competitive and recreational sports, and year-round and seasonal participation on physical and mental health. In the context of the present study, a comparison of team vs. individual sports was not possible given the limited access to and participation in individual sports. Moreover, we did

not differentiate level of competition on the student questionnaire. Other relevant aspects of sport participation (e.g., coach-athlete relationships, team cohesion, etc.) may also influence mental health outcomes for athletes. These aspects may be best evaluated using semi-structured interviews, compared with surveys or questionnaires. Lastly, this was a cross-sectional study that was a necessary first step in examining the relationships between physical activity, sport participation, and physical/mental health in an under-studied, at-risk population of adolescents. Future longitudinal investigations are needed to understand how these relationships may change throughout adolescence and to determine any causal influence of physical activity and sport participation on physical/mental health.

Conclusion

Given the prevalence of obesity and high mental health burden exhibited by the participants in the present study (i.e., those from low-income, rural areas), further research is needed to address these health disparities. Given the barriers to mental health services in rural areas (Douthit et al., 2015), understanding the relationships between physical activity, sport participation, and mental health burdens among this population is vitally important. Although, sport participation had varying influences on mental health, there was a positive influence of sport participation on several aspects of physical fitness. This suggests that sport participation may be a means for maintaining and improving physical health among rural, low-income adolescents. Furthermore, team sports (Boone & Leadbeater, 2006) and youth development programs (Weiss, Kipp, & Bolter, 2012) have been associated with better physical activity and mental health outcomes (e.g., self-esteem, body size satisfaction, relatedness, etc.) among adolescent populations. These types of programs specifically target mental health and physical health through education in a supportive environment and may influence positive trajectories of health in this population.

Chapter 3 – Study 2: Relationships between physical and mental health in adolescents from low-income, rural communities: Group- and individual-level analyses

Introduction

Adolescence represents a critical period during which problems in physical health (e.g., lower physical activity levels, increased obesity) and mental health (e.g., increased symptoms of depression, anxiety, stress) emerge and may lead to long-term health burdens (Das et al., 2016). National surveys suggest that only 26.1% of high school students report meeting physical activity guidelines (i.e., 60 minutes of physical activity per day) with more males (35.3%) reported meeting physical activity guidelines than females (17.5%) (Kann et al., 2018). However, studies employing quantitative measurement of physical activity via accelerometers report that far fewer adolescents actually meet these guidelines (i.e., 7.5% of 12- to 15-year-olds and 5.1% of 16- to 19-year-olds) (Katzmarzyk et al., 2016; National Center for Health Statistics, 2006). Furthermore, the current estimates of adolescent obesity (i.e., having a BMI in the 95th percentile) range from 14.8% (Kann et al., 2018) to 20.6% (Hales et al., 2017). These percentages have increased steadily over the past three decades (Federal Interagency Forum on Child and Family Statistics, 2017), identifying the need for intervention.

Current mental health statistics for this population are also concerning. An estimated 31.9% of adolescents ages 13-18 years have been or are currently diagnosed with an anxiety disorder (Merikangas et al., 2010). Moreover, 13.3% of adolescents ages 12-17 have experienced a major depressive episode in the last year (U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, & Center for Behavioral Health Statistics and

Quality, 2018), with 31.5% reporting feeling sad or hopeless almost every day for 2 or more weeks in a row (Kann et al., 2018). Both clinical prevalence of anxiety and depression as well as reported depressive symptoms are higher in females than males (Kann et al., 2018; Merikangas et al., 2010; U.S. Department of Health and Human Services et al., 2018). Moreover, the estimated prevalence of these disorders has increased incidence by as much as 37% from 2005 to 2014 in this population (Mojtabai et al., 2016). Although studies have not estimated the prevalence of subclinical levels of stress or anxiety, it is likely that subclinical prevalence mirrors that of clinical diagnoses. Together, these statistics suggest that interventions during adolescence are necessary to mitigate risks for health problems across both physical and mental health domains.

Indeed, physical and mental health are inter-related across development, particularly during adolescence (Biddle & Asare, 2011; Biddle et al., 2019; Lubans et al., 2016). For example, a longitudinal cohort study of Norwegian adolescents ages 13-19 found that lower physical activity levels were associated with greater levels of depression and anxiety in male adolescents (Fløtnes et al., 2011). More recently, results from another large European cohort found that lower physical activity levels were associated with greater levels of depression and anxiety as well as worse overall well-being for both male and female adolescents ages 14-16 (McMahon et al., 2017). Although these studies provide support for the interrelation between physical and mental health outcomes in adolescents, these European cohorts may not be representative of all adolescents (e.g., countries with different health policies, in populations with limited access to medical care, and those from lower socioeconomic status (SES)).

Studies have consistently reported that environment (rural vs. urban), SES, and to a lesser extent race/ethnicity are moderating factors of physical health outcomes in adolescents. Specifically, adolescents from rural areas (Johnson & Johnson, 2015) and those from families with lower SES (Hanson & Chen, 2007) report lower physical activity levels and are more likely to be overweight or obese, compared with those from urban areas or families with higher SES, respectively. Environmental barriers, such as lack of access to transportation, which may be common in rural areas are negatively associated with physical activity levels among adolescents (Kahn et al., 2008). Common barriers to participating in physical activity reported by rural adolescents include lack of opportunities outside of the school environment and physical distance/transportation (Edwards et al., 2014; Moore et al., 2010). Recent national data suggest that the prevalence of obesity was higher among both Black and Hispanic adolescents than White adolescents (Kann et al., 2018). However, the influence of race as a moderator of physical activity is unclear, as results differ between studies (National Physical Activity Plan Alliance, 2018). For example, the 2016 National Survey of Children's Health report found that a greater percentage of Black adolescents participated in 60 minutes of physical activity every day than White adolescents (Child and Adolescent Health Measurement Initiative & Data Resource Center for Child and Adolescent Health, 2017), while the Youth Risk Behavioral Surveillance System found that more White adolescents reported being physically active for at least 60 minutes on 5 or more days than Black or Hispanic adolescents (Kann et al., 2018).

Evidence regarding the impact of SES and race on mental health status has been mixed. One literature review suggested that low SES was associated with greater self-reported mental health problems among adolescents (Reiss, 2013), however data from a national survey found no

relationship between SES and mental health diagnoses (Merikangas et al., 2010). These divergent findings may be related to the way in which mental health problems were operationalized (i.e., self-report vs. clinical diagnoses). Furthermore, White children and adolescents ages 9-17 from families with low SES were more likely to be diagnosed with depression or anxiety than Black children and adolescents from families with low SES (Costello et al., 2001). More recent studies have shown that White and Black adolescents report depressive symptoms at similar rates, however SES and/or its interaction with race were not evaluated (Kann et al., 2018). Despite these inconsistencies in the literature regarding race, greater mental health stigma has been reported in Black communities compared with white communities (Gary, 2005), resulting in lower utilization of mental health care services (De Luca et al., 2016). Additionally studies investigating the impact of environment (i.e., rural vs. urban) on mental health, suggest that there are greater barriers for receiving mental health services in rural environments (e.g., cultural perception, ability to travel to/from services, quality of care, etc.) (Douthit et al., 2015; Priester et al., 2016). Collectively, these studies suggest that minority adolescents, particularly Black adolescents, from rural areas and low SES backgrounds are at the greatest risk for cumulative physical and mental health burden and that these problems may underlie the health disparities reported in adults (i.e., lead to metabolic disease, cardiovascular disease, and mental health disorders). Moreover, despite the relationship between physical and mental health outcomes, no study has examined this relationship in rural, low-income minority communities.

Current Study

The overarching purpose of this study was to quantify physical and mental health disparities among students attending rural Title I schools (i.e., schools that receive supplemental federal

funding due to high concentrations of low-income students). We hypothesized that this population would exhibit a high prevalence of physical and mental health problems compared to national standards. We also hypothesized that better physical health outcomes would be related to fewer mental health symptoms, which would be moderated by sex. Specifically, we hypothesize that females would report lower physical activity and more mental health symptoms than males and that sex differences in the relationship between physical and mental health would be evident. Lastly, using a data-driven analytic approach, we aimed to identify clusters of students based on profiles of physical and mental health. We hypothesized four clusters of adolescents: those with good mental and physical health, those with good mental but poor physical health, those with poor mental but good physical health, and those with poor mental and physical health. These clusters could be used to identify students that may benefit from targeted interventions to mitigate risks for physical and/or mental health problems.

Methods

Participants

Tenth and eleventh grade students were recruited from four Title I high schools in rural Alabama. Title I schools receive supplemental federal funding due to high concentration of students (i.e., at least 40% of students) from low-income families that receive free or reduced meals. A total of 253 adolescents, ages 15- to 18-years participated in the program. Participant demographics are presented in Table 4.

Table 4.
Participant demographics

Demographic Variables	**Number of Participants (%), N=253**
Sex	
Male	114 (45.1%)
Female	139 (54.9%)
Age	
15	151 (59.7%)
16	80 (31.6%)
17	15 (5.9%)
18	1 (0.4%)
Not Reported	6 (2.4%)
Ethnicity	
Caucasian/White	105 (41.5%)
African American/Black	114 (45.1%)
Hispanic/Latino	4 (1.6%)
Asian/Pacific Islander	2 (0.8%)
Native American	1 (0.4%)
Mixed Race	11 (4.3%)
Not Reported	16 (6.3%)
Household Income	
< $30,000	109 (43.1%)
$30,000-$49,999	40 (15.8%)
$50,000-$99,999	53 (20.9%)
$100,000+	20 (7.9%)
Not Reported	31 (12.3%)
Parental Education	
Did Not Finish HS	39 (15.4%)
HS Diploma/GED	74 (29.2%)
Some College	44 (17.4%)
Trade, Technical, or Vocational Training	11 (4.3%)
Associate degree	26 (10.3%)
Bachelor's Degree	26 (10.3%)
Master's Degree	10 (4.0%)
Professional Degree	4 (1.6%)
Doctoral Degree	0 (0.0%)
Multiple Degrees Selected	4 (1.6%)
Not Reported	15 (5.9%)

Measures

Parent Demographic Survey. The parent demographic survey consisted of four questions to determine the ethnicity/race of the parent, their household income, their level of education, and their relationship to the child.

Student Demographic Survey. The student demographic survey was a 9-item questionnaire used to determine the participant's age, sex, ethnicity/race, family structure (single vs. two-parent household), number of siblings, extracurricular/sport participation, and the typical number of hours per week worked. Participants were categorized as athletes if they participated in at least one sport and non-athletes if they did not report participating in a sport. The total number of sports was determined from the different sports the participant reported. A 10th item regarding barriers to physical activity was added for the second year and therefore was only collected from a subset of participants. Participants were asked to choose from time-related, place-related, or person-related barriers to participating in physical activity (i.e., I didn't have time, I didn't have anywhere to go to be active, or I didn't have anyone to be active with).

PROMIS Pediatric Item Bank v1.0 – Physical Activity – Short Form 8a. This questionnaire is an 8-item measure of the frequency of moderate-to-vigorous physical activity (MVPA) per week. The conceptual framework and item development were a part of the National Institute of Health's Patient Reported Outcome Measurement Information System (Cella, Yount, et al., 2010; Forrest et al., 2012; Tucker et al., 2014a, 2014b) and the measure is appropriate for use in the general population (Tucker et al., 2014a, 2014b). Scores from each question were summed to form a composite score ranging from 8 (didn't exercise at all) to 40 (participated in MVPA 6 or 7 days per week).

PROMIS Pediatric Item Bank v2.0 – Anxiety – Short Form 8a. This questionnaire is an 8-item measure of anxiety symptoms (e.g., focusing on worrying, nervousness, and fear) and is recommended for use in the general population (Irwin et al., 2010). Participants were asked to rate the frequency of their symptoms from 1 (Never) to 5 (Almost Always) over the previous week. Scores from each question were summed to calculate a composite score ranging from 8 to 40, with higher scores representing higher levels of anxiety symptoms.

PROMIS Pediatric Item Bank v2.0 – Depressive Symptoms – Short Form 8a. This questionnaire is an 8-item measure of depressive symptoms, focusing on common depressive symptoms among children and adolescents (National Institute of Mental Health) (i.e., negative mood, negative self-views, disinterest, and negative social cognition) and is appropriate for use in the general population (Irwin et al., 2010). Participants were asked to rate the frequency of their symptoms from 1 (Never) to 5 (Almost Always) over the previous week. Scores from each question were summed to calculate a composite score ranging from 8 to 40, with higher scores representing higher levels of depressive symptoms.

PROMIS Pediatric Item Bank v1.0 – Psychological Stress Experiences – Short Form 8a. This questionnaire is an 8-item measure of psychological symptoms commonly associated with stress (i.e., feeling overwhelmed or under pressure) and is recommended for use in the general population (Bevans et al., 2018, 2013). Participants were asked to rate the frequency of their symptoms from 1 (Never) to 5 (Almost Always) over the previous week. Scores from each question were summed to calculate a composite score ranging from 8 to 40, with higher scores representing higher levels of psychological stress symptoms.

Body Shape Satisfaction Scale (BSS). A modified version of the Body Shape Satisfaction Scale (Pingitore et al., 1997) was used to assess body satisfaction/dissatisfaction. This 13-item

questionnaire has been used with both male and female adolescents (Neumark-Sztainer et al., 2012). For each item, participants rated their satisfaction with a body part or feature (e.g., height, stomach, muscles) from 1 (Very Dissatisfied) to 7 (Very Satisfied). Scores from each item were summed to calculate a composite score ranging from 13 to 91, with higher scores representing greater body satisfaction.

