# An Examination of the Relationships between Physical Activity and Mental Health among High School Youth in Tennessee

By

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A Thesis Submitted in Partial Fulfillment

Of the Requirements for the Degree of

Master of Science in Health and Human Performance

(Health Concentration)

Middle Tennessee State University

August 2023

Thesis Committee

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## ACKNOWLEDGMENTS

I am extremely grateful for the invaluable guidance and unwavering support I received from my late grandmother, Kate Bosu. Her wise counsel helped me navigate life's challenges and stay focused during my high school years. I also want to express my heartfelt appreciation to my wife, Sandra, my brother, Charlie, and my mother-in-law, Beatrice Bedford, as well as my entire family for their constant encouragement.

Furthermore, I extend my sincere gratitude to Dr. Andrew Owusu and Dr. Angela S. Bowman for their invaluable time and expertise in assisting me with my thesis. Finally, I would like to thank Dr. Chandra R. Story, Kahler W. Stone, Dr. Bethany A. Wrye, and the entire Public Health Department for their invaluable guidance and advice throughout my master's degree program at MTSU. Their support and mentorship played a pivotal role in shaping me into the confident and accomplished individual that I am today.

## Abstract

There are several research studies done on Physical activity and depression as well as screen time and suicide in the general population. However, there are a limited number of studies that have examined physical activity-related issues among high school students in Tennessee. It was further found that there was no published research study that examined the relationship between physical activity and the mental health of adolescents and adults at the high school level in Tennessee. The purpose of this study was to increase the information available about the relationship between physical activity, sedentary behavior and mental health and the associated outcomes regarding age, sex, race, and BMI. The study used the 2019 Youth Risk Behavioral Survey (YRBS) to analyze the relationship between Physical activity, depression, screen time, and suicide among high school students in Tennessee. The study utilized five questions from the 2019 YRBS to Analyze the relationships between Physical activity, sedentary behavior and mental health. Physical activity frequency was measured by how many days students were physically active for a total of at least 60 minutes every day per week. Sedentary behavior was measured by how many hours students watch television, play video or computer games and use computers for non-school activity. The mental health outcome was measured by whether students were depressed every day for two weeks or more in a row that caused them to stop doing some of their usual activities. Again, suicide was used to access mental health outcome by students reporting whether they have ever thought, planned or attempted suicide.

A significant result of this study indicates that there is a strong positive relationship between physical activity and mental health. Again, it was observed that

sedentary behavior and mental health have strong negative associations. However, unlike the previous literature, the outcome of this study found no significant association between physical activity and suicide, screen time and suicide nor screen time and depression.

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## Chapter 1: Introduction

Being physically active is highly recommended for optimal health. Physical activity does improve not only physical fitness but also improves mental health and general feelings of well-being. Physical activity helps release chemicals in the brain that bring healing and good feeling to the entire body. In addition, it helps improve concentration and boosts self-esteem and sleep. Several studies have shown that psychological disorders can be improved or prevented through participation in physical activity (World Health Organization, 2020). In several other studies, anxiety, depression, and panic disorders are reduced by regular participation in physical activity (Chekroud et al., 2018; De Moor et al., 2006; Paluska & Schwenk, 2000; Weyerer & Kupfer, 1994). The benefit physical activity (PA) gives to mental health is enormous. PA helps optimize mental health by producing endorphins, also known as "feel good" neurotransmitters which reduce stress (Mikkelsen, et. al., 2017). PA can reduce the level of cortisol, also known as the stress hormone of an individual.

Physical activity helps improve mild to moderate mental health conditions including anxiety and depression (Chekroud et al., 2018; De Moor et al., 2006). This could be achieved through participation in aerobic exercises.

Physical activity is defined as engaging the body or skeletal muscles in a general movement that demands energy spent beyond the basal metabolic level (Caspersen, Powell & Christensen,1985; Bouchard & Shephard, 1994; Vanhees. et al.,2012; WHO, 2020). On the other hand, mental health mainly refers to human emotion, psychological and social well-being (Mental Health.gov, 2022). It's in connection with our thoughts, feelings, and action and to a greater extent determines how we handle stress, relate to others, and influence our choices. Physical activities include drumming, dancing, walking, wedding, jogging, swimming, cycling, gymnastics, sports,

and all active recreation and play. These activities can be done at a participant's level of ability, from low, moderate to high-intensity levels to achieve a physically active goal. These activities help control and even prevent cardiovascular diseases, diabetes, and certain cancers, maintain healthy body weight, and improve mental health, quality of life, and general well-being (WHO, 2020). Mental health conditions include anxiety disorder, attention deficit hyperactivity disorder bipolar disorder, borderline personality disorders, depression, dissociative disorders, eating disorders, obsessive-compulsive disorder, posttraumatic stress disorders, psychosis, schizoaffective disorders, and schizophrenia. A study that focused on sedentary behavior and physiological health determinants in male and female college students showed that high sedentary behavior leads to poor quality of life whereas engagement in physical activity behavior leads to improve quality of health and well-being (Vainshelboim, et al, 2019).

The World Health Organization (WHO) defines inactive behavior as a person's failure to engage in at least 150 minutes of moderate physical activity or 75 minutes of vigorous physical activity or a combination of both intensities in the week (WHO, 2020). Physical inactivity can also be described as when an individual sits or lays down for a long time without moving to engage the body. These behaviors that contribute to inactivity are using a computer or cell phone, reading, watching television, playing video games, and listening to music or to the news.

**Research Problem**

There is a limited number of studies that have examined physical activity-related issues among high school students in Tennessee. The principal investigator for the proposed study did not find any published research study that examined the relationship between physical activity and the mental health of adolescents and adults at the high school level in Tennessee.

**Purpose of the Study**

The purpose of this study is to analyze the relationship between physical activity and mental health among high school students in Tennessee.

**Research Questions**

**1.** When controlling for age, sex, and race, what is the relationships between physical activity and the signs and symptoms of depression among high school students in Tennessee?

**2**. When controlling for age, sex, and race, what is the relationships between screen time and the signs and symptoms of depression among high school students in Tennessee?

**3**. When controlling for age, sex, and race, what is the relationships between screen time and suicide ideation among high school students in Tennessee?

**4**. When controlling for age, sex, and race, what is the relationships between physical activity and suicide ideation among high school students in Tennessee?

**Hypothesis.**

**1**. When controlling for age, sex, race, and BMI, high school students in Tennessee who are able to follow the recommended level of physical activity will be less likely to report the signs and symptoms of depression.

**2**. When controlling for age, sex, race, and BMI, high school students in Tennessee who spend more time on screens will be more likely to report the signs and symptoms of depression.

**3.** When controlling for age, sex, race, and BMI, high school students in Tennessee who spend more time on screens will be more likely to report suicide ideation.

**4**.When controlling for age, sex, race, and BMI, high school students in Tennessee who are able to follow the recommended level of physical activity will be less likely to report suicide ideation.

**Significance of the Study**

Results from the examination of the relationship between physical activity and mental health among high school students in Tennessee can be used to guide the design of physical activity and mental health programs for adolescents.

**Limitation**

The finding of this study includes these limitations. First, the YRBS is a cross-sectional survey. Data collected is collected at a specific point in time and therefore renders it unable to make causal inferences. Second, YRBS data is self-reported by the students and therefore relies on what they remember at that particular point in time of responding to the survey. Thirdly, the survey population is limited to Tennessee High school students aged 14 and beyond only, and therefore the results cannot be generalized across age nationwide.

## Chapter 2: Literature Review

Physical activity is an important intervention for the recovery and even prevention of poor mental health conditions (Marashi et al., 2021; De Moor et al., 2006; Paluska &Schwenk, 2000; World Health Organization,2020) whereas, on the other hand, poor mental health conditions can highly be a factor in influencing physical inactive behavior in especially nonwork physical activity ((Buchan et al., 2021; Carpiniello et al.,2013; Marashi et al. 2021).

The purpose of this study is to analyze the relationship between physical activity and mental health among high school students in Tennessee. Being physically active is highly recommended for optimal health. Physical activity helps release chemicals in the brain that bring healing and good feeling to the entire body. In addition, it helps improve concentration and boosts self-esteem and sleep. Several studies have shown that anxiety, depression, panic disorders, as well as psychological disorders, can be improved or prevented through participation in physical activity (WHO,2020 Chekroud et al. 2018; De Moor et al., 2006; Paluska & Schwenk, 2000; Weyerer and Kupfer, 1994

The benefit physical activity (PA) gives to mental health is enormous. PA helps optimize mental health by producing endorphins, also known as "feel good" neurotransmitters which reduce stress (Mikkelsen, K., et. al., 2017). PA can reduce the level of cortisol, also known as the stress hormone of an individual.

Physical activity helps improve mild to moderate mental health conditions including anxiety and depression (Chekroud et al., 2018; De Moor et al., 2006). This could be achieved through participation in aerobic exercises.

