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Relationship Between Screentime and Depressive Symptoms and Associated Mediators for African American Adolescents in the United States

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This is to certify that the doctoral study by

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Abstract

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by

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MPH, Georgia State University, 2017

BA, College of St. Benedict and St. John's University, 2015

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

The prevalence of adolescent depression in the United States is increasing as adolescents' use of electronic screen devices increases. Some studies have found associations between screentime and adolescent depression, and other researchers have posited that screentime is not intrinsically harmful. High screentime in African American adolescents may place them at risk for worse depressive symptom outcomes, but the relationship between screentime and depressive symptoms for this population is unknown. The three research questions of this study addressed whether there is a relationship between screentime and depressive symptoms in African American adolescents and whether sleep duration and the frequency of physical activity mediate the relationship, controlling for age and sex. This quantitative correlational study used the 2019 Youth Risk Behavior Survey. The conceptual framework presupposed that screentime can predict depressive symptoms and that sleep duration and frequency of physical activity potentially mediate the relationship between the two variables. The binary logistic regression and mediation analyses results indicated screentime as a significant but weak predictor of depressive symptoms. Exposure slightly lowered the likelihood of depressive symptoms [(*OR* = .948, 95% CI (.908, .990)]. Only sleep duration was a significant partial mediator of small effect [Effect = .006, CI (.001, .013)]. There are likely stronger predictors of depressive symptoms than screentime, but education on sleep hygiene, monitoring of screentime and depressive symptoms, and advocacy for online safety are needed. Social change amid technological advances requires ongoing research on how screentime can preserve the benefits of socializing, learning, and entertainment while protecting mental health.

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Dedication

This study is dedicated firstly to God for giving me the grace and strength to persevere and excel. To my parents Ronald and Peatra Jones and my brother Bryantt Jones, your moral support and belief in me are invaluable. To my significant other and closest friends, your prayers, insight, and words of encouragement kept me motivated to complete this journey. This milestone is a shared victory that could not have been attained without each of you. Finally, I dedicate this study to those whose lives will be positively impacted by my work in Public Health.

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I would like to acknowledge Dr. Sanggon Nam and Dr. Stacy-Ann Christian, my Chair and Committee Member, for their guidance, advice, feedback, and support during this journey. Thank you for supporting my development as a scholar-practitioner. I also express gratitude to my professional colleagues who have been sources of inspiration and provided words of wisdom for navigating this journey. Thank you for cheering me to the finish line.

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Section 1: Foundation of the Study and Literature Review

Introduction

Depression is one of the leading global causes of disability among adolescents (World Health Organization [WHO], 2021). In the United States, the rate of depression among adolescents has been increasing (Lu, 2019; Mojtabai et al., 2016; Twenge, Cooper, et al., 2019; Yang et al., 2020). The increasing prevalence of adolescent depression parallels the increasing proliferation of smartphones since 2012 (Odgers & Jensen, 2020; Twenge, 2020b). The simultaneous positive trends have raised raise public health concerns about whether increased time spent using screen-based digital devices impacts adolescent depression outcomes.

Moreover, the COVID-19 pandemic transpired within a technological context whereby portable electronic screen devices and internet access were ubiquitous. Temporary government orders to stay at home, temporary transitions to online learning, and requirements for social distancing all contributed to increased reliance on digital media among adolescents for entertainment, socialization, and education (Nagata et al., 2022a). The increase in weekly recreational screentime for American adolescents from 25.9 hours in 2018 to 28.5 hours in 2020 indicated increasing exposure (Wagner et al., 2021). The growing prevalence of screentime during the pandemic added to existing public health concerns about its impact on adolescent mental health (Hattersley et al., 2009; Twenge, Martin, et al., 2019).

African American adolescents (AAA) daily use electronic screen devices for 2 hours longer for recreational purposes than their White counterparts (Rideout et al.,

2022), and have lower treatment rates for depression (Lu, 2020). Therefore, it is important to investigate whether screentime has an impact on depressive outcomes for AAA to inform public health recommendations that reduce their risk of screen-related depressive symptoms. Furthermore, it is important to investigate whether sleep duration and frequency of physical activity impact the relationship between screentime and depressive symptoms to inform the scaling up of public health guidance, communications, and interventions among AAA for adequate sleep and physical activity as protective factors against depression.

Adolescence is a crucial period for brain development, emotional and intellectual maturity, and psychosocial development (Moukaddam et al., 2019). Undiagnosed and untreated depression can have adverse acute and long-term impacts on adolescents. Public health strategies to prevent depression, especially among AAA, are critical to reducing their likelihood of experiencing impaired functioning in school, interpersonal challenges in adulthood, the onset of other mental health disorders, lowered likelihood of future employment, an increased risk of developing chronic illnesses or committing suicide, poor social functioning, and poor school and work performance (Moukaddam et al., 2019; Mullen, 2018; WHO, 2021). Therefore, positive social change for a better quality of life and mental health outcomes for AAA can be achieved by avoiding the onset of depression.

The first section will highlight the background and describe the problem, outline the purpose of the study and research questions, provide the conceptual framework and relevant literature, and detail the scope and limitations of the study.

Background

The research literature does not provide conclusive evidence about the heightened concern among parents and researchers that increasing screentime causes depression in adolescents. There is a dearth of longitudinal and experimental studies on adolescent depression and screentime (Odgers & Jensen, 2020). Most available data on adolescent screentime and depressive symptoms are cross-sectional data and do not qualitatively explore perceptions of adolescents about how their screentime influences their mental health. Correlational studies are the primary research design used to investigate the associations between screentime and adolescent depression in current literature. The detection of positive associations in some studies (Boers et al., 2019; Nagata et al., 2022a; Twenge, Joiner, et al., 2018) is weakened by the findings of literature reviews that determine that the detected positive associations between increasing screentime and increasing prevalence and severity of adolescent depression have small effect sizes, and little accounting for relevant mediating factors of the association (Odgers & Jensen, 2020; Orben, 2020; Sanders et al., 2019). For example, according to Twenge and Campbell (2018), adolescents 14–17 years who spend greater than 7 hours daily exposed to screen devices are 2 times more likely to be diagnosed with depression compared to adolescents who are only exposed to 1 hour daily of screentime. However, the effect size is small (d = .23). According to Twenge and Joiner (2018), adolescents who use screen devices such as smartphones have a higher likelihood of experiencing high depressive symptoms, but the increases in depressive symptoms in females between 2010–2015 were of small effect (d = 0.27). Therefore, there is a need to build evidence for the

relationship and implications of screentime on adolescent depressive symptoms. The lack of definitive evidence in the literature complicates the translation of study results into clinical and public health guidance for adolescents, their parents, and health care providers.

Beyond weak detected associations, some studies detected no associations between screentime and adolescent depression. For example, according to Przybylski and Weinstein (2017), exposure to television, movies, videogames, computers, and smartphones for 2–5 hours daily is not intrinsically harmful to adolescent mental health. Additionally, Baiden et al. (2019) posited that excessive screentime was more likely among the 40.9% of adolescents who already felt depressed, compared to the 40.3% of adolescents who did not feel depressed. This underscores the need to investigate how much screentime is healthy for adolescent mental health and the influence of underlaying factors. For example, some adolescents use their screentime as a coping strategy to relieve depression or to gain more knowledge about their related symptoms (Pretorius et al., 2019).

The lack of a defined healthy duration of screentime has hampered the development of both global and national standardized health guidelines in the United States for screentime exposure in adolescents (Singh & Balhara, 2021). Therefore, through this study, I sought to build evidence on the nature of the relationship between screentime and adolescent depressive symptoms and associated mediating factors among AAA. The study findings may inform the development of public health screentime guidance for AAA to improve their mental health outcomes.

The Problem

In the United States, the prevalence of depression among adolescents has been increasing (Lu, 2019) and is purportedly linked to increasing screentime (Twenge, 2020b). It is not clear how screentime effects depressive symptoms in a nationally representative sample of AAA and which factors mediate the association in this population. During the COVID-19 pandemic, AAA consumed a daily average of 10.6 hours of screentime, compared to only 6.98 hours for White adolescents (Nagata et al., 2022a), and this may have put AAA at risk for worst outcomes for depression due to their poor mental health seeking for diagnosis and treatment of depression (Fan et al., 2022). As early as ages 9–10 years, African American youth reported 1.58 more hours of daily screentime than their White counterparts (Nagata et al., 2022b). Additionally, Black adolescents with 12-month major depression are less likely to receive treatment both in specialty mental health settings (65.2%) and in general medical settings (11.9%) compared to their White peers, at 80.4% and 21%, respectively (Lu, 2020). The disparity in AAA mental health seeking may indicate an underestimation of their burden of depression (Fan et al., 2022). As screened electronic devices become more ubiquitous, there is a need to examine whether there is a relationship between increasing screentime and depressive symptoms in AAA.

The problem is serious because the disparity in the prevalence of major depressive episodes among AAA (12.9%) compared to White adolescents (18.7%) in 2020 (National Institute of Mental Health, 2022) may be an underestimation due to low mental health-seeking behavior, thus potentially placing AAA at higher risk of worse outcomes.

Furthermore, although school is the context where 45.6% of AAA receive mental health care (Lu, 2020), pandemic-related school and church closures lowered their access to community-based mental health services needed for timely diagnosis and treatment (DeSouza et al., 2021; Marques de Miranda et al., 2020). Additionally, the temporary discontinuation of in-person mental health services and the lack of internet connection in some households to virtually resume services placed adolescents at risk of having mental health conditions remain untreated and of symptoms worsening while increasing the likelihood of emergency room visits (Listernick & Badawy, 2021). Therefore, the impact of screentime on depressive outcomes may be more consequential for AAA compared with their White counterparts.

The rapid evolution of technology requires ongoing research specifically to close the knowledge gap on the relationship between screentime and depressive symptoms and mediators of the relationship within a nationally representative sample of AAA. The closing of this gap through this study is pivotal to informing public health practice for the development of guidance and interventions needed to address AAA screentime behavior, and the increasing prevalence of depression in AAA.

The Purpose of the Study

The purpose of this quantitative, correlational study was to examine the relationship between screentime and depression in AAA in the United States and the mediators of that association, controlling for age and sex. The current literature is inconclusive about the impact of screentime on adolescent depression and does not

explore the influence of mediators such as sleep and physical activity on the association within a nationally representative population of AAA.

Research Questions and Hypotheses

The first research question was the following: What is the relationship between screentime and depressive symptoms in African American adolescents in the United States when controlling for age and sex? The null hypothesis was that there is no relationship between the number of hours of screentime and depressive symptoms in African American adolescents in the United States. The alternative hypothesis was that there is a relationship between the number of hours of screentime and depressive symptoms in African American adolescents in the United States.

The second research question was the following: What is the mediating impact of sleep duration on the relationship between screentime and depressive symptoms in African American adolescents in the United States when controlling for age and sex? The null hypothesis was that the relationship between the number of hours of screentime and depressive symptoms among African American adolescents in the United States is not mediated by the number of hours of sleep. The alternative hypothesis was that the relationship between the number of hours of screentime and depressive symptoms among African American adolescents in the United States is mediated by the number of hours of sleep.

The third research question was the following: What is the mediating impact of frequency of physical activity on the relationship between screentime and depressive

symptoms in African American adolescents in the United States when controlling for age and sex? The null hypothesis was the relationship between the number of hours of screentime and depressive symptoms among African American adolescents in the United States is not mediated by the frequency of physical activity. The alternative hypothesis was that the relationship between the number of hours of screentime and depressive symptoms among African American adolescents in the United States is mediated by the frequency of physical activity.

Conceptual Framework Overview

This study was grounded in the preposition that screentime can predict the presence of depressive symptoms among AAA, and that the relationship between these two variables can potentially be mediated by the number of hours of sleep and the frequency of weekly physical activity. The current study is within the context of growing concern about increasing adolescent exposure to electronic screen devices and smartphones, which have become more ubiquitous (Odgers & Jensen, 2020). Adolescents increasingly use screen devices to communicate with friends, learn something new, avoid interactions with people, and to pass time (Schaeffer, 2019; Smith et al., 2020). A positive association had been found between smartphone screentime and the fear of missing out, which drives heightened screentime (Song & Kim, 2022). The increasing integration of digital screen devices into the lives of adolescents as educational requirements, tools for communication, and mechanisms of accessing entertainment

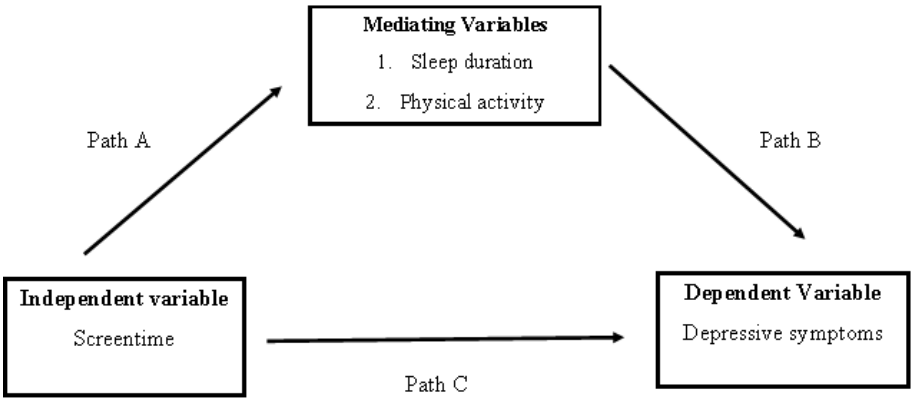
platforms (Odgers & Jensen, 2020) justifies the need for more investigation about its impact on depressive symptoms.

Some researchers have found positive associations between screentime and depression. However, deriving conclusive recommendations is a challenge because the causal relationship remains unclear for AAA. Furthermore, the impact of mediating variables on the relationship between screentime and depressive symptoms among AAA is understudied. Therefore, the research questions of this study built upon existing knowledge by seeking to investigate the relationship between the independent and dependent variables, and the mediators of that relationship, specifically for a nationally representative sample of AAA.

The conceptual framework in Figure 1 was constructed to depict the expected relationships between the independent, dependent, and mediating variables.

Figure 1

Conceptual Framework of Screentime Impact on Depressive Symptoms



Nature of the Study

A quantitative, correlational research design was selected to address the research questions in this study using binary logistic regression to examine the relationship between screentime and depressive symptoms in AAA, controlling for age and sex, and mediation analysis to examine the effects of sleep duration and the frequency of physical activity on the relationship. Binary logistic regression is appropriate for predicting the presence of the outcome variable based on the values of the predictor variable. Mediation analysis is appropriate for examining how the presence of third mediating variables impacts the relationship between the predictor and outcome variables.

For this study, the dependent variable, depressive symptoms, was a feeling of sadness or hopelessness consistently for 2 weeks or more over the past year. The independent variable, screentime, was the number of hours spent playing games, watching videos, texting, or using social media via a smartphone, computer, Xbox, PlayStation, iPad, or other tablet for recreational purposes on an average school day. The covariates were age, measured in years, and sex, defined as being male or female. The mediating variables were sleep duration measured by the number of hours of sleep an adolescent gets on an average school night, and physical activity measured as the number of days an adolescent was physically active for at least 1 hour during the past week.

Secondary data from the 2019 Youth Risk Behavior Survey collected by the Centers for Disease Control and Prevention (CDC) were used for this cross-sectional investigation, and the analyses were conducted using version 28 of the SPSS statistical software.

Literature Search Strategy

The Walden University Library, Google Scholar, Embase, ProQuest Central, PubMed, Science Direct, APA PsycInfo, and Taylor and Francis Online were used to source current literature for the investigation of the research problem. Peer-reviewed journals sourced articles using combinations of the key terms *adolescents*, *teenage*, *depression*, *depression risk factors*, *depression protective factors*, *mediators of depression*, *screentime and depression*, *excessive screen time*, *screen-based media*, *media use*, *technology and adolescent depression*, *sleep deprivation*, *sleep and depression*, *sedentary time*, *COVID-19 and adolescent depression*, *adolescents or teenagers or young adults*, *adolescent mental health*, and *depression in African American or Black adolescents*. Searches were limited to full-text peer-reviewed scholarly journals and articles written between the years 2017 and 2022. Article alerts with these criteria were set up for the journals. The snowball method also sourced additional journal articles from the reference section of each article.

Expanded Conceptual Framework

The conceptual framework for this study indicated that increased exposure to screentime causes an increase in depressive symptoms among AAA, and that the relationship between these two variables is mediated by the number of hours of sleep and the frequency of weekly physical activity. This concept is linked to the phenomena of simultaneous increases in adolescent depressive symptoms and screentime after the introduction of the smartphone. The smartphone with internet access was released in

2007, and by the time it saturated the market in 2012, the prevalence of depressive symptoms among adolescents began to sharply increase (Twenge, 2020a, 2020b). For Black adolescents, depressive symptoms increased from 14% in 2012 to 19% in 2015 (Twenge, Joiner, et al., 2018).

As screentime increased, in 2018, 54% of American adolescents 13–17 years of age were concerned that they spent too much time on mobile phones and 52% attempted to reduce their use (Jiang, 2018). As adolescents age, they evaluate that they spend too much time exposed to screen devices (Smith et al., 2020). Despite this perception, adolescents spend on average 3.2 hours of their daily entertainment screen use on watching videos or television, with 24% using YouTube most frequently (Rideout et al., 2022). This high screentime behavior is believed to be the driver of adolescent depression.

Dr. Jean Twenge, an American psychologist, has conducted numerous studies on the linkage between screentime and mental health among adolescents. Her research findings indicate that higher screentime among adolescents makes them significantly more likely to experience higher symptoms of depression (Twenge, Joiner, et al., 2018). Further, screentime on electronic devices is associated with higher odds of a short duration of sleep (Hisler et al., 2020; Twenge et al., 2017), and portable screen devices are more strongly associated with sleep duration (Twenge, Hisler, et al., 2019). Additionally, more time spent using social media, the internet, text messaging, and gaming via screen devices among adolescents is associated with lower self-esteem, life satisfaction, and happiness (Twenge, Martin, et al., 2018). Adolescents ages 14–17 years

who consume 7 or more hours of screen activity daily are 2.39 times more likely to ever be diagnosed with depression (Twenge & Campbell, 2018).

Despite conflicting evidence about the relationship between adolescent screentime and depressive symptoms, in response to the sharply increasing prevalence of depression, especially among girls in the United States, "for which no one has found a plausible alternative explanation," Twenge and coauthors noted that "these associations should not be dismissed" (Twenge et al., 2020, p. 348).

Under this conceptual framework, screentime has been defined as the number of hours an adolescent spends watching television, videos, or playing video games on television and using a computer, cellphone, portable video game, and other electronic devices for recreational purposes on an average weekday (Twenge, Hisler, et al., 2019). The depressive symptoms definition includes life feeling meaningless, not enjoying life in comparison to others, the future seeming hopeless, feeling like one cannot do anything right, feeling like one's life is not useful, and feeling like it is not good to be alive (Twenge, Joiner, et al., 2018).

Previous studies have applied this conceptual framework to examine the impact of various types of screen devices on depressive symptoms among Japanese adolescents (Kidokoro et al., 2022), to examine the impact of screentime on various measures of psychological well-being beyond depressive symptoms among both American children and adolescents (Twenge & Campbell, 2018), and to explore the association between screentime and depressive symptoms among adolescents in the United Kingdom using time diaries (McAllister et al., 2021). However, the dearth of studies conducted within

nationally representative samples of AAA created an opportunity for the application of this conceptual framework to answer the research questions of this study. Therefore, the current study sought to build on the existing literature to better understand the relationship between screentime and depressive symptoms within the target population of AAA.