Rosenberg Self-Esteem Scale (RSES). The Rosenberg Self-Esteem Scale short form (Rosenberg, 1965) was used to assess global self-esteem. This 6-item questionnaire has been used with adolescents with varying demographic backgrounds (Van Den Berg et al., 2010). For each item (e.g., "On the whole, I am satisfied with myself", "At times I think I am no good at all") rated their agreement with the statement from 1 (Strongly Disagree) to 4 (Strongly Agree). Scores from each item were combined to calculate a composite score ranging from 6 to 24, with higher scores representing greater self-esteem.

Functional Fitness and Health Testing. FITNESSGRAM® physical fitness testing consisted of anthropometrics (height, weight, body mass index [BMI]), body composition (% fat mass, % lean mass), resting heart rate, blood pressure, muscular strength and endurance (push-ups, curl-ups), and aerobic capacity (Progressive Aerobic Cardiovascular Endurance Run [PACER]). Body composition was measured using a TANITA total body composition analyzer (SC-331S Total Body Composition Analyzer, TANITA) and blood pressure and heart rate were measured via an Omron® automatic blood pressure monitor (5 Series Upper Arm Blood Pressure Monitor BP742N, Omron Healthcare)**.**

Procedure

Wellness programs were conducted at each of the Title I high schools, during which physical health and mental health measures were obtained. Prior to the program, parents completed the informed consent to allow their child to participate in the program and the parent demographic survey. Students completed the student demographic survey and the PROMIS Pediatric Physical Activity, PROMIS Pediatric Anxiety, and PROMIS Pediatric Depression questionnaires prior to the program. During the wellness program, students attended small group sessions that discussed different aspects of mental health (i.e., depression, anxiety, stress, self-harm, peer support, help-seeking behaviors) and completed the PROMIS Pediatric Psychological Stress questionnaire, the BSS, and the RSES. Groups of 4-8 students of the same sex rotated through a circuit of the tasks that comprised the functional fitness and health assessment.

Statistical Analyses

Rates of anxiety, depression, and stress were computed based on the PROMIS questionnaires. Overweight and obesity rates were calculated using the measured BMI according to Center for Disease Control standards (i.e., overweight is 85^{th}-95^{th} percentile and obese is $\geq 95^{th}$ percentile). Body fat percentage was categorized into very lean, healthy fitness zone (HFZ), needs improvement (NI), and needs improvement – health risk (NI – HR) according to FITNESSGRAM® standards. Physical fitness scores (push-ups, curl-ups, PACER) were categorized into HFZ, NI, and NI – HR (when applicable) according to FITNESSGRAM® standards. Self-report physical activity, anxiety and depression scores were standardized and categorized into normal, mild, moderate, and severe according to PROMIS norms (Cella, Riley, et al., 2010; Rothrock et al., 2010). Psychological stress scores were standardized and

categorized into low, average, high or very high according to PROMIS norms (Cella, Riley, et al., 2010; Rothrock et al., 2010).

MATLAB version R2018a (MathWorks Inc., Natick, MA, USA) was used to conduct Pearson correlations to examine bivariate correlations amongst the physical (body fat percentage, BMI, physical activity), mental health (stress, depression, anxiety), body image, and self-esteem dependent measures. The three physical health measures were selected as they provide an overall representation of physical health. The level of significance was set to $p < .05$.

In addition to these standard analyses, a multivariate data-driven cluster analysis (using the clustergram function in MATLAB version R2018a [MathWorks Inc., Natick, MA, USA]) was used to identify groups of students based on 13 variables representing mental health (stress, depression, anxiety), physical health characteristics (physical activity level, body fat percentage, BMI, systolic blood pressure, diastolic blood pressure, resting heart rate, number of sports), and physical fitness measures (push-ups, curl-ups, PACER). The cluster analysis normalized each variable and computed the Euclidian distance between individuals based on the normalized score for all 13 variables. Individuals and clusters were linked based on the shortest average distance between individuals. The cluster analysis also groups variables based on the similarity between the profile of data across individuals.

Missing Data

As participants completed and returned the consent forms and some of the questionnaires prior to the wellness program (i.e., demographic survey, PROMIS Pediatric Physical Activity, PROMIS

Pediatric Anxiety, and PROMIS Pediatric Depression questionnaires), data are missing at random for the following reasons: the student completed and returned the questionnaire packet prior to the day of the program, but did not attend the program; the student attended the program, but did not return or complete the questionnaire packet; the student attended the program, but chose not to complete a test or questionnaire; the student did not receive the PROMIS Psychological Stress questionnaire due to experimenter miscommunications. Lastly, as the BSS and RSES were added to the protocol after some schools had already participated, only a subset of students completed these questionnaires.

Results

Barriers to Physical Activity

As previously stated, only a subset of the participants (n=124) completed the item asking about barriers to physical activity. The most common reported barrier was not having the time to be physically active. A total of 62.1% participants reported that on the days they were not physically active, not having time kept them from being physically active. The rates of person and place-related barriers were much lower, with 29.0% reporting not having anyone to be active with and 24.2% reporting not having anywhere to go to be active.

Mental and Physical Health Characteristics

Less than half the participants were in the normal range for anxiety (43.5%), depressive (43.5%), and stress (43.9%) symptom levels. Specifically, 36.4% reported moderate or severe anxiety symptoms, 36.0% reported moderate or severe depressive symptoms, and 28.1% reported high or very high psychological stress symptoms (See Table 5). Additionally, of the 223 participants with body composition data, 44.4% were either overweight (17.9%) or obese (26.5%).

Almost half of the participants were categorized as having healthy body composition (47.8% for body fat percentage and 47.4% for BMI) according to FITNESSGRAM® standards. About half (49.4%) met FITNESSGRAM® standards for push-ups and curl ups (49.8%). Participants also performed poorly on the PACER test, with only 20 participants (7.9%) meeting criteria for healthy standards, while the majority (63.2%) fell into the needs improvement – health risk category (See Table 6). Although many students did not perform well on the physical fitness tests, 64.8% of students fell into the normal range of physical activity based on the PROMIS questionnaire. The distributions with category cut-points for the PROMIS physical activity and mental health T-scores are depicted in Figure 12.

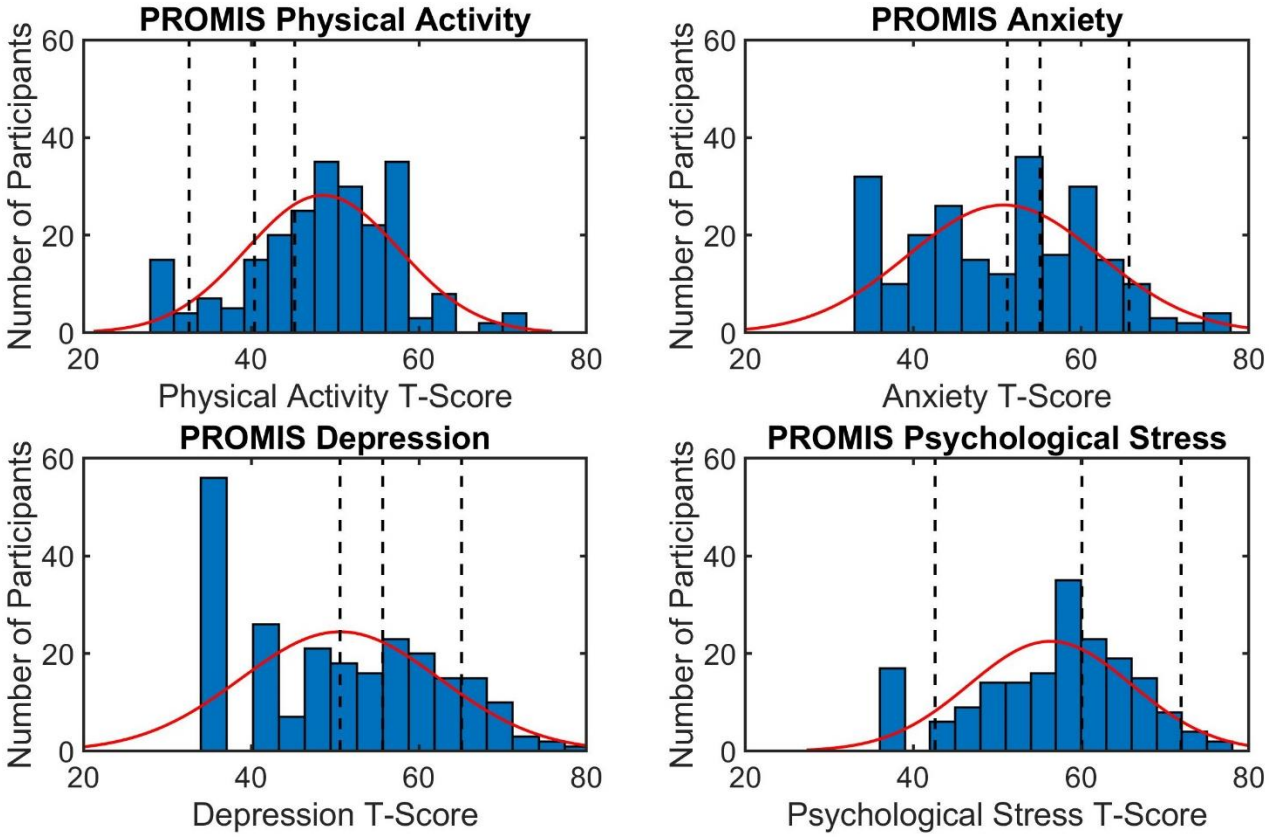

Figure 12. Distribution of T-scores for each of the four PROMIS measures. For each figure, the x-axis represents PROMIS standardized T-score and the y-axis represents the number of

participants. The vertical dashed lines depict the cut-points for each category (normal, mild, moderate, severe [physical activity, anxiety, depression] or low, average, high, very high [psychological stress]).

Table 5.
PROMIS Categorization

Questionnaire	**Normal**	**Mild**	**Moderate**	**Severe**
PROMIS Physical Activity	164 (64.8%)	32 (12.6%)	19 (7.5%)	15 (5.9%)
PROMIS Anxiety	110 (43.5%)	32 (12.6%)	70 (27.7%)	22 (8.7%)
PROMIS Depression	110 (43.5%)	34 (13.4%)	58 (22.9%)	33 (13.0%)
	Low	**Average**	**High**	**Very High**
PROMIS Psychological Stress	17 (6.7%)	94 (37.2%)	60 (23.7%)	11 (4.3%)

Table 6.
FITNESSGRAM™ Categorization

Test	**Underweight**	**Normal**	**Overweight**	**Obese**
Obesity (by BMI)	4 (1.6%)	120 (47.4%)	40 (15.8%)	59 (23.3%)
	Very Lean	**HFZ**	**NI**	**NI – HR**
FITNESSGRAM – Body Fat	6 (2.4%)	121 (47.8%)	51 (20.2%)	44 (17.4%)
		HFZ	**NI**	**NI – HR**
FITNESSGRAM – PACER		20 (7.9%)	39 (15.4%)	160 (63.2%)
		HFZ	**NI**	
FITNESSGRAM – Push-Up		125 (49.4%)	98 (38.7%)	
FITNESSGRAM – Curl-Up		126 (49.8%)	98 (38.7%)	

*NI – HR = Needs Improvement – Health Risk; NI = Needs Improvement; HFZ = Healthy Fitness Zone

Relationships Between Mental and Physical Health

After controlling for sex, the bivariate correlations revealed significant positive correlations between body fat percentage and anxiety ($r = .20$, $p < .01$), depression ($r = .15$, $p = .03$), stress ($r = .19$, $p < .01$), and BMI ($r = .92$, $p < .001$). Additionally, body fat percentage was negatively correlated with body satisfaction ($r = -.33$, $p < .01$). Body satisfaction was negatively correlated with BMI ($r = -.37$, $p < .01$), anxiety ($r = -.29$, $p = .01$), depression ($r = -.34$, $p < .01$) and

positively correlated with self-esteem (r = .42, p < .001). Self-esteem was also negatively correlated with BMI (r = -.28, p < .01), anxiety (r = -.44, p < .001), depression (r = -.62, p < .001) and psychological stress (r = -.49, p < .001) Interestingly, neither body fat percentage (r = -.09, p = .19) nor BMI (r = -.03, p = .72) were significantly correlated with self-report physical activity levels. A correlation matrix containing relationships between all the examined variables is depicted in Figure 13.