**Physical Activity**

Physical activity is defined as engaging the body or skeletal muscles in a general movement that demands energy spent beyond the basal metabolic level (Caspersen, Powell & Christensen,1985; Bouchard & Shephard, 1994; Vanhees. et al.,2012; WHO, 2020). These activities include drumming, dancing, walking, gardening, jogging, swimming, cycling, gymnastics sports, and all active recreation and play (WHO,2022). These activities can be engaged in at a participant's level of ability, from low, moderate to high-intensity levels to achieve a physically active goal. These activities help control and even prevent cardiovascular diseases, diabetes, and certain cancers, maintain healthy body weight, and improve mental health, quality of life, and general well-being (WHO, 2020).

Several research studies have indicated that adhering to physical activity guidelines can effectively be beneficial to an individual's cardiovascular and general health overall. Vanhees. et al.,2012, indicated clearly how physical activity is found to improve cardiovascular health. There are several Systematic reviews that indicated that physical activity has a clear positive impact on all-cause mortality (Blair, Cheng, & Scott Holder, 2001). A systematic review and updated meta-analysis conducted by Nocon et al. on 33 studies with 883,372 subjects with a follow up of 4 years to beyond 20 years indicated that there is a reduction of 30-50% in cardiovascular mortality, whereas all-cause mortality is reduced by 20-50% (Nocon, et al.,2008). Physical activity benefits have been evaluated by several studies. Evaluation of effectiveness of following PA guidance in 252,925 men and women by Leitzmann et al. indicated that adhering to physical activity guidelines is evidence of avoiding risks of several diseases (Leitzmann et al.,2007).

## Physical Activity Recommendation

For children and adolescents from the age group of 5-17, it is recommended that an average of 60 minutes of the moderate-to-vigorous intensity of physical activity, mostly aerobic and muscle and bone strengthening activities should be done. It is also recommended that adults engage in at least 75-150 minutes of vigorous-intensity aerobic physical activity or a combination of moderate and vigorous intensity activity at least 5 days a week and to do muscle-strengthening activities at a moderate or greater intensity to engage all major muscles (WHO, 2020).

In the United States, 53.3% of adults 18 years and above were able to meet the aerobic physical activity recommendation whereas only 23.2% were able to meet both aerobic and muscle strengthening physical activity recommendations (CDC, 2020).

For adolescents, 2017 health statistical data indicated that there were 26.1% (24.1-28.3) who were physically active for 60 minutes or more per day on 7 days, 51.1% (47.5-54.7) were able to meet the guidelines for muscle strength on three or more days per week, whereas 20% (17.2-23) were able to meet the guidelines for both aerobic and muscle strengthening (CDC, 2022). The WHO recommends that Muscle strengthening Exercises (MSE) are highly necessary as physical activity for health (WHO,2010), however, it was indicated in a National Representative Samples of United States Adults Surveillance System that between 2011 and 2017 nearly 70.9% of US adults did not meet the MSE guidelines (Bennie, J.A. et al., 2020)

## Factors that Affect Physical Activity Level

Regular participation in physical activity is associated with cognitive, psychosocial, and physiological benefits (CDC, 2019). Unfortunately, a great deal of the public encountered

barriers to regular participation in physical activity. These barriers that include an individual's knowledge, perception, gender, culture, marital status, community or environment, and socioeconomic status are noted in several research studies (Yen Sin Koh et al. 2022) Advancement in technology is on the rise. There has been a growing use of machines and equipment which are used to lower the rate of physically active work. There has been high growth in office work as well. This is leading to most of the global population saying bye to the original way of active life through manual means for food, clothing, and shelter. In view of this development, modernization and technology can be highly blamed for the ascendency of physical inactivity and long sitting time which has been a major root of global public health problems for the past decade (Moxley et al, 2021). Modernization and technological advances could therefore be said to be a major factor in the prevalence of physical inactivity. "This is militating against the global goal of reducing physical inactivity by 2030". Many studies indicate that physical inactivity is responsible for the cause of major noncommunicable diseases and premature mortality worldwide. In Olson, J. et al. 2018, it was noted that all-cause mortality is highly influenced by inactive behavior. It has been noted in studies that physical inactivity is associated with major chronic diseases including stroke, hypertension, certain cancers, diabetes, and coronary heart diseases (US Department of Health and Human Services, 1996). For this reason, the American College of Sports Medicine and the Centers for Disease Control and Prevention (CDC) recommend that adults achieve at least 150 minutes of moderate physical activity weekly (Pate et al, 1995). Studies have identified physical inactivity as a major factor that threatens the health and well-being of the public (Blair, 2019). Unfortunately, most Americans do not engage in regular physical activity (Centers for Disease Control and

Prevention, 2020). Studies show that only one-fourth of United States adults and one-fifth of high school students get the recommended levels of physical activity.

Barriers to physical activity can be categorized into three main levels of influence. These include intrapersonal, interpersonal, community, or environmental factors of influence (U. S Department of Health and Human Services,2010), and Institute of Medicine (2001). In intrapersonal factors, we refer to the individual characteristics that influence physical activity. These include knowledge, beliefs, attitudes, and personality traits. Factors related to social influences from friends, family, and cultural norms are interpersonal factors. Community or environmental influence refers to physical and social environmental characteristics as well as public policies. These include facilities and other community structures available, physical, and social environment

**Intrapersonal Barrier to Physical Activity**

***Time Constraints or Lack of Time***: Time available to individuals is one of the major barriers to participating in Physical activity. The busy schedule of individuals makes it difficult for people, in general, to engage in physical activity. The most frequently identified barrier to physical activity in a considerable number of qualitative research studies has been the lack of or inadequate time to participate in physical activity (Dunn 2008; Handerson & Ainsworth 200a; Ingram et al. 2011; Jefferson et al.). Inadequate time to participate in physical activity has also been examined as a potential barrier in quantitative research studies. Primarily, the lack of time to engage in physical activity due to work schedule (Ingram et al. 2011; Richter et al. 2002) and family or caretaking responsibilities (Ingram et al. 2011; Dunn 2008 and Pekmezi et al. 2013) were identified as barriers.

***Health Status and Physical Activity-Related Health Concerns:*** The health condition of an individual dictates how much physical activity an individual can take part in, be it formal or informal. In most cases, poor quality of health takes away the motivation and energy for physical activity pursuit. The poor quality of health is even worse in individuals who encounter chronic health threats like stroke, severe obesity, heart diseases, and general cardiovascular conditions. In a considerable number of qualitative studies, participants who do not engage in physical activity were noted to have health conditions and physical activity-related health concerns (Dunn 2008; Evans 2011; Hoebeke 2008; Ingram et al. 2011; Bopp et al. 2007; Zunker et al. 2008). Misconceptions and physical activity-related health concerns are also seen as major barriers to participation in physical activity. Most people decide to stay away from physical activity, even at work, simply because they do not want to experience muscle soreness, fatigue, injuries, and sweating (Evans 2011; Eyler et al. 1998; Wilcox et al. 2005 Pekmezi et al. 2013;)

A study in 2006 by Bopp et al. which focused on examining the relationship between chronic health conditions and physical activity found an inverse relationship between chronic adverse health conditions and physical activity.

Qualitative research conducted by Romero-Elías et al. indicates that among colorectal cancer patients (stage II and III), fatigue and reduced physical fitness are associated with a colorectal cancer diagnosis when involve in adjuvant chemotherapy with colorectal cancer diagnosis This makes it difficult for them to participate in PA (Romero-Elias et al., 2020)

Chemotherapy leads to several side effects that impact a patient's health, such as fatigue, chronic pain, impaired physical function, and decreased quality of life (Pachman et al., 2012).

***Lack of or Inadequate Knowledge*:** A well-planned physical activity to achieve a specific outcome is very important for an individual's objective of achieving optimal health and general

well-being. However, a few qualitative studies indicate that participants are of the view that their daily activities involve enough physical exertion for them to avoid well-planned and specific physical activity (Prohaska 2001; Pekmezi et al. 2013; Wilcox et al. 2005). The knowledge about how to plan and execute a specific physical activity for a desirable health benefit or what constitutes physical activity is something that a lot of people do not know (Nies, Vollman, & Cook 1999; Wilcox et al. 2002) (Pekmezi et al. 2013; Wilcox et al. 2005). Moreover, the knowledge about the usage of gymnasium machines and even exercise equipment is not common to a lot of the public and as a result, hinders people from engaging in well-planned or formal physical activity (Bopp et al. 2007; Harley et al. 2009; Wilcox et al. 2005). Qualitative research conducted by Romero-Elías et al indicated that the health professionals themselves do not have enough knowledge to prescribe PA for their patients.

**Tiredness or Fatigue.** In most qualitative studies, tiredness or fatigue was reported to be a barrier to physical activity. This barrier was identified to come about because of participants' ability to balance work and household or caregiving responsibilities (Evans 2011; Hoebeke 2008; Pekmezi et al. 2013; Richter et al. 2002; Zunker et al. 2008). In Heesch et al. 200, a quantitative study that focused to examine tiredness or fatigue indicated that tiredness or fatigue was seen to be a major contributory factor to the behavior of participants who are physically inactive.

**Interpersonal Barriers**

***Gender and Family Role*:** Gender and family roles play a contributory role in Physical activity participation. This is mainly seen in formal types of physical activity whereby it is well planned, organized, and executed. In most cases, females are more likely to find themselves in relationships with unsupportive husbands. In such a situation whereby, a husband does not acknowledge the benefits of exercising regularly, the wife must sacrifice her time for formal

physical activity to save her marriage. This is mostly seen in playing the role of a wife, mother, and caregiver in meal preparation, childcare, laundry, and extra home chores.