This conceptual framework is useful for understanding the current context of screentime among the current generation of adolescents who do not have experiences of life without exposure to technology and digital media (Anderson & Jiang, 2018). All types of screens, including televisions, tablets, smartphones, computers, and video game consoles, are increasingly becoming a pervasive part of the lives of American adolescents as they spend more time online (American College of Pediatricians, 2020; Odgers & Jensen, 2020). The framework is needed to answer the research questions on whether depressive symptoms in AAA are linked to screentime and understanding the role of sleep and frequency of physical activity in that association.

Literature Review

Prevalence of Depression in Adolescents

Depression is one of the global leading causes of disability among adolescents aged 10–19 years of age (WHO, 2021). The global prevalence of clinically elevated depressive symptoms is 25.2%, which represents 1 in 4 adolescents (Racine et al., 2021). In the United States, adolescent depressive symptoms have been quickly increasing in prevalence (Keyes et al., 2019), with sharp increases since the saturation of the market

with smartphones in 2012, compared to prior decades when depressive symptoms were decreasing or stable (Twenge, Joiner, et al., 2018).

The increased prevalence of depressive symptoms in American adolescents is not the only public health concern. Severe impairment related to depression also increased from 2.2.% to 4.1 % in boys and from 9.8% to 12% in girls between 2016 and 2019, respectively (Substance Abuse and Mental Health Services Administration [SAMHSA], 2019). Additionally, between 2010 and 2015, adolescent females in the United States accounted for 58% of the increase in depressive symptoms (Twenge, Joiner, et al., 2018). This disparity by sex indicated that sex is a variable that should be accounted for in the analysis of this study.

Depression is a common mental health condition that impacts 4.1 million American adolescents ages 12–17 years (17% of the national population), 18.7% of which are White, 15.7% of which are Hispanic, 13.9% of which are Asian, and 12.9% of which are Black or African American (National Institute of Mental Health, 2022). Although AAA account for the smallest proportion of depressed adolescents, depressive episodes are significantly increasing within this subpopulation. Between 2010 and 2016, the lifetime prevalence and past-year prevalence of major depressive episodes (MDE) in AAA were 12.57% and 8.08%, respectively (Zhang et al., 2021). According to SAMHSA, in 2016, the prevalence of depressive episodes among AAA was 9.1%, and by 2019, the prevalence increased to 11.4% (SAMHSA, 2019).

The burden of depression among AAA may be underestimated due to underreporting and low health care-seeking behavior. Between 2010 and 2016, only

29.17% of AAA received specialty mental health services (Zhang et al., 2021). Between 2011 and 2016, AAA were less likely to receive treatment (34.9%) compared to White peers (38.7%; Lu, 2019). This phenomenon mimicked the findings of racial disparities in mental health care in many studies (Alegria et al., 2010; Elster et al., 2003; Lu, 2017), and the sociocultural and mediating factors that contribute to this trend warrant further investigation (Keyes et al., 2019). AAA have poor mental-health-seeking behaviors due to the social norm of stigma about mental health conditions, distrust of the health system, lack of culturally diverse providers, poor therapeutic relationships, unsupportive attitudes toward mental health seeking, lack of insurance or underinsurance, belief that therapy is unnecessary, challenges with self-expression, and lack of knowledge about depression (Clement et al., 2015; Cook et al., 2017; Fan et al., 2022; Hannor-Walker et al., 2020; Lu, 2020). These factors may contribute to worse mental health outcomes for AAA.

Depression as a Public Health Issue for African American Adolescents

Among the African American population, in the absence of mental health seeking, alternative practices are adopted. The social norm of coping with depression includes cultural, spiritual, and creative practices such as prayer, dancing, listening to music, and poetry, as well as spending time with family, to cope with and conceal depression (Conner & Yeh, 2018; Hannor-Walker et al., 2020). This population highly values religion, which is associated with lowered utilization of mental health services because help-seeking behavior may be perceived as incongruent with sociocultural norms and

values (Lukachko et al., 2015). These factors impede public health interventions to prevent the onset of mental conditions such as depression among AAA.

Barriers to mental health seeking in this population threaten to worsen depressive outcomes. The barriers to care include the perceptions of parental caregivers that mental health issues are nonexistent or not serious, the assertion of primary providers that mental health challenges are only temporary phases that do not require additional support services, and cultural beliefs that African Americans are resilient to mental illness (Planey et al., 2019). Additionally, negative coping strategies include the use of illicit drugs, self-harm, harmful sexual activity, and isolation (Hannor-Walker et al., 2020). Compounding these barriers are the experiences of racial discrimination among African American and Afro-Caribbean adolescents, a cultural experience that is associated with both lifetime and 12-month major depression in this subpopulation (Pachter et al., 2018).

Characterization of Major Depressive Disorder

Depression, clinically known as major depressive disorder (MDD), is a mood disorder that is characterized in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) by feeling depressed and loss of interest within a 2-week period that is not attributable to any other medical condition or substance, as well as four or more symptoms such as difficulty sleeping or concentrating, feelings of fatigue or worthlessness, changes in weight, and thoughts of suicide (American Psychiatric Association, 2013). The variation in symptom presentation of depression among adolescents is a challenge, and MDD is often underdiagnosed and undertreated in

adolescents (Mullen, 2018). Younger adolescents aged 12 years may present with low self-esteem and feelings of hopelessness or guilt, while adolescents aged 13–18 years may present with increases in irritability, impulsivity, declining school performance, sleep disturbances, and suicidality (Mullen, 2018). The onset of depression is common during adolescence, and symptoms of MDD may be episodic with episodes within 2 weeks, or recurrent with episodes of symptoms separated by a minimum of 2 months (American Psychiatric Association, 2013). Symptoms of depression in adolescents may be overlooked due to irritability and mood instability that are common during this life phase (Petito et al., 2020).

The prevalence of major depressive episodes (MDEs) among adolescents ages 12–17 years is increasing in the United States. Adolescents aged 14–15 years are 1.71 times more likely and those aged 16–17 years are 1.99 times more likely to experience MDE (Lu, 2019). This underscores that age is an important variable to account for in the analysis. In 2019, the national Survey on Drug Use and Health revealed that 23% of adolescent females and 8.8% of adolescent males had an MDE (National Institutes of Health, 2021). This indicated that sex is also an important control variable. According to the 2020 iteration of the same survey, 17% or 4.1 million American adolescents ages 12–17 years experienced an MDE within the previous year, a sharp increase from 5.7% or 1.4 million in 2010 (SAMHSA, 2011, 2020). Data from the SAMHSA National Surveys on Drug Use and Health indicate an increase in MDE prevalence from 6.4% among non-Hispanic Black adolescents in 2010 compared to 11% in 2018. According to the 2020 National Survey of Children's Health, of the 4.1% of adolescents who had ever been

diagnosed with depression, 3.4% were currently depressed, 1.5% to a mild degree, 1.5% to a moderate degree, and 0.3% to a severe degree (U.S. Census Bureau, 2021).

Depression is especially a challenge among adolescent girls. Girls are more likely to report MDE and mental health decline compared to boys (Chen et al., 2021; Fan et al., 2022; Gul et al., 2021; Hawes et al., 2021; Liu et al., 2021; Magson et al., 2021; Marques de Miranda et al., 2020; Racine et al., 2021), and are also more likely to access services in a specialty mental health setting (Lu, 2020). The 52% increase in past-year MDE among girls aged 12–17 years (from 8.7% in 2005 to 13.2% in 2017; Twenge, Cooper, et al., 2019) and the 25.2% prevalence of MDE among adolescent girls, compared to 9.2% in boys in 2020 (National Institute of Mental Health, 2022), indicate that sex is also a covariate to account for in the analysis.

Increasingly, adolescents who experience depression are not receiving treatment (Lu, 2019). In 2020, 58.4% of adolescents in the United States living with MDE, and 51.3% of the adolescents with severe impairments related to MDE did not receive treatment within the previous year (National Institute of Mental Health, 2022). Furthermore, the onset of depression in adolescence increases the likelihood of experiencing MDD twofold and suicide attempts fivefold in adulthood (Weissman et al., 1999). Therefore, depression is a serious public health concern for this population.

The impact of screentime on adolescent depression can have serious implications for societal costs, including the costs of receiving health care, the costs of receiving services from a mental health professional, medical exams, and medications. The non-health-related costs of adolescent depression include loss of productivity and school

absenteeism (Bodden et al., 2018). Therefore, depression in this population is a priority public health issue.

In the current literature, studies have applied numerous scales to measure depression such as the Center for Epidemiologic Studies Depression Scale, which measures the frequency of symptoms such as trouble concentrating and crying spells (Przepiorka & Blachnio, 2020). The National Comorbidity Survey for Adolescents has also been applied which measures lifetime MDE as having a depressed mood or loss of interest in daily activities for 2 or more weeks at any time while simultaneously having four or more symptoms that indicate functional changes (Lu, 2019). Other studies have measured depressive symptoms by asking about the perceptions of life seeming meaningless, and the future seeming hopeless. Questions have also been asked about whether a person felt it was good to be alive, and whether their lives were as enjoyable as other people's lives (Keyes et al., 2019). Other studies still have used structured interviews for 12-month MDE based on the DSM-4 (Lu, 2020), the Reynolds Adolescent Depression Scale, the Kesler Psychological Distress Scale, and the Children's Depression Inventory (Hawes et al., 2021). This approach of using scales and interviews based on established definitions of the DSM allows for objective measures of the construct of depression. However, the inconsistent use of scales across studies represents a weakness in the literature approach.

Researchers have approached the analysis of depression by using correlational designs such as Pearson's chi-square test to identify bivariate associations and logistic regression to assess predictors of MDE and the prevalence of MDE (Hertz et al., 2022;

Lu, 2019; Zhang et al., 2021). These methodologies are consistent with the scope of this study to answer the research questions for the population of AAA.

Adolescent Depression During the COVID-19 Pandemic

The doubling of the global pooled estimates of depressive symptoms to 25.2% among adolescents at the start of the COVID-19 pandemic in 2020 compared to prepandemic estimates suggests that 1 in 4 adolescents are experiencing such symptoms (Racine et al., 2021). However, according to a Norwegian prospective longitudinal study, having a history of prior mental health illness was a predictor of adolescent mental health challenges during the pandemic (Hafstad et al., 2021). Additionally, pre-existing internalizing problems increase the risk of depression (Hafstad et al., 2021; Kiss et al., 2022). The acute increase in depressive symptoms during the pandemic indicated the importance of accounting for the influence of exposure to pre-existing and external factors on cross-sectional measurements of depressive symptoms.

During the pandemic in the United States, despite decreases in screening for depressive symptoms among adolescents in primary care settings, the increase in the positivity rate for depressive symptoms was a challenge (Mayne et al., 2021). According to a study conducted within the Children's Hospital of Philadelphia's primary care network, there was a slight decrease in preventive visits for AAA (from 23.4% in 2019 to 21.6% in 2020; Mayne et al., 2021). However, the national trend of a 31% increase in mental health-related emergency department visits among 12- to -17-year-old adolescents in 2020, compared to 2019, is concerning (Leeb et al., 2020). These results are likely due

to the closure of outpatient mental health services during the pandemic. Closures may have also contributed to missed opportunities to identify and treat AAA with mild or moderate symptoms of depression that did not present to emergency health services.

As technology continues to evolve, the ubiquity of electronic devices and screentime is expected to continue increasing. According to the 2018 Pew Research survey, 95% of adolescents in the United States have access to a smartphone or computer, 88% have access to a laptop or desktop computer at home, 89% own a smartphone, and 45% are nearly constantly online (Anderson & Jiang, 2018; Rideout & Robb, 2018). As a result, daily total screentime among 13- to 18-year-old American adolescents increased from 6.4 hours in 2015, to 7.2 hours in 2019, to 8.4 hours in 2021 (Rideout et al., 2022). The rate of these increases during the pandemic was faster compared to the previous 4 years.

Adolescents are using online communication to support functions that they traditionally performed offline, such as building friendships and intimacy and showing affection. The prevalence of smartphone ownership among African American and White American adolescents is the same, 94%, and desktop or laptop computer ownership was similar for both racial groups, 89%, and 90%, respectively (Anderson & Jiang, 2018). Furthermore, AAA aged 10–14 years engage in an average of 7.7 hours of screentime daily (Nagata et al., 2022a). Among Black adolescents 13–18 years of age, daily screentime is 9.5 hours, compared to White counterparts with 7.5 hours daily (Rideout et al., 2022). Furthermore, compared to the 91% of White counterparts with access to home computers, 81% of Black adolescents ages 8–18 years had access to laptops or desktops

at home in 2021 (Rideout et al., 2022). AAA have significantly higher screentime, despite slightly lower access to computers, compared to their White counterparts. Therefore, it is important to clarify how screentime impacts depressive outcomes in a nationally representative sample of AAA, when controlling for age and sex (Baiden et al., 2019; Li et al., 2019; Lu, 2019; Magson et al., 2021; Zhu et al., 2019).

Adolescent Use of Screens and Recommendations for Screentime

Screentime is defined as the duration of recreational time spent watching television, playing video games, using the internet, using a smartphone, and engaging on social media (Marciano & Camerini, 2021). Passive screentime is defined as the number of hours on average spent consuming videos on electronic mobile devices, consuming news and websites, scrolling on social media, and watching television or movies (Rosen et al., 2021). A review of current literature revealed that screentime is primarily measured in the number of hours of use of electronic devices (J. Liu et al., 2022). However, there is a lack of consensus on what constitutes too much screentime, though 3 hours or more is the defined threshold of excess (Kann et al., 2014).

The use of online media is also known as internet use and smartphone use, which encompasses a vast number of activities, including browsing the internet, checking emails, using social media, and engaging in online gaming, whether for entertainment or communicating (Shin et al., 2022). For online media use and screentime, the recommended number of hours for adolescents on a daily or weekly basis is unclear. Globally, there are no standardized defined times for maximal daily exposure to screen

devices for adolescents set by the WHO (Singh & Balhara, 2021). The American College of Pediatricians (2020) recommends that screen devices remain out of the bedroom and that alternate forms of entertainment are pursued but offers no clarity for adolescent screentime recommendations. Nationally, the United States does not have clear guidance for adolescent screentime due to inconclusive or weak study results in the literature (Singh & Balhara, 2021). However, the Canadian and Australian governments recommend no more than 2 hours of daily exposure to screen devices for adolescents, and the British government recommends that adolescents minimize the time they spend engaging in sedentary behaviors such as screen use (Tremblay et al., 2016; Davies et al., 2019).

During the COVID-19 pandemic, the guidance from the American Academy of Child and Adolescent Psychiatry on the use of screen devices during the quarantine period was for adolescents to have structured daily routines that limited their screen entertainment (American Academy of Child and Adolescent Psychiatry, 2020). Despite guidance for limiting screentime, exposure to screen media for entertainment purposes in 13-to-18-year-old adolescents has increased to 41% in 2021, compared to 29% in 2019 (Rideout et al., 2022). Besides virtual learning, internet-based technology is prevalent in use for the maintenance of social connections among peers, gaming, and streaming services. The COVID-19 pandemic, however, built on the previous trend whereby since 2010, adolescents have spent more time on new media screen activities and less time on activities that do not involve screen devices (Twenge, Joiner, et al., 2018). The proliferation of smartphones by 2012, combined with the increased ownership of

smartphones at 73% in 2015, compared to37% in 2012, contributed to the increase in the amount of time spent using electronic forms of communication for social interaction among adolescents (Pew Research Center, 2017; Twenge, Martin, et al., 2018; Twenge, Joiner, et al., 2018). This phenomenon is demonstrated by the average adolescent using their smartphone for text messaging, going online, and using social media for 6 hours daily (Twenge et al., 2019).

Screentime Among African American Adolescents

Among American adolescents, 46.1% play video or computer games, use electronic screen devices to send text messages, or use social media on their smartphones for reasons not related to school for or more hours every day (CDC, 2019b). Black or AAA teens constitute 47.8% of highly exposed teens. Furthermore, 19.8% of adolescents watch television for 3 or more hours daily. Black or African American teens constitute 31.6% of this rate (CDC, 2019b). Adolescents' access to internet-enabled devices is increasing, and in the current era of evolving technology, digital platforms, and interactive software, media engagement behaviors are quickly changing. Research has sought to improve the understanding of the impact of screen devices on mental health. Investigating the impact on AAA is important considering Twenge et al. (2018) found that adolescents who spend more time using screen devices and electronically communicating are less happy and satisfied with their lives, and have lower self-esteem.

A systematic review of 70 previous studies revealed that the construct of screentime has primarily been measured using parental reports, and self-reports from

adolescents on the amount of time they engage in sedentary and screen-based activities (Zink et al., 2020). The weakness of this approach is that it is subjected to recall bias of the participants or their parents. Additionally, although there were common conceptualizations of screentime, including watching television, using a computer, or playing video games, the definitions were not standardized across studies (Zink et al., 2020). The inconsistent measures of the construct indicated that the findings of individual studies were only applicable to the operational definitions that were provided. For this study, the use of cross-sectional survey data required the self-reporting of screentime, which is supported by the literature, although it is not the most objective approach. The operational definition of screentime for this study defined the scope of the interpretation of the findings.

Conflicting Evidence

Some studies demonstrated linkages between the proliferation of smartphones and declining mental health in adolescents (Keyes et al., 2019; Twenge, Joiner, et al., 2018). According to Kiss et al. (2022), the amount of time spent watching music videos, text messaging on a cellular phone, tablet, or computer, and using multiplayer video games are predictors of increased depression (Kiss et al., 2022). Furthermore, according to Twenge, Joiner et al. (2018), spending more time on screen devices significantly increases the likelihood of depressive symptoms among adolescents in the eighth through 12^{th} grades. Although the result of the study raised concerns about screentime and its linkage to the growing prevalence of depression since 2010, the effect size of the

association was relatively small. Additionally, there was no accounting for mediating factors, particularly among AAA.

Not all studies, however, provided supporting evidence for the relationship between screentime and depression in adolescents. Among Japanese adolescents, the number of hours spent using mobile phones to search the internet, and play games and videos were not associated with depression (Tamura et al., 2017). Although excessive internet use, defined as the use of the internet for more than 4 hours per day, was associated with poor quality of sleep, it was not found to be associated with high levels of depression among Vietnamese adolescents (Nguyen et al., 2021). Moreover, according to Baiden et al. (2019), as adolescents age, they are less likely to indulge in excessive screentime, but are more likely to indulge if they are depressed. Exposure to television reports and social media posts about the pandemic also did not significantly impact depressive symptoms in adolescents (Magson et al., 2021). The mixed findings in the literature justify further investigation of screentime and its mental health impact among the target population of this study.

Potential Benefits of Screentime

As portable electronic devices continue to evolve, and adolescent online interactions continue to increase, there is a need to continually investigate whether screen exposure harms adolescent mental health. Given that 11.26% of adolescents in a nationally representative sample were online consistently (Rutter et al., 2021), a constant connection may have serious implications for their mental well-being. The inconclusive

findings in the literature call for the generation of evidence to inform the development of guidance for screentime, especially among AAA. AAA have higher exposure to screentime, and lower accessibility to mental health services to identify and treat depressive symptoms. Screentime may be highly beneficial to the mental health outcomes of this population.

The current technological era also calls for the investigation of whether screentime is protective against adolescent depressive symptoms. Notably, screen devices can be used to help adolescents to cope with distress, boredom, and isolation, while social media and online games can facilitate social connectivity and self-expression (Neset al., 2021). Screentime may also be beneficial for creating, building, and maintaining friendships, and improving social connectedness, particularly for adolescents who are not well socially supported, or may have trouble with in-person socializing (Canadian Paediatric Society, 2019).