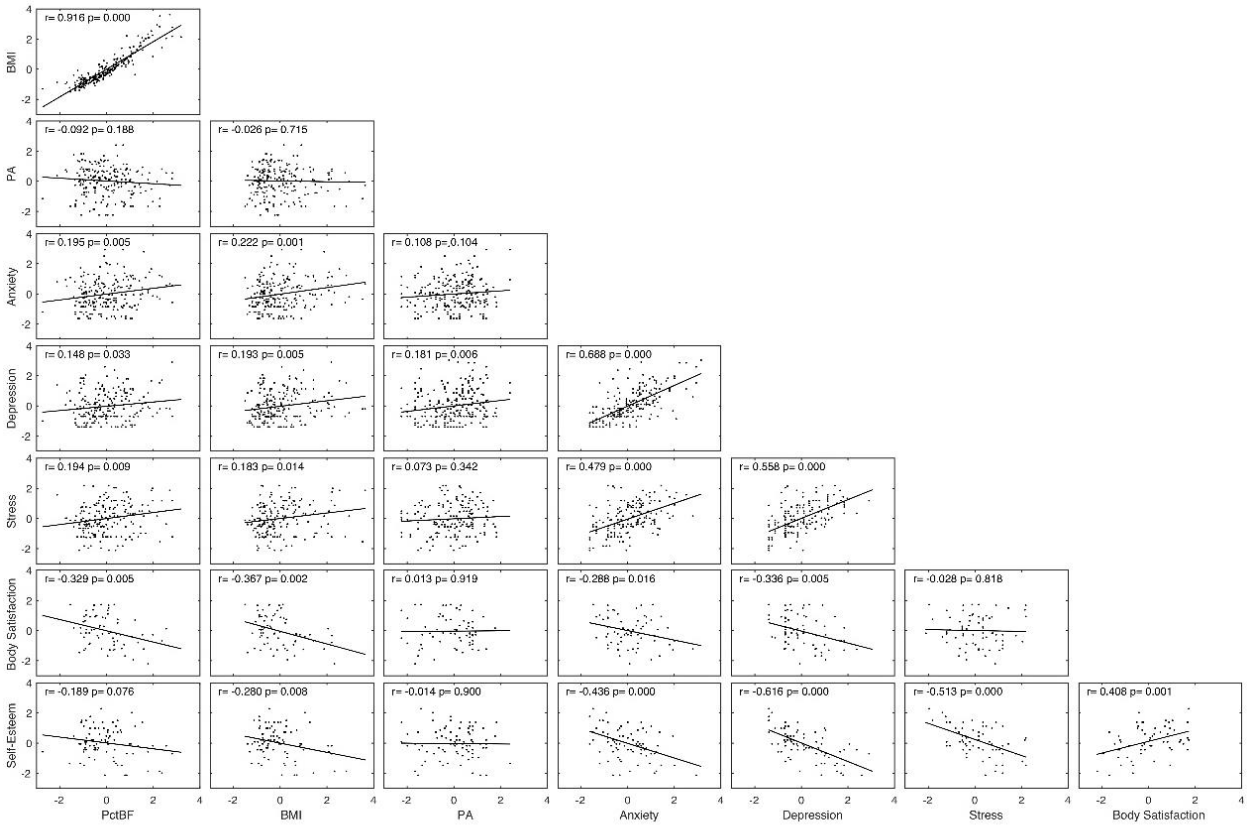

Figure 13. Pearson partial correlation matrix controlling for sex between percent body fat, BMI, physical activity, anxiety symptoms, depressive symptoms, psychological stress symptoms, body satisfaction, and self-esteem. For each figure, r and p values are located in the upper left corner and the least squares line is overlaid.

Data Driven Classification of Variable Clusters. Figure 14 depicts the cluster results. The first-level separation of variables in the cluster analyses (top of Figure 14) split the physical fitness (i.e., curl-up, push-up, PACER) and physical activity measures (i.e., number of sports, self-report physical activity) from the blood pressure, resting heart rate, body composition (i.e., percent body fat, BMI), and mental health measures (i.e., anxiety, depression, stress). This first level clustering suggests that body composition and resting heart rate are more closely related to mental health than physical fitness, supporting the use of body composition measures to explore relationships between physical and mental health.

Data Driven Classification of Participant Clusters. The cluster analysis revealed four distinct clusters of participants as well as three separate branches each representing 1-5 individuals that were distinct from the other clusters (Figure 14 left side). The first branch separated one female whose data profile was distinct from other in that she exhibited very high body fat percentage, BMI, anxiety, depression, and high curl-up score (top). The second branch separated two individuals, one male and one female, with very high blood pressure and slightly above average body composition (bottom). The third branch separated one male with very high body fat percentage, BMI, systolic blood pressure, and curl-up scores.

With respect to the larger clusters of individuals (i.e., those with more than 5 participants), Cluster 1 (blue) included 31 males and 2 females. The profile for the participants in this cluster included those with a high number of sports, healthy body composition, above average physical fitness scores, and mostly normal or mild levels of anxiety, depression, and stress (i.e., only 7 out

of 33 exhibited moderate mental health symptoms). Cluster 2 (purple) included 106 participants (49 males, 57 females) who had healthy body composition and typically met standards for the push-ups (78/106 [73.6%] HFZ) and curl-ups (71/106 [67.0%] HFZ), but not the PACER test (3/106 [2.8%] HFZ). These participants also reported generally normal or mild levels of anxiety, depressive, or stress symptoms (i.e., 34 out of 106 exhibited moderate or severe symptoms). Overall, the majority of the individuals in Clusters 1 and 2 exhibited few physical and mental health problems.

Clusters 3 and 4 identified participants experiencing greater physical and/or mental health problems and included a large number of female students. Cluster 3 (red) included 11 males and 42 females with mixed body composition (21 out of 53 with normal BMI) and performance on the physical fitness tasks (31 out of 53 in the healthy fitness zone). Additionally, all but one individual reported moderate or severe anxiety, depressive, and/or stress symptoms. Cluster 4 (green) included 40 participants (8 males, 32 females) with unhealthy body composition and poor physical fitness performance (needs improvement or needs improvement health risk). Compared to Clusters 1 and 2, anxiety, depression and stress levels were elevated, with 27 of the 40 participants reporting moderate or severe anxiety, depressive, and/or stress symptoms.

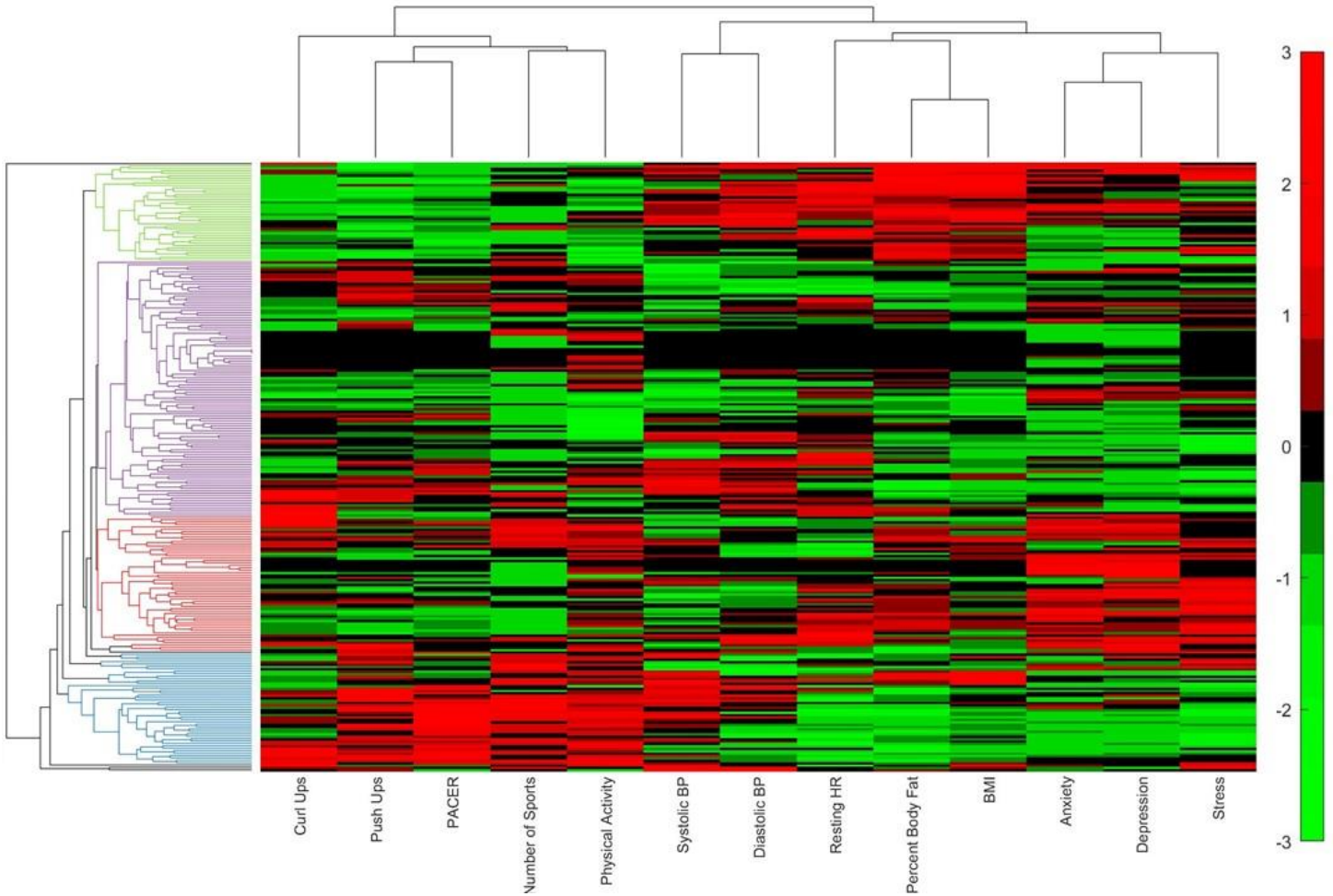

Figure 14. Clustergram of the population across the 13 variables of interest. The x-axis represents each of the 13 variables of interest and their clustering based on similar response profiles across participants. The y-axis represents each participant and their clustering based on similar profiles across all 13 variables (i.e., shortest Euclidian distance across all variables). The red-green color coding

represents the normalized scores for each variable, where red represents high scores for a particular variable, black represents average scores, and green represents low scores.

Discussion

Prevalence of Physical and Mental Health Issues

The combination of standard statistical analyses and a data-driven multivariate analysis allowed for unique insights at the group and individual levels, respectively. At the group level, these data indicate that rural, low-income adolescents exhibited greater obesity and internalizing mental health issues than previous state (Child and Adolescent Health Measurement Initiative & Data Resource Center for Child and Adolescent Health, 2017) and national-level data noted (Child and Adolescent Health Measurement Initiative & Data Resource Center for Child and Adolescent Health, 2017; Merikangas et al., 2010). Specifically, the obesity rate of 26.5% in this sample was 8.3% greater than the most recently reported obesity rate of adolescents in the state of Alabama (18.2%) (Child and Adolescent Health Measurement Initiative & Data Resource Center for Child and Adolescent Health, 2017) and 11.7% higher than the national average (14.8%) (Kann et al., 2018). These data are alarming in that Alabama was ranked 42 out of 51 (including all 50 states and the District of Columbia) for adolescent obesity (Child and Adolescent Health Measurement Initiative & Data Resource Center for Child and Adolescent Health, 2017) and yet, a greater percentage of participants in this study were considered overweight or obese compared to the most recent report. The mental health statistics were also higher than previous national estimates; 36.4% reported moderate or severe anxiety symptoms, 36.0% reported moderate or severe depressive symptoms, and 28.1% reported high or very high psychological stress symptoms. A previous national estimate for adolescent anxiety was 4.5% lower (31.9%) (Merikangas et al., 2010) and that for depression was 6% lower (30%) (Center for Disease Control, 2017) than the current sample. Alarmingly, less than half the participants were in the normal range for anxiety (43.5%), depressive (43.5%), and stress (43.9%) symptom levels.

With respect to the mental health prevalence, the present results replicate and extend previous research suggesting that low-income, rural populations may be at elevated risk for mental health issues (Douthit et al., 2015; Priester et al., 2016; Reiss, 2013), with a large percentage of participants exhibiting moderate or severe symptoms of depression, anxiety, or stress. Moreover, consistent with national-level data, females in this population exhibited a significantly greater risk for both mental (Center for Disease Control, 2017; Kann et al., 2018; Merikangas et al., 2010) and physical (Kann et al., 2018) health issues than males.

Relationships Between Mental and Physical Health

At the variable level, the cluster analysis found that the body composition measures (body fat percentage, BMI) and resting heart rate were more closely related to mental health compared to the physical activity or physical fitness measures. This is somewhat in contrast with findings from Fløtnes et al. (2011) that greater physical activity was related to lower anxiety/depressive symptoms in adolescent males, but that there was no relationship between BMI and anxiety/depressive symptoms for males or females. These discrepancies may be due to the population studied (Norwegian adolescents vs. rural, low-income, American adolescents), particularly given the high prevalence of obesity among the present sample. The bivariate correlations revealed positive relationships between body composition and all mental health variables and negative correlations between body satisfaction and anxiety and depressive symptoms. Unexpectedly, there was a positive relationship between physical activity and depressive symptoms. The cause of this relationship is unknown and should be explored in future research. Although the present analysis controlled for sex, relationships between body composition, body satisfaction, and mental health outcomes may be different for males and

females. Indeed, a previous study found that the relationships between body image and mental health outcomes were sex dependent; males that rated themselves as thin/very thin and females that rated themselves as very fat/chubby or thin/very thin had a higher risk of symptoms of anxiety or depression (Fløtnes et al., 2011). However, that study did not find a relationship between BMI and mental health outcomes (Fløtnes et al., 2011). Future studies are needed to determine if the relationship between mental and physical health is mediated by body composition or body satisfaction. To our knowledge, this was the first study to address relationships between physical health and mental health among low-income, rural adolescents. Therefore, additional studies are needed to replicate and extend the present study in similar populations.

At the individual level, the cluster analysis identified groups of participants with similar physical and mental health profiles. This analysis revealed four main clusters. The first two clusters identified students with average to good physical and mental health. A third cluster identified individuals with poor mental health but average to good physical health, while the fourth cluster identified individuals with poor physical health and poor to average mental health. While these clusters were not entirely in line with the hypothesized clusters (i.e., good physical and mental health, poor physical and mental health, good physical and poor mental health, poor physical and good mental health), the cluster analysis did reveal groups of individuals with greater mental and physical health burdens. These individuals may benefit from targeted interventions to reduce mental or physical health burdens. It is important to note that the cluster analysis normalizes each individual's data, such that those who exhibit an unhealthy profile are unhealthy compared to the rest of the sample. Given that this population is already a high-risk population, those identified

by the cluster analysis can be considered in greatest need for intervention. Data acquired from in similar populations may yield similar clusters and identify those at highest risk.