(Bopp et al. 2004; Evans 2011; Eyler et al. 1998; Harley et al. 2009; Pekmezi et al. 2013; Young et al. 2002; Zunker et al. 2008)

This in addition to the official occupation that they do, becomes a huge barrier because it renders them fully engaged and fatigued at the expense of specifically well-planned formal physical activity for achieving a particular health outcome for optimal health and general well-being.

***Inadequate or Lack of Social Support*:** Although the benefits of especially formal physical activity have been acknowledged and recommended by researchers and public health professionals centuries ago, there are many individuals who do not embrace the need to find time to engage the body in exercise to compensate for inactive behavior due to their nature of work or for any other reason. Individuals who find themselves in a family, friend, or large social networks who do not cherish and engage in physical activity for any reason are likely to be influenced in so many ways to be physically inactive. This is because human behavior is noted to be communicable in many studies. For instance, the results of many studies show that obesity can spread from person to person in a network in a neighborhood (Christakis, N. A. & Fowler, J.H., 2007). As a result, those who do not receive the needed support from families and social networks are at risk of inactive behavior. Most qualitative studies showed that a considerable number of participants lack the support of their families, friends, and social network members for physical activity participation (Henderson and Ainsworth 2000a; Hoebeke 2008; Nies, Vollman, and Cook 1999; Wilcox et al. 2002).

A study that was used to examine whether lack of social support was a barrier to physical activity in an overweight population indicated that lack of social support was the main barrier and was

also noted to be a barrier as well in even normal-weight participants (Genkinger et al. 2006). Whereas on the other hand, Sanderson et al. (2003) and Wilbur et al. (2003) study on whether participants who have close friends who exercise were also more likely to meet the national physical activity recommendations and showed highly probable results than those exhibiting inactive behavior.

Some also are denied support for a reason of ill health. Qualitative research conducted by Romero-Elías et. al reveals that colorectal cancer patients do not enjoy any support for physical activity participation. Families overprotect them because of their condition, and this affects their physical activity participation. (Romero-Elias et al., 2020).

**Community or Environmental Factors of Influence**

***Community or Neighborhood Insecurity*:** One of the barriers to physical activity is Community or neighborhood insecurity. Insecurity in most communities and neighborhoods has been noted to be a threat to outdoor physical activity. Even those who exercise in the gymnasium are also faced with this same insecurity because some of them must commute far before they get to a gymnasium. Insecurity can be seen in attacks from stray dogs, verbal harassment, physical assaults, and gun violence. Neighborhood insecurity as a barrier to physical activity was identified in several qualitative studies (Bopp et al. 2007; Eyler et al. 1998; Henderson and Ainsworth 2000a; Hoebeke 2008; Im et al. 2013; Ingram et al. 2011; Nies, Vollman, and Cook 1999; Richter et al. 2002)

***The Built Environment*:** One barrier to physical activity participation is the built environment. Except for the few sportsmen who follow a well-planned workout, the majority group who are not into active sports but have an intention to exercise for health and well-being only do so through basic activities like taking a walk in the neighborhood, hiking, mountaineering, and

more. This majority group is discouraged from participating in these activities because of poorly planned neighborhoods that are not supportive of physical activity participation. These include neighborhoods and communities that are not planned by incorporating playgrounds, gardens, walking paths, playing courts, swimming pools, sidewalks, and more (Sterling et al. 2015). In several qualitative studies lack of sidewalks was identified as a barrier to physical activity (Bopp et al. 2007; Eyler et al. 1998; Hoebeke 2008; Richter et al. 2002). On the contrary, Ainsworth et al. 2003 and Lee et al. 2011 noted a highly positive association between the presence of sidewalks and an increase in physical activity.

Lack of neighborhood facilities like recreational centers, parks, and gymnasiums was noted to be one of the main barriers to physical activity in a considerable number of quantitative studies (Bopp et al. 2004 Sanderson, Littleton, and Pulley 2002; Wilcox et al. 2005; Young et al. 2002). Lack of neighborhood facilities was also noted to be a major barrier to physical activity in quantitative studies (Heesch, Brown, and Blanton 2000; Zenk et al. 2009)

***Weather Conditions*:** Many of those who are not into active sports always rely on outdoor training because they are unable to afford to pay for gymnasium training bills, nor buy personal training equipment and machines. Some also do not feel comfortable being observed by other people training at the gymnasium. These people do physical exercise by taking a walk, riding a bicycle, playing games, and engaging themselves in outdoor physical activity. All those in this category of people are being faced with threatening outdoor weather conditions. During the winter, they are faced with extremely cold temperatures, wind, and precipitation whereas weather also becomes a barrier in the summer as well with extreme heat stroke from the scorching sun. Threatening climatic conditions are seen as a barrier to physical activity in several qualitative studies (Henderson, Littleton & Pulley 2002; Evans 2011; Henderson and Ainsworth 2000a;

Hoebeke 2008). Weather conditions are also identified as well by several quantitative studies (Genkinger et al. 2006; Heesch, Brown, & Blanton 2000; King et al. 2000).

**Differences in Physical Activity Engagements based on Gender, Race, and Age.**

Physical activity engagement level and duration may differ due to individual differences in terms of gender, race, and age. Factors that might account for the difference in specific physical activity engagement difference include an individual's technique level, ability, and socioeconomic factors (Cheah, Y. K. et al, Cule & Guliani, 2022, Leslie, E. et al. 200, Kaczynski A.T. et. al, 2013). A study that examined gender-based differences in participation and time spent in physical activity in Albania indicated that young adult (18-24 years) males are highly likely to participate in physical activity whereas older males are less likely to participate but on the contrary, females older than 40 years in spite of facing factors like childrearing responsibility, were found to be more likely to participate in physical activity than young females below 40 years (Cule & Guliani, 2022). Cule and Guliani study which examined gender-based differences in participation and time spent in physical activity in Albania was found to be consistent with other studies that physical activity participation level decreases as individuals grow in age ((Cule & Guliani, 2022, Brown & Roberts, 2011, Cheah, Y. K. et al., 2017, Humphreys & Ruseski, 2015).

Leslie, E. et al. 2001 study that focused on the differences in physical activity behaviors in young adults for the age ranges of 18-19, 20-24, and 25- 29 years indicated that males have a high participation rate in vigorous and moderate-intensity physical activity than females for all age groups except walking (Leslie, et al. 2001). Males were also noted to be significantly involved in non-work physical activity compared to females. (Saffer, et al, 2013). This low level of non-work physical activity was said to be driven by education, social-economic status, time

constraints, and neighborhood or environmental effects. In a study that was conducted to examine the differences in physical activity behaviors in young adults for the age ranges of 18-19, 20-24, and 25- 29 years, it was found that there were less than 8% differences in the rate of walking in all age groups. For vigorous-intensity leisure-time physical activity, it was indicated that there was at least a 15% difference from 18-19 years to the 25–29-year age groups whereas moderate-intensity leisure-time physical activity was noted with a difference of at least 10% across age groups. (Leslie, et al. 2001). Study findings from Kaczynski et. al, which examined physical activity differences in youth in park settings indicated that boys are more active than girls, however, by race and ethnicity, among youth, there was no significant difference noticed (Kaczynski et. al, 2013).

By sex, there was no significant difference that was found among adults in moderate and vigorous physical activity levels overall in park settings (Kaczynski A.T. et. al (2013).

A study that examined racial/ethnic, and gender differences in physical activity found that minority racial/ethnic groups are engaged in high levels of work physical activity but are involved in lower levels of nonwork physical activity which is positively associated with health.

Unlike other studies that found the minority less likely to participate in moderate and vigorous physical activity at the park as opposed to the whites who are more likely to participate in moderate and vigorous physical activity. On the other hand, this study examines the difference in youth and adults' physical activity in park settings and did not find any significant difference (Kaczynski et. al (2013).

## Mental Health

Mental health refers to human emotion and psychological, and social well-being. It is in connection with our thoughts, feelings, and actions and to a greater extent determines how we handle stress, relate to others as well as influence our choices. It is estimated that more than 970 million of the world's population are affected by mental health conditions. In the US, it is estimated that 1 out of 5 adults experiences mental illness each year, and 1 out of 20 adults experiences serious mental illness each year. In addition, 1 in 6 youth aged 6-17 experience a mental health disorder each year, and 50% of all lifetimes mental illness begins by age 14, and 75% by age 24. Mental health conditions include Anxiety Disorder, Attention Deficit Hyperactivity Disorder (ADHD), Bipolar disorders, Borderline Personality Disorders, Depression, Dissociative Disorders, Eating Disorders Obsessive Compulsive Disorder Posttraumatic Stress Disorders, Psychosis, and schizoaffective disorders.