Screen devices have also become a part of the treatment regimen for depression, especially among the African American population. Faith-based webinars and presentations on mental health matters were used to deliver interventions by phone and computer during the COVID-19 pandemic (DeSouza et al., 2021). Therefore, in the absence of in-person mental health services, screen devices may continue to be useful for treating depression and encouraging medication adherence through apps and text messages. The forwarding of reminders to adolescents can help them to avoid the worsening of a mental health condition. Telehealth is an effective mechanism for treating mental health conditions and is expected to continue playing a pivotal role in the delivery

of mental health services, both during and beyond the COVID-19 pandemic (Listernick & Badawy, 2021).

Sleep in Adolescents

Sleep deprivation is an issue that is common among adolescents and is characterized by having less than 6 hours of sleep every night (Roberts & Duong, 2014). Technology use is one of the risk factors for inadequate sleep among adolescents (Fernandez, 2019; Gaarde et al., 2020). Furthermore, adolescents who spend more time exposed to screen devices such as televisions, video game consoles, and portable electronics are more likely to have fewer hours of sleep (Twenge, Hisler, et al., 2019). Screen devices entered the bedrooms of adolescents for online engagements because technology has become a pivotal part of their daily functioning (Fry, 2021). However, sleeping with portable screen devices, having multiple electronics in the bedroom, and having screen devices on before bed were noted as poor sleep hygiene practices that shorten sleep duration among adolescents (Baiden et al., 2019; Kansagra, 2020).

In a study where African American or Black adolescents constituted 47.4% of the sample, screentime used for social messaging, web surfing, watching television or movies, and playing games. The results revealed that screentime was positively associated with experiencing problems falling and staying asleep and was negatively associated with having shorter sleep duration during the week. Furthermore, the three types of sleep problems mediated the association between the four types of screen

activities and depressive symptoms (Li et al., 2019). These results, however, have not been replicated in a nationally representative sample of AAA.

The decline in sleep duration starting in 2012, has paralleled the period of the increasing prevalence of smartphones (Twenge et al., 2017). Experiences of difficulty in sleep onset have been attributed to frequent use of mobile phones, video games, social networking, and music listening before bed (Arora et al., 2014). Moreover, the portable nature of smartphones and handheld electronic devices makes the duration of their use, particularly for social media, longer (Fernandez, 2019). The reduced number of hours of sleep due to screentime is mainly driven by portable screen devices such as cellphones, tablets, and handheld gaming devices, and not stationary devices like televisions and gaming consoles (Twenge, Hisler, et al., 2019). At least one nocturnal awakening every month due to mobile phones was found to make adolescents 3.51 times more likely to have issues falling asleep within one year (Foerster et al., 2019).

Adolescents may get fewer hours of sleep because they use screen devices due to boredom, or to occupy their leisure time as a mindless activity (Mazzer et al., 2018). Such practices lower sleep duration and increase the frequency of insufficient sleep because adolescents voluntarily go to bed later than they would like to, and find it difficult to quit distracting activities on screen devices (Kadzikowska-Wrzosek, 2020). However, it is important to note that some teens use their mobile phones as a sleep aid to play relaxing music, listen to audiobooks, make phone calls, and view media, and social media content that helps them obtain a state of calm before sleep (Hedin et al., 2020). Therefore, it is important to consider how the duration of sleep because of exposure to

screen devices mediates the relationship between screentime and depressive symptoms in a nationally representative sample of AAA.

One multicounty meta-analysis found that studies in the United States primarily used self-reports from adolescents and parental reports to measure sleep duration. Additionally, instruments such as the School Sleep Habits Survey, the American College Health Association's National College Health Assessment II, the Insomnia Severity Index, the Pittsburgh Sleep Quality Index, and the DSM-IV criteria for insomnia were used in American studies (O'Callaghan et al., 2021). However, few studies applied the use of polysomnography or actigraphy to objectively measure sleep duration and other related variables (Hamann et al., 2019). Polysomnography is the gold standard for objectively measuring sleep duration (Jamieson et al., 2020; Scott et al., 2019) and improves the reliability and validity of measures for sleep duration (Glozier et al., 2014). The use of self-reported data to measure sleep duration is a weak methodological approach (Paruthi et al., 2016) that can introduce reporting biases (Seo et al., 2017). One study, however, asserted that self-reports of sleep duration are consistent with polysomnographic measures (Vazsonyi et al., 2021). Another weakness in the literature is the inconsistency in reporting sleep duration defined by either the number of hours of sleep within 24 hours or the number of hours of sleep overnight (Paruthi et al., 2016). For this study, the operational definition of sleep duration guided the development of subsequent recommendations.

Most studies in the literature utilized cross-sectional data and correlational analyses to investigate the variable of sleep duration among adolescents. The use of

secondary data, as with this study, limits objective measurements for sleep duration and subsequent analysis to correlational designs. However, the methodological approach for this study to investigate the mediating impact of sleep is well grounded in the literature.

Recommendations for Adolescent Sleep

The American Academy of Pediatricians recommended that adolescents aged 13-18 years sleep for 8 to 10 hours every 24 hours (Paruthi et al., 2016). The American Academy of Pediatrics shared this recommendation. The National Sleep Foundation recommended that adolescents aged 14-17 years get 8-10 hours of sleep, while acknowledging that 7-11 hours may also be appropriate (Schrack & Seidenberg, 2021). In the United States, 77.9% of adolescents did not get at least 8 hours of sleep on an average school night and Black or African American teens constituted 80.5% of sleep-deprived adolescents (CDC, 2019b).

The use of screen devices can disrupt or replace the recommended hours of sleep within this population. Additionally, the presence and use of more than one electronic like televisions, music devices, video games, computers, mobile phones, and tablets in the bedroom constitute poor sleep hygiene that disrupts and shortens sleep. However, not all devices have the same impact. Computers, for example, are more interactive than televisions, and have more disruptive impacts on sleep. Moreover, the portable nature of smartphones and handheld devices makes the duration of their use longer, particularly for social media.

During adolescence, hormonal changes and changes in chronotype toward evening or later bedtimes, have been found to contribute to inadequate sleep (Chaput et al., 2018). Additionally, bright screens emitting blue lights known as electromagnetic radiation have been found to increase alertness and suppress melatonin, which can disturb the circadian rhythm of sleep (Fernandez, 2019; Singh & Balhara, 2021). Recreational computer use and the use of screen devices beyond bedtime are not uncommon among adolescents. However, adolescents who only get 6 - 6.5 hours of sleep are most likely to use screen devices after going to bed (Widome et al., 2019).

In one study, the average bedtime of AAA aged 13-18 years on weekdays was found to be 10:41 pm, which was 5 minutes later than their White peers. Additionally, the average sleep duration for AAA was 7.35 hours, which was 9 minutes less than their Whites peers (Zhang et al., 2017). Inadequate sleep was characterized by feeling unhappy and hopeless about the future, or sad (Berger et al., 2019). Therefore, poor adherence to the recommended number of hours of sleep due to the use of screen devices may increase the risk of depression among AAA.

Physical Activity in Adolescents

The WHO defines physical activity as any skeletal muscular activity that produces bodily movement that requires energy expenditure and can be conducted with moderate and vigorous intensity for leisure, transportation, and work purposes (WHO, 2020). More than half (55.9%) of American adolescents are not engaging in physical activity for at least 60 minutes daily on 5 or more days (CDC, 2019b). Black or African

American teens constitute 62.8% of physically inactive adolescents. The use of screen technology has an impact on adolescent physical activity because frequent use of television, video games, and cellular phones for text messaging, video, or audio calling is associated with less time spent engaging in exercise (Fomby et al., 2021). However, some screen activities like exergaming promote physical activity in adolescents (Lanningham-Foster et al., 2009).

School settings provide structure and routine for adolescents' daily activities, and encourage participation in physical activity (Rosen et al., 2021). The closure of schools during the pandemic represented the removal of a protective factor that adversely impacted the engagement of adolescents in physical activity. This is consequential because physical activity is a protective factor against depression (Chen et al., 2021).

In the United States, the prevalence of physical inactivity among adolescents remained relatively stable at 77% in 2001 and 72% in 2016 despite the introduction and proliferation of smartphones in 2007 and 2012 (Guthold et al., 2020). This phenomenon suggests that the current technological era and the increased access to smartphones may not be driving physical inactivity, but merely replacing previous sedentary behaviors such as reading books, magazines, and newspapers (van Sluijs et al., 2021). Therefore, it is important to investigate whether physical activity has a mediating impact on the relationship between time and depression in AAA.

Studies in the current literature have measured the frequency and intensity of physical activity using self-reports via questionnaires that inquire about the number of days of physical activity for at least 60 minutes within the past week or within a typical

week (Velazquez et al., 2022). Some studies also measured physical activity during free time, physical education class, lunchtime, after school, and on weekends (Shen et al., 2022). One study used time diaries to record adolescents' engagement in unstructured play, and leisure and organized sports as measures of physical activity (Fomby et al., 2021), which is more reliable than recall questions that were used in another study (Brown et al., 2021). A more robust measure of physical activity was employed in a study by Kadola et al. (2020) that used accelerometers to collect data. The use of secondary data collected via questionnaire for my study limited the measure of physical activity to the recollection of adolescents. Nevertheless, this methodology is grounded in the research literature.

Recommendations for Adolescent Physical Activity

Adolescents up to age 17 years should engage in 60 minutes or more of moderately or vigorously intense physical activity daily (CDC, 2022). Adolescents who regularly engage in physical activity are more likely to be male, White, and participate in sports (He et al., 2018).

Assumptions

The purpose of this quantitative study was to predict and explain the relationship between screentime and depressive symptoms in AAA, and the mediating role of sleep duration and frequency of physical activity. Therefore, the quantitative approach of the study applied a methodological assumption that entails the use of objective measurements

and statistical analysis for the generation of knowledge. This assumption was important to establish objectivity because the study applied a deductive process in the development of the conceptual framework and hypotheses, the statistical testing of the hypotheses, and the generation of evidence within the framework. The rhetorical assumption of the study was that formal language was used in the research paper, and the research was grounded in objective definitions of the variables. This assumption was important because the results of statistical tests were structured and reported in American Psychological Association (APA) style. The reporting language was assumed to be empirical.

Scope and Delimitations

This study only focused on the effect of screentime, which was playing games, watching videos, texting, or using social media via a smartphone, computer, Xbox, PlayStation, iPad, or other tablet devices for recreational purposes on a school day, on depressive symptoms, which was feeling sad or hopeless every day for 2 weeks or more over the past year in AAA in the United States in 2019. The study focused on these variables to fill the gap in the literature by examining the relationship between screentime and depressive symptoms, the possible mediating effects of the number of hours of sleep on a school night, and the frequency of physical activity within the past week, controlling for age and sex.

The onset of depressive symptoms in adolescents can be due to numerous other biological factors like having a family history of depression or chronic illness, psychological factors like experiencing stress related to school and low self-esteem, and

environmental factors like exposure to natural disasters and loss of loved ones (Selph & McDonagh, 2019). Such factors have not been measured in the selected dataset of this study, and could not be controlled for potential confounding effects on the study outcomes. However, the random selection and consideration of covariates in this study aimed to strengthen internal validity. The scope of the study was limited to investigating whether screentime impacted depressive symptoms in AAA.

Plausible theories that were not investigated in this study are that depressive symptoms are not only impacted by the number of hours of exposure to electronic screen devices, but also the content and context of the exposure in adolescents (Coyne et al., 2020; Zink et al., 2020). However, the examination of the effect of the content and context of screentime on depressive symptoms in AAA was beyond the scope of this study because the screentime data were not collected to explore these theories.

This study also did not explore the theory of smartphone or internet addiction as an explanation for depressive symptom outcomes. Cellphone use is problematic when it hinders other important work or consumes too much time (Coyne et al., 2019). Additionally, it is problematic when a person has a strong drive and an impaired ability to control the use of smartphones, when a person gives higher priority to the smartphone over other activities, and when smartphone use continues despite experiencing adverse impacts (Yang et al., 2020). According to a multi-country systematic review study by Yang et al. (2020), problematic smartphone use is significantly associated with an increased risk of depression. However, this theory is beyond the scope of my study.

The restricting of this study to AAA and the defined constructs reduced possible external validity as the results can only be generalized to the AAA population in the United States.

Limitations

The first limitation of this study is that the survey data on screentime were not collected to disaggregate exposures by types of electronic screen devices, the content of exposure, or the context of exposures. Therefore, the interpretation of the analyses was limited to the aggregate measure of screentime in the number of hours. Moreover, the development of public health screentime guidance for content exposure, stratified by the type of electronic device, cannot be derived from this study.

The second study limitation is that the mediation analysis did not account for the potential impact of loneliness as a confounder on both the independent and dependent variables. Experiences of loneliness were found to be heightened during the adolescent phase of life, and a reciprocal relationship between screen use and loneliness during adolescence has also been found (Lawrence et al., 2022). Additionally, a meta-analysis study found that loneliness significantly affects moderate depression (Erzen & Çikrikci, 2018). My study, however, did not account for loneliness because the construct was not collected in the selected dataset.

The third limitation is that data for the constructs were collected using a questionnaire tool whereby responses were based on recall. This methodology made th responses susceptible to recall bias. However, this threat was minimized through the

careful designing of the questionnaire instrument with clear definitions of the constructs that were studied.

Significance

This study closes the literature gap by investigating the relationship between screentime and depressive symptoms in AAA, and the mediating effects of the number of hours of sleep on a school night, and the frequency of physical activity on the relationship, controlling for age and sex. The results are useful for informing recommendations for adolescent screentime behaviors, parental monitoring of screentime and symptoms of depression, and screening by health providers for adolescent depression. The results of this study also clarify mixed findings and implications of simultaneously increasing screentime and depressive symptoms in AAA. Evidence on the mediating impacts of sleep duration and the frequency of physical activity can inform the development of public health policies, communications, and interventions as potential treatments for depressive symptoms among AAA. As the technological culture among adolescents continues to increase, this study can inform strategies for the healthy engagement of AAA in screentime that facilitates their education and socialization without increasing their risk of depression.

Summary and Conclusion of Literature Review Section

The literature review revealed that the prevalence of depression in adolescents has simultaneously increased with the growing prevalence of electronic screen devices. Mixed results about the relationship between screentime and depressive symptoms

among adolescents have been found. The impact of screentime and the potential mediators of the relationship with depressive symptoms in AAA is unclear.

The high levels of screentime among AAA, combined with their poor mental health seeking, may increase their risk for adverse mental health outcomes. To build evidence for lowering the risk of depression among AAA, this study defines the nature of the relationship between screentime and depression among AAA, and the impacts of potential mediators when controlling for age and sex. These findings can clarify and extend the public health knowledge and guidance on the recommended exposure to screentime for AAA. The study can also inform clinical and public health practices for depressive symptom screening and monitoring by healthcare providers and parents,..

The following section details the research design for the investigation of the three research questions of this study.

Section 2: Research Design and Data Collection

Introduction

The purpose of this study was to examine the relationship between screentime and depression in AAA in the United States, and the potential mediating impact of sleep duration and frequency of physical activity on that association. This section defines the research questions, research approach, research design, study population, and approach for data analysis using vrsion 28 of the SPSS statistical package.

Research Questions

The first research question was the following: What is the relationship between screentime and depressive symptoms in African American adolescents in the United States when controlling for age and sex? The null hypothesis was that there is no relationship between the number of hours of screentime and depressive symptoms in African American adolescents in the United States. The alternative hypothesis was that there is a relationship between the number of hours of screentime and depressive symptoms in African American adolescents in the United States.

The second research question was the following: What is the mediating impact of sleep duration on the relationship between screentime and depressive symptoms in African American adolescents in the United States when controlling for age and sex? The null hypothesis was that the relationship between the number of hours of screentime and depressive symptoms among African American adolescents in the United States is not mediated by the number of hours of sleep. The alternative hypothesis was that the

relationship between the number of hours of screentime and depressive symptoms among African American adolescents in the United States is mediated by the number of hours of sleep.

The third research question was the following: What is the mediating impact of frequency of physical activity on the relationship between screentime and depressive symptoms in African American adolescents in the United States when controlling for age and sex? The null hypothesis was that the relationship between the number of hours of screentime and depressive symptoms among African American adolescents in the United States is not mediated by the frequency of physical activity. The alternative hypothesis was that the relationship between the number of hours of screentime and depressive symptoms among African American adolescents in the United States is mediated by the frequency of physical activity.

Research Approach

A quantitative approach was undertaken to answer the three research questions of this study. The 2019 National Youth Risk Behavior Survey (YRBS) cross-sectional dataset from the CDC's Division of Adolescent and School Health was used to conduct the analysis. The CDC YRBS is a nationally representative school-based survey administered to American youth in ninth through 12^{th} grades that is used to monitor the prevalence of health behaviors that contribute to morbidity, mortality, and other social issues.

Research Design

A cross-sectional correlational, quantitative design was applied to this study to test whether screentime has an effect on depressive symptoms in AAA. The design is useful in determining whether there is a relationship between screentime, the independent variable, and depressive symptoms in AAA, the dependent variable, and to identify the extent to which sleep duration and frequency of physical activity, the mediating variables, explain the nature of the relationship.

Applying the mediation analysis to the research design added to the robustness of the investigation of screentime and depressive symptoms in AAA. This approach is needed to advance knowledge on potential external influences on depressive symptom outcomes among AAA, within the context of increasingly prolific electronic devices and technological advances.

Study Population

The study population was all AAA ages 12–18 years in the United States who participated in the 2019 YRBS. Race was determined based on respondents' identification as "Black or African American." A three-stage cluster sample design was used to draw a nationally representative sample of American students in the ninth through 10^{th} grades in public and private schools across 50 states and the District of Columbia. The total sample size of AAA respondents was 2,040, 49.66% of whom were male and 50.34% of whom were female (CDC, 2021).

Sampling Procedures

The national YRBS employed a three-stage cluster sample design to draw a nationally representative sample of American students in Grades 9–12 in both public and private schools in the 50 states and the District of Columbia. The first stage of sampling was of large counties, the second was of schools, and the third involved the random selection of classes in each of the grades at each school. Entire classes were included in the sampling frame, as all students in the selected classes were eligible to participate. Parental consent documents were issued before the fielding of the survey in schools. Trained data collectors or schoolteachers administered the questionnaires to students. Data collection was anonymous and voluntary, and used computer-scannable answer sheets. Makeup data collection opportunities were extended to students who were absent on the days of initial data collection. Raw datasets were sent to the CDC for cleaning and processing. For this study, the inclusion criterion was respondents who identify as Black or AAA.

The minimum sample size ($N = 208$) was calculated using G*Power, a power analysis program that was designed for multiple types of statistical tests (Faul et al., 2009). The calculation used the odds ratio as a measure of effect size ($OR = 1.5$) indicating the odds that a relationship does exist between the independent and dependent variable, alpha level ($\alpha = .05$) representing only a 5% chance of rejecting the null hypothesis if it is true, and power level ($1 - \beta = .8$) representing 80% odds that the statistical test correctly rejects the null hypothesis.

Data Quality

The dataset is available for public use and is accessible through the CDC's website (https://www.cdc.gov/healthyyouth/data/yrbs/data.htm). The data were processed by the CDC with the technical assistance of a contractor for scanning and generation of the raw dataset. The CDC then collected the raw dataset for cleaning and processing to address outlier responses, logical inconsistencies, and missing data for quality control. The edited data were reshared with the contractor for weighting by the statisticians. These steps demonstrate that the data processing procedure was conducted to ensure quality control.

The selected dataset was the best source for this study because it appropriately measured the variables needed to address the research questions through statistical analyses.

