Spring 2023

Associations Between Screen Use and Depression in the Youth Population

David Franta
University of North Dakota

Associations Between Screen Use and Depression in the Youth Population

by

David Franta, PA-S

Bachelor of Science in Nursing, St. John's University, 2018

Contributing Authors: Vicki Andvik, MPAS, PA-C and

Russell Kauffman, MPAS, PA-C

A Scholarly Project

Submitted to the Graduate Faculty of the University of North Dakota

in partial fulfillment of the requirements for the degree of

Master of Physician Assistant Studies

May 2023~~2~~

Table of Contents

Acknowledgements....3

Abstract....4

Introduction....5

Statement of the Problem....5

Research Question....6

Methods....6

Literature Review....7

Different Types of Screen Time and Their Association to Depression in Youth....7

Screen Time and Depression between Males and Females....23

Screen Time and Depression between Age Groups....29

Self-Harm and Suicide in Relation to Screen Media....45

Discussion....48

Conclusion and Applicability to Clinical Practice....59

References....63

Acknowledgementss

I would like to thank my advisor Vicki Andvik, MPAS, PA-C and my instructor Russell Kauffman, MPAS, PA-C for their support and insight regarding the development of this scholarly project. I would also like to thank Megan Denis, MLIS at the University of North Dakota's Library Resources, as her insight has been invaluable and a truly fantastic contribution to my research. In addition, I would like to thank Dr. Marilyn Klug for her insight regarding statistical analysis, which was instrumental to the data interpretation component of this scholarly project. Of course, I would like to thank my fellow classmates for remaining an unwavering support system throughout my time as a student in the UND Physician Assistant program. Thank you to Aubrey Sieberg, PsyD, LP for her insight regarding clinical assessment and practice. I would also like to thank United Hospital District for fostering a wonderful clinical environment, and a special thank you goes out to Dr. Aaron Johnson, MD and Kara Ristau FNP-C for unparalleled teaching and clinical preceptorship throughout my time in family practice. Finally, I would like to thank my family, ~~my~~ my fiancé Emma, and ~~my~~ my loyal dog Morgan for supporting me with understanding, patience, and encouragement throughout my time as a Physician Assistant student.

~~TBD...~~

Abstract

The association between depression in the youth population and screen use has remained largely unclear. Depression is a common finding in children and adolescents, and as mobile phones, computers, and television are becoming more readily available to young populations, evaluation of the relationship between the two could likely be very important. Unfortunately, little concrete evidence has been established regarding the direct effects of screen time and the presence or development of depression. A literature review comprised of both cross-sectional and longitudinal studies was performed to evaluate the current literature regarding screen use and depression in the youth population, including differences between sexes, across ages, and amongst different types of screen time, based on the current available body of evidence.

This literature review's results demonstrate that an association between screen use and depression in the youth population does exist, particularly cross sectionally. The results also show that a causative relationship may exist between screen use and the development of later depressive symptoms, however, the causative influence that screen use has upon depressive symptoms is quite minor. Social media and internet use were found to have the greatest association with depressive symptoms, and girls tend to use these platforms at higher volumes than boys. Insights gathered from this literature review could be helpful in both guiding screen use recommendations and identifying youth at risk for depression.

Keywords: screen time, screen use, depression, children, adolescent, adolescents, social media, mental disorders, mental health, depressive disorder, youth, screen media, digital media