Limitations and Future Research

This study specifically targeted high school students from rural, Title I schools as an important and under-represented group in the research literature. As such, this sample lacked diversity with respect to race and socioeconomic status; nearly all students were African American/Black (45.1%) or Caucasian/White (41.5%), and nearly half (43.1%) reported household incomes less than $30,000. The present categories for income were based on those used a previous study (Duncan, Duncan, Strycker, & Chaumeton, 2002) and the median income for the state of Alabama. As such, the very lowest income category did not sufficiently differentiate those in the very low-income category (e.g., <$30,000). Future studies in this population may need additional income stratification for those with low income (e.g., <$15,000, $15,000-29,999, $30,000-49,999). Additional future research addressing physical and mental health burdens should focus on comparing urban and rural adolescents with similar SES and racial backgrounds. This comparison would help to determine which of the three demographic factors (i.e., environment, race, or SES) is the most influential. For example, if minimal differences are found between urban and rural adolescents, this may suggest that race and/or SES are the more influential factors. Additionally, it was not possible to conduct multilevel modeling to assess school-level differences as only four schools of varying size were included in the present study. Future studies are necessary to replicate and extend these findings in a larger population of adolescents from rural, Title I schools to enable multilevel analyses. Lastly, this was a cross-sectional study whose aim was to determine health disparities in rural, low-income schools and demonstrate the utility

of data-driven methods to identify groups of individuals that may benefit from targeted health interventions. Therefore, this study was not able to provide insights regarding changes in physical and mental health outcomes in this population or the efficacy of targeted interventions with this population. With that said, targeted interventions such as school-based physical activity and/or mental health programs and longitudinal tracking are essential to reduce mental health and physical health burdens, particularly in female adolescents in this population.

Policy Implications

As the prevalence of both physical and mental health problems continues to increase among adolescents from this population (Center for Disease Control, 2017; Hanson & Chen, 2007; Johnson & Johnson, 2015; Kann et al., 2018), local education and health policies are needed to detect, treat, and prevent physical and mental health problems. The efficacy of school-based mental and physical health interventions have been demonstrated previously (Annesi, Trinity, Mareno, & Walsh, 2015; Feiss et al., 2019; Melnyk et al., 2013) and may serve as a convenient method of targeting this unique population, especially if there are barriers to access to specialized health programs (e.g., transportation, limited facilities, cost, etc.). Moreover, programs delivered at the school may also help reduce barriers to physical activity participation as the programs could enable time during the school day to be physically active. This would address the main barrier to physical activity reported by the students in the present study. Culturally-sensitive practices and incorporating group sessions of same-race participants may be particularly important for minority, low-income, and/or rural populations (Griner & Smith, 2006; Planey, Smith, Moore, & Walker, 2019).

State-level policies requiring schools to provide mental health education, such as those implemented by New York, Virginia, and Florida, may improve mental health outcomes, including reducing mental health stigma known to limit help-seeking behaviors (Mellor, 2014; Mukolo & Heflinger, 2011). Broad dissemination of similar programs, particularly in the rural South, may reduce mental health burdens that continue into adulthood. Programs that target mental and physical health burdens by including both physical activity and psychotherapy components have been shown to increase physical activity and reduce mental health symptoms (Thomas, Thirlaway, Bowes, & Meyers, 2020). Education and health policies should continue to integrate physical activity and mental health education in school curricula.

Conclusion

The current study identified physical and mental health disparities in a group of rural, low-income adolescents. We also investigated relationships between mental and physical health and the factors that influence those relationships. While these relationships have been explored in previous studies in populations of adolescents, they have not been investigated in this particular at-risk population. Overall, physical and mental health disparities were indeed evident in this rural, low-income adolescent population. These health burdens were prevalent in female adolescents. The correlations between body composition, body satisfaction, self-esteem, and mental health measures suggest that mental health programs may benefit from the discussion of these related topics. Taken together, the present findings indicate that efforts must be made towards reducing both mental and physical health burdens among rural, low-income adolescents as a key at-risk population. In particular, school-based programs that integrate physical and mental health education may be important to reduce these health burdens.

Chapter 4 – General Discussion

Overall, studies suggest that adolescents from rural areas and low SES backgrounds are at the greatest risk for both physical (Hanson & Chen, 2007; Johnson & Johnson, 2015) and mental health (Douthit et al., 2015; Reiss, 2013) burdens. These problems may underlie the health disparities exhibited in adults (i.e., metabolic disease, cardiovascular disease, and mental health disorders [Hallal et al., 2006; Tammelin et al., 2003]). Moreover, despite the relationship between physical and mental health outcomes, no studies have examined this relationship in adolescents from rural, low-income communities. Therefore, the overarching purpose of these studies was to investigate relationships among adolescents' mental and physical health outcomes and the factors that may influence these relationships.

Study 1 examined the influences of demographics, sport participation, and physical activity on mental health and physical health and fitness outcomes. The results of this study demonstrated that similar to other populations, rural, low-income females participate in fewer sports, report less physical activity, and experience greater internalizing mental health symptoms (i.e., anxiety, depressive, and stress symptoms) than their male counterparts. Additionally, as expected, sport participation and/or physical activity were related to increased physical fitness/physical health, although these relationships were influenced by sex and/or race. Surprisingly, greater physical activity levels were associated with increased anxiety in females and depressive symptoms in female athletes. Given that the present sample includes a large proportion of adolescents from low-income, minority backgrounds living in rural areas. It is possible that the level of participation in physical activity and barriers for achieving additional physical activity participation outside of school (e.g., access to gyms, recreational sports, and other facilities) are

not sufficient to reduce the elevated mental health symptoms experienced by females in this population. Another somewhat surprising finding was that sport participation was only associated with decreased depressive and psychological stress symptoms for Caucasian/White adolescents. These racial differences may be due to cultural differences in the rationale for participating in sport or the experience of adolescent athletes (Duncan et al., 2015). For example, Black males report that sport participation is outlet to demonstrate their masculinity or a way out of unfavorable conditions by Black males (Faulk et al., 2017). Additionally, Black families may place more emphasis on sport participation than other activities compared to White families (Eitle & Eitle, 2002). Although sport participation had varying influences on mental health, there was a positive influence of sport participation on several aspects of physical fitness. This suggests that sport participation may be a means for maintaining and improving physical health among rural, low-income adolescents. Furthermore, team sports (Boone & Leadbeater, 2006) and youth development programs (Weiss et al., 2012) have been associated with better physical activity and mental health outcomes (e.g., self-esteem, body size satisfaction, relatedness, etc.) among adolescent populations. These types of programs specifically aim to improve mental health and physical health through education and activities in a supportive environment and may influence positive trajectories of health in this population.

Study 2 examined profiles of physical and mental health in adolescents from low-SES communities using a cluster analysis to determine mental and physical health burdens and possible relationships between these health outcomes. The combination of standard statistical analyses and a data-driven multivariate analysis allowed for unique insights at the group and individual levels, respectively. At the group level, these data indicate that rural, low-income

adolescents exhibited greater obesity and internalizing mental health issues than that reported in previous state (Child and Adolescent Health Measurement Initiative & Data Resource Center for Child and Adolescent Health, 2017) and national-level data (Child and Adolescent Health Measurement Initiative & Data Resource Center for Child and Adolescent Health, 2017; Merikangas et al., 2010). As expected, even after controlling for sex, the bivariate correlations revealed positive relationships between body composition (i.e., body fat percentage and BMI) and all mental health variables. Negative correlations between body satisfaction and body composition, and anxiety and depressive symptoms were also observed. Interestingly, physical activity was not correlated with body fat percentage or BMI but was positively correlated with depressive symptoms. While this finding was not expected, it is in line with the findings from Study 1 regarding the positive relationship between physical activity and depressive symptoms in female athletes. At the individual level, the cluster analysis identified groups of participants with similar physical and mental health profiles. This analysis revealed four main clusters. The first two clusters identified students with average-to-good physical and mental health. A third cluster identified individuals with poor mental health but average-to-good physical health, while the fourth cluster identified individuals with poor physical health and poor-to-average mental health. While these clusters were not entirely in line with the hypothesized clusters (i.e., good physical and mental health, poor physical and mental health, good physical and poor mental health, poor physical and good mental health), the cluster analysis did reveal groups of individuals with greater mental and physical health burdens. These individuals may benefit from targeted interventions to reduce mental or physical health burdens. Overall, physical and mental health burdens were indeed evident in this rural, low-income adolescent population, particularly among female adolescents. The correlations between body composition, body satisfaction, self-esteem,

and mental health measures suggest that mental health programs may benefit from the discussion of these related topics. The findings from Study 2 indicate that efforts must be made towards reducing both mental and physical health burdens among rural, low-income adolescents as a key at-risk population. In particular, the implementation of school-based programs that integrate physical and mental health education may reduce these health burdens.

Taken together, these studies have added to existing literature examining the prevalence of mental and physical health among adolescents and the relationships among these domains. However, to our knowledge, this was the first study to address relationships between physical health and mental health among low-income, rural adolescents. Therefore, additional studies are needed to replicate and extend the present study in similar populations to gain a better understanding of these relationships and how they are influenced by sex, race, and possibly income. Due to homogeneity in SES in the present sample and the unequal distribution of race across the income categories, we were unable to address the unique influence of household income on sport participation, physical activity, and physical/mental health measures. To address this limitation, future studies need a greater parcellation of the lower SES category (i.e., <$15,000, $15,000-30,0000, etc.) as well as a larger number of individuals from middle and higher incomes living in rural areas. Additional future research addressing physical and mental health burdens should focus on comparing urban and rural adolescents with similar SES and racial backgrounds. This comparison would help to determine which of the three demographic factors (i.e., environment, race, or SES) is the most influential. For example, if minimal differences are found between urban and rural adolescents, this may suggest that race and/or SES are the more influential factors. An additional limitation was the use of a self-report physical

activity measure instead of quantitatively assessed physical activity (e.g., via accelerometer), particularly given the tendency of adolescents to over-estimate their physical activity levels. Future studies, particularly intervention-based studies should consider the use of an accelerometer in addition to or in place of a self-report physical activity measure. Unfortunately, we were not able to complete the longitudinal analyses as planned because there were too few returning 11th grade students (i.e., some schools did not offer the program to returning 11th grade students, schools limited the second fair to 10th grade students, or there was limited participation from 11th grade students at schools that offered the fair to returning students). Therefore, this study was not able to provide insights regarding changes in physical and mental health outcomes. With that said, targeted interventions such as school-based physical activity and/or mental health programs and longitudinal tracking are essential to reduce mental health and physical health burdens, particularly in female adolescents in this population. Increased buy-in or cooperation from schools, students, families, and the community may be necessary to conduct sustainable, high-quality interventions in this population.

Lastly, we believe that these studies have accumulated evidence to support health and education policies to target the health burdens in the present population. State-level policies requiring schools to provide mental health education, such as those implemented by New York, Virginia, and Florida, may improve mental health outcomes, including reducing mental health stigma known to limit help-seeking behaviors (Mellor, 2014; Mukolo & Heflinger, 2011). Broad dissemination of similar programs, particularly in the rural South, may reduce mental health burdens that continue into adulthood. Statewide collection of similar data in Alabama, particularly anxiety and depressive symptoms, physical activity, BMI, and body fat percentage

would provide a comprehensive picture of the overall health of adolescents in Alabama. Moreover, these data can provide evidence for the adoption of new policies or adaptation of existing policies for mental and physical health education and practices, particularly in areas serving those in low-income, rural areas of the state. The efficacy of school-based mental and physical health interventions have been demonstrated previously (Annesi et al., 2015; Feiss et al., 2019; Melnyk et al., 2013) and may serve as a convenient method of targeting this unique population, especially if there are barriers to access to specialized health programs (e.g., transportation, limited facilities, cost, etc.). Culturally-sensitive practices and incorporating group sessions of same-race participants may be particularly important for minority, low-income, and/or rural populations (Griner & Smith, 2006; Planey et al., 2019). These practices may also help to reduce stigma surrounding mental health issues, which may contribute to the increased prevalence of mental health issues among low-income, rural, or minority populations (DeLuca, 2019) and is shown to be a major barrier for help-seeking among adolescents (Bowers, Manion, Papadopoulos, & Gauvreau, 2013; DeLuca, 2019). Programs that target mental and physical health burdens by including both physical activity and psychotherapy components have been shown to increase physical activity and reduce mental health symptoms (Thomas et al., 2020). Education and health policies should integrate physical activity and mental health education in school curricula.

Overall, this project has served as a very important initial stepping-stone for future research with this population, particularly for the development of culturally appropriate interventions. This project was the first connection made between the School of Kinesiology and many of the high schools and their administrators. This project required that Dr. Pangelinan and I reached out to

the administrators of 16 public and private high schools in a 1-hour radius of Auburn University on several occasions to set-up meetings to describe and pitch the program. This process began 6 months before the start of the program and required follow-ups with schools. The first year, we received responses from 4 of the 16 schools and were able to set up meetings with each of these four schools. During these meetings, we described the overall program and explained how it could be customized to fit the needs of their students. These customizations included bringing in speakers who had similar backgrounds and demographics to students at the school and specific topics that were relevant to current issues faced by the students at each school. For example, during one meeting, the counselor mentioned that her students were dealing with the recent suicide of a student from a nearby school. For this school, one the small group mental health sessions discussed depression, suicide awareness, and peer advocacy.

Leading up to the fairs, weekly communication via email, phone, and in-person visits were also necessary to ensure correct distribution and collection of program information, consent forms, and participation packets. Moreover, it became very apparent that cooperation and involvement from multiple administrators including the principal and school counselor was necessary for the program to be successful. For example, the schools where we worked with only the counselor or the principal had the least buy-in from the students, with less than 15% of students returning consent forms at these schools. However, the schools where at least two members of the administrative staff (i.e., principal, vice principal, counselor, nurse) were involved, buy-in from students was much better, with at least 70% of the students returning consent forms at these schools. Therefore, to continue these types of programs in the future, we would recommend minimally working with the principal and the head counselor at each school.