Data Analysis

Although the dataset had already been cleaned by the CDC, a revision was conducted to ensure that the measures for the variables of interest were correctly formatted. Descriptive statistics were run to examine the frequencies and identify missing values. Detected missing values were replaced using the series means and mode. The minimum and maximum values were examined to determine that no out-of-range values were present.

Measures

The independent variable, screentime, was operationally defined as the number of hours adolescents played video or computer games or used a computer for something that was not schoolwork on an average school day. It was measured by using the question "On an average school day, how many hours do you play video or computer games or use a computer for something that is not school work?" The question was inclusive of time spent playing games, watching videos, texting, or using social media via a smartphone, computer, Xbox, PlayStation, iPad, or other tablet. The response options were coded as 1 = *no screentime*, 2 = *less than 1 hour per day*, 3 = *1 hour per day*, 4 = *2 hours per day*, 5 = *3 hours per day*, 6 = *4 hours per day*, or 7 = *5 or more hours per day*.

The dependent variable, depressive symptoms, was operationally defined as feeling sad or hopeless almost daily for 2 or more successive weeks that interrupted usual activities within the past year. It was measured using the question "During the past 12 months, did you ever feel so sad or hopeless almost every day for 2 weeks or more in a row that you stopped doing some usual activities?" This question captured depressive symptoms that were consistent with the diagnostic criteria of the DSM-5. The response options were coded as 1 = *yes* or 2 = *no*.

The first mediating variable, sleep duration, was operationally defined as the number of hours of sleep that an adolescent got on an average school night. It was measured using the question "On an average school night, how many hours of sleep do you get?" Responses were coded as 1 = *4 or less hours*, 2 = *5 hours*, 3 = *6 hours*, 4 = *7 hours*, 5 = *8 hours*, 6 = *9 hours*, and 7 = *10 or more hours*. The second mediating

variable, frequency of physical activity, was operationally defined as the number of days of being physically active for at least 60 minutes daily over the past week. It was measured using the question "During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?" and included physical activities that increased heart rate and made them breathe hard some of the time. The responses were coded as 1 = *0 days*, 2 = *1 day*, 3 = *2 days*, 4 = *3 days*, 5 = *4 days*, 6 = *5 days*, 7 = *6 days*, and 8 = *7 days*.

The covariate sex was operationally defined as the distinction between being female and male and was coded as 1 = *female* or 2 = *male*. The covariate age was operationally defined as the age of the adolescent measured in years and was coded as 1 = *12 years older or younger*, 2 = *13 years old*, 3 = *14 years old*, 4 = *15 years old*, 5 = *16 years old*, 6 = *17 years old*, or 7 = *18 years old or older*.

Statistical Analysis

The dataset was analyzed using version 28 of the SPSS statistical analysis program. Descriptive statistics were conducted to summarize the frequency distribution of sex, age, screentime exposure, and depressive symptoms among AAA. Binary logistic regression was used to investigate the relationship between screentime, the independent variable, and depressive symptoms, and the dependent variable, controlling for sex and age. The first assumption of this test was that the dependent variable, depressive symptoms, was dichotomous. The presence of depressive symptoms, measured by a yes or no response, indicated that this assumption was not violated. The second assumption

was that the independent variable, screentime, was continuous or categorical. Screentime, measured in hours, was a continuous variable and did not violate this assumption. The third assumption was that the observations of the measures were independent and that the dependent variable had mutually exclusive categories. This assumption was met as the dataset consisted of individual responses for screentime and experiences of depressive symptoms. The binary response options for depressive symptoms were also mutually exclusive. The final assumption was that there was linearity between the independent variable and the logit of the dependent variable. This assumption was tested using the Box-Tidwell procedure.

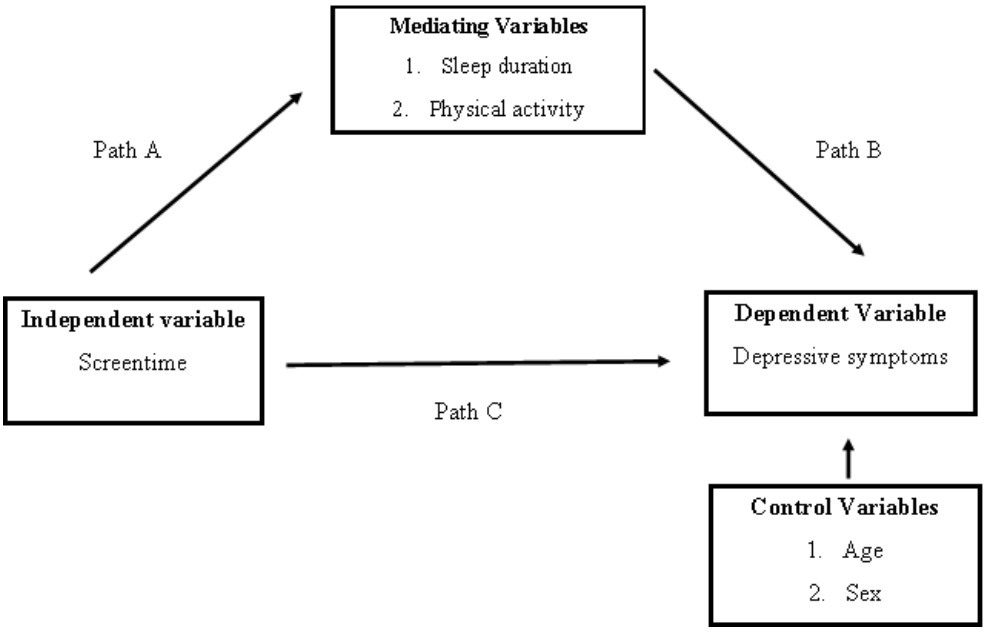
The overall significance of the model, the classification accuracy of the model, the estimated odds ratios, and the 95% confidence intervals were used as measures of the likelihood of AAA having depressive symptoms based on their screentime. A cross-tabulation was constructed to examine the distribution of depressive symptoms among AAA across the exposure levels of screentime.

To investigate the mediating roles of sleep duration and frequency of physical activity on the association between screentime and depressive symptoms, mediation path models were constructed, adjusting for sex and age. Like the binary logistic regression, the assumptions of this analysis were independence of observations and linearity in the relationship between the independent variable and the logit of the dependent variable. The third assumption was normal distribution in the errors that was tested using the histogram of the regression standardized residuals. The first step tested whether there was a significant relationship between screentime and sleep duration, and screentime and

frequency of physical activity in AAA, Path A. The second step was to determine, when adjusting for screentime, whether sleep duration and frequency of physical activity were significantly associated with depressive symptoms, Path B. The significance of the indirect effect of screentime on depressive symptoms through the mediators of sleep duration and frequency of physical activity was used to determine the presence of a mediation effect. The PROCESS version 4.1 macro (model 4) in SPSS 28 was used for the mediation analyses of sleep duration and frequency of physical activity, with bias-corrected accelerated bootstrap 95% confidence intervals in 5,000 resamples. The PROCESS macro was written by Dr. Andrew Hayes, and version 4.1 was released in April 2022 (Hayes, 2022b). PROCESS is a logistic regression path analysis modeling tool that is appropriate for conducting mediation analyses in SPSS. The tool has been used in health sciences to estimate the direct and indirect impacts of mediators. PROCESS was used to access the association between recreational screen activities and the psychological well-being of Australian adolescents, and whether sleep duration and the frequency of physical activity mediated the association (Khan et al., 2021). It has also been used to investigate the mediation role of procrastination in the relationship between problematic smartphone use and depression in Chinese adolescents (Wang et al., 2019). Figure 2 illustrates the relationship between the mediating, independent, and dependent variables and covariates of this study. The covariates, age and sex, were included as control variables as they affect the experience of depressive symptoms among adolescents (Lu, 2019; National Institute of Mental Health, 2022; Twenge, Cooper, et al., 2019).

Figure 2

Mediation Pathway of the Effect of Sleep Duration and Frequency of Physical Activity



Threats to Validity

One potential threat to construct validity is inexact definitions. Screentime was only measured by the number of hours spent recreationally engaging with screen devices on school days, but was not exhaustive to include non-school days. The operational definition and scope of this study were limited to only measuring the construct of screentime for school days. No threats to statistical conclusion validity were identified.

A second potential threat to construct validity is mono-operation bias whereas there are multiple ways to measure the construct of screentime. However, for this study, only the amount of screentime in hours was used as a measure for the construct. Other measures that might have been considered were the context of screentime, whether in the

bedroom (LeBourgeois et al., 2017), or just before bed, and the content of screentime, such as emails, social media, and other activities (Shin et al., 2022). Because these measures were not included in the dataset, the study only examined the construct of screentime in hours.

A final potential threat to construct validity is mono-method bias. For this study, the use of secondary YRBS survey data limited the implementation of multiple methods to examine the construct of screentime. Another method that might have been employed to measure the construct was the use of time diaries to record the number of hours engaged in screentime (McAllister et al., 2021). This approach would have reduced the potential for recall bias. However, for the cross-sectional secondary data that were used for this study, screentime was only measured using the questionnaire method.

Ethical Procedures

For the dataset used in this study, numerous efforts were made to address potential ethical issues. The Institutional Review Board of the CDC provided approval of the protocols of the YRBS study. The survey instrument was crafted to protect the privacy and anonymity of respondents as no identifiable information was collected, and respondent participation was voluntary (Underwood et al., 2020). Parental consent was also obtained before the fielding of the survey so that parents were made aware of the purpose and risks of participating to inform their decisions. Although no confidential data were analyzed, for this study, the electronic dataset and subsequent data files were password protected and securely stored in an encrypted file on my computer. Data

analysis was preceded by the revision and approval of Walden University's Institutional Review Board, approval number 10-14-22-0760479, to ensure that the methodology of the study did not violate the ethical standard of research. There were no conflicts of interest to report on.

Section Summary

This correlational, quantitative study applied binary logistic regression and mediation analysis using PROCESS in SPSS 28 to test the hypotheses of the three research questions. The results and findings of the statistical analysis are presented in the following section in a stepwise manner.

Section 3: Presentation of the Results and Findings

Introduction

The purpose of this quantitative, cross-sectional study was to examine the effect of screentime on depressive symptoms in AAA in the United States, and the potential mediators of the association, controlling for age and sex. The study was conducted to answer the following research questions:

RQ1. What is the effect of screentime on depressive symptoms in African American adolescents in the United States when controlling for age and sex?

RQ2. What is the mediating impact of sleep duration on the effect of screentime on depressive symptoms in African American adolescents in the United States when controlling for age and sex?

RQ3. What is the mediating impact of physical activity on the effect of screentime on the presence of depressive symptoms in African American adolescents in the United States when controlling for age and sex?

The null hypothesis for the first question was that the number of hours of screentime does not affect the presence of depressive symptoms in African American adolescents in the United States. For the second and third research questions, the null hypotheses were that the effect of the number of hours of screentime on the presence of depressive symptoms among African American adolescents in the United States is not mediated by the number of hours of sleep nor the number of hours of physical activity, controlling for age and sex.

In this third section of the study, I detail the stepwise process of secondary data analysis using SPSS to answer the research questions, present the results of the analysis, and offer a summary of the results. Table and figures are embedded to illustrate theresults of the analyses.

Accessing Data for Secondary Analysis

The data from the YRBS were collected during the spring semester of 2019. The school response rate was 75.1%, the student response rate was 80.3%, and the overall response rate was 60.3% (CDC, 2020). A total of 13,677 respondents were included in the nationally representative survey.

For the data analysis, the values for the variables of interest were coded for the nationally representative sample of 2,040 AAA respondents. Data screening and cleaning were conducted by assessing the central tendencies of the variables. A missing values analysis was run using Little's test to determine whether the missing values were missing completely at random. As displayed in Table 1, the test was not found to be significant (p = .107), indicating that the missing values were missing completely at random.

Table 1

Little's Missing Completely at Random Test Result

Age	PhysAct	Screentime	Sleep
4.98	4.16	4.02	3.25

Note. Little's MCAR test: Chi-square = 26.918, df = 19, Sig. = .107.

Table 2 displays that all the variables of interest had missing values before data screening and cleaning.

Table 2

Missing Values for Variables

		Age	Sex	DepSymp	PhysAct	Screen-time	Sleep
N	Valid	2,034	2,034	1,979	1,897	1,886	1,867
	Missing	6	6	61	143	154	173
Mean		4.98	1.50	1.68	4.15	4.00	3.26
Median		5.00	1.00	2.00	4.00	4.00	3.00
Mode		5	1	2	1	1	3
Minimum		1	1	1	1	1	1
Maximum		7	2	2	8	7	7

The missing values for the nominal variables of depressive symptoms and sex were replaced with the series mode. The missing values for the scale-interval variables of age, physical activity frequency, sleep duration, and screentime were replaced with the series means. Table 3 displays the descriptive statistics after data imputation. All the values for each variable were within the defined range.

Table 3

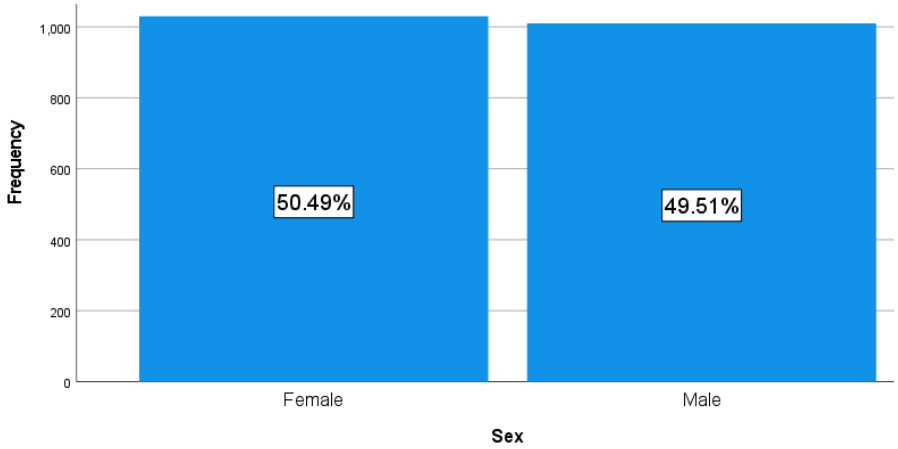
Frequencies of Imputed Variables

		Age	Sex	DepSymp	PhysAct	Screentime	Sleep
N	Valid	2,040	2,040	2,040	2,040	2,040	2,040
	Missing	0	0	0	0	0	0
Mean		4.98	1.50	1.69	4.14	4.00	3.23
Mode		5	1	2	1	1	3
Minimum		1	1	1	1	1	1
Maximum		7	2	2	8	7	7

The baseline statistics indicated that 50.49% of the respondents were female and 49.51% were male, as depicted in Figure 3.

Figure 3

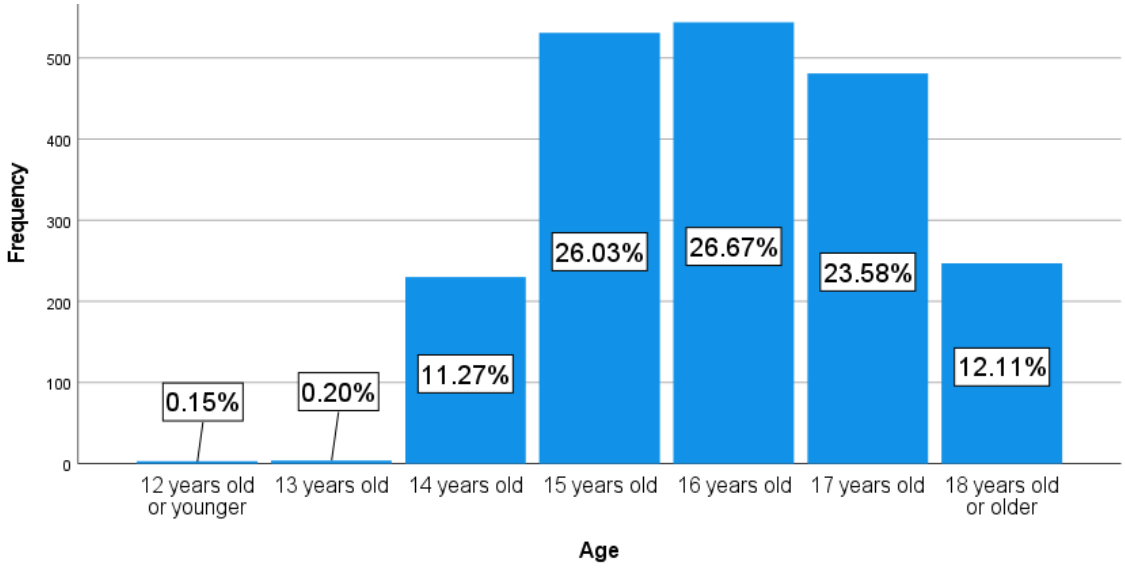
Frequency Distribution of Sex



The majority of AAA (76.28%) were between the ages of 15 and 17 years, as displayed in Figure 4.

Figure 4

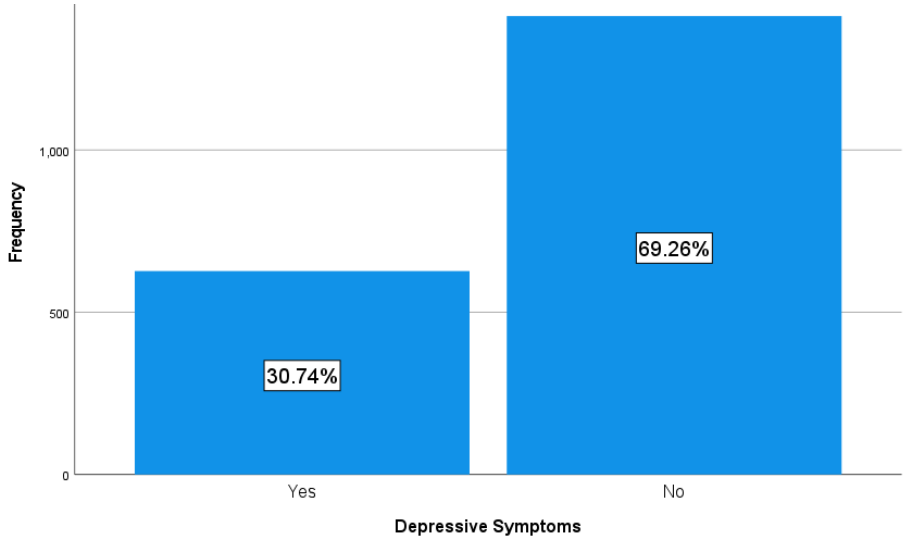
Frequency Distribution of Age



As depicted in Figure 5, 30.74% of AAA had depressive symptoms.