Introduction

Statement of the Problem

Depression in children and adolescents is and will undoubtedly remain a condition that primary care ~~provider~~ providers and pediatric specialists will encounter on a regular basis. According to the 2022 *Current Diagnosis and Treatment: Pediatrics*, data shows the incidence of depression is 1-3% in childhood, and this number increases to 9% in the adolescent population. However, one in five adolescents will experience depression at some point. Those who are depressed in these populations will often experience symptoms such as social isolation, poor performance in school, a loss of interest in activities, irritability, fatigue, and anger, as well as physical symptoms, including abdominal and musculoskeletal pain and headaches. Suicide risk is the most pronounced complication of depression in childhood and adolescence, and those who are depressed are more likely to harm themselves or attempt suicide. Effective identification and treatment can often lead to remission of depressive symptoms within a few months (Abzug, et al., 2022). In the age of technology, with large quantities and varieties of screen media open to consumption by children and adolescents, the use of screens is staggering. In fact, according to the American Academy of Child and Adolescent Psychiatry ~~(~~[~~[~~AACAP~~]~~, ~~(~~2022), the average child aged 8-12 years old consumes between ~~four~~ 4 and ~~six~~ 6 hours of screen time daily. The AACAP goes on to state that some teens will spend up to ~~nine~~ 9 hours viewing screens daily. The American Academy of Pediatrics (AAP) recommend that children spend less than ~~two~~ 2 hours daily viewing screens in a sedentary setting (Hill, et al., 2016). A question that remains largely unanswered is the connection between screen use, particularly different types of screen time, and depression. If a significant association between the two can be identified, particularly if

elevated screen use can be implicated as a cause of depression in the youth, much insight could be lent to healthcare providers, parents, and pediatric patients regarding recommendations for restricting screen use and effectively preventing and treating depression in the youth population.

Research Question

Do pediatric patients with increased daily screen time experience a higher prevalence of depression when compared to those with limited daily screen time?

Methods

A thorough literature review was conducted regarding screen time and depression in the youth population, with a focus on youth aged~~s seventeen~~ 17 and younger. Due to the demographic of the available research, a majority focused on the adolescent population. Both MeSH terms and keywords were used to find research via databases including Pubmed, Embase, PsychInfo, and Google Scholar. Google Scholar was primarily used as a search engine to ~~find~~ identify research not found on the other databases on initial searches, allowing a more all-encompassing assessment of the current literature. Pubmed comprised the source of most of the studies utilized, although a considerable amount of overlap was witnessed between search engines. Priority of research was given to studies with larger sample sizes, particularly when evaluating cross-sectional research. Studies were also prioritized based on how directly they evaluated the relationship between screen time and depression, alone, rather than conditions encompassing depression (such as “mental health,” “self-image,” “self-concept” and “internalizing disorders”)~~,~~; however, some studies ~~were included~~ that evaluated these conditions were included due to the strength of the study and the implications that the study could provide to medical practice. Longitudinal studies were also prioritized because of the potential to demonstrate the presence or absence of a causal relationship between depression and screen time.

To eliminate bias, studies were ~~evaluated~~ selected based ~~by~~ on ~~their~~ strength, control of variables, sample size, and ~~how well they reflect~~reflection of the general population prior to evaluation of the results of the study. In this way, research was neither included nor excluded based on results. Priority was given to studies published within the past five years. This is important in that screen time is continuously evolving, and recent research will likely better reflect current trends between screen time and depression. S~~Similarly, s~~ome studies focused solely on social media and were included because social media is now frequently used by the youth population. Criteria of exclusion included studies published more than five years ago, studies with ~~small~~ sample sizes less than 200, and studies that did not focus on the research question. A synthesis matrix was utilized to organize research, develop themes, categorize age groups, and analyze strength of research.

Literature Review

Different Types of Screen Time and Their Association to Depression in Youth

Robertson et al. (2022) analyzed data collected from the baseline collection of the 10-year longitudinal Adolescent Brain and Cognitive Development (ABCD) Study to analyze the effect screen time may have on internalizing disorders in 9-10-year-olds. The ABCD Study will release data annually, beginning in 2018 for use in the research community. Participants have been selected to represent the U.S. demographic. According to the **Adolescent Brain Cognitive Development** [~~school selection and role -~~ **ABCD**] study ~~study~~ **(2022)**, there are 11,880 students who have enrolled in the study, and public, private, and charter elementary schools within travel distance from the 21 research sites in the U.S. were contacted to provide information packets to students and their families~~)~~. Thus, the study uses data from students that represent the variability in living conditions, education, race, ethnic background, and income level that is found

throughout the U.S. According to Robertson et al., the average age was 9.91 years old, and ~~.~~ ~~–~~48% of the participants were female; ~~.~~ ~~–~~59% were white, 9% were black, 19% Hispanic, 2% Asian, and 10% of another, unspecific race. The participants self-reported the number of hours ~~daily~~ spent daily on different types of screen media, including TV shows/movies, online videos, video games, texting, and utilizing social media. ~~According to Robertson, et al.,~~ *N* = 11,780 (Robertson et al., 2022) ~~.~~ ~~–~~