The availability of resources also differed between schools. Ideally, the physical fitness data collection would take place in the gymnasium and the small group sessions would take place in separate classrooms. For most of the fairs, these resources (i.e., the gymnasium and 2-4 classrooms) were available for use during the program. However, often times, the classrooms were far away from each other and/or the gymnasium, causing some logistical issues for moving students between the two components of the fair. Additionally, one school requested that the physical fitness component of the program be completed in the cafeteria rather than the gymnasium. This created multiple scheduling issues including limited time for set up and a request that the program be run in a shorter time than planned as the cafeteria was used for both breakfast and lunch. As far as the resources in the classrooms for the small group sessions, access to a projector and/or whiteboard/chalkboard was requested. Most schools met this requirement rather easily, with a few technological issues here and there. However, we also brought a portable projector and prepared speakers to lead without the assistance of a PowerPoint presentation if necessary. For replication and/or extension of the program, we recommend requesting access to the gymnasium and 2-4 classrooms (depending on the size of the school) with access to a projector and whiteboard/chalkboard for the most efficient delivery of the program. Additionally, we recommend asking to use classrooms as close to the gymnasium as possible to increase the ease of transferring students between the physical fitness and small groups components.

In addition to the logistics of school cooperation, the other major logistical constraints included recruiting speakers who led the small group sessions and training the research assistants to

collect the physical fitness data. Once we met with the schools to determine the topics for the small group sessions, we contacted faculty and graduate students from the School of Kinesiology, the Department of Human Development and Family Studies, the Department of Psychological Services, the Clinical Mental Health Counseling program, the Counseling Psychology program, the School Counseling program, the Clinical Rehabilitation Counseling program, and the Counselor Education program to recruit graduate students and faculty speakers for the mental health component program. We met with the speakers individually and in group settings to discuss the goals of the program, match them to the school based on their demographics, background, knowledge and experiences, and availability, and develop their talks. The total prep time was about 3 months from speaker recruitment to being ready to present at the fair. Ideally, 2-4 speakers and backups were needed for each school depending on capacity. The research assistants (RAs)were recruited through the Pediatric Movement and Physical Activity Lab and the School of Kinesiology. RAs completed three training sessions where they were taught the data collection techniques (i.e., each station of the fitness assessments, practiced collecting data, and were instructed on data entry). Each research assistant was trained on the full physical fitness assessment but was assigned to a specific station when collecting data at the schools. Students were observed during the first two training sessions and assigned to a specific task/station for the third session based on their previous experiences and demonstrated abilities. If needed, I met individually with students to ensure they understood each of the tasks in the physical fitness assessment, particularly the one for which they were assigned. Ideally, 20-25 RAs were needed for efficient data collection and data entry.

In all, frequent and clear communication between the project leader(s) and the school administrators, speakers, and research assistants was essential for the success of this project and would be required for the replication and extension of this project or any similar school-based programs. Additionally, the project leader, speakers, and research assistants must be flexible and ready to adapt to last minute changes in scheduling and space available, which were common occurrences. Lastly, we believe that the ability of the speakers to appear relatable to the students was one of the most important factors in the success of the small group sessions. Therefore, this aspect of the program is essential for successful replication and extension of this project or similar programs.

After the program, a report including a summary of the program activities, recommendations for improving different aspects of physical fitness, a summary of the students physical and mental health characteristics, contact information for mental health resources, and a summary of nutritional intake information was sent to the administrators at each school. The administrators were told that they were welcome to share this information with other administrators, teachers, or parents. During a follow-up interview a nurse at one of the schools mentioned that this report would be very useful in discussing overall student health issues with the superintendent; however, it is unclear if the information was passed on to the superintendent. No other administrator made mention of using or distributing these reports. The administrators were also provided with individualized reports for any student that completed a consent form. They were told that these reports could be shared with the student and/or the student's parent(s)/guardian(s). The main goal of these reports was to allow the school counselor(s) to identify students that may be at-risk for mental health issues. Again, no administrators, students, or parents/guardians made

mention of using or distributing these reports or contacted myself or Dr. Pangelinan about the reports. I believe these types of reports could be useful to administrators, teachers, students, and parents/guardians. However, discussions with the administrators regarding the contents of the reports and how they might be useful may be necessary to increase their impact on the school and/or students.

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Appendix A: Informed Consent Form

SCHOOL OF
KINESIOLOGY

AUBURN UNIVERSITY
COLLEGE OF EDUCATION

(NOTE: DO NOT SIGN THIS DOCUMENT UNLESS AN IRB APPROVAL STAMP WITH CURRENT DATES HAS BEEN APPLIED TO THIS DOCUMENT.)

PARENT PERMISSION/MINOR ASSENT (AGES 13+)

for a Research Study entitled

"A wellness fair to assess mental and physical health in high school students"

You are invited to participate in a research study to determine the impact of a Health and Wellness Fair on high school students. The study is being conducted by Robyn Feiss (Graduate Student), Dr. Melissa Pangelinan (Assistant Professor), and Dr. Jamie Roper in the School of Kinesiology, Dr. Onikia Brown in Nutrition, Dietetics, and Hospitality Management, and Dr. Chippewa Thomas in Special Education, Rehabilitation, and Counseling at Auburn University. You were selected as a possible participant because:

- Your child is a 10th or 11th grade student at a high school which has chosen to host a Health and Wellness Fair.

What will be involved if you participate? A Pre-Program Assessment Packet has been sent home with your child. It includes demographics questions for both you and your child to complete, as well as questions related to mental health symptoms and physical activity habits. This survey should be completed before the Health and Wellness Fair at your child's school and can be returned to the school before the fair or brought to school with your child on the day of the Health and Wellness Fair. The packet will take approximately 30-45 minutes to complete.

The Health and Wellness Fair is a 3-hour program which consists of "Healthy Mind" and "Healthy Body" programs. During the "Healthy Mind" program, participants will attend small group sessions on several health topics including: improving physical health through sport and recreation, identifying mental health signs and symptoms, peer-advocacy to improve wellness, healthy eating, and stress management. During the "Healthy Body" program, participants will complete physical fitness testing, a nutritional assessment, and will be asked about lower limb and head injuries over in the past year.

During the "Healthy Mind" portion of the program, participants will complete a series of questionnaires designed to assess mental health knowledge and symptoms, as well as attitudes

and stigmas towards peers with mental health problems. Completion of the questionnaires and participation in the small group sessions will take approximately 1 hour and 15 minutes. During the "Healthy Body" portion of the program, aerobic endurance, muscular endurance, muscular strength, body composition, flexibility, gait, and nutrition will be assessed. During the "Healthy Body" session, a photograph will be taken of your child's foot/ankle to measure foot/ankle movement. The photograph will only cover the foot/ankle, without the possibility of including potential personal identifiers (i.e., tattoos, birthmarks, etc.). The total time for the "Healthy Body" part of the program is 1 hour and 15 minutes. Breaks will be given between assessments to reduce fatigue and maintain motivation and all procedures are completely non-invasive.

Approximately 1-year following the Health and Wellness Fair you will be contacted to have your child complete the same series of questionnaires designed to assess mental health knowledge and symptoms, attitudes and stigmas towards peers with mental health problems, and physical activity, nutrition habits, and lower limb/head injury history. If your child's high school chooses to host a second Health and Wellness Fair, they will complete the surveys during the program.

Are there any risks or discomforts? Due to the sensitive nature of some of the session topics in the "Healthy Mind" program, participants may experience emotional distress. To reduce the likelihood of emotional distress and any negative impact it may have, participants will be allowed to choose the topics they attend sessions regarding, certified clinicians and/or school counselors will be present at any session on sensitive topics, and participants will be taught healthy coping methods to deal with emotional distress throughout the Health and Wellness Fair. If participating in this study upsets your child or if your child would like to talk, your child's school counselor is available during school hours and the study staff is happy to talk with your child during today's event. If you are troubled, please talk to one of the counselors available today.

Participants may experience physical fatigue (muscle fatigue and soreness) from the physical activities in the "Healthy Body" program. To alleviate this fatigue, participants are encouraged (and will be reminded) to take breaks at any time or stop participating all together. It is important to note that the physical activities included in this program and during all testing sessions are similar to that of a physical education class, sport/recreational, or exercises session.

In addition, there is a risk of a breach of confidentiality. However, all efforts will be taken to maintain confidentiality. All information collected in this study is strictly confidential, and your name or that of your child will not be identified at any time. The data collected will be grouped with data from other subjects for presentations at scientific conferences and publication in scientific journals. Data will be stored in a locked file cabinet in a locked room and/or on a password-protected computer. Only the investigator will have access to the data. Your or your child's information may be shared with representatives of Auburn University and government

authorities if required by law.

Are there any benefits to yourself or others? Participants will be provided with information intended to improve physical health and reduce the impact of and provide safe and healthy coping mechanisms for dealing with mental health problems such as stress.

Will you receive compensation for participating? If your child returns this signed consent form and the Pre-Program Assessment Packet they will receive a free t-shirt with the program's logo.

Are there any costs to participating? In the unlikely event that you sustain an injury from participation in this study, the investigators will summon emergency help, however medical expenses will not be paid for by the study.

If you change your mind about participating, you and your child can withdraw at any time during the study. If you or your child choose to withdraw, all data can be withdrawn as long as it is identifiable. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University or the School of Kinesiology.

Your privacy will be protected. All information collected in this study is strictly confidential, and your name or that of your child will not be identified at any time. The data collected will be grouped with data from other subjects for presentations at scientific conferences and publication in scientific journals. Data will be stored in a locked file cabinet in a locked room and/or on a password-protected computer. Only the investigator will have access to the data. Your or your child's information may be shared with representatives of Auburn University and government authorities if required by law.

If you have questions about this study, please contact Robyn Feiss at rsf0012@auburn.edu or Dr. Melissa Pangelinan at melissa.pangelinan@auburn.edu or by phone at 334-844-8055. A copy of this document will be given to you to keep.

Participant's Initials _____

If you have questions about your rights as a research participant, you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334)-844-5966 or e-mail at hsubjec@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO PARTICIPATE.

Child's Name	Child's Signature	Date
Parent's Name	Parent's Signature	Date
Investigator Obtaining Consent	Investigator's Signature	Date

The Auburn University Institutional Review Board has approved this Document for use from 09/17/2019 to 03/20/2020 Protocol # 18-109 MR 1803

Participant's Initials _____

Appendix B: Recruitment Emails to Administrators

Initial Email:

Good morning/afternoon/evening,

The faculty in the School of Kinesiology, Special Education, Rehabilitation, and Counseling, and Auburn University Athletics are developing programming for a Wellness Fair to provide education and conduct a needs assessment regarding physical and mental health in high school students. The goal of the program is to not only increase student outcomes but also to help schools identify student health priority areas.

The Wellness Fair will be run over the course of 3 hours, 1.5 hours will be spent having the students participate in Field Day Fitness Assessments and 1.5 hours will be spent rotating through break out rooms discussing the following topics:
-Healthy eating
-Developing good sleep patterns
-Managing student stress
-Balancing academics and extra-curricular activity (including sports)
-Injury prevention and management (mostly specific to sports)
-Maintaining healthy weight

We are contacting you to determine your interest in participating in this program. Please complete this qualtrics survey so that we may follow-up with you regarding your specific interest.

High School Wellness Program Interest Survey

Your interest and commitment are vital to the success of this program and we look forward to setting up a meeting with you. Please do not hesitate to contact me with any questions.

Thanks so much and War Eagle.

Follow-Up Email:

Dear ____,

I would like to follow up with you regarding the High School Wellness Fair that we would like to run at _____ High School.

After speaking with other local high school administrators/social workers, we believe it would be best to focus on 10th graders. We would like to run the Wellness Fair (1 day, ~3.5 hours) in October, as October is both Health Literacy Month and National Bullying Prevention Month.