Figure 5

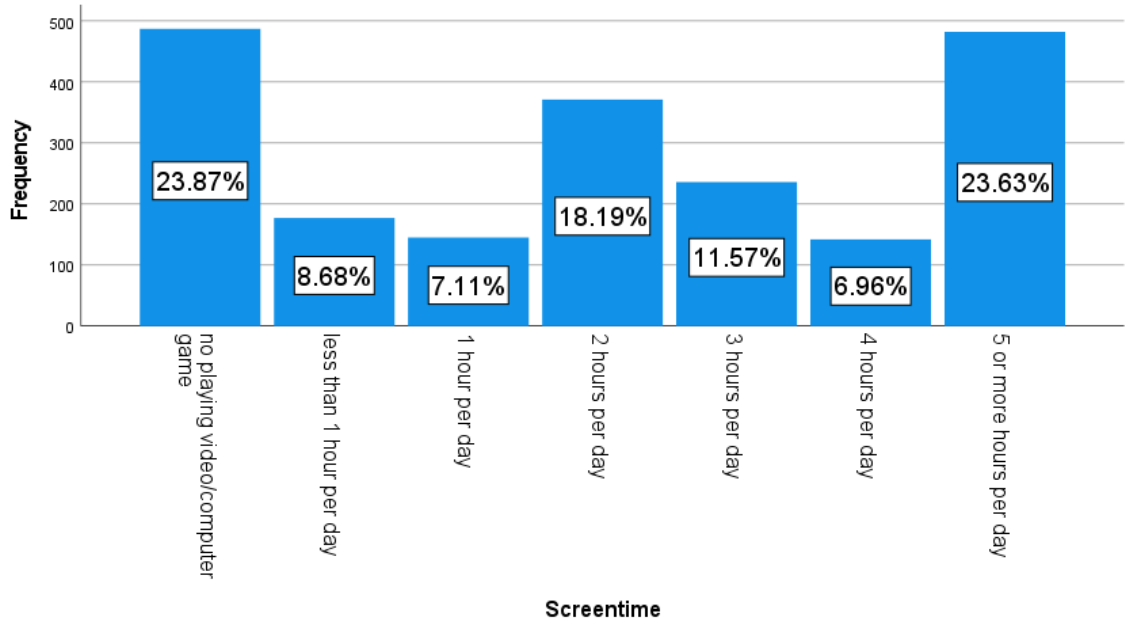
Frequency Distribution of Depressive Symptoms



As displayed in Figure 6, the highest frequencies were observed among AAA with no screentime (23.87%), followed by those exposed to 5 or more hours per day (23.63%) and those exposed to 2 hours per day (18.19%).

Figure 6

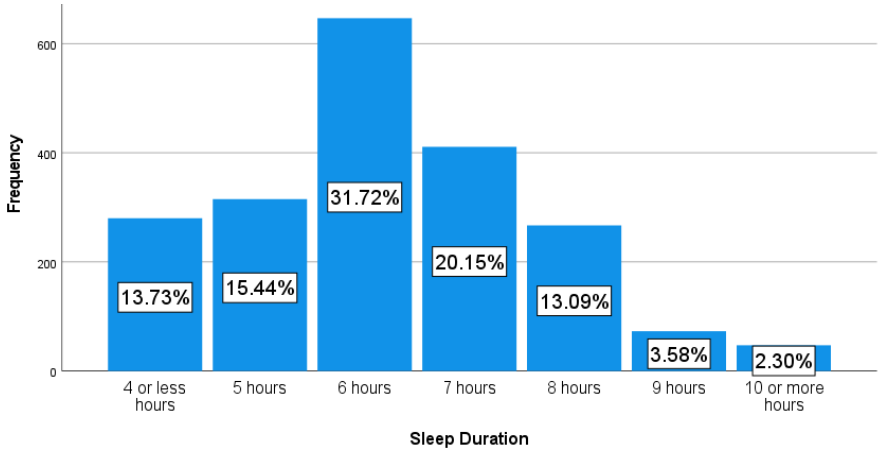
Frequency Distribution of Screentime



As depicted in Figure 7, only 18.97% of AAA slept the recommended 8–10 hours daily.

Figure 7

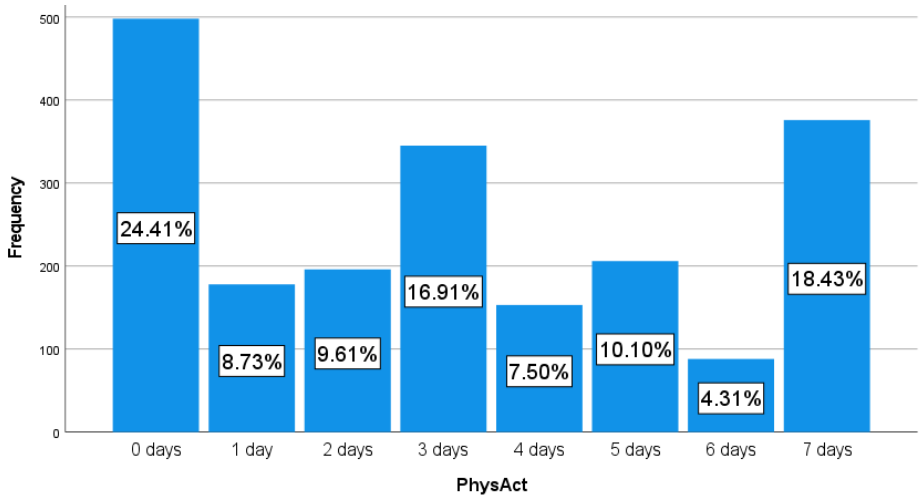
Frequency Distribution of Sleep Duration



As depicted in Figure 8, only 18.43% were physically active every day for a total of at least 60 minutes per day.

Figure 8

Frequency Distribution of Physical Activity



Results

For the first research question, a cross-tabulation of screentime and depressive symptoms was constructed to examine the distributions of reported depressive symptoms among AAA across the various exposure levels of screentime. As displayed in Table 4, there was a relatively equal distribution of cases across the various levels of exposure to screentime among AAA who experienced depressive symptoms.

Table 4

Crosstabulation of Depressive Symptoms and Screentime

			Depressive sym		
			Yes	No	Total
Screentime	No screentime	% within screentime	29.0%	71.0%	100.0%
	Less than 1 hour per day	% within screentime	32.2%	67.8%	100.0%
	1 hour per day	% within screentime	31.0%	69.0%	100.0%
	2 hours per day	% within screentime	28.6%	71.4%	100.0%
	3 hours per day	% within screentime	29.7%	70.3%	100.0%
	4 hours per day	% within screentime	28.2%	71.8%	100.0%
	5 or more hours per day	% within screentime	34.9%	65.1%	100.0%

A binary logistic regression analysis was conducted to investigate whether screentime had a relationship with depressive symptoms in AAA, controlling for age and sex. Three assumptions of this test were not violated, as the dependent variable, depressive symptoms, is dichotomous, the independent variable, screentime, is continuous, and there are independent observations for each participant.

For the binary logistic regression, Table 5 depicts that the overall model was found to be statistically significant, $\chi 2$ (3, N = 2,040) = 100.19, $p < .001$.

Table 5

Model Statistical Significance

		Chi-square	*df*	Sig.
Step 1	Step	100.193	3	< .001
	Block	100.193	3	< .001
	Model	100.193	3	< .001

The fourth assumption of linearity in the relationship between the independent variable and the logit of the dependent variable was tested using the Box-Tidwell procedure (Box & Tidwell, 2012). As depicted in Table 6, the logit of screentime (lnST) is not significant (p = .112), indicating that the assumption of linearity was not violated.

Table 6

Box-Tidwell Procedure Result

			Score	*df*	Sig.
Step 0	Variables	lnST	2.533	1	.112
		Age	.119	1	.731
		Sex	92.901	1	< .001
		ST	2.228	1	.136
	Overall statistics		98.682	4	< .001

Adding screentime, the overall classification accuracy rate of the model to correctly predict the category of depressive symptoms was 69.3%, as depicted in Table 7.

Table 7

Classification Accuracy

			Predicted		
			Depressive sym		Percentage
	Observed		Yes	No	correct
Step 1	Dep	Yes	0	627	.0
		No	0	1,413	100.0
	Overall percentage				69.3

However, only 6.8% (R^2_N = .068) of the observed variance in depressive symptoms were explained by the screentime, controlling for age and sex, as depicted in Table 8.

Table 8

Model Summary

Step	-2 log likelihood	Cox & Snell *R* square	Nagelkerke *R* square
1	2417.030	.048	.068

Controlling for age and gender, the results indicated that there was a significant relationship between screentime and depressive symptoms in AAA, Wald's χ^2 (1, N = 2,040) = 5.9, p = .015, as depicted in Table 9. Therefore, the null hypothesis that the number of hours of screentime has no effect on the presence of depressive symptoms in AAA in the United States was rejected. The model accounted for 6.8%, (R^2_N = .068) of the observed variance in whether or not AAA develop depressive symptoms. The effect of screentime on depressive symptoms was found to be small and inverse (B = -.053, SE = .022, p = .015). The estimated odds ratio [OR = .948, 95% CI (.908, .990)] suggested that AAA exposed to screen devices were less likely to have depressive symptoms.

Table 9

Statistical Significance of Predictor Variable

							95% *CI* for EXP(B)	
		B	*SE*	Wald	*df*	Sig.	Exp(B)	Lower	Upper
Step 1[a]	Age	-.005	.041	.017	1	.898	.995	.919	1.077
	Sex	.977	.101	93.549	1	< .001	2.657	2.180	3.238
	Screentime	-.053	.022	5.903	1	.015	.948	.908	.990
	Constant	-.362	.263	1.901	1	.168	.696		

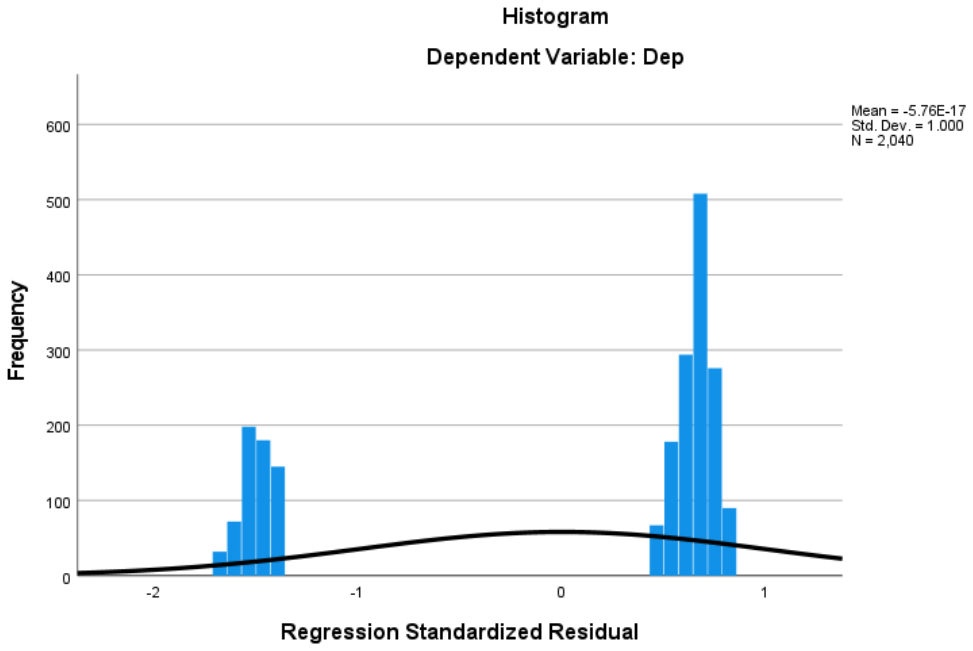
Note. [a] Variable(s) entered on Step 1: Age, Sex, Screentime.

For the second research question, to investigate whether there was a mediating impact of sleep on the relationship between screentime and depression, a simple mediation analysis was performed using PROCESS (Hayes, 2022a). The first assumption

of the test, normal distribution of errors as depicted in Figure 9, was not violated. Bootstrapping was also performed in the analysis.

Figure 9

Histogram of Regression Standardized Residual



The second assumption, independence of observation, was not violated as the responses of each participant were mutually exclusive. The third assumption of linearity in the relationship between the independent variable and the logit of the dependent variable has been demonstrated in the previous research question to not have been violated.

Path A, depicted in Figure 10, was statistically significant, whereby screentime predicted sleep duration [b = .036, SE = *.014*, t = 2.51, CI (.008, .063), p = .012].

Figure 10

Path A of Mediation Analysis for Sleep Duration

OUTCOME VARIABLE:
Sleep

Model Summary

R	R-sq	MSE	F	df1	df2	p
.1027	.0106	2.0467	7.2398	3.0000	2036.0000	.0001

Model

	coeff	se	t	p	LLCI	ULCI
constant	3.5835	.1717	20.8647	.0000	3.2467	3.9203
ST	.0355	.0141	2.5082	.0122	.0077	.0632
Age	-.0975	.0262	-3.7226	.0002	-.1489	-.0461
Sex	-.0040	.0637	-.0634	.9494	-.1289	.1208

When adjusting for screentime, the B path as depicted in Figure 11 was statistically significant, whereby sleep duration predicted depressive symptoms [b = .177, SE = .036, z = 4.95, CI (0.11, 0.25), p < .001].

Figure 11

Path B of Mediation Analysis for Sleep Duration

Model Summary

-2LL	ModelLL	df	p	McFadden	CoxSnell	Nagelkrk
2391.8567	125.3658	4.0000	.0000	.0498	.0596	.0841

Model

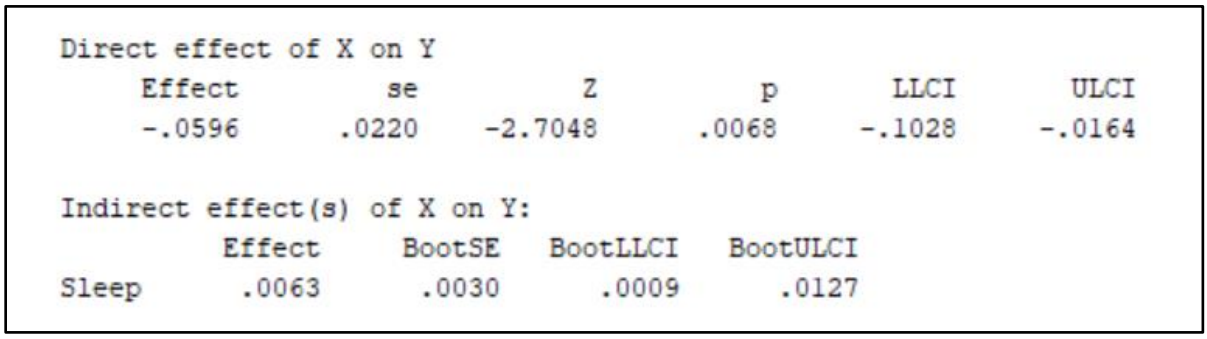
	coeff	se	Z	p	LLCI	ULCI
constant	-.9922	.2936	-3.3799	.0007	-1.5675	-.4168
ST	-.0596	.0220	-2.7048	.0068	-.1028	-.0164
Sleep	.1770	.0358	4.9464	.0000	.1068	.2471
Age	.0100	.0411	.2426	.8083	-.0705	.0905
Sex	.9904	.1017	9.7345	.0000	.7910	1.1898

The indirect effect of screentime on depressive symptoms, controlling for age and gender, was found to be significant [Effect = .006, SE = .003, CI (.001, .013)], as

depicted in Figure 12. Therefore, the null hypothesis that sleep duration mediates the relationship between screentime and depressive symptoms in AAA in the United States was rejected. Furthermore, the direct effect of screentime on depressive symptoms in the presence of sleep duration, C´, was also found to be significant [Effect = -.06, *SE* = .022, *p* = .007, CI (-.103, -.016)]. Hence, sleep duration partially mediated the relationship between screentime and depressive symptoms. The mediation was also found to be competitive as the direct effect and the indirect effect, as summarized in Table 10, were in different directions (Nitzl et al., 2016). A part of the effect of screentime on depressive symptoms was mediated through sleep duration. Additionally, independent of sleep duration, a part of depressive symptoms was explained by screentime.

Figure 12

Path C of Mediation Analysis for Sleep Duration



```
Direct effect of X on Y
     Effect         se          Z          p       LLCI       ULCI
     -.0596      .0220    -2.7048      .0068    -.1028    -.0164

Indirect effect(s) of X on Y:
          Effect     BootSE   BootLLCI   BootULCI
Sleep      .0063      .0030      .0009      .0127
```

Table 10

Sleep Duration Mediation Analysis Summary

Relationship	Total effect	Direct effect	Indirect effect	Confidence interval	
Screentime → sleep duration → depressive symptoms	-.0533	-.0596	.0063	Upper bound .0009	Lower bound .0127

For the third research question, to investigate whether there was a mediating impact of physical activity on the relationship between screentime and depressive symptoms, a simple mediation analysis was performed using PROCESS (Hayes, 2022a). The assumptions of this test are the same as reported in the second research question.

Path A was statistically significant where screentime predicted physical activity [*b* = .068, *SE* = .025, *t* = 2.77, *CI* (.019, .117), *p* = .006], as depicted in Figure 13.

Figure 13

Path A of Mediation Analysis for Physical Activity

```
OUTCOME VARIABLE:
 PhysAct

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .1924      .0370     6.2124    26.0889     3.0000  2036.0000      .0000

Model
              coeff         se          t          p       LLCI       ULCI
constant     2.7620      .2992     9.2306      .0000     2.1752     3.3489
ST            .0682      .0246     2.7676      .0057      .0199      .1165
Age          -.0460      .0456    -1.0073      .3139     -.1355      .0435
Sex           .8926      .1109     8.0480      .0000      .6751     1.1102
```

When adjusting for screentime, the Path B was not statistically significant as shown in Figure 14, as physical activity did not predict depressive symptoms [*b* = .036, *SE* = .02, *z*= 1.79, *CI* (-.0033,.0751) *p* = .073].

Figure 14

Path B of Mediation Analysis for Physical Activity

Model Summary

-2LL	ModelLL	df	p	McFadden	CoxSnell	Nagelkrk
2413.8004	103.4221	4.0000	.0000	.0411	.0494	.0697

Model

	coeff	se	Z	p	LLCI	ULCI
constant	-.4642	.2691	-1.7251	.0845	-.9916	.0632
ST	-.0552	.0219	-2.5172	.0118	-.0982	-.0122
PhysAct	.0359	.0200	1.7940	.0728	-.0033	.0751
Age	-.0034	.0407	-.0846	.9326	-.0832	.0763
Sex	.9461	.1024	9.2413	.0000	.7454	1.1467

The indirect effect of screentime on depressive symptoms, controlling for age and gender, was not found to be statistically significant [Effect = .002, *SE* = .002, 95% *CI* (-.0002, .0064)], as depicted in Figure 15. Therefore, the null hypothesis that physical activity mediates the relationship between screentime and depressive symptoms in AAA in the United States was not rejected.

Figure 15

Path C of Mediation Analysis for Physical Activity

Direct effect of X on Y

Effect	se	Z	p	LLCI	ULCI
-.0552	.0219	-2.5172	.0118	-.0982	-.0122

Indirect effect(s) of X on Y:

	Effect	BootSE	BootLLCI	BootULCI
PhysAct	.0024	.0017	-.0002	.0064

Summary of Results

There was a relatively equal distribution of cases across all the levels of exposure to screentime among AAA who experienced depressive symptoms. Controlling for age

and gender, a statistically significant relationship between screentime and depressive symptoms was found among AAA (Wald $\chi 2$ (1, N = 2,040) = 5.903, p = .015). Controlling for age and gender, sleep duration had a partial mediating effect on the relationship between screentime and depressive symptoms [Effect = .006, *SE* = .003, 95% *CI* (.001, .013)], and frequency of physical activity did not have a mediating effect [Effect = .002, *SE* = .002, 95% *CI* (-.0002, .0064)].

These findings have some implications for the practice of public health and social change among parents, AAA, health care providers, and public health researchers. The following section details the interpretation of these findings, recommendations for further research, study limitations, and implications for professional practice and social change.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

The purpose of this quantitative, cross-sectional study was to examine the effect of screentime on depression in AAA in the United States, and the mediators of that association, controlling for age and sex. This study was important to conduct because AAA have higher screentime and poor mental health seeking, which may put them at risk for worse mental health outcomes. The first key finding of this study was that there is a relatively equal distribution of cases across all levels of exposure to screentime among AAA who experienced depressive symptoms. The second key finding was that controlling for age and gender, there is a significant inverse relationship between screentime and depressive symptoms in AAA. The third key finding was that sleep duration has a partial mediating effect on the relationship between screentime and depressive symptoms. The final key finding was that physical activity does not have a mediating effect on the relationship.