Participants quantified their screen ~~time with~~use for each type of screen media. Mental disorders were evaluated using a modified version of the Kiddie Schedule for Affective Disorders and Schizophrenia (K-SADS-5) to measure both current and past symptoms of disorders~~,~~ based on DSM-V criteria (Robertson et al., 2022). K-SADS-5 assessed depressive disorders, anxiety disorders, suicidal ideation, suicide attempts, and non-suicidal acts of self-harm. Data was analyzed both for screen time quantity, as well as by splitting types of screen time into "a~~A~~ll s~~S~~creen t~~T~~ime" and "d~~D~~igital m~~M~~edia t~~T~~ime" (comprising social media, gaming, texting, and internet videos). First, total screen time was analyzed between those spending more than ~~two~~ 2 hours daily using screen media and those ~~spending~~ using screens l~~l~~ess than ~~two~~ 2 hours daily. Time spent on each specific type of screen media was analyzed, as well. ~~Then,~~ ~~d~~Data was then analyzed, comparing gross quantity (up to ~~seven~~ 7 or more hours daily) for both total screen time and individual screen media types. Analyses were also conducted separately by gender. Relative risk was reported, as well as adjusted relative risk, to account for demographic controls (Robertson et al., 2022).

Digital media was also broken down into social media, gaming, texting, and online videos. Analysis of each single faction of digital media was completed by comparing those spending more than ~~two~~ 2 hours daily on each faction of digital media ~~and comparing it~~ to those

who spent less than ~~two~~ 2 hours on each respective faction. Due to the low prevalence of 9 and 10-year-olds spending more than ~~two~~ 2 hours daily on social media, those who used any social media were compared to those using no social media at all, and it was found that those spending any amount of time on social media in a day were significantly more likely to have a depressive disorder, with higher severity of depression being found in females (aRR 1.74 [1.34, 2.26] for girls; aRR 1.38 [1.05, 1.83] for boys) (Robertson et al. (2022). Overall, the study performed by Robertson et al., showed that those spending more than ~~two~~ 2 hours daily on any screen were more likely to meet criteria for depressive disorders, suicidal ideation, self-harm, and suicide attempts ~~(Robertson et al., 2022)~~. It also showed that girls spending more than ~~two~~ 2 hours daily on social media or online videos were statistically more likely to meet criteria for depressive disorders, but this was not the case for girls spending more than ~~two~~ 2 hours on gaming or texting. For boys, spending more than ~~two~~ 2 hours on any individual form of digital media (social media, texting, gaming, or videos) was associated with increased likelihood of meeting criteria for depressive disorders. For girls, total screen time, total digital media time, and video chat time of more than ~~two~~ 2 hours duration daily was associated with increased prevalence of depression, but this was not true for total time spent on TV and movies totaling greater than ~~two~~ 2 hours. For boys, very similar results were found, in that a duration of greater than ~~two~~ 2 hours daily spent on TV and movies were the only screen time sources not associated with increased depression (Robertson et al., 2022). This is a crucial piece of literature that assesses the 9–10-year-old population. The breakdown of the differences witnessed between males and females is noted in the next theme.

Strengths of this study include a large sample size drawn from participants in a similar age group but representing a variety of racial, economic, and cultural demographics,

representative of the continental U.S. Another strength is that it ~~both~~ measures quantitative screen time ~~measurements~~ while also distinguishing different types of screen media. A limitation of the study includes that it is cross-sectional and retrospective, making the determination of a causal relationship between screen media time and depression impossible. At this time, it is only able to be used cross-sectionally, but in the future, longitudinal conclusions from this study will likely provide further insight.