## Positive Impact of Physical Activity on Mental Health

A nationally representative cross-sectional study that focused on the relationship between physical activity and mental health indicated that there is a greater benefit for mental health when participants exercise for 40-50 minutes per session at least 3 times every week. Participants who were put on different kinds of physical activity got their mental health improved in the category of healthy people bicycling 28.32%, hiking 28.36% whereas jogging maximized the improvement to 30%. In the category of obese people with no chronic comorbidity condition, mental health was improved for study subjects who participated in machine exercise by 19.13%, jogging by 19.25%, and golf by 19.95%. In the category of obese people with one chronic comorbid condition, aerobic exercise videos or classes showed 22.14% of greater improvement whilst obese people with two or more chronic comorbid conditions improved by 19.60%. In

addition to the above, jogging was found to be having a positive effect on mental health in a scoping review that included 116 papers (Oswald et al., 2020). Mindfulness yoga, Pilates, and home-based walking exercise were noted to be very impactful intervention measures to improve mood disorders in overweight and obese individuals.

A large-scale cross-sectional survey found that team sports played the most important role in relieving people's mental disorders (Chekroud et al., 2018). Team sports were also found to play a significant role in improving mental disorders during a large-scale cross-sectional survey (Chekroud et al., 2018)

Several research studies have indicated that PA is one major effective means through which psychological disorders can be improved or prevented (World Health Organization, 2020). Regular physical activity has been noted to highly reduce symptoms of depression, anxiety, and panic disorders and improve mental health in general (Chekroud et al., 2018; De Moor et al., 2006; Paluska & Schwenk, 2000; Weyerer & Kupfer, 1994).

In conclusion, the results of the study generally indicated that all PA types were associated with better improvement in mental health conditions.

**Mental Health as a Barrier to Physical Activity**

Poor health outcomes and disability are being noted to be highly influenced by mental disorders and physical inactivity in the later life of many individuals globally. Depression and anxiety symptoms are noted to begin in childhood to adulthood. A research study in Canada for instance found that about 20% of Canadian youths are diagnosed with at least one mental disorder before they turn 18 years (Buchan et al., 2021). It has been noted in studies that individuals who participate in organized sports as well as stronger social networks report fewer and lower levels of depression and anxiety. On the other hand, individuals who are diagnosed

with psychiatric disorders are noted to participate in low levels of physical activity (Buchan et al., 2021).

Being physically active has great potential for poor mental health recovery and optimal mental health in general. Stress-induced mental illness can be effectively prevented by physical activity. Being physically active prevents anxiousness and depression. When an individual workout for 30 minutes of moderate-intensity aerobic exercise a week, it is equally effective in reducing symptoms of depression and anxiety as antidepressant medication (Marashi et al. 2021). Self-reported levels of anxiety and depression predicted self-perceived barriers to exercise. In this study, the participants who reported higher symptoms of depression expressed a lack of motivation to exercise their body and anxiety as a barrier to physical activity (Marashi et al. 2021).

A case-control study on attitudes, preferences, and perceived barriers to physical activity and mental disorders by Carpiniello et al. in 2013 in Italy, showed that subjects affected by mental disorders are associated with low intensity of physical activity compared to their other counterparts in the control group not affected by mental health. Individuals who are going through mental health issues, though they acknowledge how beneficial well-structured and organized physical activity can positively impact their mental health and general well-being, are, however, negatively influenced by their psychological state and therefore are not motivated enough to participate.

### *Depression*

Depression is a common mental condition characterized by persistent sadness and loss of interest in an individual's daily enjoyable activities. It is the global leading cause of ill health and disability and 5% of adults suffer from depression globally. High BMI is noted to be likely

associated with anxiety and depression mostly in adolescent girls (Meagher, et al. 2017; Anderson et al., 2007). Generally, more women are affected by depression than men. Currently, over 300 million of the world's population are affected by depression which is an increase of 18% between 2005 and 2015 (WHO, 2022).

### *United States Trend on Depression*

Among US children, 1.9 million aged 3-17 years were diagnosed with depression in 2018 (C D C "Data and Statistics on Children's Mental Health", 2018) and approximately 17.3 million (7.1%) American adults suffered major depressive disorders in 2017.

### *Mental Health (MH) Promotion*

Promoting mental health is a very important public health program, especially for children, adolescents, and young adults. This is because that is normally the stage for the onset of this health condition. Programs for improving MH and well-being include raising public awareness of mental health and mental illness and promoting positive mental health and emotional well-being, eliminating the stigma of mental ill health and the discrimination that people with mental health problems still encounter, preventing suicide, and helping cope with the aftermath of suicide, promoting and supporting people's recovery from mental illness (W H O, 2005).

### *Positive School Culture for Promoting MH*

To promote mental health in schools the school culture should be built around a vision with the values upholding to eliminate all forms of discrimination, respect, equality for all, diversity, and collaboration. Schools should promote a listening culture to promote openness on

mental health issues, talks and support on mental health should be available particularly, during anxiety and depressive periods like the examination period (Glazzard & Bostwick, 2018).

Factors that might Contribute to Suicide Risks as a Result of MH Disorder

There is a high association between mental disorders and risks of suicide, particularly depression in most high-income countries. Mental health may worsen and influence the risk of suicide behavior whereby there is a breakdown in the ability to handle unexpected life events like discrimination, abuse, loss and a sense of isolation, violence, experiencing conflict, disaster, relationship break-up, chronic pain, and illness (W H O, 2022)

Suicide Methods

WHO estimates that apart from hanging and firearms, 20% of the world's suicides are caused by using pesticides for self-poisoning. These mostly happen in countries of low and middle-income agricultural areas (W H O, 2022)

prevention strategies that have been shown to be effective, such as restriction of access to means of suicide.

***Prevention and Controlling Suicide and Suicide Attempts*.**

WHO, 2005 and 2022 recommended the following strategies as effective means of controlling and even preventing suicide. These include "fostering socio-emotional life skills in adolescents, identifying and reducing the availability of and access to the means of suicide e.g. pesticides, firearms, certain medications, improving health care services and promoting support and rehabilitation functions for persons affected by suicidal behavior, improving diagnostic procedures and subsequent treatment, increasing the awareness of health care staff of their own attitudes and taboos towards suicide prevention and mental illness, increasing knowledge through public education about mental illness and its recognition at an early stage, supporting

media reporting on suicide and attempted suicide, promoting research on suicide prevention and encouraging the collection of data on the causes of suicide by avoiding duplication of statistical records" (World Health Organization, 2005 & 2022). This confirms the study that suicide, especially firearms are high among men than women. (Kaplan, M.S. et al. 2022)

**PA, Suicide, Screen Time, and Depression**

***Association between Physical Activity and Suicide*:** Suicide among adolescents is one of the major public health burdens. Public concerns in suicide are very important because this is the third leading cause of death in the adolescent. Globally, 67,000 adolescents die from suicide annually (World Health Organization, 2017). It is worthwhile to assume that since Physical activity is effective in prevention, controlling and treatment of significant mental health disorders, it may also have positive influence on suicide. A Cross-sectional study that focused on the association between physical activity and suicide attempts among adolescents aged 12–15 year from forty-eight countries worldwide showed that boys are less likely to seriously consider attempting suicide but on the other hand most likely for girls to attempt suicide. (Felez-Nobrega et al., 2020). Again, a study that focused on physical activity, sport participation, and suicidal behavior in U.S. High School Students showed that both adolescents boys and girls who met physical activity guidelines had lower odds of suicide ideation (Brown et al., 2007).

***Association between Screen Time and Depression*:** The technological advancement in the twenty-first century has made screen time including playing video games on mobile phones and computers, as well as watching television, and visiting other social media sites common among especially adolescent daily routines and as a result, a major sedentary behavior driving preventable cardiovascular diseases.

A study that repeatedly measured the association between screen time and depression indicated a time varying association between screen time and depression (Boers, et al., 2019). Again, a systematic review and meta-analysis of cross-sectional and longitudinal studies on association between screen time and depression showed that there is a positive association in the female population between screen time and depression, especially when it beyond 2 hours per day (Wang, Li & Fan, 2019).

***Association between Screen Time and Suicide*:** There has been a rise in suicide rate over the past decade of which the social media in particular has been attributed to the main cause of this rise. (Coyne, S.M. et al.,2021). Studies show that adolescents who report two and more hours of daily elevated screen time are highly likely to increase their suicidal risks (Barthorpe, et al.,2020; Leventhal, et al. 2021 & Twenge, et al., 2019). Again, a research study shows that when girls engage in social media use, television, and video games continuously for considerable number of years they stand a risk of suicide ideation, plan, and attempt (Coyne, S.M. et al.,2021).

# CHAPTER III: METHODOLOGY

This study will attempt to determine the relationship between physical activity and mental health among high school youth in the State of Tennessee, United States. This chapter discusses the study subjects, data sources, selected measures, and the analysis plan.

## Data Source and Instruments

The data source for this study will be the 2019 State of Tennessee Youth Risk Behavior Survey.