Interpretation of Findings

The finding of a 30.74% prevalence of depressive symptoms in 2019 among AAA aligns with previous research findings that an increasing prevalence of depression is a public health concern for this population (CDC, 2019). A combined total of 42.16% of AAA were exposed to 3 hours or more of recreational screentime daily, which is consistent with previous literature indicating that AAA are highly exposed to screen devices (CDC, 2019). The reasons why AAA are exposed to high levels of screentime are

unclear, however. Their high screentime may be because they use screened devices as a coping strategy to relieve depression (Pretorius et al., 2019). Conversely, 23.87% of AAA have no recreational screentime, and this may be the result of parental restrictions on screen devices during school days. Among the nonexposed proportion of AAA, the prevalence of depressive symptoms was 29%. This finding points to previous literature that suggests that some AAA may have already felt depressive symptoms (Baiden et al., 2019), or their symptoms were being driven by other unmeasured factors such as the quality of the community, home and school environments, socioeconomic conditions, or stigma and discrimination (WHO, 2021). The selected dataset did not include these constructs. Therefore, the impacts of these additional factors were unmeasured.

Among AAA exposed to 5 or more hours of screentime, 34.9% had depressive symptoms. This finding is consistent with some studies that have linked higher exposure to screentime with a greater likelihood of experiencing depressive symptoms (Twenge & Campbell, 2018; Twenge, Joiner, et al., 2018). For a subset of AAA, high exposure to screentime may place them at higher risk of depressive symptoms.

Only about 19% of AAA slept for the recommended 8 or more hours nightly, and only 18% were physically active every day for the recommended 60 minutes. These findings were consistent with the current literature on sleep deprivation and sedentary behaviors that are common among adolescents (CDC, 2019; Fomby et al., 2021; Roberts & Duong, 2014). These factors place AAA at risk for other adverse health outcomes such as feelings of unhappiness and hopelessness about the future, or sadness (Berger et al.,

2019); overweight and obesity; and chronic illnesses, which may threaten their future productivity.

For the first research question, a significant relationship between screentime and depressive symptoms in AAA was found. Screentime accounted for 6.8% of the variance in depressive symptoms in AAA, indicating a weak effect. This finding can be explained by factors noted in the literature that are potentially stronger predictors of depressive symptoms, such as socioeconomic status, school, and level of parental education (Boers et al., 2019; Twenge, Martin, et al., 2018), which were not available for inclusion in the binary logistic model. Although there was found to be a significant relationship between screentime and depressive symptoms, it is important to note that the effect was very small (B = -.053, SE = .022, p = .015), and the meaningfulness of practical implications must be deduced cautiously. The estimated odds ratio [OR = .948, 95% CI (.908, .990)] suggested that AAA exposed to screen devices were slightly less likely to experience depressive symptoms.

This finding counters much of the concerns of parents and researchers about screentime exposure driving mental health issues in adolescents, and aligns with the previous research that demonstrated weak associations between screentime and depressive symptoms and emotional well-being (Twenge & Campbell, 2018; Twenge, Joiner, et al., 2018). Screen devices may be beneficial to AAA as a coping mechanism for distress, boredom, and isolation, and for allowing social connectivity and self-expression (Nesi et al., 2021). AAA may also use screen devices for building friendships and improving social connectedness, as they may use online platforms to support functions

they traditionally do offline (Canadian Paediatric Society, 2019). Therefore, the findings of this study among AAA support the position of a previous study that exposure to television, movies, videogames, computers, and smartphones for 2–5 hours daily, is not intrinsically harmful to adolescent mental health (Przybylski & Weinstein, 2017).

For the second research question, controlling for age and gender, only sleep duration partially mediated the impact of screentime on depressive symptoms. However, the indirect effect of screentime on depressive symptoms through sleep duration was small [Effect = .006, *SE* = .003, *CI* (.001, .013)], and the direct effect of screentime on depressive symptoms, in the presence of the mediator [Effect = -.06, *SE* = .022, *p* = .007, *CI* (-.103, -.016)], was even smaller and in the opposite direction. This finding aligns with the position that factors other than screentime may be stronger predictors of depressive symptoms. Additionally, some of the variance in depressive symptoms was explained by sleep duration; however, based on the magnitude, the effect was very small, and there are likely stronger mediators of the relationship.

For the third research question, the finding that physical activity did not mediate the relationship between screentime and depressive symptoms in AAA [Effect = .002, *SE* = .002, *CI* (-.0002, .0064)] was counter to previous research that posited that screentime replaced traditional forms of sedentary behaviors such as reading books, magazines, and newspapers (van Sluijs et al., 2021). Therefore, there are other mediators of the relationship between screentime and depressive symptoms that are not accounted for in the model.

Limitations of the Study

The first limitation of this study was that the YRBS data on screentime were not collected using objective measures for the number of hours that AAA were exposed to electronic screen devices, the number of hours of sleep, and the number of days of physical activity. Reports for these variables may have been subjected to recall bias (Foerster et al., 2019). Additionally, the lack of disaggregation of the measure for the types of screen exposures limited the investigation of how AAA interact with various types of portable and nonportable screen devices. The data were also not collected to account for the types of activities AAA were engaged in that may have provided information on differential impacts of activity exposures.

The second limitation was the use of depressive symptoms as a proxy for the outcome of a diagnosis of depression. This dataset could not be used to investigate the diagnostic outcome of depression or measure the severity of depression because an objective tool was not used. The limited data collection for other potentially relevant variables in the selected dataset indicates that another source of data may be more useful for a comprehensive investigation.

The third limitation was that other potentially stronger predictors and mediators of depressive symptoms in AAA were not measured, as they were not available in the dataset for analysis. The final limitation was that data used for this study were from 2019 and did not reflect the post-COVID-19 impacts of screentime on depressive symptoms. The 2021 dataset was not available at the time of analysis for this study.

Recommendations for Future Research

This study identifies opportunities to extend research on screentime and depressive symptoms in AAA. The first recommendation is for future research to disaggregate the measures of screentime by type of electronic device and use objective measures for screentime such as the recorded history of the electronic device. This approach would add rigidity to a study to detect the differential impacts of various types of screen devices on depressive symptom outcomes among AAA. Objective measures should also be used for depression such as the Patient Health Questionnaire (PHQ-9), for sleep duration such as polysomnography (Jamieson et al., 2020; Scott et al., 2019), and for physical activity such as a diary record. These strategies may contribute to minimizing recall bias.

The second recommendation is for the replication of the methodology of this study with the inclusion of additional independent variables, mediators, and control variables, using a different dataset. This approach could strengthen the robustness of the investigation through the modeling of the relationship between screentime and depressive symptoms among AAA.

The third recommendation is for future studies to examine the specific effects of individual, cultural, and social factors on depressive symptoms among AAA. Biological factors such as a family history of depression and social factors such as loss of loved ones, school-related stress, low self-esteem, and exposure to natural disasters can all have implications for depressive symptom outcomes (Selph & McDonagh, 2019). Additionally, exposure to community violence, for example, is a type of trauma that is

considered an adverse childhood experience that increases the risk of the onset of mental health disorders such as depression (Lee et al., 2020; Pierre et al., 2020). For AAA, the risk of exposure to community violence is high due to conditions of poverty, racism, limited education and employment opportunities, and other socioeconomic factors (Christine Leibbrand et al., 2020; Sheats et al., 2018). Upstream structural and social determinants of health should not be ignored when investigating the drivers of mental health outcomes.

The fourth recommendation is for researchers to conduct longitudinal and experimental studies to examine changes in the effect of exposure to various types of screen devices and activities on depressive symptoms in AAA over time. As technology continues to evolve, it is important to understand the longitudinal impact of increasing exposure on mental health outcomes. Moreover, the rapidly emerging metaverse that seeks to merge physical and digital realities is expected to become prolific for education and socialization (Rospigliosi, 2022). Access to internet-enabled devices will continue to increase with evolving technology, and interactive software and is likely to have implications for screen-based behaviors. Therefore, studies should focus on distinguishing the potential long-term benefits and harms of exposure to various types and durations of screen devices and screen-based activities.

Implications for Professional Practice

Despite screentime being found as a significant but not strong predictor of depressive symptoms, the prevalence of depressive symptoms among AAA is still a

public health concern that can have long-term implications for mental well-being in adulthood. As future research continues to explore the stronger drivers of depressive symptoms in AAA, public health practice can still benefit from the findings of this study.

In the era of evolving technology and as electronic screen devices become a staple in the daily functioning of adolescents (Fry, 2021), it is likely that the use of screen devices as tools for learning, communicating, and accessing entertainment platforms will remain prevalent (Odgers & Jensen, 2020). Given the slight protective effect of screentime in reducing the likelihood of depressive symptoms, public health practitioners may recommend that the use of screentime is focused on beneficial activities such as education, socialization, and entertainment (Nagata et al., 2022a). Engagement in such activities can have a protective effect against depressive symptoms. Public health educators may also teach AAA how to monitor their screen behaviors and monitor their mental and emotional state in response to screen exposure. Although the evidence of the association between screentime and depressive symptoms is not strong enough to develop standardized guidelines for AAA, public health educators may offer advice to AAA on how to healthily interact with electronic screen devices. This may include safety mechanisms against online predictors and security features against unsolicited content (UNICEF, 2017). Public health practitioners can also encourage parents and AAA to objectively monitor their screentime and educate them on signs of when excessive use is becoming harmful, such as when it presents as a hindrance to other important work, consumes more time, and involves an inability to control use (Yang et al., 2020).

Given that depression was observed at both high and low levels of screentime exposure, health care providers should conduct routine screening of AAA, regardless of their exposure, for the early detection and treatment of depressive symptoms. For AAA with no screentime, routine screening can be beneficial for identifying the factors that are stronger than screentime in predicting depressive symptoms. For AAA with high screentime who also experience depressive symptoms, routine screening is important for early detection and the development of individual recommendations for adjustments in screen behaviors to improve outcomes.

Although sleep duration, a significant mediator, has a small effect on the relationship between screentime and depressive symptoms, health care providers and public health educators may educate AAA about good sleep hygiene practices such as not sleeping with portable devices, not having multiple electronics in the bedroom, and not having screen devices on before bed (Baiden et al., 2019; Kansagra, 2020).

Additionally, health educators should continue to promote adherence to the physical activity recommendations, as it is essential to the promotion of good mental health in adolescence. Given that nearly 20% of AAA are not meeting the recommendations for adequate physical activity, education by health professionals is critical to building their awareness and skills for lifestyle changes that facilitate more hours of exercise.

Community health workers can have a role in encouraging mental-health-seeking behaviors among AAA. Furthermore, they may provide screening services to identify AAA who may be at higher risk of developing depression. The at-risk AAA who are

identified at the community level can be referred for specialized or follow-up evaluations by a mental health professional in primary care settings or mental health facilities to avoid further progression into major depression. This initiative is important for AAA who have poor mental-health-seeking behaviors and can lower their risk of worse mental health outcomes, whether driven by screentime, inadequate sleep, or other stronger predictors.

Primary care providers may also conduct research by collecting and analyzing qualitative data among identified AAA with depressive symptoms to better understand their individual, sociocultural, and structural drivers and determinants of high levels of recreational screentime. For AAA with no exposure to screentime who still have depressive symptoms, providers can also drive research studies to identify the upstream factors that contribute to the outcome. Semistructured interviews and focus groups can be conducted to identify key themes and predictive factors that may be used to inform future research among this population.

Finally, public health practitioners can lead longitudinal research within the target population using robust measures of screentime duration, nature of content and activity, and type of screen device to build evidence about the benefits and harms of screentime exposure under specific conditions. Given that electronic screen devices will continue to be a significant part of the daily lives of AAA, public health researchers will need to continue efforts to investigate the impacts of rapidly advancing technology on mental health.

Implications for Social Change

The findings of this study can inform behaviors and practices at the individual, community, and policy levels that are important to bring about social change. First, educating AAA to meet recommendations for the number of hours of sleep can lower their risk of depressive symptoms as well as chronic conditions such as obesity, diabetes, and heart diseases, in addition to promoting improvements in mood, school performance, and decision making (U.S. Department of Health and Human Services, 2022). Similarly, encouraging AAA to meet the recommendations for physical activity can reduce their risk for chronic diseases, and such improvements can contribute to a better quality of life and future productivity in adulthood.

Social change can also be brought about when parents become more involved in monitoring the screentime of their children. Given that the duration of screentime is not likely to decrease in the era of technological advancements, parental supervision can help to protect AAA from exposure to risks such as cyberbullying, online predators, and inappropriate content (UNICEF, 2017). Parents are often the providers of screen devices for children and are best positioned to make and enforce rules for screentime. Such parental efforts can make the experiences of AAA screentime safer without limiting their capacity for social connection and learning.

Parental monitoring is also beneficial for the early detection of symptoms of depression that may be related to the overuse of screen devices. In the home context, they are likely to have close interaction with AAA and can identify when screen use is becoming problematic and unhealthy such as procrastination, feeling depressed, getting

less sleep, and failing to stop the use of screen devices, (S. Liu et al., 2022; Raudsepp & Kais, 2019; Wang et al., 2019). Reasonable adjustments for permitted screentime can be made by parents to preserve the benefits of education, socialization, and entertainment without compromising their mental and emotional state of well-being. In cases of depressive symptoms that require professional intervention, parents can also play a role in facilitating referrals before symptoms develop into a diagnosis of major depression. In the long-term, early detection has implications for the prevention of the onset of depression and the aversion of future avoidable expenditure for mental health services for professional visits, medical exams, and medications (Bodden et al., 2018).

Within health care settings, physicians can bring about social change by educating their AAA patients and their parents to identify symptoms of depression as defined by the DSM-5 as feeling depressed and loss of interest within a 2-week period that is not attributable to any other medical condition or substance, in conjunction with four additional symptoms (American Psychiatric Association, 2013). Although screentime does not have a large effect on depressive symptoms in AAA, when health care providers teach them to identify signs of depression and encourage mental health seeking, they can promptly receive the necessary care and treatment, regardless of the causes of depression.

Finally, at the societal level, as public health practitioners continue research on the relationship between screentime and depressive symptoms among AAA, they can effect social change through advocacy for safe online environments through content regulation and privacy mechanisms on the platforms adolescents use for socializing, learning, and

entertainment. Evidence-based advocacy can be critical to policy reformation for safer screentime experiences for AAA and other adolescents.

Conclusion

There has been growing concern about the simultaneous increase in screentime and depressive symptoms among adolescents in the United States. However, for AAA, screentime is a significant but weak predictor of depressive symptoms, and contributes to a slight reduction in the likelihood of them developing depressive symptoms. Sleep duration has a small mediating effect on the relationship between screentime and depressive symptoms. Given that the use and exposure to electronic screen devices will continue to be prolific in the current generation for socialization, education, and entertainment, AAA, parents of AAA, health care providers, and public health researchers have pivotal roles in monitoring screentime behaviors and depressive symptoms and signs, educating about the symptoms of depression, and advocating for safe online environments. There is also an important need for continued research to understand the impacts of evolving technology on AAA mental health, and to identify the strongest drivers of their depressive symptoms for prevention, early detection, and treatment of depressive symptoms.

References

Alegria, M., Vallas, M., & Pumariega, A. (2010). Racial and ethnic disparities in pediatric mental health. *Child and Adolescent Psychiatric Clinics of North America*, *19*(4), 759–774. https://doi.org/10.1016/j.chc.2010.07.001

American Academy of Child and Adolescent Psychiatry. (2020). *Media habits during COVID-19: Children and teens on screen in quarantine*. https://www.aacap.org/App_Themes/AACAP/Docs/resource_libraries/covid-19/Screen-Time-During-COVID.pdf

American College of Pediatricians. (2020). *Media use and screen time—Its impact on children, adolescents, and families*. https://acpeds.org/position-statements/media-use-and-screen-time-its-impact-on-children-adolescents-and-families

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Anderson, M., & Jiang, J. (2018). *Teens, social media & technology 2018*. Pew Research Center. https://www.pewresearch.org/internet/2018/05/31/teens-social-media-technology-2018/

Baiden, P., Tadeo, S. K., & Peters, K. E. (2019). The association between excessive screen-time behaviors and insufficient sleep among adolescents: Findings from the 2017 Youth Risk Behavior Surveillance System. *Psychiatry Research, 281*, Article 112586. https://doi.org/10.1016/j.psychres.2019.112586

Berger, A., Wahlstrom, K., & Widome, R. (2019). Relationships between sleep duration and adolescent depression: A conceptual replication. *Sleep Health*, *5*(2), 175–179. https://doi.org/10.1016/j.sleh.2018.12.003

Bodden, D. H. M., Stikkelbroek, Y., & Dirksen, C. D. (2018). Societal burden of adolescent depression, an overview and cost-of-illness study. *Journal of Affective Disorders*, *241*, 256–262. https://doi.org/10.1016/j.jad.2018.06.015

Boers, E., Afzali, M. H., Newton, N., & Conrod, P. (2019). Association of screen time and depression in adolescence. *JAMA Pediatrics*, *173*(9), 853–859. https://doi.org/10.1001/jamapediatrics.2019.1759

Box, G. E. P., & Tidwell, P. W. (2012). Transformation of the independent variables. *Technometrics*, *4*(4), 531–550. https://doi.org/10.1080/00401706.1962.10490038

Brown, D. M. Y., Kwan, M. Y., Arbour-Nicitopoulos, K. P., & Cairney, J. (2021). Identifying patterns of movement behaviours in relation to depressive symptoms during adolescence: A latent profile analysis approach. *Preventive Medicine*, *143*, Article 106352. https://doi.org/10.1016/j.ypmed.2020.106352

Canadian Paediatric Society. (2019). Digital media: Promoting healthy screen use in school-aged children and adolescents. *Paediatrics & Child Health*, *24*(6), 402–408. https://doi.org/10.1093/pch/pxz095

Centers for Disease Control and Prevention. (2019a). *Being sad or hopeless: YRBS—Graph*. https://yrbs-explorer.services.cdc.gov/#/graphs?questionCode=H25&topicCode=C01&location=XX&year=2019

Centers for Disease Control and Prevention. (2019b). *Youth online: High school YRBS—United States 2019 results.* https://nccd.cdc.gov/Youthonline/App/Results.aspx?TT=A&OUT=0&SID=HS&QID=QQ&LID=XX&YID=2017&LID2=&YID2=&COL=S&ROW1=N&ROW2=N&HT=QQ&LCT=LL&FS=S1&FR=R1&FG=G1&FA=A1&FI=I1&FP=P1&FSL=S1&FRL=R1&FGL=G1&FAL=A1&FIL=I1&FPL=P1&PV=&TST=False&C1=&C2=&QP=G&DP=1&VA=CI&CS=Y&SYID=&EYID=&SC=DEFAULT&SO=ASC

Centers for Disease Control and Prevention. (2020). *2019 YRBS data user's guide*. https://www.cdc.gov/healthyyouth/data/yrbs/pdf/2019/2019_National_YRBS_Data_Users_Guide.pdf

Centers for Disease Control and Prevention. (2021). *2019 Sample sizes, response rates, and demographic characteristics: Results, YRBSS—Data: Adolescent and school health.* https://www.cdc.gov/healthyyouth/data/yrbs/2019_tables/sample_sizes.htm

Centers for Disease Control and Prevention. (2022). *How much physical activity do children need?* https://www.cdc.gov/physicalactivity/basics/children/index.htm

Chaput, J.P., Dutil, C., & Sampasa-Kanyinga, H. (2018). Sleeping hours: What is the ideal number and how does age impact this? *Nature and Science of Sleep*, *10*, 421–430. https://doi.org/10.2147/NSS.S163071

Chen, X., Han, Q., Liu, R., Yuan, F., Li, W., Mi, X., Teris, C., Jackson, T., Wang, G., & Yu-Tao, X. (2021). Depression, anxiety and associated factors among Chinese

adolescents during the COVID-19 outbreak: A comparison of two cross-sectional studies. *Translational Psychiatry*, *11*, Article 148. https://doi.org/10.1038/s41398-021-01271-4

Christine Leibbrand, Heather Hill, Ali Rowhani-Rahbar, & Frederick Rivara. (2020). Invisible wounds: Community exposure to gun homicides and adolescents' mental health and behavioral outcomes. *SSM - Population Health*, *12*, Article 100689. https://doi.org/10.1016/j.ssmph.2020.100689

Clement, S., Schauman, O., Graham, T., Maggioni, F., Evans-Lacko, S., Bezborodovs, N., Morgan, C., Rüsch, N., Brown, J. S. L., & Thornicroft, G. (2015). What is the impact of mental health-related stigma on help-seeking? A systematic review of quantitative and qualitative studies. *Psychological Medicine*, *45*(1), 11–27. https://doi.org/10.1017/S0033291714000129

Conner, L. C., & Yeh, C. J. (2018). Stress, coping, and depression among Black urban adolescents: Implications for school counseling. *Journal of School Counseling*, *16*(15), 1-31. https://search.ebscohost.com/login.aspx?direct=true&AuthType=shib&db=edo&AN=132550660&site=eds-live&scope=site.