Kim et al. (2020) utilized data collected from the 2014 Ontario Child Health Study (OCHS), which included 2,320 adolescents between the ages of 12-17. The goal was to determine if a relationship exists between increased screen time when comparing active forms of screen use (video gaming, chatting, and working on a computer) to passive forms (watching TV, movies, of videos, including YouTube) in relation to the presence of major depressive episodes and anxiety disorders. The OCHS selected children ages 4-17 years old from within Ontario, Canada. Cluster sampling of households was utilized, based on area of residency, to include area of residency (urban versus~~s.~~ rural) and income levels. C~~The c~~ollection of ~~the~~ data occurred from October 2014 through October 2015. Although the OCHS study used participants aged 4-17, this study only used adolescent youth, aged~~s~~ 12-17 (*N* = 2,320). Adolescents reported screen time use, which was differentiated into "passive" and "active," by asking very specific questions about screen time use. When eliciting the quantity of passive screen time, researchers asked, "over the past seven days, on average how many hours per day did you sit and watch TV, movies, or videos, including Youtube?" (Kim et al., 2020). To quantify participants' active screen time use, ~~they~~ the researchers asked, "over the past seven days, on average, how many hours per day did you spend outside of school on a computer, laptop, tablet, or smart-phone (working, playing games, emailing, chatting, surfing the Internet, etc.)?" (Kim et al., 2020).

Participants were given the scoring options of ~~(~~0~~)~~ (-lless than ~~one~~ 1 hour), ~~(~~1~~)~~ ~~(one to two~~1-2 hours), ~~(~~2~~)~~ (2-3~~two to three~~ hours)~~,~~ ~~(~~3~~)~~ (~~three to four~~3-4 hours)~~,~~ ~~(~~4~~)~~ (~~four to five~~4-5 hours), and ~~(~~5~~)~~ (~~five~~ 5 or more hours). Physical activity, socioeconomic status, and sleep were also assessed in this study~~,~~ to account for these variables when analyzing the interaction between passive and active screen media usage and the prevalence of depression and anxiety. Episodes of major depressive disorder and anxiety disorders, ~~(~~based on Diagnostic and Statistical Manual of Mental Disorders IV TR (DSM-IV-TR), were the dependent variables.~~,~~ ~~and t~~These were evaluated using a modified form of the Mini International Neuropsychiatric Interview for Children and Adolescents (MINI-KID), which was administered by trained individuals to the adolescent participants (Kim et al., 2020). The MINI-KID was administered to both the child and the child's parents, separately, and if either interview revealed positive results, the participant was classified as having the disorder. Odds ratios with 95% CIs were used and were adjusted twice (Model 1 adjusted for age, sex, low income, and active and passive forms of screen time; Model 2 included additional adjustment for sleep quality, sleep duration, and physical activity).

When comparing the prevalence of major depressive episode after full adjustment, those using greater than ~~four~~ 4 hours of passive screen time daily were more than twice as likely to have experienced a major depressive episode in the past ~~six~~ 6 months (OR 2.73 [1.28-5.81]) when compared to the control (those using less than ~~two~~ 2 hours daily). Passive screen time of more than ~~two~~ 2 hours daily but fewer than ~~four~~ 4 hours daily did not demonstrate a statistical difference when compared to the control. There was no statistically significant association between levels of active screen time and the presence of major depressive episodes, even with use above 4 hours daily (Kim, et al., 2020). ~~Thus,~~ B~~b~~ased on these study results, ~~we can~~

~~conclude that four~~4 or more hours daily of passive screen time was associated with increased odds of having a major depressive episode, but no other significant findings were present.

Strengths of this study include the fact that multiple variables were accounted for. The sample size was ~~fairly large~~sizeable, and although it did not distinguish ages between 12-17 years old, it provided a reflection of the adolescent age group, as a whole. Another strength of this study is that it delineates between different types of screen media based on the activity of the user, which has not been found in other research and is an important consideration. Finally, a strength of this study is that the data were collected via interview by trained interviewers, rather than via questionnaire. Limitations of this study include ~~that it is~~its cross-sectional nature, which eliminates the ability to claim causation, in that depressed individuals might be more likely to participate in high volumes of passive screen time, resulting in an association between high levels of passive screen time and depression. The authors also mention that a weakness of the study is that it does not reveal the extent or mechanism in which sleep and physical activity contribute to screen time use and the prevalence of depression. Additionally, the authors mention that self-reporting of the data by the participants might reduce the accuracy of the study, and ~~that~~ the study lacks specificity in differentiating between different types of screen media (ex: social media, video games, and internet surfing) (Kim et al., 2020).