The Youth Risk Behavior Surveillance System (YRBSS) was developed to monitor six main health behaviors often established during childhood and early adolescence, including behaviors that contribute markedly to the leading causes of death, disability, and social problems among youth and adults in the United States. These behaviors, often established during childhood and early adolescence, include Behaviors that contribute to unintentional injuries and violence, sexual behaviors, alcohol and other drug use, tobacco use, unhealthy dietary behaviors, and inadequate physical activity (CDC,2020)

## Participants

The 2019 Tennessee YRBS reflects data from high school students in grades 9-12 in the state. The YRBS used a two-stage cluster sampling approach for data collection. During the first step, schools were selected systematically with probability proportional to enrollment in grades 9 through 12 using a random start (Centers for Disease Control and Prevention, 2018-f).

There were **2153** study subjects from Tennessee high schools who were selected to take part in this study.

**Selected YRBS Measures**

***Independent Variable*:** The selected independent variable for this study is physical activity. Two categories of questions were selected as measures of physical activity. The categories are physical activity frequency and sedentary behavior (measuring lack of physical activity). The selected physical activity-related questions from the YRBS are questions 78, 79, and 80.

Question 78 was selected as the measure for physical activity frequency. Question 78 states "During the past 7 days, how many days were you physically active for a total of at least 60 minutes per day? (Add up all the time you spent in any kind of physical activity that increased your heart rate and made you breathe hard some of the time.)" The answer options included A. 0 days B. 1 day C. 2 days D. 3 days E. 4 days F. 5 days G. 6 days H. 7 days.

One of the two measures selected from the YRBS to assess sedentary behavior (lack of Question

Question 79 was selected as one of the two measures for sedentary behavior. Question 79 states "On the average school day, how many hours do you watch TV?" The answer options include A. I do not watch TV on an average school day B. Less than 1 hour per day C. 1 hour per day D. 2 hours per day E. 3 hours per day F. 4 hours per day G. 5 or more hours per day.

Question 80, the 2nd measure for sedentary behavior states "On an average school day, how many hours do you play video or computer games or use a computer for something that is not schoolwork? (Count time spent playing games, watching videos, texting, or using social media on your smartphone, computer, Xbox, PlayStation, iPad, or another tablet.)" The answer options include A. I do not play video or computer games or use a computer for something that is not schoolwork B. Less than 1 hour per day C. 1 hour per day D. 2 hours per day E. 3 hours per day F. 4 hours per day G. 5 or more hours per day.

***Dependent Variable*:** The dependent variable for this study is mental health. The selected proxy measures for mental health are questions 25 and 26 from the 2019 Tennessee YRBS Survey. Question 25 assesses the signs and symptoms of depression. It states "During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing some usual activities? The answer options included A. Yes B. No. Question 26 assesses suicide ideation. It states. "During the past 12 months, did you ever seriously consider attempting suicide?" The answer options included A. Yes B. No

***Control variables*:** The control variables are age, sex, race, and BMI

Question one asks about age.

Question 1 States. "How old are you?" The answer options included A. 12 years old or younger B. 13 years old C. 14 years old D. 15 years old E. 16 years old F. 17 years old G. 18 years old or older.

Question 2 asks about sex.

Question 2 states. "What is your sex?" Answer options include A. Female B. Male

Question five asks about race. (Select one or more responses.)

Question 5 states. "What is your race?" Answer options included A. American Indian or Alaska Native B. Asian C. Black or African American D. Native Hawaiian or Other Pacific Islander E. White

**Analysis Plan:** This is a cross-sectional study. A complex sample multinomial logistic regression analysis was conducted to examine the relationship between physical activity and mental health from a broader perspective. IBM's SPSS version 25 analysis module was used to analyze the 2019 YRBS data for Tennessee. The independent variable was Physical Activity (physically active or inactive). The dependent variable was Mental Health (Poor mental health

condition for being physically inactive or improved mental health condition for being physically active). The control variables are age, sex, race and BMI. A descriptive analysis was conducted to examine the descriptive statistics of the data. The multinomial logistic regression was conducted to examine the likelihood of following the recommended guidelines for physical activity improving mental health conditions or physical inactivity influencing poor mental health. There was also an examination as to whether there is an association between sedentary behavior and poor mental health.

# CHAPTER IV: RESULTS

The purpose of this study was to examine the relationship between physical activity (PA) and mental health (MH) among high school students in Tennessee. The 2019 Youth Risk Behavior Survey for Tennessee was utilized to analyze the results. Binomial logistic regression was conducted on sex, race, age, and BMI using IBM SPSS Version 25.0 to analyze the relationship between PA and MH

## Demographic Data

There were a total of 2217 students from age 14 and above who were included in the analysis. Of the 2217 students, 1187 (49.0%) identified as female and 1030 (51.0%) as males with a standard error of 2.0% for both sexes. Among students who reported their race, 1274 (64.6%) indicated they are Whites, with a standard error of 4.9%, 389 (23.5%) Black with a standard error of 4.3%, 329 (9.1%) Hispanics with a standard error of 1.3%, and 191(2.9%), constituting students of all other races, with a standard error of 0.2%. For the BMI category, 1281 (60.8%) of students were classified as underweight or normal weight, with a standard error of 1.5, 384 (18.3%) were overweight, with a standard error of 1.0% and 408 (20.9%) were obese, with a standard error of 1.4%. For additional details see Table 1 and the graph.

**Table 1**

*Participants' Demographics including BMI Information*

| Demographics | N (S.E) | % |
|---|---|---|
| **Gender** | | |
| Female | 1187(2.1) | 49.0 |
| Male | 1030(2.0) | 51.0 |
| **Race** | | |
| White | 1274(4.9) | 64.6 |
| Black | 389(4.3) | 23.5 |
| Hispanic | 329(1.3) | 9.1 |
| All other races | 191(0.2) | 2.9 |
| **BMI** | | |
| Underweight/Normal weight | 1281(1.5) | 60.8 |
| Overweight | 384(1.0) | 18.3 |

**Students' Physical Activity Participation and Sedentary Behavior**

There were a total of 2153 students who responded on physical activity engagement levels. 849 (39.9%) students reported they were physically active for at least 60 minutes per day on 5 or more days compared to 1304 (60.1%) who could not meet the guidelines for PA recommendations for adolescents with a standard error of 1.3% for both groups. Moreover, out of 2097 students, there were 1311(62.1%) who could spend as much as three hours and more on-

screen time whereas 786 (37.9%) spent less than three hours on screen time with a standard error of 1.8%.

**Mental Health Signs and Symptoms**

Among students who reported on signs and symptoms of depression that rendered them unable to do usual activity for not less than two weeks, ,848 (37.5%) reported signs and symptoms of depression compared to 1332 (62.5%) who reported no signs and symptoms with a standard error of 1.8% for both groups while 441(19.2%) reported thinking about committing suicide, i.e., suicide ideation with a standard error of 1.4%. Among students who responded to the question about suicide attempts, 1759 (80.8%) of respondents reported they did not make serious attempts to commit suicide, 441(19.2%) reported seriously considered attempting suicide, with a standard error of 1.4%

**Association between Physical Activity and Depression**

There was a significant relationship between PA and signs and symptoms of depression. Among students who reported engaging in physical activity for at least 60 minutes per day on 5 or more days 264(30%) reported signs and symptoms of depression compared to 576(70%) who did not report signs and symptoms of depression, with a standard error of 2.2% for both groups. Again, among students who did not report engaging in physical activity per day for 5 or more days, 560(42.8%) reported signs and symptoms of depression compared to 714 (57.2%) who reported no signs and symptoms of depression with a standard error of 2.4%.

**Crosstabulations for Depression**

***Age***

Among the age groups, 33.8% of students aged 14 reported signs and symptoms of depression whereas 188 (66.2%) reported no signs and symptoms of depression with a standard

error of 3.0%. Among students who were aged 15 years, 241 (37.3%) reported signs and symptoms of depression whereas 415 (62.7%) reported no signs and symptoms of depression, with a standard error of 3.0%. For students aged 16 years, 213(39.1%) reported signs and symptoms of depression whereas 282 (60.9%) reported no signs and symptoms of depression with a standard error of 3.7%. Among the students aged 17, 173(38.1%) reported signs and symptoms of depression whereas,268 (61.9%) reported no signs and symptoms of depression, with a standard error of 3.2%. Among the students aged 18 years and beyond, 100 (36.4%) reported signs and symptoms of depression whereas 175 (63.6%) did not report signs and symptoms of depression, with a standard error of 3.4%. Overall, 839 (37.4%) of students reported feeling depressed as opposed to 62.6% who reported no signs or symptoms of depression, with a standard error of 1.8% for both groups.

***Sex***

Among female students, 549 (47.1%) reported signs and symptoms of depression whereas 621(52.9%) reported no signs and symptoms of depression, with a standard error 2.0%. Among the male students, 293 (27.9%) reported signs and symptoms of depression whereas 708(72.1%) reported no signs and symptoms of depression, with a standard error of 2.2%. In both sexes overall, 842(37.4%) reported signs and symptoms of depression whereas 1329(62.6%) reported no signs and symptoms of depression, with a standard error of 1.8%.