Cook, B. L., Trinh, N.-H., Li, Z., Hou, S. S.-Y., & Progovac, A. M. (2017). Trends in racial-ethnic disparities in access to mental health care, 2004–2012. *Psychiatric Services*, *68*(1), 9–16. https://doi.org/10.1176/appi.ps.201500453

Coyne, S. M., Rogers, A. A., Zurcher, J. D., Stockdale, L., & Booth, M. (2020). Does time spent using social media impact mental health?: An eight year longitudinal

study. *Computers in Human Behavior*, *104*, Article 106160. https://doi.org/10.1016/j.chb.2019.106160

Coyne, S. M., Stockdale, L., & Summers, K. (2019). Problematic cell phone use, depression, anxiety, and self-regulation: Evidence from a three year longitudinal study from adolescence to emerging adulthood. *Computers in Human Behavior*, *96*, 78–84. https://doi.org/10.1016/j.chb.2019.02.014

Davies, S.C., Artherton, F., McBride, M., & Calderwood, C. (2019). *UK Chief Medical Officers' Physical Activity Guidelines*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/832868/uk-chief-medical-officers-physical-activity-guidelines.pdf

DeSouza, F., Parker, C. B., Spearman-McCarthy, E. V., Duncan, G. N., & Black, R. M. M. (2021). Coping with racism: A perspective of COVID-19 church closures on the mental health of African Americans. *Journal of Racial and Ethnic Health Disparities*, *8*(1), 7–11. https://doi.org/10.1007/s40615-020-00887-4

Elster, A., Jarosik, J., VanGeest, J., & Fleming, M. (2003). Racial and ethnic disparities in health care for adolescents: A systematic review of the literature. *Archives of Pediatrics & Adolescent Medicine*, *157*(9), 867–874. https://doi.org/10.1001/archpedi.157.9.867

Erzen, E., & Çikrikci, Ö. (2018). The effect of loneliness on depression: A meta-analysis. *International Journal of Social Psychiatry*, *64*(5), 427–435. https://doi.org/10.1177/0020764018776349

Fan, Q., DuPont-Reyes, M. J., Hossain, M. M., Chen, L.-S., Lueck, J., & Ma, P. (2022). Racial and ethnic differences in major depressive episode, severe role impairment, and mental health service utilization in U.S. adolescents. *Journal of Affective Disorders*, *306*, 190–199. https://doi.org/10.1016/j.jad.2022.03.015

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, *41*(4), 1149–1160. https://doi.org/10.3758/BRM.41.4.1149

Fernandez, S. (2019). Adolescent sleep: Challenges and solutions for pediatric primary care. *Pediatric Annals*, *48*(8), 292–295. https://doi.org/10.3928/19382359-20190724-02

Foerster, M., Henneke, A., Chetty-Mhlanga, S., & Röösli, M. (2019). Impact of adolescents' screen time and nocturnal mobile phone-related awakenings on sleep and general health symptoms: A prospective cohort study. *International Journal of Environmental Research and Public Health*, *16*(3), Article 3. https://doi.org/10.3390/ijerph16030518

Fomby, P., Goode, J. A., Truong-Vu, K.-P., & Mollborn, S. (2021). Adolescent technology, sleep, and physical activity time in two U.S. cohorts. *Youth & Society*, *53*(4), 585–609. https://doi.org/10.1177/0044118X19868365

Fry, C. (2021). Sleep deprived but socially connected: Balancing the risks and benefits of adolescent screen time during COVID-19. *Journal of Children and Media*, *15*(1), 37–40. https://doi.org/10.1080/17482798.2020.1858907

Gaarde, J., Hoyt, L. T., Ozer, E. J., Maslowsky, J., Deardorff, J., & Kyauk, C. K. (2020). So much to do before I sleep: Investigating adolescent-perceived barriers and facilitators to sleep. *Youth & Society*, *52*(4), 592–617. https://doi.org/10.1177/0044118X18756468

Glozier, N., O'Dea, B., McGorry, P. D., Pantelis, C., Amminger, G. P., Hermens, D. F., Purcell, R., Scott, E., & Hickie, I. B. (2014). Delayed sleep onset in depressed young people. *BMC Psychiatry*, *14*, Article 33. http://doi.org/10.1186/1471-244X-14-33

Gul, M. K., & Demirci, E.(2021). Psychiatric disorders and symptoms in children and adolescents during the COVID-19 pandemic: A review. *Eurasian Journal of Medicine and Oncology*, *5*(1), 20. http://doi.org/10.14744/ejmo.2021.14105

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2020). Global trends in insufficient physical activity among adolescents: A pooled analysis of 298 population-based surveys with 1.6 million participants. *The Lancet Child & Adolescent Health*, *4*(1), 23–35. https://doi.org/10.1016/S2352-4642(19)30323-2

Hafstad, G. S., Sætren, S. S., Wentzel-Larsen, T., & Augusti, E.-M. (2021). Adolescents' symptoms of anxiety and depression before and during the Covid-19 outbreak – A prospective population-based study of teenagers in Norway. *The Lancet Regional Health - Europe*, *5*, Article 100093. https://doi.org/10.1016/j.lanepe.2021.100093

Hamann, C., Rusterholz, T., Studer, M., Kaess, M., & Tarokh, L. (2019). Association between depressive symptoms and sleep neurophysiology in early adolescence.

Journal of Child Psychology and Psychiatry, *60*(12), 1334–1342. https://doi.org/10.1111/jcpp.13088

Hannor-Walker, T., Bohecker, L., Ricks, L., & Kitchens, S. (2020). Experiences of Black adolescents with depression in rural communities. *Professional Counselor*, *10*(2), 285–300. https://files.eric.ed.gov/fulltext/EJ1260089.pdf

Hattersley, L. A., Shrewsbury, V. A., King, L. A., Howlett, S. A., Hardy, L. L., & Louise, B. A. (2009). Adolescent-parent interactions and attitudes around screen time and sugary drink consumption: A qualitative study. *International Journal of Behavioral Nutrition & Physical Activity*, *6*, Article 61. https://doi.org/10.1186/1479-5868-6-61

Hawes, M. T., Szenczy, A. K., Klein, D. N., Hajcak, G., & Nelson, B. D. (2021). Increases in depression and anxiety symptoms in adolescents and young adults during the COVID-19 pandemic. *Psychological Medicine*, *52*(14), 3222-3230. https://doi.org/10.1017/S0033291720005358

Hayes, A. (2022a). *Download*. The PROCESS Macro for SPSS, SAS, and R. http://processmacro.org/download.html

Hayes, A. (2022b). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (3rd ed.). The Guilford Press.

He, J.P., Paksarian, D., & Merikangas, K. R. (2018). Physical activity and mental disorder among adolescents in the United States. *Journal of Adolescent Health, 63*(5), 628–635. https://doi.org/10.1016/j.jadohealth.2018.05.030

Hedin, G., Norell-Clarke, A., Hagell, P., Tønnesen, H., Westergren, A., & Garmy, P. (2020). Facilitators and barriers for a good night's sleep among adolescents. *Frontiers in Neuroscience*, *14*, Article 92. https://www.frontiersin.org/articles/10.3389/fnins.2020.00092

Hertz, M. F., Kilmer, G., Verlenden, J., Liddon, N., Rasberry, C. N., Barrios, L. C., & Ethier, K. A. (2022). Adolescent mental health, connectedness, and mode of school instruction during COVID-19. *Journal of Adolescent Health, 70*(1), 57–63. https://doi.org/10.1016/j.jadohealth.2021.10.021

Hisler, G., Twenge, J. M., & Krizan, Z. (2020). Associations between screen time and short sleep duration among adolescents varies by media type: Evidence from a cohort study. *Sleep Medicine*, *66*, 92–102. https://doi.org/10.1016/j.sleep.2019.08.007

Jamieson, D., Beaudequin, D. A., McLoughlin, L. T., Parker, M. J., Lagopoulos, J., & Hermens, D. F. (2020). Associations between sleep quality and psychological distress in early adolescence. *Journal of Child & Adolescent Mental Health*, *32*(2–3), 77–86. https://doi.org/10.2989/17280583.2020.1811288

Jiang, J. (2018). How teens and parents navigate screen time and device distractions. *Pew Research Center*. https://www.pewresearch.org/internet/2018/08/22/how-teens-and-parents-navigate-screen-time-and-device-distractions/

Kadzikowska-Wrzosek, R. (2020). Insufficient sleep among adolescents: The role of bedtime procrastination, chronotype and autonomous vs. controlled motivational

regulations. *Current Psychology*, *39*(3), 1031–1040. https://doi.org/10.1007/s12144-018-9825-7

Kandola, A., Lewis, G., Osborn, D. P. J., Stubbs, B., & Hayes, J. F. (2020). Depressive symptoms and objectively measured physical activity and sedentary behaviour throughout adolescence: A prospective cohort study. *The Lancet Psychiatry*, *7*(3), 262–271. https://doi.org/10.1016/S2215-0366(20)30034-1

Kann, L., Kinchen, S., Shanklin, S. L., Flint, K. H., Hawkins, J., Harris, W. A., Lowry, R., Olsen, E. O., McManus, T., Chyen, D., Whittle, L., Taylor, E., Demissie, Z., Brener, N., Thornton, J., Moore, J., & Zaza, S. (2014). *Youth Risk Behavior Surveillance—United States, 2013.* Centers for Disease Control and Prevention. https://www.cdc.gov/mmwr/preview/mmwrhtml/ss6304a1.htm#:~:text=Introduction,15%25)%20(1).

Kansagra, S. (2020). Sleep disorders in adolescents. *Pediatrics*, *145*(Suppl.2), S204–S209. https://doi.org/10.1542/peds.2019-2056I

Keyes, K. M., Gary, D., O'Malley, P. M., Hamilton, A., & Schulenberg, J. (2019). Recent increases in depressive symptoms among US adolescents: Trends from 1991 to 2018. *Social Psychiatry and Psychiatric Epidemiology*, *54*(8), 987–996. https://doi.org/10.1007/s00127-019-01697-8

Khan, A., & Burton, N. W.(2021). Electronic games, television, and psychological wellbeing of adolescents: Mediating role of sleep and physical activity. *International Journal of Environmental Research and Public Health*, *18*(16), Article 8877. http://doi.org/10.3390/ijerph18168877

Kidokoro, T., Shikano, A., Tanaka, R., Tanabe, K., Imai, N., & Noi, S. (2022). Different types of screen behavior and depression in children and adolescents. *Frontiers in Pediatrics, 9,* Article 822603. https://doi.org/10.3389/fped.2021.822603

Kiss, O., Alzueta, E., Yuksel, D., Pohl, K. M., de Zambotti, M., Műller-Oehring, E. M., Prouty, D., Durley, I., Pelham, W. E., McCabe, C. J., Gonzalez, M. R., Brown, S. A., Wade, N. E., Marshall, A. T., Sowell, E. R., Breslin, F. J., Lisdahl, K. M., Dick, A. S., Sheth, C. S., … Baker, F. C. (2022). The pandemic's toll on young adolescents: Prevention and intervention targets to preserve their mental health. *Journal of Adolescent Health, 70*(3), 387–395. https://doi.org/10.1016/j.jadohealth.2021.11.023

Lanningham-Foster, L., Foster, R. C., McCrady, S. K., Jensen, T. B., Mitre, N., & Levine, J. A. (2009). Activity promoting games and increased energy expenditure. *The Journal of Pediatrics*, *154*(6), 819–823. https://doi.org/10.1016/j.jpeds.2009.01.009

Lawrence, D., Hunter, S. C., Cunneen, R., Houghton, S. J., Zadow, C., Rosenberg, M., Wood, L., & Shilton, T. (2022). Reciprocal relationships between trajectories of loneliness and screen media use during adolescence. *Journal of Child & Family Studies*, *31*(5), 1306–1317. https://doi.org/10.1007/s10826-021-02066-3

LeBourgeois, M. K., Hale, L., Chang, A.-M., Akacem, L. D., Montgomery-Downs, H. E., & Buxton, O. M. (2017). Digital media and sleep in childhood and adolescence. *Pediatrics*, *140*(Suppl. 2), S92–S96. https://doi.org/10.1542/peds.2016-1758J

Lee, H., Kim, Y., & Terry, J. (2020). Adverse childhood experiences (ACEs) on mental disorders in young adulthood: Latent classes and community violence exposure. *Preventive Medicine*, *134*, Article 106039. https://doi.org/10.1016/j.ypmed.2020.106039

Leeb, R. T., Bitsko, R.H., Radhakrishnan, L., Martinez, P., Njai, R., & Holland, K.M.(2020). *Mental health–related emergency department visits among children aged 18 years during the COVID-19 pandemic—United States, January 1–October 17, 2020.* Centers for Disease Control and Prevention. https://doi.org/10.15585/mmwr.mm6945a3

Listernick, Z. I., & Badawy, S. M. (2021). Mental health implications of the COVID-19 pandemic among children and adolescents: What do we know so far? *Pediatric Health, Medicine and Therapeutics*, *12*, 543–549. https://doi.org/10.2147/PHMT.S315887

Liu, J., Riesch, S., Tien, J., Lipman, T., Pinto-Martin, J., & O'Sullivan, A. (2022). Screen media overuse and associated physical, cognitive, and emotional/behavioral outcomes in children and adolescents: An integrative review. *Journal of Pediatric Health Care*, *36*(2), 99–109. https://doi.org/10.1016/j.pedhc.2021.06.003

Liu, S., Xu, B., Zhang, D., Tian, Y., & Wu, X. (2022). Core symptoms and symptom relationships of problematic internet use across early, middle, and late adolescence: A network analysis. *Computers in Human Behavior*, *128*, Article 107090. https://doi.org/10.1016/j.chb.2021.107090

Liu, Y., Yue, S., Hu, X., Zhu, J., Wu, Z., Wang, J., & Wu, Y. (2021). Associations between feelings/behaviors during COVID-19 pandemic lockdown and depression/anxiety after lockdown in a sample of Chinese children and adolescents. *Journal of Affective Disorders*, *284*, 98–103. https://doi.org/10.1016/j.jad.2021.02.001

Lu, W. (2020). Treatment for adolescent depression: national patterns, temporal trends, and factors related to service use across settings. *Journal of Adolescent Health, 67*(3), 401–408. https://doi.org/10.1016/j.jadohealth.2020.02.019

Lu, W. (2019). Adolescent depression: National trends, risk factors, and healthcare disparities. *American Journal of Health Behavior*, *43*(1), 181–194. https://doi.org/10.5993/AJHB.43.1.15

Lu, W. (2017). Child and adolescent mental disorders and health care disparities: results from the national survey of children's health, 2011–2012. *Journal of Health Care for the Poor and Underserved*, *28*(3), 988–1011. https://doi.org/10.1353/hpu.2017.0092

Lukachko, A., Myer, I., & Hankerson, S. (2015). Religiosity and mental health service utilization among African Americans. *The Journal of Nervous and Mental Disease*, *203*(8), 578–582. https://doi.org/10.1097/NMD.0000000000000334

Magson, N. R., Freeman, J. Y. A., Rapee, R. M., Richardson, C. E., Oar, E. L., & Fardouly, J. (2021). Risk and protective factors for prospective changes in adolescent mental health during the COVID-19 pandemic. *Journal of Youth and Adolescence*, *50*(1), 44–57. https://doi.org/10.1007/s10964-020-01332-9

Marciano, L., & Camerini, A. L. (2021). Recommendations on screen time, sleep and physical activity: Associations with academic achievement in Swiss adolescents. *Public Health, 198*, 211–217. https://doi.org/10.1016/j.puhe.2021.07.027

Marques de Miranda, D., da Silva Athanasio, B., Sena Oliveira, A. C., & Simoes-e-Silva, A. C. (2020). How is COVID-19 pandemic impacting mental health of children and adolescents? *International Journal of Disaster Risk Reduction, 51*, Article 101845. https://doi.org/10.1016/j.ijdrr.2020.101845

Mayne, S. L., Hannan, C., Davis, M., Young, J. F., Kelly, M. K., Powell, M., Dalembert, G., McPeak, K. E., Jenssen, B. P., & Fiks, A. G. (2021). COVID-19 and adolescent depression and suicide risk screening outcomes. *Pediatrics, 148*(3), Article e2021051507. https://doi.org/10.1542/peds.2021-051507

Mazzer, K., Bauducco, S., Linton, S. J., & Boersma, K. (2018). Longitudinal associations between time spent using technology and sleep duration among adolescents. *Journal of Adolescence, 66*, 112–119. https://doi.org/10.1016/j.adolescence.2018.05.004

McAllister, C., Hisler, G. C., Blake, A. B., Twenge, J. M., Farley, E., & Hamilton, J. L. (2021). Associations between adolescent depression and self-harm behaviors and screen media use in a nationally representative time-diary study. *Research on Child and Adolescent Psychopathology, 49*(12), 1623–1634. https://doi.org/10.1007/s10802-021-00832-x

Mojtabai, R., Olfson, M., & Han, B. (2016). National trends in the prevalence and treatment of depression in adolescents and young adults. *Pediatrics*, *138*(6), Article e20161878. https://doi.org/10.1542/peds.2016-1878

Moukaddam, N., Cavazos, E., Nazario, M., Murtaza, S., & Shah, A. A. (2019). Depression and its impact on adolescents. *Psychiatric Annals*, *49*(6), 256–262. https://doi.org/10.3928/00485713-20190506-01

Mullen, S. (2018). Major depressive disorder in children and adolescents. *Mental Health Clinician*, *8*(6), 275–283. https://doi.org/10.9740/mhc.2018.11.275

Nagata, J. M., Cortez, C. A., Cattle, C. J., Ganson, K. T., Iyer, P., Bibbins-Domingo, K., & Baker, F. C. (2022a). Screen time use among us adolescents during the COVID-19 pandemic: Findings from the Adolescent Brain Cognitive Development Study. *JAMA Pediatrics*, *176*(1), 94–96. https://doi.org/10.1001/jamapediatrics.2021.4334