Boers et al. (2019) used data from a randomized clinical trial that was used for a drug and alcohol prevention program;~~,~~ however, data was also collected regarding students' use of screen time and depressive symptoms to develop a longitudinal study regarding screen time and depression in students. Thirty-one schools in the Greater Montreal area were recruited, and participants completed web-based surveys to evaluate depression and screen ~~time~~use. ~~This~~ Surveys were~~was~~ completed in class~~,~~ every year, beginning in 2012 (when all the kids were in

~~7th~~ seventh grade) and ending in 2016 (when the kids were in 11th grade). Sex, age, school, and socioeconomic status were other factors considered. The Brief Symptoms Inventory (BSI), which includes seven symptoms of depression, each of which are scored 0 (not at all) to 4 (very much) by the students, was used to evaluate depressive symptoms. Screen time use was evaluated by asking how much time was spent daily playing video games, on Facebook or Twitter (or other social networking sites), watching TV shows or movies, and other activities on the computer. The total sample size was 3,826 adolescents, with 47% being female and a mean age of 12.7 years old ~~,~~ at the beginning of data collection (Boers et al., 2019).

Girls and those with a lower socioeconomic status reported more extreme depressive symptoms, overall. As a whole, the mean usage of social media and television increased each year. Video game usage decreased slightly over ~~four~~ 4 years, and computer use remained relatively stable over the course of four years (Boers, et al., 2019). Data was evaluated both for between-person and within-person interactions over the course of ~~four~~ 4 years. ~~; it was reported as (SD [95% CI]).~~ It was found that a ~~one~~1 ~~-~~hour increase (between-person) in social media use was associated with a 1-year mean 0.64-unit increase in depressive symptoms (~~SD~~ 0.64, 95% CI [0.48 - 0.81]) on the BSI. It was also found that a 1~~one~~-hour increase in social media (within-person) was associated with a 0.41-unit increase in depressive symptom severity over the course of ~~four~~ 4 years (~~SD~~ 0.41 [0.32 - 0.51]). No significant difference in the severity of depressive symptoms was seen for video gaming in neither between-person nor within-person evaluation. For computer use, a 0.69-unit increase in depressive symptom severity for every ~~one~~ hour increase in computer use was seen when analyzing between-person data (~~SD~~ 0.69 [0.47 - 0.91]), however, no significant increase was noted in within-person evaluation. ~~Actually~~Contrarily, when increasing the amount of TV watched on a daily basis by ~~one~~ 1 hour, a significant 0.22-

unit decrease (in BSI scoring) was witnessed (~~SD~~ 0.22 [-0.40 - 0.05]), however, when analyzing television use from a within-person perspective, each hour of TV increase yielded a 0.18-unit increase in depressive symptom severity (~~SD~~ 0.18 [0.09 - 0.27] (Boers et al., 2019).

This study showed that high means of social media use over four years, as well as any additional increase in social media use in that same year, was associated with increased severity of depressive symptoms. In summary, an increase in TV usage was associated with lower severity of depressive symptoms, however, within that same year, if TV usage increases, it is associated with higher severity of depressive symptoms. Higher levels of computer use are associated with increased severity of depressive symptoms, but increasing computer use within a year's time does not further increase depression. ~~Video gaming, in this study~~In this study, video gaming ~~does~~ did not have a significant association with depression. It is ~~very~~ important to note that social media use and TV use, over time, was shown to be associated with lower self-esteem (Boers et al., 2019).

Strengths of this study include that it allows association between depression and different types and volumes of screen time to be analyzed over a ~~four~~4-year period, using a sample of students aging from ~~grade 7 to grade 11~~seventh to 11th grade (over the course of the study). It uses a ~~fairly~~ large sample size, ~~as well,~~ and it effectively analyzes different types of screen time. A limitation exists within the fact that the sample was drawn completely from the Greater Montreal area, and the data was self-reported (Boers et al., 2019).