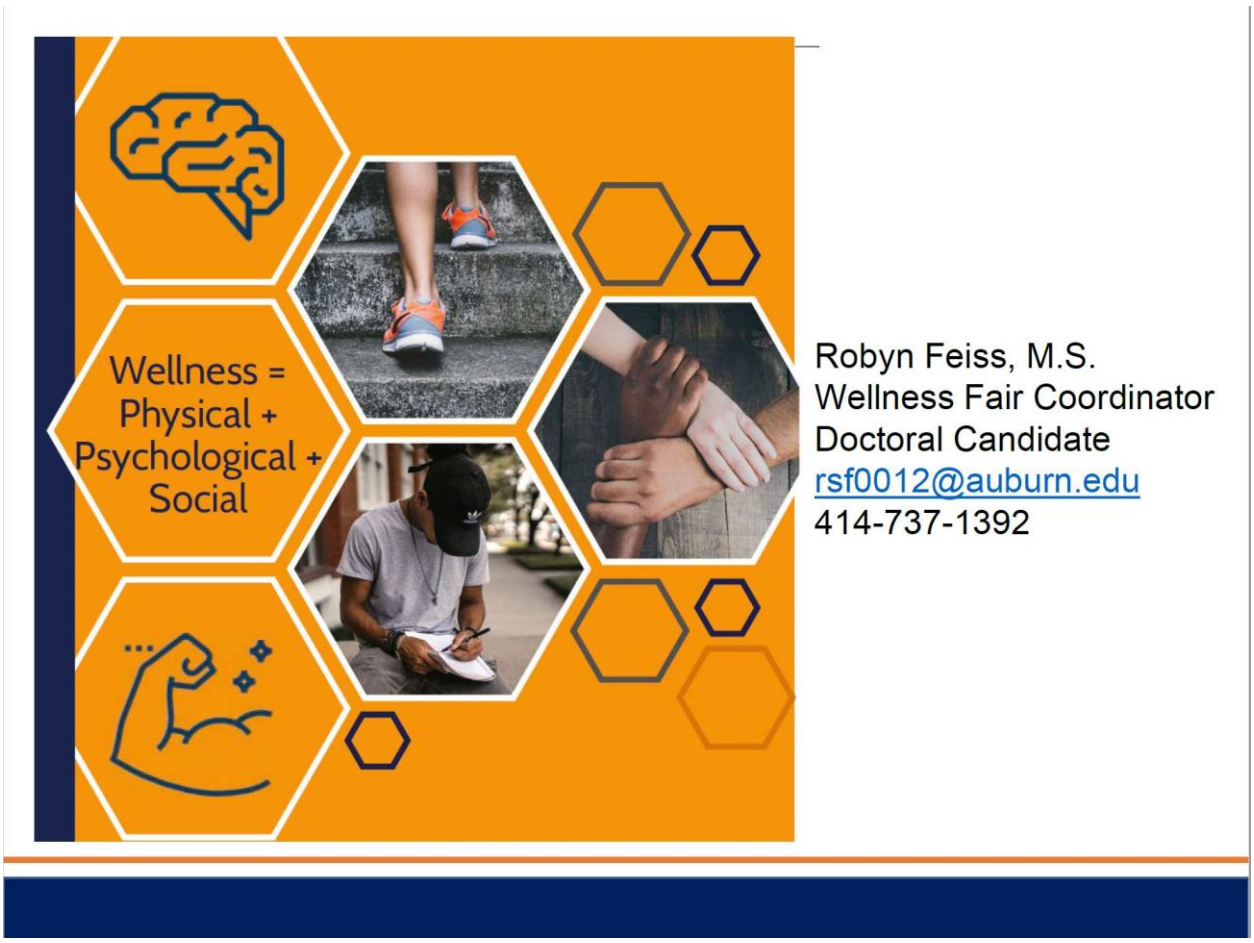
Now that school is out of session, we were hoping that you would have availability to meet with us to discuss this program further and to determine how to best structure the program for _____ High School.

Here is a link to a doodle poll that will help us schedule a time for us to come and meet with you: {HYPERLINK “https://doodle.com/poll/ryqv43uvk568xyr6”}

Best,
Melissa Pangelinan

Dr. Melissa Pangelinan, Ph.D.
Assistant Professor
School of Kinesiology - Auburn University

Appendix C: Program Brochure



Program Schedule

Wellness Fairs are scheduled for 3-3.5 hours. To maximize student participation, students will be split into two groups as follows:

Group A Schedule:

8:15-8:30: General Assembly

8:45-10:00: Healthy Body - Physical Health Program

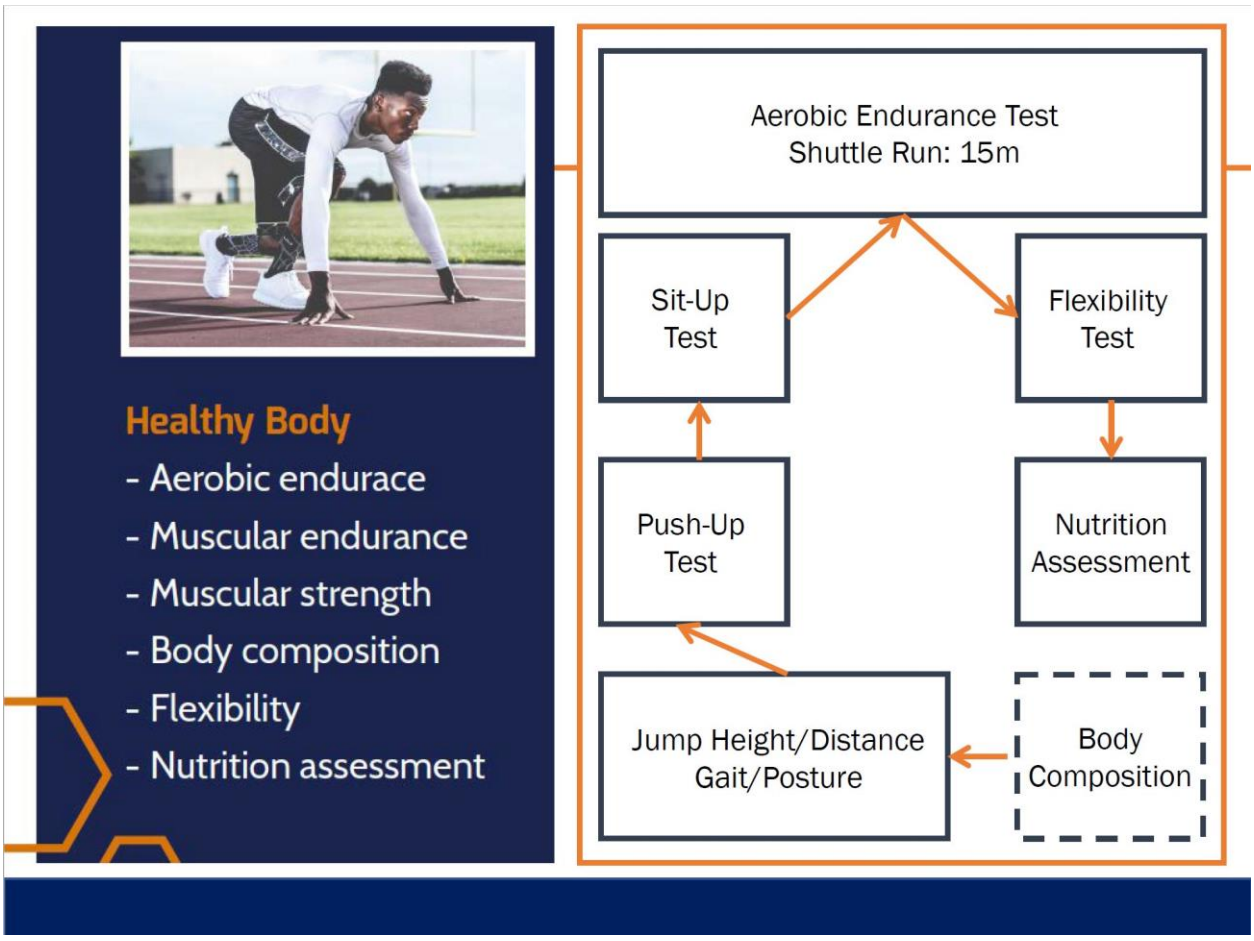
10:15-11:30: Healthy Mind - Mental Health Program

Group B Schedule:

8:15-8:30: General Assembly

8:45-10:00: Healthy Mind - Mental Health Program

10:15-11:30: Healthy Body - Physical Health Program


Healthy Body
- Aerobic endurace
- Muscular endurance
- Muscular strength
- Body composition
- Flexibility
- Nutrition assessment
Aerobic Endurance Test
Shuttle Run: 15m
Sit-Up Test
Flexibility Test
Push-Up Test
Nutrition Assessment
Jump Height/Distance
Gait/Posture
Body Composition

Healthy Mind

Students will rotate through two small group sessions on topics of interest. Speakers will talk about their personal experiences related to the topic. The speakers will lead a discussion and activities with students on that topic.

Healthy Eating The food you eat affects your physical and mental abilities. Learn how to make good food choices that keep you going all day!

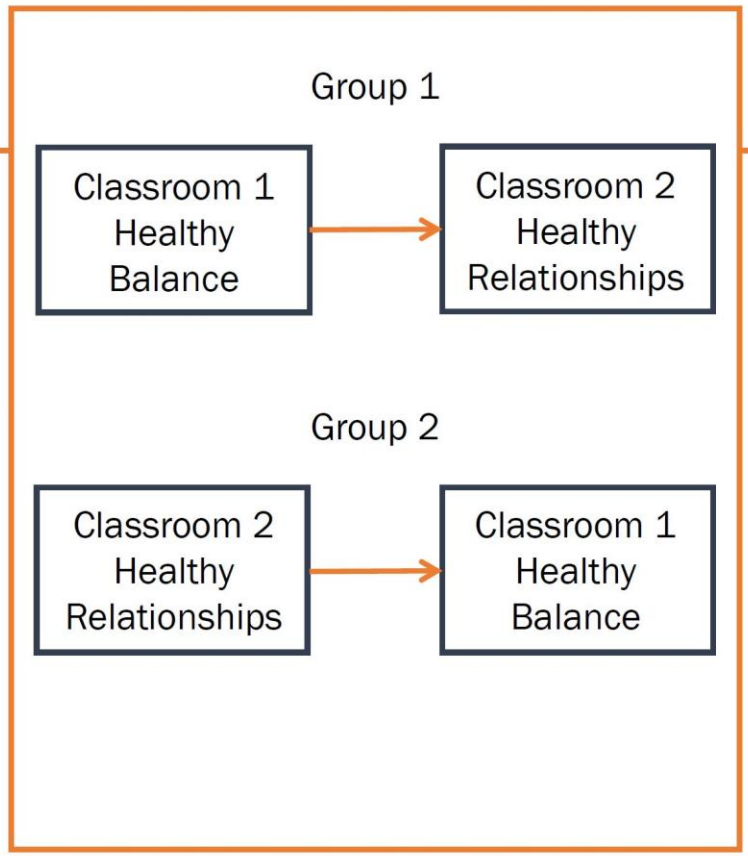
Healthy Relationships Friends are one of the most important aspects of a student's life. Learn how to build stronger and more compassionate friendships.

Healthy Sleep Your body and mind need good quality sleep. Learn how to improve your sleep so that you can perform your best all day.

Healthy Balance Balancing school, extra-curriculars, and personal responsibilities is really stressful! Learn how to reduce your stress and develop balance for a healthy, happy, life.

Additional Topics:

- Stress reduction through mindfulness
- Race and place in academics and athletics
- Holistic health
- Athletic injury prevention and management
- Other – based on your students needs!



Program Customization

- # of students
- # of classrooms available
- Topics of interest for Healthy Mind sessions
- Buy in from coaches/teachers/counselors/coaches
- Potential alumni partners

AUBURN
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Appendix D: Parent Packet Instructions

Pediatric Movement and Physical Activity Lab
School of Kinesiology - Auburn University

MOVEMENT. HEALTH. PERFORMANCE.

Parent/Guardian Packet

Your child's high school has chosen to host a high school wellness fair! Enclosed are the following:

- A release waiver which allows your child to participate in the day's activities including physical fitness testing and group discussions about physical and mental health and nutrition. **Both you and your child should sign this form.**
- A consent form which allows us to use the information we are collecting from you and your child in a research study. **Both you and your child should sign this form and you should also initial at the bottom of each page.**
- A photo release which allows photographs to be taken of your child during the wellness fair activities.
- A demographic survey to be completed by you.

All of these forms should be completed and returned to the school before or on the day of the wellness fair.

Your child has also been given a packet of questionnaires that should be completed and returned to the school before or on the day of the wellness fair.

If you have any questions or concerns please contact me at rsf0012@auburn.edu

Thank you,
Robyn Feiss, M.S.

Pediatric Movement and Physical Activity Lab
School of Kinesiology - Auburn University

Appendix E: Parent Demographics

Study ID:_____

Pediatric Movement and Physical Activity Lab
School of Kinesiology - Auburn University

Demographic Survey

Parent/Guardian Demographics

1. Ethnicity/Race

   _____ Caucasian/White _____ African American/African/Black/Caribbean

   _____ Hispanic/Latino _____ Asian/Pacific Islander _____ Native American

   _____ Other (please specify) _____

2. What is your annual household income?

   _____ Less than $15,000 _____ $15,000-$29,999 _____ $30,000-$49,999

   _____ $50,000-$74,999 _____ $75,000-$99,999 _____ $100,000 or more

3. What is your highest education level?

   _____ Did not finish high school _____ High school diploma/GED

   _____ Trade/technical/vocational training _____ Some college

   _____ Associate degree _____ Bachelor's degree

   _____ Master's degree _____ Professional degree (M.D., J.D)

   _____ Doctorate degree (Ph.D.)

   _____ Other(please specify):_____

4. What is your relationship to the student?

   _____ Mother _____ Father _____ Other Family Member (Aunt/Uncle/Grandparent)

   _____ Guardian _____ Other(please specify):_____

Appendix F: Student Packet Instructions

Name _____

Pediatric Movement and Physical Activity Lab
School of Kinesiology - Auburn University

MOVEMENT. HEALTH. PERFORMANCE.

Student Packet

Your high school has chosen to host a high school wellness fair! Before the wellness fair, we want to learn some information about you. To help us do this please answer the questions in this packet as best and as honestly as you can.

In this packet there is also a photo release. Signing this allows us to take photographs of you during the wellness fair activities.

Please return this packet and the packet of signed sheets before or on the day of your high school's wellness fair.

Appendix G: Student Demographic Survey

Study ID:_____

Student Demographics

1. Age: _____

2. Gender:
   _____ Male _____ Female

3. Ethnicity/Race
   _____ Caucasian/White _____ African American/African/Black/Caribbean
   _____ Hispanic/Latino _____ Asian/Pacific Islander _____ Native American
   _____ Other (please specify) _____

4. Do you currently live in a single-parent or two-parent household?
   _____ Single-parent _____ Two-parent

5. How many brothers and sisters do you have?
   _____ None _____ 1-2 _____ 3-4 _____ 5 or more

6. What extracurricular activities do you participate in (select all that apply)?
   _____ None _____ Sport _____ Theatre/Art _____ Music
   _____ Other (please specify) _____

7. If you selected sport, what sport(s) do you participate in?
   _____

8. How many hours/week do you spend participating in extracurricular activities?
   _____ 0 _____ 1-3 _____ 3-5 _____ 5-7 _____ 7-10 _____ 11+

9. Do you have a job? If yes, how many hours/week do you typically work?
   _____ No _____ Yes, 1-5 _____ Yes, 5-10 _____ Yes, 10-15
   _____ Yes, 15-20 _____ Yes, 21+

Appendix H: PROMIS Pediatric Anxiety Symptoms

PROMIS Pediatric Item Bank v2.0 – Anxiety – Short Form 8a

Pediatric Anxiety – Short Form 8a

Please respond to each question or statement by marking one box per row.