***Race***

Among White Students, 504 (39.3%) reported signs and symptoms of depression with a standard error of 2.6% whereas 753 (60.7%) reported no signs and symptoms of depression with a standard error of 2.6%. Among Blacks, 117 (30.4%) reported signs and symptoms of depression with a standard error of 2.2% whereas 259 (69.6%) reported no signs and symptoms

of depression with a standard error of 2.2%. Among Hispanics, 136 (40.6%) reported signs and symptoms of depression with a standard error of 3.5% whereas 184 (59.4%) reported no signs and symptoms of depression with a standard error of 3.5%. For all other races, 71 (42.7%) reported signs and symptoms of depression with a standard error of 4.2% whereas 113 (57.3%) reported no signs and symptoms of depression with a standard error of 4.2%. Overall, among the racial groups, 829 (37.5%) of students reported signs and symptoms of depression, with a standard error of 1.9% whereas 1309 (62.5%) reported no signs and symptoms of depression with a standard error of 1.9%.

***BMI Category***

Among underweight and normal-weight students, 481 (37.2%) reported signs and symptoms of depression with a standard error of 1.5% compared to 782 (62.8%) who did not report they did not feel sad or hopeless, with a standard error of 1.5% for both groups.

Among overweight students,133 (36.0%) reported signs and symptoms of depression compared to 239 (64.0%) who reported no signs and symptoms of depression with a standard error of 2.9%, for both groups.

Among the obese students, 168 (38.3%) reported signs and symptoms of depression compared to 234 (61.7%) who reported no signs and symptoms of depression with a standard error of 1.9% for both groups. Among all the BMI categories,782 (37.2%) reported signs and symptoms of depression whereas 1255 (62.8%) did not report signs and symptoms of depression with a standard error of 1.9% for both groups.

***PA Level***

Among the students who reported they were physically active for at least 60 minutes per day for five or more days 264 (30.0%) of them reported signs and symptoms of depression

compared to 576 (70.0%) who did not report signs and symptoms of depression, with a standard error of2.2%, for both groups.

Among the students who reported they were not physically active for 60 minutes per day for less than five days in a week, 560(42.8%) reported signs and symptoms of depression whereas 714 (57.2%) did not report signs and symptoms of depression with a standard error of 2.4 for both groups.

Among both categories, 842 (37.6%) reported signs and symptoms of depression among those who were physically active per week whereas 1290 (62.4%) did not report signs and symptoms of depression with a standard error of 2.0% for both groups.

**Cross Tabulations for Considered Attempting Suicide**

***Age 14 and beyond***

Among age groups, 63 (18.0%) of students aged 14 reported they seriously considered attempting suicide compared to 273 (82.0%) who reported they did not seriously consider attempting suicide, with a standard error of 2.1%, for both groups.

Among the students who were aged 15 years, 129 (19.9%) reported they seriously considered attempting suicide whereas 532 (80.1%) reported they did not seriously consider attempting suicide with a standard error of 2.6%. Among the students aged 16, 111 (21.2 %) reported they seriously considered attempting suicide whereas 392 (78.8%) reported they did not seriously consider attempting suicide with a standard error of 2.6% for both groups. Among the students aged 17, 85 (18.2%) reported they seriously considered attempting suicide whereas 359 (81.8%) reported they did not seriously consider attempting suicide, with a standard error of 2.1% for both groups. Among the students aged 18 years and beyond, 45 (16.2%) reported they seriously

considered attempting suicide whereas 233 (83.8%) reported they did not seriously consider attempting suicide, with a standard error of 1.8%, for both groups.

In all the ages overall, 433 (19.0%) reported they seriously considered attempting suicide as opposed to 1753 (81.0%) who did not report seriously considering suicide with a standard error of 1.4% for both groups.

***Sex***

Among females, 289 (24.4%) reported they seriously considered attempting suicide whereas 892 (75.6%) reported they did not seriously consider attempting suicide, with a standard error of 1.3%, for both groups.

Among the male students, 145 (13.7%) reported they seriously considered attempting suicide whereas 865 (86.3%) reported they did not seriously consider attempting suicide, with a standard error of 2.0% for both groups. In both sexes overall, 434 (19.0%) reported they seriously considered attempting suicide whereas 1757 (81.0 %) reported they did not seriously consider attempting suicide, with a standard error of 1.4%.

***Race***

Among White Students, 264 (20.5%) reported they seriously considered attempting suicide whereas 1001 (79.5%) reported they did not seriously consider attempting suicide, with a standard error of 2.0%, for both groups.

Among Blacks, 62 (15.4%) reported they seriously considered attempting suicide whereas 319 (84.6%) reported they did not seriously consider attempting suicide, with a standard error of 2.0%, for both groups.

Among Hispanics, 60 (18.0%) of the students reported they seriously considered attempting suicide whereas 261 (82.0%) reported they did not seriously consider attempting suicide, with a

standard error of 3.2%. For all other races, 46 (27.9%) reported they seriously considered attempting suicide whereas 143 (72.1%) reported they did not seriously consider attempting suicide, with a standard error of 2.3%. Among the racial groups, 432 (19.3%) of students reported they seriously considered attempting suicide whereas 1724 (80.7%) reported they did not seriously consider attempting suicide, with a standard error of 1.4%, for both groups.

**BMI Category**

Among students who reported on suicide ideation, 218(16.9%) of the underweight and the normal weight category reported they seriously considered attempting suicide whereas 1051(83.1%) reported they did not seriously consider attempting suicide, with a standard error of 1.1%, for both groups.

Among the overweight students, 88 (22.4%) reported they seriously considered attempting suicide whereas 288 (77.6%) reported they did not seriously consider attempting suicide, with a standard error of 2,5%, for both groups.

Among the obese students, 97 (21.9%) reported they seriously considered attempting suicide whereas 310 (78.1%) reported they did not seriously consider attempting suicide, with a standard error of 3.1%. Among all the BMI categories, 403 (18.9%) of students reported they seriously considered attempting suicide whereas 1649 (81.1%) did not report they seriously consider attempting suicide, with a standard error of 1.4%, for both groups.

**Association between Physical Activity Suicide**

Among the students who reported they were physically active for at least 60 minutes per day for five or more days, 144 (15.9%) reported they seriously considered attempting suicide whereas 707 (84.1%) reported they did not seriously consider attempting suicide, with a standard error of 1.7%, for both groups. Among the students who reported they were not physically active

for 60 minutes per day for less than five days, 281 (20.9%) reported they seriously considered attempting suicide whereas 1002 (79.1%) did not report they seriously considered attempting suicide, with a standard error of 1.9% for both groups. In both categories, 421 (18.9%) reported they seriously considered attempting suicide among those who reported they were physically active per week whereas 1709 (81.1%) did not report they seriously considered attempting suicide among the students who reported they were not physically active per week, with a standard error of 1.5% for both groups. For additional details see table 5

## Logistic Regression

### *Physical Activity in Relation to Depression*

When controlling for age, sex, race, and BMI those who met the PA guidelines were 0.66 (0.49, 0.90) times less likely to report signs and symptoms of depression than those who did not meet the guidelines. For additional details see table 2 below.

Table 2

*Model Summary of Logistic Regression Using Physical Activity Predicting Feelings of Sadness and Hopelessness (N = 2228)*

| | | | 95% Confidence Interval | |
|---|---|---|---|---|
| Variable | | Odd ratio | Lower | Upper |
| Physical Activity | | | | |
| | Met PA Criteria | 0.66 | 0.49 | 0.90 |
| | Did Not Meet Criteria | Reference | | |
| BMI | | | | |
| | Overweight | 0.88 | 0.63 | 1.24 |
| | Obese | 1.17 | 0.84 | 1.64 |
| | Average | Reference | | |
| Sex | | | | |
| | Female | 2.20 | 1.68 | 2.88 |
| | Male | Reference | | |
| Race | | | | |
| | Black | 0.66 | 0.45 | 0.96 |
| | Hispanic | 1.07 | 0.74 | 1.53 |
| | Others | 1.21 | 0.77 | 1.89 |
| | White | Reference | | |
| Age | | | | |
| | 14+ | 1.04 | 0.91 | 1.19 |

*Note*: Model Chi Square = 25.66, $df = 8, 10$ ($p < .001$); Nagelkerke $R^2 = .08$

* $p < .05$.

### *Association between Screen Time and Depression*

Among the students who spent three hours or more of their time on screen, 514 (38.6%) reported signs and symptoms of depression whereas 782 (61.4%) did not report signs and symptoms of depression, with a standard error of 2.0% for both groups. Among students who reported they spend less than three hours of their time on screen, 288 (35.2%) reported signs and symptoms of depression whereas 477 (64.8%) reported no signs and symptoms of depression, with a standard error of 2.9%. In both categories, 802 (37.3%) of those who spent three hours or

more on the screen reported signs and symptoms of depression whereas 1259 (62.7%) of students who spent less than three hours of their time on the screen did not report signs and symptoms of depression, with a standard error of 2.0% for both groups.

### *Association between Screen Time and Suicide*

Among the students who spent three hours or more of their time on screen, 269 (20.0%) reported they seriously considered attempting suicide whereas 1036 (80%) did not report they seriously considered attempting suicide, with a standard error of 1.3% for both groups. Among those who spend less than three hours of their time on screen, 138 (16.6% reported they seriously considered attempting suicide whereas 632(83.4%) reported they did not seriously consider attempting suicide, with a standard error of 2.0% for both groups. In both categories, 407(18.8%) of those who spent three hours or more on the screen reported they seriously considered attempting suicide compared to 1668(81.2%) of students who spent less than three hours of their time on the screen reported they did not seriously consider attempting suicide, with a standard error of 1.4% for both groups. For more details see table 4.