Vannucci ~~, et al~~and McCauley Ohannessian (2019) conducted a study that aimed to examine the longitudinal relationship between different social media platforms and their quantity of use ~~and~~ in relation to later ~~(six months)~~ development of psychosocial symptoms, including internalizing and externalizing symptoms. This study was longitudinal, but it only lasted 6

months. This study focused on those aged 11-14 years old. Students were eligible if they were enrolled in one of five New England public schools, did not have a significant developmental/educational delay, and were in ~~grades 7-8~~seventh or eighth grade. ~~They~~ Students were drawn from a wide range of socioeconomic and racial demographics, which reflected the New England communities ~~from~~ on which the study focused (Vannucci ~~et al.~~& McCauley Ohannessian, 2019). The total sample population was 1,205, with 51% being female and 51% being white. Consent was obtained from both the parents and the adolescents, and the first wave of study ensued in the fall of 2016 with the second wave occurring ~~six~~ 6 months later in the spring of 2017. Trained individuals administered the questionnaires used to collect data. One thousand and sixty students were retained from Wave 1 to Wave 2, thus *N* = 1060 (Vannucci ~~et al.~~& McCauley Ohannessian, 2019). The Technology Use Questionnaire (TUQ) was used to evaluate the amount of time spent using social media (Twitter, Tumblr, discussion boards, Facebook, Instagram, Pin Boards, Google +) ~~in~~ each day, which were scored from 0 (never) to 8 (almost constantly). ~~They~~ Participants were also asked to quantify how many different sites they used and how much time they spent on various social media platforms. Depressive symptoms were evaluated using the~~a twenty~~20 ~~-~~question ~~scale called the~~ Center for Epidemiological Studies Depression Scale for Children ~~and~~ to quantify~~ied~~ depressive symptoms within the past week (Vannucci ~~et al.~~& McCauley Ohannessian, 2019).

Based on baseline trajectories, three categories of social media use among participants were identified with high validity. These groups included 1) High Social Media Use s~~S~~ubgroup (~~across~~ encompassing all social media platforms, with frequent, daily use; *N* = 89), 2) High Instagram/Snapchat s~~S~~ubgroup (hourly use of Snapchat/Instagram, with low use in other types of social media; *N* = 642), and 3) Low Social Media Use s~~S~~ubgroup (less than daily use of any

social media platform; *N* = 474) (Vannucci et al. & McCauley Ohannessian, 2019). Students were assigned one of the subgroups based on their use of social media. MAs stated above, most students were found to either use low amounts of social media or predominantly use Snapchat and Instagram. Those in the High Social Media Use sSubgroup spent significantly more time using social media than, as a whole, than did the Snapchat/Instagram group (Vannucci et al., 2019). The High Social Media use subgroup consumed an average of 4.7 hours daily (SD = 4.58), while the High Instagram/Snapchat subgroup used an average of 3.58 hours daily (SD = 3.28), and the Low Social Media Use subgroup used an average of 1.15 hours daily (SD = 1.76) (Vannucci & McCauley Ohannessian, 2019).

When examining depressive symptoms at Wave 2, those in the High Social Media Use sSubgroup experienced significantly more depressive symptoms when compared to both the High Instagram/Snapchat Use sSubgroup and the Low Social Media Use sSubgroup (***p*** = < 0.01 for both) (Vannucci et al. & McCauley Ohannessian, 2019). However, no differences in depression were witnessed when comparing the High Instagram/Snapchat Use sSubgroup and the Low Social Media Use sSubgroup. Overall, those in the High Social Media Use sSubgroup used social media for an average of four to five 4-5 hours daily. Those in the High Instagram/Snapchat Subgroup used social media nearly four 4 hours daily. Younger adolescents in this study tended to be in the Low Social Media Use sSubgroup. Those in the High Social Media Use sSubgroup could be predicted to have worse internalizing symptoms (which includes depression) at Wave 2 when compared to the other social media use groups (Vannucci et al., 2019). Those in this the High Social Media Use subgroup spent more time on social media platforms, but also used the highest number of different platforms, which complicates the ability to isolate the causative factor (Vannucci et al. & McCauley Ohannessian, 2019).