	In the past 7 days…	Never	Almost Never	Sometimes	Often	Almost Always
2220R2r	I felt like something awful might happen..	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
713R1r	I felt nervous.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
227bR1r	I felt scared.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
5044R1r	I felt worried.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
3459bR1r	I worried when I was at home	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
2230R1r	I got scared really easy.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
231R1r	I worried about what could happen to me..	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
3150bR2r	I worried when I went to bed at night	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Appendix I: PROMIS Pediatric Depression Symptoms

PROMIS Pediatric Item Bank v2.0 – Depressive Symptoms – Short Form 8a

Pediatric Depressive Symptoms – Short Form 8a

Please respond to each question or statement by marking one box per row.

	In the past 7 days…	Never	Almost Never	Sometimes	Often	Almost Always
488R1r	I could not stop feeling sad	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
461R1r	I felt alone.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
5041R1r	I felt everything in my life went wrong.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
5035R1r	I felt like I couldn't do anything right.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
711R1r	I felt lonely	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
228R1r	I felt sad.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
712R1r	I felt unhappy	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
3952aR2r	It was hard for me to have fun.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Appendix J: PROMIS Pediatric Physical Activity

PROMIS Pediatric Item Bank v1.0 – Physical Activity – Short Form 8a

Physical Activity – Short Form 8a

Please respond to each question or statement by marking one box per row.

In the past 7 days…

		No days	1 day	2-3 days	4-5 days	6-7 days
PAC_M_009R1	How many days did you exercise or play so hard that your body got tired?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PAC_M_105R1	How many days did you exercise really hard for 10 minutes or more?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PAC_M_002R1	How many days did you exercise so much that you breathed hard?.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PAC_M_008R1	How many days were you so physically active that you sweated?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PAC_M_010R1	How many days did you exercise or play so hard that your muscles burned? ...	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PAC_M_011R1	How many days did you exercise or play so hard that you felt tired?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PAC_M_114R1	How many days were you physically active for 10 minutes or more?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
PAC_M_134R1	How many days did you run for 10 minutes or more?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Appendix K: PROMIS Pediatric Physical Stress Symptoms

Physical Stress Experiences – Short Form 8a

Please respond to each question or statement by marking one box per row.

	In the past 7 days…	Never	Rarely	Sometimes	Often	Always
EoS_S_032R1	My heart beat faster than usual, even when I was not exercising or playing hard	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
EoS_S_033R1	I had trouble breathing, even when I was not exercising or playing hard	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
EoS_S_039R1	My body shook	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
EOS_S_046R1	I had pain that really bothered me	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
EoS_S_017R1	My muscles felt tight	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
EoS_S_024R1	My mouth was dry	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
EoS_S_042R1	I had a headache	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
EoS_S_044R1	My back hurt	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Appendix L: PROMIS Pediatric Psychological Stress Symptoms

PROMIS Pediatric Item Bank v1.0 – Psychological Stress Experiences – Short Form 8a

Psychological Stress Experiences – Short Form 8a

Please respond to each question or statement by marking one box per row.

	In the past 7 days…	**Never**	**Rarely**	**Sometimes**	**Often**	**Always**
EOS_P_011R1	I felt stressed.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
EOS_P_064R1	I felt that my problems kept piling up	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
EOS_P_067R1	I felt overwhelmed.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
EOS_P_112R1	I felt unable to manage things in my life..	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
EOS_P_048R1	Everything bothered me.....	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
EOS_P_063R1	I felt under pressure	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
EOS_P_105R1	I had trouble concentrating	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
EOS_P_118R1	I felt I had too much going on	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Appendix M: Body Satisfaction Scale (BSS)

Pediatric Movement and Physical Activity Lab
School of Kinesiology - Auburn University

Body Satisfaction Scale (BSS)

This question asks about your satisfaction with different parts of your body from 1 (Very dissatisfied) to 7 (Very satisfied)

1) How satisfied are you with your *(please circle one for each line)*:

	Very Dissatisfied						Very Satisfied
Height	1	2	3	4	5	6	7
Weight	1	2	3	4	5	6	7
Body shape	1	2	3	4	5	6	7
Waist	1	2	3	4	5	6	7
Hips	1	2	3	4	5	6	7
Thighs	1	2	3	4	5	6	7
Stomach	1	2	3	4	5	6	7
Face	1	2	3	4	5	6	7
Body build	1	2	3	4	5	6	7
Shoulders	1	2	3	4	5	6	7
Muscles	1	2	3	4	5	6	7
Chest	1	2	3	4	5	6	7
Overall Body Fat	1	2	3	4	5	6	7

Appendix N: Rosenberg Self-Esteem Scale (RSES)

Pediatric Movement and Physical Activity Lab
School of Kinesiology - Auburn University

Rosenberg Self-Esteem Scale

This question asks about your self-esteem. Please rate each statement as 1 (Strongly Disagree), 2 (Disagree), 3 (Agree), or 4 (Strongly Agree)

1) How strongly do you agree with the following statements *(please circle one for each line)*:

	Strongly Disagree	Disagree	Agree	Strongly Agree
On the whole, I am satisfied with myself	1	2	3	4
I feel that I have an number of good qualities	1	2	3	4
At times I think I am no good at all	1	2	3	4
I am able to do things as well as most other people	1	2	3	4
I wish I could have more respect for myself	1	2	3	4
I certainly feel useless at times	1	2	3	4

Appendix O: Grade/School Report Example

_____ High School 10th and 11th Grade High School Wellness Fair 2019 - Report

Your 10th and 11th grade classes participated in a Healthy Body Healthy Mind Wellness Fair. During this fair, your 10th and 11th grade students completed a fitness assessment, questionnaires asking about their anxiety, depression, stress, and nutritional intake, and participated in small group discussions about peer pressure and building healthy relationships/friendships. Below are the outcomes from the fitness assessment and questionnaires along with recommendations and resources to promote a healthy body and healthy mind. If you have any questions, please feel free to contact Ms. Robyn Feiss (rsf0012@auburn.edu) or Dr. Melissa Pangelinan (mgp0020@auburn.edu).

TEST DESCRIPTION:
FITNESSGRAM - FITNESS ASSESSMENT

The FITNESSGRAM fitness assessment is a standardized test that characterizes children's fitness level and overall body composition. It consists of the following tests: aerobic functioning, body composition, strength and endurance, and flexibility and range of motion.

Each student's performance was ranked based on normative data for their age and sex. Each performance aspect is divided using three criteria:

- Health Risk (Health Risk)
- NI (Needs Improvement)
- HFZ (Health Fitness Zone)

Task	Students in Health Risk	Students in NI	Students in HFZ
1. Aerobic Functioning (PACER)	33	8	5
2. Body Composition (Body Fat Percentage)	11	9	25
3. Muscular Strength/Endurance (Push-ups)	N/A	19	32
4. Muscular Strength/Endurance (Curl-ups)	N/A	11	38
5. Muscular Strength (Grip Strength)	N/A	31	20
6. Flexibility (Sit-and-Reach Right/Left)	N/A	9	36
7. Flexibility (Shoulder Stretch)	N/A	33	26

TASK DETAILS

1. Aerobic Functioning

   15m PACER Test: The 15 meter Progressive Aerobic Cardiovascular Endurance Run (PACER) test measuring aerobic capacity. Students were asked to run from one line to another line, staying with a cadence and completing as many laps as they could. The pacing starts slowly and then gradually gets faster.

2. Body Composition

   Body Fat Percentage: Students were asked to stand on a Bioelectric Impedance Analysis (BIA) scale. This scale sends a very small, un-noticeable electrical signal through the body to measure the amount of fat, water, and muscle in their body.

3. Muscular Strength and Endurance
   a. Push-up Test: The push-up test measures upper body muscle strength and endurance. Students were asked to complete as many push-ups as they could while staying with a provided cadence.
   b. Curl-up Test: The curl-up test measures abdominal strength and endurance. Students were asked to complete as many curl-ups as they could while staying with a provided cadence.
   c. Grip Strength Test: Students were asked to squeeze a hand grip dynamometer with one hand as hard as they could for 3 seconds. Scores were recorded for both hands.

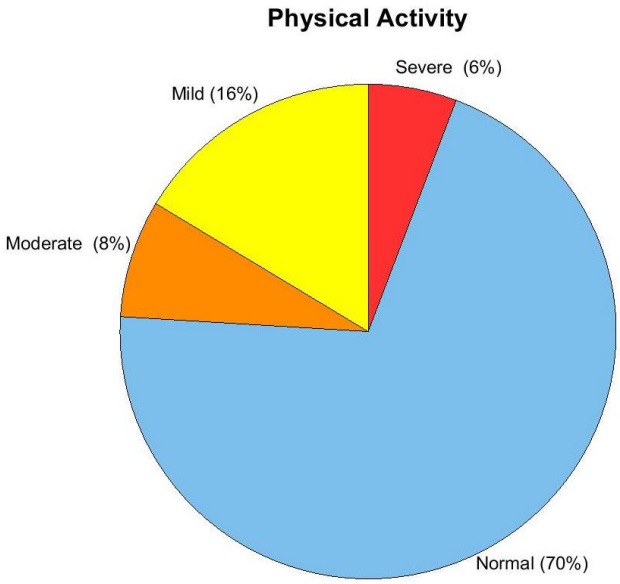
4. Flexibility
   a. Sit-and-Reach Test: The sit-and-reach test measures hamstring flexibility. With one leg extended, students were asked to reach as far as possible towards their foot.
   b. Shoulder Stretch Test: The shoulder stretch test measures upper-arm and shoulder flexibility. Students were asked to touch their fingertips together behind their back, reaching over their shoulder.

In addition, your students were asked about how frequently they are participating in physical activity. Student's responses are categorized according to normative data from children ages 8-17 years. The level of physical activity are divided into four categories:

- Within Normal Limits
- Mild (slightly below average physical activity levels)
- Moderate (below average physical activity levels)
- Severe (extremely below average physical activity levels)

Task	Normal	Mild	Moderate	Severe
Physical Activity	73	17	8	6

Percentages of 10th and 11th Grade Students at ___ High School Falling into Each Category



GENERAL PHYSICAL FITNESS RECOMMENDATIONS

Overall PA guidelines: Children and adolescents should do 60 minutes (1 hour) or more of physical activity daily. It is important to encourage young people to participate in physical activities that are appropriate for their age, that are enjoyable, and that offer variety.

- **Aerobic**: Most of the 60 or more minutes a day should be either moderate- or vigorous-intensity aerobic physical activity, and should include vigorous-intensity physical activity at least 3 days a week.
- **Muscle-strengthening**: As part of their 60 or more minutes of daily physical activity, children and adolescents should include muscle-strengthening physical activity on at least 3 days of the week.
- **Bone-strengthening**: As part of their 60 or more minutes of daily physical activity, children and adolescents should include bone-strengthening physical activity on at least 3 days of the week.

Aerobic activities are those in which young people rhythmically move their large muscles. Running, hopping, skipping, jumping rope, swimming, dancing, and bicycling are all examples of aerobic activities. Aerobic activities increase cardiorespiratory fitness.
Muscle strengthening activities make muscles do more work than usual during activities of daily life. This is called "overload," and it strengthens the muscles. Muscle-strengthening activities can be unstructured and part of play, such as playing on playground equipment, climbing trees, and playing tug-of-war. Or these activities can be structured, such as lifting weights or working with resistance bands.
Bone strengthening activities produce a force on the bones that promotes bone growth and strength. This force is commonly produced by impact with the ground. Running, jumping rope, basketball, tennis, and hopscotch are all examples of bone strengthening activities. As these examples illustrate, bone-strengthening activities can also be aerobic and muscle-strengthening.

TEST DESCRIPTION:

Patient Reported Outcomes Measurement Information System (PROMIS)

The PROMIS questionnaires are standardized assessments for Anxiety, Depression, Psychological Stress and Physical Stress, appropriate for children ages 8-17 years. The Anxiety questionnaire asked your students about 8 common symptoms of Anxiety and the frequency of experiencing these symptoms over the past 7 days. The Depression questionnaire asked your students about 8 common symptoms of Depression and the frequency of experiencing these symptoms over the past 7 days. The Psychological Stress questionnaire asked your students about 8 common psychological symptoms of stress and the frequency of experiencing these symptoms over the past 7 days. The Physical Stress questionnaire asked your students about 8 common physical symptoms of stress and the frequency of experiencing these symptoms over the past 7 days.