### *Screen Time*

When controlling for age, sex, race, and BMI, females were 2.04 (1.51, 2.77) times more likely to seriously consider attempting suicide than males.

When controlling for age, sex, race, and BMI, blacks were 0.63 (0.38, 1.03) times less likely to seriously consider attempting suicide than whites.

When controlling for age, sex, race, and BMI Hispanics were 0.76 (0.54, 0.94) times less likely to seriously consider attempting suicide than Whites. Finally, when controlling for age, sex, race, and BMI there was a 1.06 (1.02, 1.11) increase in the odds of considering suicide. For more details see table 3.

Table 3

*Model Summary of Logistics Regression using Screen Time Predicting Feeling of Sadness and Hopelessness (N= 2228)*

| | | | 95% Confidence Interval | |
|---|---|---|---|---|
| Variable | | Odd ratio | Lower | Upper |
| Screen Time | | | | |
| | 3 hours or more of Screen Time | 1.24 | 0.922 | 1.68 |
| | Less than 3hrs of Screen Time | Reference | | |
| BMI | | | | |
| | Overweight | 0.85 | 0.58 | 1.25 |
| | Obese | 1.22 | 0.90 | 1.68 |
| | Average | | | |
| Sex | | | | |
| | Female | 2.47 | 1.93 | 3.17 |
| | Male | Reference | | |
| Race | | | | |
| | Black | 0.66 | 0.45 | 0.97 |
| | Hispanic | 1.15 | 0.81 | 1.64 |
| | Others | | | |
| | White | Reference | | |
| Age | | | | |
| | 14+ | 1.05 | 0.92 | 1.21 |

Note: Model Chi-Square = **13.00**, df =8, 10 ($p < .001$); Nagelkerke $R^2$ =.07 * $p <$ **.05**

Table 4

*Model Summary of Logistic Regression Using Screen Time Predicting Suicide Ideation (N= 2228)*

| | | | 95% Confidence Interval | |
|---|---|---|---|---|
| Variable | | Odd ration | Lower | Upper |
| Screen Time (ST) | | | | |
| | ST continuous Variable effect on suicide ideation | 1.06 | 1.02 | 1.11 |
| | No Screen Time | Reference | | |
| BMI | | | | |
| | Overweight | 1.29 | 0.89 | 1.87 |
| | Obese | 1.59 | 1.12 | 2.26 |
| | Average | | | |
| Sex | | | | |
| | Female | 2.05 | 1.51 | 2.77 |
| | Male | Reference | | |
| Race | | | | |
| | Black | 0.63 | 0.39 | 1.04 |
| | Hispanic | 0.76 | 0.55 | 1.06 |
| | Others | 1.26 | 0.82 | 1.93 |
| | White | Reference | | |
| Age | | | | |
| | 14+ | 0.96 | 0.87 | 1.07 |

Note: Model Chi-Square = 6.40, df =8, 10 ($p < .005$); Nagelkerke $R^2$ =.05 * $p <$ **.05**

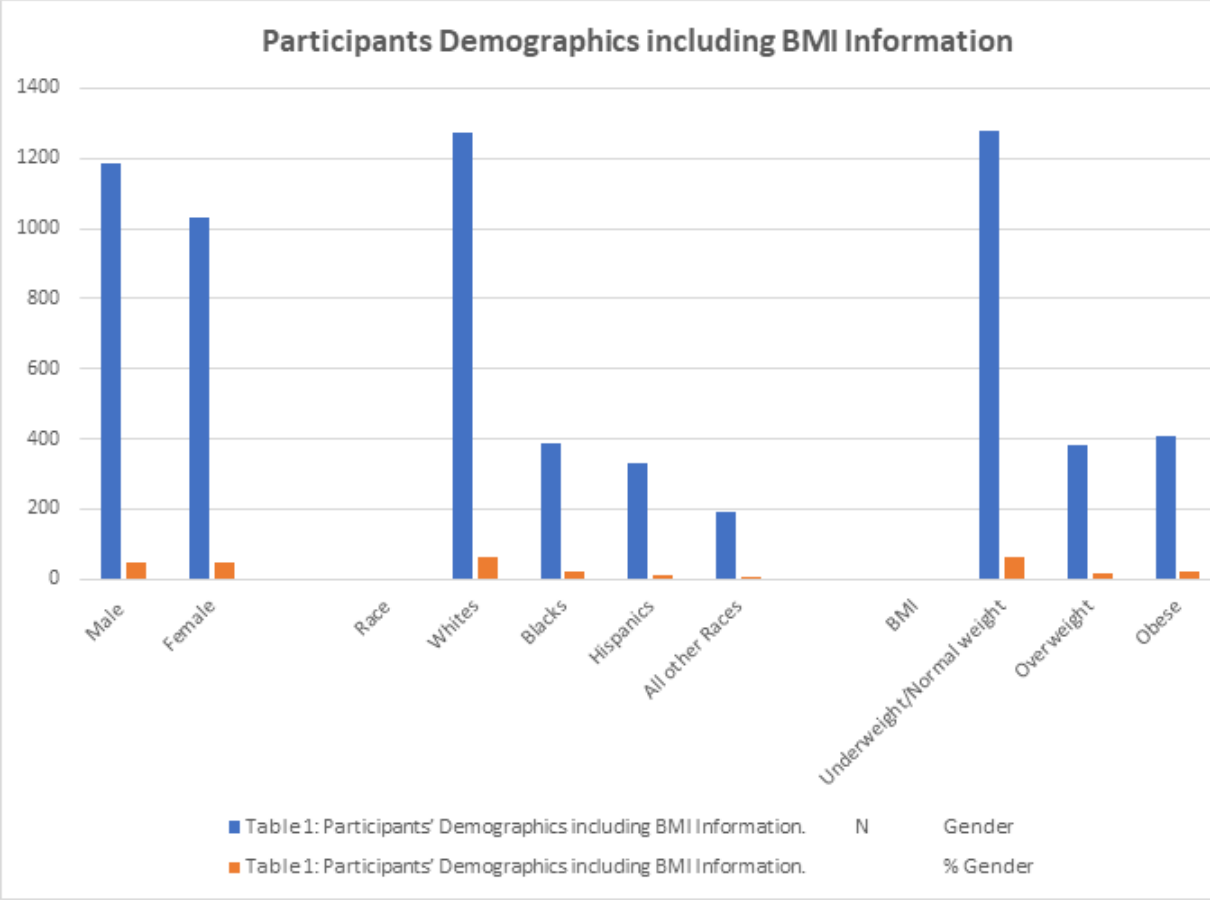
Participants Demographics including BMI Information
1400
1200
1000
800
600
400
200
0
Male
Female
Race
Whites
Blacks
Hispanics
All other Races
BMI
Underweight/Normal weight
Overweight
Obese
Table 1: Participants' Demographics including BMI Information.
N
Gender
Table 1: Participants' Demographics including BMI Information.
% Gender

Table 5

*Model Summary of Logistics Regression Using Physical Activity Predicting Suicide Ideation (N=2228)*

| | | | 95% Confidence Interval | |
|---|---|---|---|---|
| Variable | | Odd ratio | Lower | Upper |
| Physical Activity | | | | |
| | Met PA Criteria | 0.85 | 0.57 | 1.26 |
| | Did Not Meet Criteria | Reference | | |
| BMI | | | | |
| | Overweight | 1.36 | 0.99 | 1.89 |
| | Obese | 1.60 | 1.12 | 2.27 |
| | Average | | | |
| Sex | | | | |
| | Female | 1.94 | 1.38 | 2.72 |
| | Male | Reference | | |
| Race | | | | |
| | Black | 0.68 | 0.40 | 1.15 |
| | Hispanic | 0.77 | 0.55 | 1.08 |
| | All other races | 1.39 | 0.91 | 2.12 |
| | White | Reference | | |
| Age | | | | |
| | 14+ | 0.97 | 0.87 | 1.09 |

Note: Model Chi-Square = 15.35, df =8, 10 (p < .001); Nagelkerke R2 =.04 * p < .05

**Control Variables**

***Age***

There was a need to control age because physical activity engagement levels can be highly influenced by age. Children and adolescents are more likely to participate in physical activity than adults, especially in old age (Wienert, Gellert & Lippke, 2017). In the same way, age can influence the level of mental health symptoms of the study participants. This is because aging is associated with depression and hence might cause an individual to be susceptible to experiencing

more depressive symptoms (Segel-Karpas et al, 2022; Chen, J. et al, 2021; Currin, Hayslip & Temple, 2011). Controlling age was necessary in order not to influence the overall outcome.