Both strengths and limitations were present in this study. Strengths include the longitudinal nature of the study and an adequate sample size with~~, as well as a fairly large sample size with good~~ good retention, allowing the authors to be able to claim that belonging to a subclass of social media users can be used to predict future psychosocial outcomes~~, (at least six~~ 6 months in the future~~)~~. The study ~~was~~ also controlled for covariates, limiting the possibility of confounding factors. The authors also mention that the study focuses on an age range of adolescents for which little research has been completed in the past, extending the current body of research. Limitations include the fact that the studied demographic may not accurately reflect the adolescent population of the nation. The authors also mention that the study only encompassed ~~six~~ 6 months, making it impossible to predict outcomes past that time. The study did not measure and analyze time spent on each specific media platform, which could yield further predictive ability. Lastly, the authors mention that self-report may lead to inaccuracies in data (Vannucci ~~et al.~~& McCauley Ohannessian, 2019).

Babic et al. (2017) used data from the Switch-off 4 Healthy Minds to conduct a longitudinal cluster randomized controlled trial over the course of ~~six~~ 6 months. Students were drawn from eight Catholic secondary schools in New South Wales, Australia. The study's participants were all in their first year of secondary school (~~Grade 7~~seventh grade), with the average age being 14.4 ± 0.6 years. *N*~~*n*~~=322 with 65.5% of the population being female. Students were eligible if they reported at least two hours of recreational screen time daily. The first 40 students from each school were recruited into the study. Two groups were utilized with random clustered placement into each group. After baseline assessments were obtained, the study group was provided with interventions and were informed (both the parents and the students) to reduce recreational screen time over the next ~~six~~ 6 months, while the control group was not provided

interventions (Babic et al., 2017). The primary outcome of the study was recreational screen time, which was measured using the Adolescent Sedentary Activity Questionnaire (ASAQ) ~~,~~ ~~which~~ and delineated how much time each person spends on each respective activity: watching TV, watching DVDs and Movies, using a computer for fun, and using tablets, iPads/iPods/iPhones, etc. T~~hen, t~~otal screen time was calculated by adding the screen time from each category together (Babic et al., 2017).

Secondary outcomes included physical self-concept, psychological well-being, and psychological difficulties. Physical self-concept was evaluated using Marsh's Physical Self-Description Questionnaire, with higher scores indicating higher physical self-concept. Psychological well-being was measured using the Flourishing Scale, which is an eight-item summary of self-perceived success in a variety of areas, including relationships, self-esteem, meaning, purpose, and more. To measure psychological difficulties, the Strengths and Difficulties Questionnaire (SDQ) was utilized, which evaluates "emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and prosocial behavior." Of the 322 students initially included in the study, 308 were maintained throughout the study (Babic, et al., 2017).

Over the course of ~~six~~ 6 months, changes in total screen time and the use of tablets/mobile phones were found to have a negative association with physical self-concept (as recreational screen time increased, physical self-concept decreased). When analyzing physical self-concept in relation to total recreational screen time, a standard regression coefficient (β) -0.09 and standard error (SE) of 0.046; ***p*** ~~-value~~ = ~~0~~.048 were found. For tablets/mobile phone use and its relationship to physical self-concept, β = -0.18, SE = ~~0~~.040, and ***p*** ~~-value~~ = 0.001 (Babic et al., 2017). Thus, total recreational screen time has a negative association with physical self-

concept. Changes to the use of total recreational screen time ~~(total)~~, as well as recreational computer use were also negatively associated with psychological well-being. For recreational computer use and psychological well-being, β = -0.23, SE = 0.081, ***p*~~-value~~** = 0.003. For total recreational screen time and psychological well-being, β = -0.20, SE = 0.059, and ***p*~~-value~~** = 0.001 (Babic et al., 2017). Again, as total recreational screen time or recreational computer use increases, psychological well-being decreases. Psychological difficulties were positively associated with changes in quantity of TV/DVD use (β = 0.16, SE = 0.064, and ***p*~~-value~~** = ~~0~~.015). Otherwise, no significant associations between types of screen time and use of different types (and total) of screen time were noted (Babic et al., 2017).