Students' responses are categorized according to normative data from children ages 8-17 years. The degree of Anxiety and Depression are divided into four categories:

- Within Normal Limits
- Mild
- Moderate
- Severe

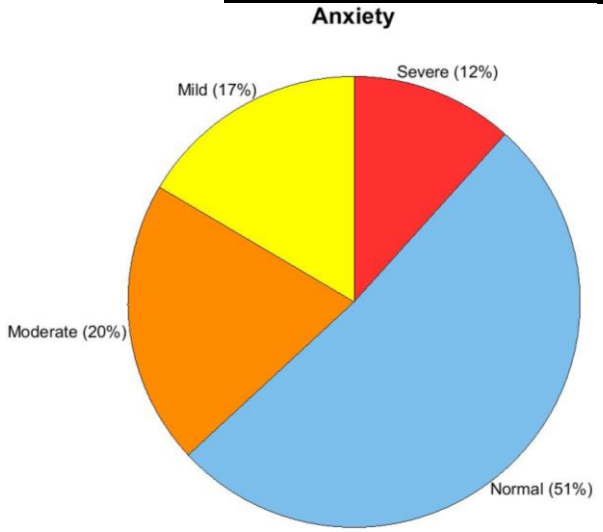
Task	Normal	Mild	Moderate	Severe
1. Anxiety	53	17	21	12
2. Depression	46	11	30	18

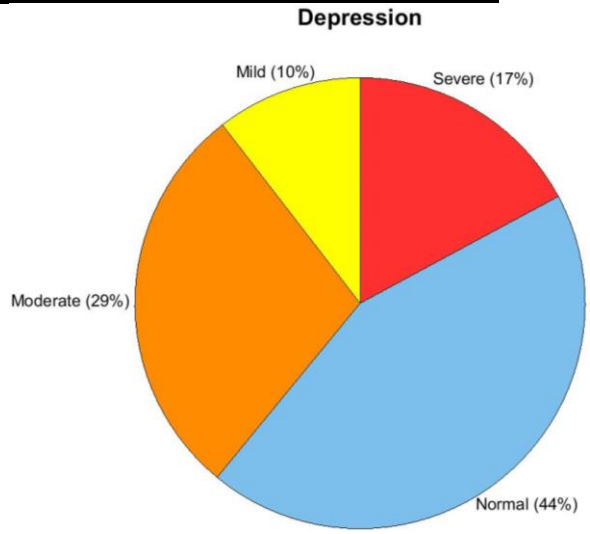
The degree of Psychological and Physical Stress are divided into four categories:

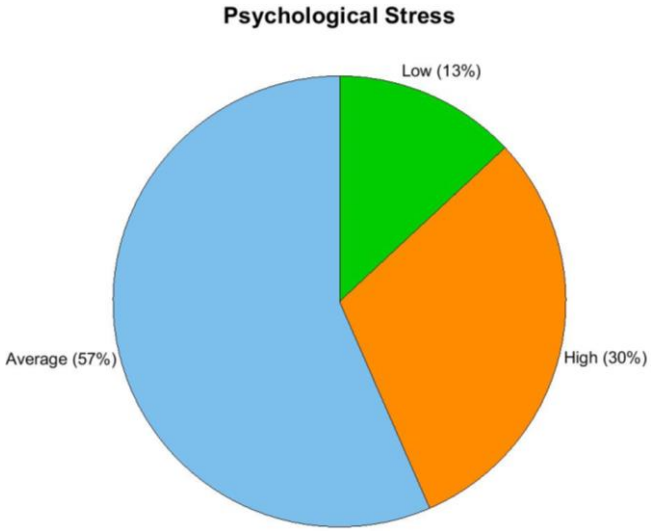
- Low
- Average
- High
- Very High

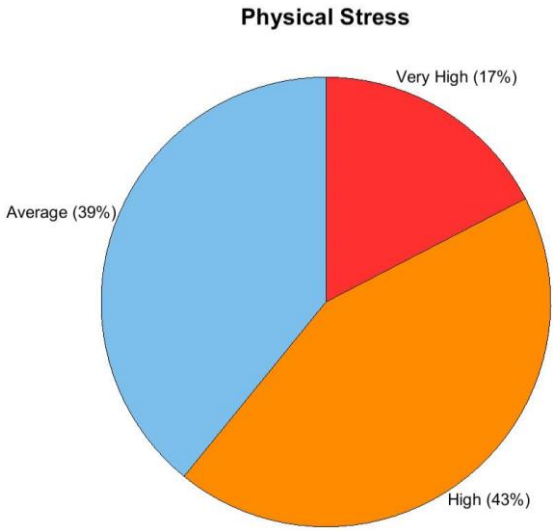
Task	Low	Average	High	Very High
1. Psychological Stress	3	13	7	0
2. Physical Stress	0	9	10	4

Percentages of 10th and 11th Grade Students at _____ High School Falling into Each Category









QUESTIONNAIRE DETAILS

Example question from PROMIS Pediatric Anxiety Questionnaire

In the past seven (7) days I felt nervous:

1) NEVER 2) ALMOST NEVER 3) SOMETIMES 4) OFTEN 5) ALMOST ALWAYS

Example question from PROMIS Pediatric Depressive Symptoms Questionnaire

In the past seven (7) days it was hard for me to have fun:

1) NEVER 2) ALMOST NEVER 3) SOMETIMES 4) OFTEN 5) ALMOST ALWAYS

Example question from PROMIS Psychological Stress Experiences Questionnaire

In the past seven (7) days I felt that my problems kept piling up:

1) NEVER 2) RARELY 3) SOMETIMES 4) OFTEN 5) ALWAYS

Example question from PROMIS Physical Stress Experiences Questionnaire

In the past seven (7) I had trouble breathing, even when I was not exercising or playing hard:

1) NEVER 2) RARELY 3) SOMETIMES 4) OFTEN 5) ALWAYS

GENERAL MENTAL HEALTH RESOURCES

- Your child's school counselor

- East Alabama Mental Health Center
  - Website: http://eamhc.org/
  - Phone: (334) 742-2877 or (800) 815-0630

- National Alliance on Mental Health (NAMI)
  - Crisis Text Line: Text "NAMI" to 741-741
  - HelpLine: Call 1-800-950-NAMI (6264) or Email info@nami.org
  - Website: https://www.nami.org/#

- National Suicide Prevention Lifeline
  - Call: 1-800-273-TALK (8255)
  - Website: https://suicidepreventionlifeline.org/

TEST DESCRIPTION:

NUTRITIONAL INTAKE SURVEY

The Nutritional Intake Survey asked your students during the past 7 days how often they consumed different food and beverages. The average number of days students are consuming each food/beverage is reported.

	Average Number of Days	Most Common Number of Days	Range of Days
Eat whole **fruit** such as an apple, banana, or orange?	2.71	1	0-7
Eat **vegetables** such as carrots, green beans, or broccoli?	2.57	0	0-7
Drink a **can, bottle, or glass of soda or sweet beverage**, such as Coke, Sweet Tea, or Kool-Aid?	4.76	7	0-7
Drink a **can, bottle, or glass of 100% fruit juice** such as Apple Juice (Do not count punch, Kool-Aid, or other fruit flavored drinks).	3.04	0	0-7
Drink a **can, bottle, or glass of a sports drink**, such as Gatorade?	3.20	0	0-7
Drink a **can, bottle, or cup of coffee or energy drink**, such as RedBull?	1.75	0	0-7
Drink a **bottle, or glass of plain water** (Do not include flavored water)?	5.45	7	0-7
Eat **sweet or salty snacks** such as chips, fries, candy, cookies, or cake?	4.86	7	0-7
Eat **fast food** such as McDonalds, Chick-Fil-A, Taco Bell, or Other?	2.75	2	0-7
Eat **at a sit down restaurant** such as Cracker Barrel, a Mexican restaurant, Diner, or Other?	1.71	1	0-7

Appendix P: Individual Report Example

Participant Name: [redacted]
Date Tested: October 26, 2018
Participant's Age: 15
Participants Sex: Female

Your child participated in a Healthy Body Healthy Mind Wellness Fair held at your child's school. During this fair, your child completed a fitness assessment, questionnaires asking about your child's anxiety, depression, and participated in small group discussions about managing stress and building healthy relationships/friendships. Below are the outcomes from the fitness assessment and questionnaires along with recommendations and resources to promote a healthy body and healthy mind. If you have any questions, please feel free to contact Ms. Robyn Feiss (rsf0012@auburn.edu) or Dr. Melissa Pangelinan (mgp0020@auburn.edu).

TEST DESCRIPTION:
FITNESSGRAM - FITNESS ASSESSMENT

The FITNESSGRAM fitness assessment is a standardized test that characterizes children's fitness level and overall body composition. It consists of the following tests: aerobic functioning, body composition, strength and endurance, and flexibility and range of motion.

Your child's performance is based on normative data for 15 year-old females. Each performance aspect is divided using three criteria:

- Health Risk (Health Risk)
- NI (Needs Improvement)
- HFZ (Health Fitness Zone)

Performance Category	Value	Performance Rating	Health Fitness Zone
1. Aerobic Functioning (PACER)	10	Health Risk	39+ Laps
2. Body Composition (Body Fat Percentage)	51.2	Health Risk	14.6-29.1% Body Fat
3. Muscular Strength/Endurance (Push-ups)	1	NI	7+
4. Muscular Strength/Endurance (Curl-ups)	16	NI	18+
5. Flexibility (Sit-and-Reach Right/Left)	16/17	NI/NI	18 inches
6. Flexibility (Shoulder Stretch)	0/0	NI	Both Arms Pass

TASK DETAILS

1. Aerobic Functioning
   15m PACER Test: The 15 meter Progressive Aerobic Cardiovascular Endurance Run (PACER) test measuring aerobic capacity. Students were asked to run from one line to another line, staying with a cadence and completing as many laps as they could. The pacing starts slowly and then gradually gets faster. Your child's score reported is the number of laps they completed during the test. ***Please note your child's score depends heavily on their motivation to complete this test to the best of their ability.**

2. Body Composition
   Body Fat Percentage: Students were asked to stand on a Bioelectric Impedance Analysis (BIA) scale. This scale sends a very small, un-noticeable electrical signal through the body to measure

the amount of fat, water, and muscle in their body. Your child's body fat percentage reading from the scale is reported above.

3. Muscular Strength and Endurance
    a. Push-up Test: The push-up test measures upper body muscle strength and endurance. Students were asked to complete as many push-ups as they could while staying with a provided cadence. Your child's reported score is the number of correct push-ups they performed during the test.
    b. Curl-up Test: The curl-up test measures abdominal strength and endurance. Students were asked to complete as many curl-ups as they could while staying with a provided cadence. Your child's reported score is the number of correct curl-ups they performed during the test.

4. Flexibility
    a. Sit-and-Reach Test: The sit-and-reach test measures hamstring flexibility. With one leg extended, students were asked to reach as far as possible towards their foot. Your child's score reported represents how far they were able to reach on each leg.
    b. Shoulder Stretch Test: The shoulder stretch test measures upper-arm and shoulder flexibility. Students were asked to touch their fingertips together behind their back. Your child's score reflects whether they could touch their fingertips together.

GENERAL PHYSICAL FITNESS RECOMMENDATIONS

Overall PA guidelines: Children and adolescents should do 60 minutes (1 hour) or more of physical activity daily. It is important to encourage young people to participate in physical activities that are appropriate for their age, that are enjoyable, and that offer variety.

- **Aerobic**: Most of the 60 or more minutes a day should be either moderate- or vigorous-intensity aerobic physical activity, and should include vigorous-intensity physical activity at least 3 days a week.
- **Muscle-strengthening**: As part of their 60 or more minutes of daily physical activity, children and adolescents should include muscle-strengthening physical activity on at least 3 days of the week.
- **Bone-strengthening**: As part of their 60 or more minutes of daily physical activity, children and adolescents should include bone-strengthening physical activity on at least 3 days of the week.

Aerobic activities are those in which young people rhythmically move their large muscles. Running, hopping, skipping, jumping rope, swimming, dancing, and bicycling are all examples of aerobic activities. Aerobic activities increase cardiorespiratory fitness.

Muscle strengthening activities make muscles do more work than usual during activities of daily life. This is called "overload," and it strengthens the muscles. Muscle-strengthening activities can be unstructured and part of play, such as playing on playground equipment, climbing trees, and playing tug-of-war. Or these activities can be structured, such as lifting weights or working with resistance bands.

Bone strengthening activities produce a force on the bones that promotes bone growth and strength. This force is commonly produced by impact with the ground. Running, jumping rope, basketball, tennis, and hopscotch are all examples of bone strengthening activities. As these examples illustrate, bone-strengthening activities can also be aerobic and muscle-strengthening.

TEST DESCRIPTION:
Patient Reported Outcomes Measurement Information System (PROMIS)

The PROMIS questionnaires are standardized assessments for Anxiety and Depression, appropriate for children ages 8-17 years. The Anxiety questionnaire asked your child about 8 common symptoms of Anxiety and the frequency of experiencing these symptoms over the past 7 days. The Depression questionnaire asked your child about 8 common symptoms of Depression and the frequency of experiencing these symptoms over the past 7 days.

Your child's responses are tallied to provide a total score for Anxiety and Depression, which is compared to normative data from children ages 8-17 years. The degree of Anxiety and Depression are divided into four categories:

- Within Normal Limits
- Mild
- Moderate
- Severe

Performance Category	Score	Category	Within Normal Limits
1. Anxiety	18	Mild	8-15
2. Depression	15	Mild	8-14

QUESTIONNAIRE DETAILS

Example question from PROMIS Pediatric Anxiety Questionnaire
In the past seven (7) days I felt nervous:
1) NEVER 2) ALMOST NEVER 3) SOMETIMES 4) OFTEN 5) ALMOST ALWAYS

Examples question from PROMIS Pediatric Depressive Symptoms Questionnaire
In the past seven (7) days it was hard for me to have fun:
1) NEVER 2) ALMOST NEVER 3) SOMETIMES 4) OFTEN 5) ALMOST ALWAYS

GENERAL MENTAL HEALTH RESOURCES

- Your child's school counselor

- East Alabama Mental Health Center
  - Website: http://eamhc.org/
  - Phone: (334) 742-2877 or (800) 815-0630

- National Alliance on Mental Health (NAMI)
  - Crisis Text Line: Text "NAMI" to 741-741
  - HelpLine: Call 1-800-950-NAMI (6264) or Email info@nami.org
  - Website: https://www.nami.org/#

- National Suicide Prevention Lifeline
  - Call: 1-800-273-TALK (8255)
  - Website: https://suicidepreventionlifeline.org/