Nagata, J. M., Ganson, K. T., Iyer, P., Chu, J., Baker, F. C., Pettee Gabriel, K., Garber, A. K., Murray, S. B., & Bibbins-Domingo, K. (2022b). Sociodemographic correlates of contemporary screen time use among 9- and 10-year-old children. *The Journal of Pediatrics, 240,* 213-220. https://doi.org/10.1016/j.jpeds.2021.08.077

National Institute of Mental Health. (2022). *Major Depression*. . https://www.nimh.nih.gov/health/statistics/major-depression

Nesi, J., Rothenberg, W. A., Bettis, A. H., Massing-Schaffer, M., Fox, K. A., Telzer, E. H., Lindquist, K. A., & Prinstein, M. J. (2021). Emotional responses to social media experiences among adolescents: Longitudinal associations with depressive

symptoms. *Journal of Clinical Child & Adolescent Psychology*, *51*(6), 907-922. https://doi.org/10.1080/15374416.2021.1955370

Nitzl, C., Roldan, J. L., & Cepeda, G. (2016). Mediation analysis in partial least squares path modeling: Helping researchers discuss more sophisticated models. *Industrial Management & Data Systems*, *116*(9), 1849–1864. https://doi.org/10.1108/IMDS-07-2015-0302

O'Callaghan, V. S., Couvy-Duchesne, B., Strike, L. T., McMahon, K. L., Byrne, E. M., & Wright, M. J. (2021). A meta-analysis of the relationship between subjective sleep and depressive symptoms in adolescence. *Sleep Medicine, 79*, 134–144. https://doi.org/10.1016/j.sleep.2021.01.011

Odgers, C. L., & Jensen, M. R. (2020). Annual research review: Adolescent mental health in the digital age: facts, fears, and future directions. *Journal of Child Psychology and Psychiatry, 61*(3), 336–348. https://doi.org/10.1111/jcpp.13190

Orben, A. (2020). Teenagers, screens and social media: A narrative review of reviews and key studies. *Social Psychiatry and Psychiatric Epidemiology*, *55*(4), 407–414. https://doi.org/10.1007/s00127-019-01825-4

Pachter, L. M., Caldwell, C. H., Jackson, J. S., & Bernstein, B. A. (2018). Discrimination and mental health in a representative sample of African American and Afro Caribbean youth. *Journal of Racial and Ethnic Health Disparities*, *5*(4), 831–837. https://doi.org/10.1007/s40615-017-0428-z

Paruthi, S., Brooks, L. J., D'Ambrosio, C., Hall, W. A., Kotagal, S., Lloyd, R. M., Malow, B. A., Maski, K., Nichols, C., Quan, S. F., Rosen, C. L., Troester, M. M.,

& Wise, M. S. (2016). Consensus statement of the American Academy of Sleep Medicine on the recommended amount of sleep for healthy children: Methodology and discussion. *Journal of Clinical Sleep Medicine*, *12*(11), 1549–1561. https://doi.org/10.5664/jcsm.6288

Petito, A., Pop, T. L., Namazova-Baranova, L., Mestrovic, J., Nigri, L., Vural, M., Sacco, M., Giardino, I., Ferrara, P., & Pettoello-Mantovani, M. (2020). The burden of depression in adolescents and the importance of early recognition. *The Journal of Pediatrics*, *218*, 265-267. https://doi.org/10.1016/j.jpeds.2019.12.003

Pew Research Center. (2017). The evolution of technology adoption and usage. *Pew Research Center*. https://www.pewresearch.org/wp-content/uploads/2017/01/FT_17.01.10_InternetFactSheets.png

Pierre, C., Burnside, A., & Gaylord-Harden, N. (2020). A longitudinal examination of community violence exposure, school belongingness, and mental health among African-American adolescent males. *School Mental Health, 12*(2), 388-399. https://doi.org/10.1007/s12310-020-09359-w

Planey, A. M., Smith, S., M., Moore, S., & Walker, T. D. (2019). Barriers and facilitators to mental health help-seeking among African American youth and their families: A systematic review study. *Children and Youth Services Review, 101*, 190-200. https://www.sciencedirect.com/science/article/pii/S0190740918311204

Pretorius, C., Chambers, D., Cowan, B., & Coyle, D. (2019). Young people seeking help online for mental health: Cross-sectional survey study. *JMIR Mental Health*, *6*(8), Article e13524. https://doi.org/10.2196/13524

Przepiorka, A., & Blachnio, A. (2020). The role of Facebook intrusion, depression, and future time perspective in sleep problems among adolescents. *Journal of Research on Adolescence, 30*(2), 559–569. https://doi.org/10.1111/jora.12543

Przybylski, A. K., & Weinstein, N. (2017). A large-scale test of the goldilocks hypothesis: Quantifying the relations between digital-screen use and the mental well-being of adolescents. *Psychological Science, 28*(2), 204–215. https://doi.org/10.1177/0956797616678438

Racine, N., McArthur, B. A., Cooke, J. E., Eirich, R., Zhu, J., & Madigan, S. (2021). Global prevalence of depressive and anxiety symptoms in children and adolescents during COVID-19: A meta-analysis. *JAMA Pediatrics*, *175*(11), 1142–1150. https://doi.org/10.1001/jamapediatrics.2021.2482

Raudsepp, L., & Kais, K. (2019). Longitudinal associations between problematic social media use and depressive symptoms in adolescent girls. *Preventive Medicine Reports, 15*, Article 100925. https://doi.org/10.1016/j.pmedr.2019.100925

Rideout, V., Peebles, A., Mann, S., & Robb, M. B. (2022). *The Common Sense census: Media use by tweens and teens.* Common Sense. https://www.commonsensemedia.org/sites/default/files/research/report/8-18-census-integrated-report-final-web_0.pdf

Rideout, V., & Robb, M. B. (2018). *Social media, social life: Teens reveal their experiences*. Common Sense. https://www.commonsensemedia.org/sites/default/files/research/report/2018-social-media-social-life-executive-summary-web.pdf

Roberts, R. E., & Duong, H. T. (2014). The prospective association between sleep deprivation and depression among adolescents. *Sleep, 37*(2), 239–244. https://doi.org/10.5665/sleep.3388

Rosen, M. L., Rodman, A. M., Kasparek, S. W., Mayes, M., Freeman, M. M., Lengua, L. J., Meltzoff, A. N., & McLaughlin, K. A. (2021). Promoting youth mental health during the COVID-19 pandemic: A longitudinal study. *PLoS One, 16*(8), Article e0255294. http://doi.org/10.1371/journal.pone.0255294

Rospigliosi, P.A. (2022). Metaverse or Simulacra? Roblox, Minecraft, Meta and the turn to virtual reality for education, socialisation and work. *Interactive Learning Environments*, *30*(1), 1–3. https://doi.org/10.1080/10494820.2022.2022899

Rutter, L. A., Thompson, H. M., Howard, J., Riley, T. N., Jesús-Romero, R. D., & Lorenzo-Luaces, L. (2021). Social media use, physical activity, and internalizing symptoms in adolescence: Cross-sectional analysis. *JMIR Mental Health, 8*(9), Article e26134. https://doi.org/10.2196/26134

Sanders, T., Parker, P. D., del Pozo-Cruz, B., Noetel, M., & Lonsdale, C. (2019). Type of screen time moderates effects on outcomes in 4013 children: Evidence from the Longitudinal Study of Australian Children. *The International Journal of Behavioral Nutrition and Physical Activity, 16,* Article117. https://doi.org/10.1186/s12966-019-0881-7

Schaeffer, K. (2019). Most U.S. teens who use cellphones do it to pass time, connect with others, learn new things. *Pew Research Center*.

https://www.pewresearch.org/fact-tank/2019/08/23/most-u-s-teens-who-use-cellphones-do-it-to-pass-time-connect-with-others-learn-new-things/

Schrack, S., & Seidenberg, J. (2021). Effects of insufficient sleep on behavior and emotional regulation in children. *Contemporary Pediatrics*, *38*(3), 19–21. https://cdn.sanity.io/files/0vv8moc6/contpeds/01ca334fc5b53bcedac73b1222365bb5267c07a1.pdf/cntped0321_ezine.pdf

Scott, H., Biello, S. M., & Woods, H. C. (2019). Social media use and adolescent sleep patterns: Cross-sectional findings from the UK millennium cohort study. *BMJ Open*, *9*(9), Article e031161. https://doi.org/10.1136/bmjopen-2019-031161

Selph, S. S., & McDonagh, M. S. (2019). Depression in children and adolescents: Evaluation and treatment. *American Family Physician*, *100*(10), 609–617. https://www.aafp.org/pubs/afp/issues/2019/1115/p609.html

Seo, J.H., Kim, J. H., Yang, K. I., & Hong, S. B. (2017). Late use of electronic media and its association with sleep, depression, and suicidality among Korean adolescents. *Sleep Medicine*, *29*, 76–80. https://doi.org/10.1016/j.sleep.2016.06.022

Sheats, K. J., Irving, S. M., Mercy, J. A., Simon, T. R., Crosby, A. E., Ford, D. C., Merrick, M. T., Annor, F. B., & Morgan, R. E. (2018). Violence-related disparities experienced by black youth and young adults: Opportunities for prevention. *American Journal of Preventive Medicine*, *55*(4), 462–469. https://doi.org/10.1016/j.amepre.2018.05.017

Shen, L., Gu, X., Zhang, T., & Lee, J. (2022). Adolescents' physical activity and depressive symptoms: A psychosocial mechanism. *International Journal of*

Environmental Research and Public Health, 19(3), Article 1276. http://doi.org/10.3390/ijerph19031276

Shin, M., Juventin, M., Wai Chu, J. T., Manor, Y., & Kemps, E. (2022). Online media consumption and depression in young people: A systematic review and meta-analysis. *Computers in Human Behavior, 128,* Article 107129. https://doi.org/10.1016/j.chb.2021.107129

Singh, S., & Balhara, Y. P. S. (2021). "Screen-time" for children and adolescents in COVID-19 times: Need to have the contextually informed perspective. *Indian Journal of Psychiatry, 63*(2), 192–195. https://doi.org/10.4103/psychiatry.IndianJPsychiatry_646_20

Smith, C., Wilde, T. de, Taylor, R. W., & Galland, B. C. (2020). Prebedtime screen use in adolescents: A survey of habits, barriers, and perceived acceptability of potential interventions. *Journal of Adolescent Health, 66*(6), 725–732. https://doi.org/10.1016/j.jadohealth.2019.12.007

Song, H.Y., & Kim, J.H. (2022). Smartphone use type, fear of missing out, social support, and smartphone screen time among adolescents in Korea: Interactive effects. *Frontiers in Public Health, 10,* Article 822741. https://www.frontiersin.org/article/10.3389/fpubh.2022.822741

Substance Abuse and Mental Health Services Administration. (2011). *Results from the 2011 National Survey on Drug Use and Health: Mental health findings*. https://www.samhsa.gov/data/sites/default/files/2011MHFDT/2k11MHFR/Web/NSDUHmhfr2011.htm#2.4

Substance Abuse and Mental health Services Administration. (2019). *2019 National survey on drug use and health: African Americans*. https://www.samhsa.gov/data/sites/default/files/reports/rpt31099/2019NSDUH-AA/AfricanAmerican%202019%20NSDUH.pdf

Substance Abuse and Mental Health Services Administration. (2020). *Key substance use and mental health indicators in the United States: Results from the 2020 National Survey on Drug Use and Health*. https://www.samhsa.gov/data/sites/default/files/reports/rpt35325/NSDUHFFRPDFWHTMLFiles2020/2020NSDUHFFR1PDFW102121.pdf

Tamura, H., Nishida, T., Tsuji, A., & Sakakibara, H. (2017). Association between excessive use of mobile phone and insomnia and depression among Japanese adolescents. *International Journal of Environmental Research and Public Health*, *14*(7), Article 701. https://doi.org/10.3390/ijerph14070701

Tremblay, M. S., Carson, V., Chaput, J.P., Dinh, T., Duggan, M., Faulkner, G., Gray, C. E., Gruber, R., Janson, K., Katzmarzyk, P. T., Kho, M. E., Latimer-Cheung, A. E., LeBlanc, C., Okely, A. D., Olds, T., Russell, P. R., Phillips, A., Poitras, V. J., Rodenburg, S., … Zehr, L. (2016). Canadian 24-hour movement guidelines for children and youth: An integration of physical activity, sedentary behaviour, and sleep. *Applied Physiology, Nutrition, and Metabolism*, *41*(6,Suppl. 3), S311–S327. https://doi.org/10.1139/apnm-2016-0151

Twenge, J. M. (2020a). Why increases in adolescent depression may be linked to the technological environment. *Current Opinion in Psychology*, *32*, 89–94. https://doi.org/10.1016/j.copsyc.2019.06.036

Twenge, J. M. (2020b). Increases in depression, self-harm, and suicide among US adolescents after 2012 and links to technology use: Possible mechanisms. *Psychiatric Research and Clinical Practice*, *2*(1), 19–25. https://doi.org/10.1176/appi.prcp.20190015

Twenge, J. M., & Campbell, W. K. (2018). Associations between screen time and lower psychological well-being among children and adolescents: Evidence from a population-based study. *Preventive Medicine Reports*, *12*, 271–283. https://doi.org/10.1016/j.pmedr.2018.10.003

Twenge, J. M., Cooper, A. B., Joiner, T. E., Duffy, M. E., & Binau, S. G. (2019). Age, period, and cohort trends in mood disorder indicators and suicide-related outcomes in a nationally representative dataset, 2005–2017. *Journal of Abnormal Psychology*, *128*(3), 185–199. https://doi.org/10.1037/abn0000410

Twenge, J. M., Hisler, G. C., & Krizan, Z. (2019). Associations between screen time and sleep duration are primarily driven by portable electronic devices: Evidence from a population-based study of U.S. children ages 0–17. *Sleep Medicine, 56*, 211–218. https://doi.org/10.1016/j.sleep.2018.11.009

Twenge, J. M., Joiner, T. E., & Keith, C. W. (2020). Underestimating digital media harm. *Nature Human Behaviour*, *4*(4), 346–348. https://doi.org/10.1038/s41562-020-0839-4

Twenge, J. M., Joiner, T. E., Rogers, M. L., & Martin, G. N. (2018). Increases in depressive symptoms, suicide-related outcomes, and suicide rates among U.S. adolescents after 2010 and links to increased new media screen time. *Clinical Psychological Science*, *6*(1), 3–17. https://doi.org/10.1177/2167702617723376

Twenge, J. M., Krizan, Z., & Hisler, G. (2017). Decreases in self-reported sleep duration among U.S. adolescents 2009–2015 and association with new media screen time. *Sleep Medicine*, *39*, 47–53. https://doi.org/10.1016/j.sleep.2017.08.013

Twenge, J. M., Martin, G. N., & Campbell, W. K. (2018). Decreases in psychological well-being among American adolescents after 2012 and links to screen time during the rise of smartphone technology. *Emotion*, *18*(6), 765–780. https://doi.org/10.1037/emo0000403

Twenge, J. M., Martin, G. N., & Spitzberg, B. H. (2019). Trends in U.S. adolescents' media use, 1976–2016: The rise of digital media, the decline of TV, and the (near) demise of print. *Psychology of Popular Media Culture*, *8*(4), 329–345. https://doi.org/10.1037/ppm0000203

U.S. Census Bureau. (2021). *2020 National Survey of Children's Health*. https://www2.census.gov/programs-surveys/nsch/technical-documentation/codebook/NSCH_2020_Topical_Frequencies.pdf

U.S. Department of Health and Human Services. (2022). *Get Enough Sleep—MyHealthfinder.* https://health.gov/myhealthfinder/healthy-living/mental-health-and-relationships/get-enough-sleep

https://doi.org/10.15585/mmwr.su6901a1

Underwood, J. M., Brener, N., Thornton, J., Harris, W. A., Bryan, L. N., Shanklin, S. L., Deputy, N., Roberts, A. M., Queen, B., Chyen, D., Whittle, L., Lim, C., Yamakawa, Y., Leon-Nguyen, M., Kilmer, G., Smith-Grant, J., Demissie, Z., Jones, S. E., Clayton, H., & Dittus, P. (2020). O*verview and Methods for the Youth Risk Behavior Surveillance System—United States, 2019.* US Department of Health and Human Services & Centers for Disease Control and Prevention.

UNICEF. (2017). *Children in a digital world*. https://www.unicef.org/media/48601/file

van Sluijs, E. M. F., Ekelund, U., Crochemore-Silva, I., Guthold, R., Ha, A., Lubans, D., Oyeyemi, A. L., Ding, D., & Katzmarzyk, P. T. (2021). Physical activity behaviours in adolescence: Current evidence and opportunities for intervention. *The Lancet*, *398*(10298), 429–442. https://doi.org/10.1016/S0140-6736(21)01259-9

Vazsonyi, A. T., Liu, D., Javakhishvili, M., Beier, J. J., & Blatny, M. (2021). Sleepless: The developmental significance of sleep quality and quantity among adolescents. *Developmental Psychology*, *57*(6), 1018–1024. https://doi.org/10.1037/dev0001192

Velazquez, B., Petresco, S., Pereira, R., Buchweitz, C., Manfro, P. H., Caye, A., Fisher, H. L., Kohrt, B. A., Mondelli, V., & Kieling, C. (2022). Physical activity and depressive symptoms among adolescents in a school-based sample. *Brazilian Journal of Psychiatry, 44*(3), 312-316.https://doi.org/10.1590/1516-4446-2021-2235

Wagner, B. E., Folk, A. L., Hahn, S. L., Barr-Anderson, D. J., Larson, N., & Neumark-Sztainer, D. (2021). Recreational Screen time behaviors during the covid-19 pandemic in the U.S.: A mixed-methods study among a diverse population-based sample of emerging adults. *International Journal of Environmental Research and Public Health*, *18*(9), Article 4613. https://doi.org/10.3390/ijerph18094613

Wang, P., Liu, S., Zhao, M., Yang, X., Zhang, G., Chu, X., Wang, X., Zeng, P., & Lei, L. (2019). How is problematic smartphone use related to adolescent depression? A moderated mediation analysis. *Children and Youth Services Review*, *104*, Article 104384. https://doi.org/10.1016/j.childyouth.2019.104384

Weissman, M. M., Wolk, S., Goldstein, R. B., Moreau, D., Adams, P., Greenwald, S., Klier, C. M., Ryan, N. D., Dahl, R. E., & Wickramaratne, P. (1999). Depressed adolescents grown up. *JAMA*, *281*(18), 1707–1713. https://doi.org/10.1001/jama.281.18.1707

World Health Organization. (2020). *Physical activity*. https://www.who.int/news-room/fact-sheets/detail/physical-activity

World Health Organization. (2021). *Adolescent mental health*. https://www.who.int/news-room/fact-sheets/detail/adolescent-mental-health

Yang, J., Fu, X., Liao, X., & Li, Y. (2020). Association of problematic smartphone use with poor sleep quality, depression, and anxiety: A systematic review and meta-analysis. *Psychiatry Research*, *284*, Article112686. https://doi.org/10.1016/j.psychres.2019.112686

Zhang, S., Cain, D. S., & Liao, M. (2021). Racial/ethnic disparities in the decision points of mental health service use and psychotropic medication receipt among depressed youth. *Youth & Society*, *53*(4), 610–635. https://doi.org/10.1177/0044118X19871853

Zink, J., Belcher, B. R., Imm, K., & Leventhal, A. M. (2020). The relationship between screen-based sedentary behaviors and symptoms of depression and anxiety in youth: A systematic review of moderating variables. *BMC Public Health*, *20*, Article 472. https://doi.org/10.1186/s12889-020-08572-1