***Sex***

Physical activity levels are highly influenced by sex. It has been noted that females are less likely to have high levels of physical activity than males. Several studies have consistently shown that boys have higher physical activity levels than girls in invasion games including volleyball, softball, basketball, soccer, and Frisbee (Hannon & Ratliffe 2005; Hodges Kulinna et al. 2003). So, if sex is not controlled the sex factor is likely to skew the results of the study negatively against females and this will highly affect the validity of the results. Research conducted on Interactions Between Race/Ethnicity and Gender on Physical Activity Among US High School Students indicated that female students compared to males reported significantly fewer physically active days per week (Pontes, N. M. H., Williams, W. M., & Pontes, M. C. F. 2021). Research that was conducted on the gender difference in college students' PA indicated that women engage in less muscle-strengthening activity, and informal sport participation and don't feel comfortable using campus recreational facilities, especially for weight training (Wilson et al., 2022). Females are more susceptible to mental health issues than males. There is a high prevalence of mental health issues in females than in males.
Granski et al., 2020; Currin, Hayslip & Temple, 2011).

***Race***

Physical activity engagement levels vary in terms of racial groups. White adults are known to enjoy common physical activity facilitators such as convenience, pleasure, and social support compared to other racial groups (Symons Downs & Hausenblas) which makes them have high physical activity levels. Kosma, M., & Cardinal, B. J. 2016). Research conducted on Interactions

Between Race/Ethnicity and Gender on Physical Activity Among US High School Students indicated that white students relative to non-white students are significantly more physically active weekly. Blacks and Hispanic students are noted to have lower PA compared to White students (Pontes, N. M. H., Williams, W. M., & Pontes, M. C. F. 2021).

Research shows that non-whites are known to suffer from clinically elevated depressive symptoms more than Whites. Granski, (1), et al, 2020)

***BMI***

The BMI of study participants has a great influence on physical activity pursuits. Participants with high BMI especially in the obese category have low levels of physical activity whereas the underweight and normal-weight individuals have high levels of physical activity (Ayiesah, R. et al., 2013). A study by AI SHIBATA et al. on Physical Activity, Television Viewing Time, and 12-Year Changes in Waist Circumference Indicates that higher BMI is associated with lower levels of PA (AI SHIBATA et al.,2016). In the same way, high BMI is likely to be associated with anxiety and depression mostly in adolescent girls (Meagher, et al. 2017; Anderson et al., 2007). Therefore, there is a need to control BMI to avoid the results of this study to be valid

# CHAPTER V: DISCUSSION

## Introduction

This study aimed to find if there are relationships between physical activity (PA) and mental health (MH) among high school students in Tennessee. Hence, it provided an opportunity to answer the research question when controlling for age, sex, race, and BMI, what are the relationships between the signs and symptoms of depression, time spent on sedentary behavior, and (PA) among high school students in Tennessee. The 2019 Youth Risk Behavior Survey for Tennessee was utilized to analyze the results. Binomial logistic regression was conducted on sex, race, age, and BMI using IBM SPSS Version 25.0 to analyze the relationship between PA and MH. This chapter seeks to discuss the results of the hypothesis, the core variables, and the study implications and concludes by summarizing.

## Hypotheses

The study therefore hypothesis that when controlling for age, sex, race, and BMI, high school youth in Tennessee who are able to follow the recommended level of physical activity will be less likely to report the signs and symptoms of depression and then, when controlling for age, sex, race, and BMI, high school students in Tennessee who spend more time on screens will be more likely to report the signs and symptoms of depression. This study confirmed that there is a significant relationship between following the recommended level of physical activity and depression. Again, this study also showed a significant relationship between sedentary behavior and depression. However, there was no relationship between PA and suicide ideation. This study suggests that to better understand the underlying cause there should be the use of cross-sectional

and longitudinal study data with other racial groups, age groups, different schools, and qualitative study.

**Association between Physical Activity and Depression**

The results of this study indicated that the students who reported they were physically active for at least 60 minutes per day for five or more days, were less likely to report signs and symptoms of depression compared to those who did not meet the PA guidelines. On the other hand, students who reported they were not physically active for at least 60 minutes for five or more days were more likely to report signs and symptoms of depression. This study is consistent with several other studies which indicated that adhering to PA guidelines, including playing team sports, plays a significant role in improving mental disorders during a large-scale cross-sectional survey (Chekroud et al., 2018). Again, it confirms that being physically active has great potential of reducing stress-induced mental illness, anxiety, and depression because following PA guidelines function as antidepressant medication (Marashi et al. 2021; Dunn 2008; Evans 2011; Hoebeke 2008; Ingram et al. 2011; Bopp et al. 2007; Zunker et al. 2008; Kaczynski et. al, 2013).

**Association between Screen Time and Depression**

This study indicated no significant association between three hours or more of time spent on the screens and depressive signs and systems. This is contrary to the study that repeatedly measured the association between screen time and depression that indicated a time-varying association between screen time and depression (Boers, et al., 2019). When controlling for PA, age, race and sex, there was no significant difference between BMI and depression. However, when controlling for screen time, age, sex, and BMI there was a significant difference between screen time and depressive signs and systems among races. Blacks were less likely to report

signs and symptoms of depression than Whites, however, Hispanics were as likely as all other races to report more signs and symptoms of depression.

**Association between Screen Time and Suicide**

Unlike several other studies that showed that adolescents who report two and more hours of daily elevated screen time are highly likely to increase their suicidal risks (Barthorpe, et al.,2020; Leventhal, et al. 2021 & Twenge, et al., 2019), this study did not show a significant association between Screen time and suicide ideation. However, when controlling for screen time, sex, race and BMI, all the age groups were more equally as likely to seriously consider attempting suicide. and again, when controlling for screen time, age sex and race there was no significant difference between the overweight and the obese. The study showed that being overweight is as likely as the obese to seriously consider attempting suicide. However, when controlling for screen time, age, race and BMI, there was a significant difference among sex and race. Females were more likely to seriously consider attempting suicide than males and Blacks were less likely to seriously consider attempting suicide than Whites. Lastly, for a continuous prediction, findings indicated that there is an increase in the odds of serious suicide attempts for each hour of increase in screen time.

**Association between PA and Suicide**

The results from this current study showed no significant association between PA and suicide. Among the overweight and obese who follow the PA guidelines, there was no significant difference between PA and suicide. This is contrary to a previous study that focused on physical activity, sports participation, and suicidal behavior in U.S. High School Students that showed that both boys and girls adolescents who met physical activity guidelines had lower odds of

suicide ideation (Brown et al., 2007). When controlling for PA, sex, age and race, the study indicated no association between BMI and suicide, however, among sex, the study indicated that females were more likely to seriously consider attempting suicide than males. This confirms a Cross-sectional study that focused on the association between physical activity and suicide attempts among adolescents aged 12–15 years from forty-eight countries worldwide that showed that boys are less likely to seriously consider attempting suicide but on the other hand most likely for girls to attempt suicide. (Felez-Nobrega et al., 2020). Moreover, when controlling for PA, sex, race, and BMI, age was not seen as a significant variable for suicide, however, there was a significant association of race to suicide. Blacks were less likely to consider attempting suicide than Whites, whereas Hispanics were less likely to consider attempting suicide than White. On the other hand, however, all other races were insignificant. Whites were less likely to consider attempting suicide than all other races.

**Strengths and Limitations**

The finding of this study includes these limitations. First, the YRBS data is self-reported by the students and therefore relies on what they remember at that point in time of responding to the survey. Second, the YRBS is a cross-sectional survey. Data collected at a specific point in time renders it unable to make causal inferences. Thirdly, the survey population is limited to Tennessee High school students aged 14 and beyond only, and therefore the results cannot be generalized nationwide. Notwithstanding the cross-sectional nature, state-based population, and self-reported survey, the results illustrated a significant association between physical activity and depression. Again, the control variables, age, race, sex, and BMI were all introduced to avoid skewing the results for the sake of validity and reliability.

**Specific implications.**

Public health's biggest goals include reducing non-communicable and cardiovascular diseases by creating awareness that adherence to physical activity guidelines is one of the effective, safest, convenient, evidence-based practices, as well as a cost-effective means to this course not excluding depression. Several other recommended guidelines of going about physical activity participation have been suggested by WHO which have been very effective in reducing and even preventing depressive symptoms, and anxiety as well as improving mental health, improving optimal health, and well-being in general. Specific exercises are recommended considering age, health status, fitness and skill level, convenience, and safety-wise. It is therefore advisable for the individual to be well informed about these physical exercises and health behaviors that can better mental health. For the public health community to be successful in achieving this, it will be worthwhile for the provision and referral to available PA resources while also embarking on motivational drives on PA pursuit. Lastly, schools are also to be responsible for introducing these to children and adolescents whiles they are growing up. In this way, it will form part of their daily life and grow with it.

**Conclusion**

The purpose of this study was to increase the information available about the relationship between physical activity and mental health and the associated outcomes regarding age, sex, race, and BMI and by so doing use the information to guide the design of the physical activity and mental health programs for adolescents. This study was proposed to answer the research question when controlling for age, sex, race, and BMI, what are the relationships between the signs and symptoms of depression, time spent on sedentary behavior, and physical activity among high school students in Tennessee? A significant result of this study indicates that there is

a strong relationship between physical activity and mental health. Again, it was indicated that sedentary behavior and mental health are noted to be strongly related in this current study. Public health efforts need to be maximized in educating, encouraging, and providing resources for better physical activity participation, curbing the rise of youth screen time hours, and suicide control.

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