Strengths of this study include adjustment for covariates, an objective method for measuring physical activity, and a high retention rate amongst participants (Babic et al., 2017). This study uses a longitudinal method, and it is a randomized controlled trial. ~~The authors note that~~ L~~l~~imitations to this study exist, as well. First, although the statistics were significant, the magnitude of the effects were quite small (Babic et al., 2017). Most of the participants were female and ethnically homogenous, which limits the ability to generalize findings to the Australian (and much less, the U.S.) population~~, as a whole~~. Also, participants were only selected if they were "eligible" by using recreational screen time for 2 or more~~+~~ hours daily, which means they all use high amounts of screen time at baseline, further limiting the reflection of the population. The authors note that self-reporting for screen time has high potential for inaccurate estimates of screen time. It is important to note that it is impossible to claim a causal relationship between screen time and mental health indicators, and the study focused on the volume of screen time, as opposed to the content found within the screen time being used. The authors mention that it is very possible that screen time and mental health issues have a bidirectional relationship.

Another limitation is that sleep patterns and social influences were not included within the study (Babic et al., 2017).

A study conducted by Riehm et al. (2019), which will be discussed more in depth in the third theme, focused on social media and its effect on the later development of internalizing disorders in the adolescent population. Briefly, the use of adolescent social media was associated with later comorbid internalizing and externalizing issues, as well as isolated internalizing problems in the adolescent population (ages 12-18). The study also shows that, if those using social media for greater than 30 minutes daily would begin using social media for less than 30 minutes daily, 9.4% fewer high internalizing problems would have occurred (Riehm et al., 2019).

Twenge and Farley (2020) conducted a cross-sectional study that used data collected from the Millennium Cohort Study (MCS). They evaluated associations between different types of screen time and depression. The types of screen time included social media, internet use, gaming, and television. Major gender differences were witnessed; thus, this study will primarily be discussed in the following theme. Briefly, for adolescents aged 13-15, in general, ~~the~~ more time students spent using each screen activity equated to~~, the~~ worse ~~their~~ overall mental health in the students ~~was~~. However, larger associations were found between poor mental health and both social media and internet use, while smaller associations were noted between poor mental health and both gaming and television use (Twenge & Farley, 2020).

Coyne et al. (2020) completed an ~~eight-year~~8-year longitudinal study with participants selected from the Flourishing Families Project. The total initial sample size included 500 participants, with 51.6% being female and an average initial age of 13.82 (SD = 1.03) at Wave 3 (when the current study began). Over the course of the ~~eight~~ 8years of the study (2009-2017), the

retention rate was 83%. Data was collected regarding each family's race/ethnicity, ~~if the family had two~~presence of two parents versus~~s.~~ one parent, and the family's income ~~of the families~~. Families that participated in the study were taken from an unspecified "large northwestern" U.S. city, and they were recruited via national telephone survey and selected to reflect racial, ethnic, and socioeconomic demographics of the school systems in that area (Coyne et al., 2020). To balance socioeconomic demographics, 77 families were recruited via other methods, such as referrals or fliers~~)~~, for a total of 500 families. Interviews for data collection took place in the participants' homes. This study focuses on determining if there are any longitudinal associations between social media (rather than overall screen time) use and depression and/or anxiety in the adolescent population over time. ~~They~~ It also focused on whether the sex of the adolescent is a moderating factor between social media use and mental health (Coyne et al., 2020). Although ~~it~~ the study ended with the participants aged 20 years old, a majority of the research was conducted while the participants were 17 years of age or less.

Social media time use was screened at each of the eight waves of data collection, and students were asked "how much time do you spend on social networking sites, like Facebook, on a typical day?" Responses could range from 1 (no time on social media) to 9 ~~(>~~(more than 8 hours daily) (Coyne et al., 2020). Depression was evaluated using the Center for Epidemiology Studies Depression Scale for Children (CES-DC), which includes 20 items for evaluating depressive symptoms. This study allows assessment of between-person and within-person associations between social media use and depression ~~(Coyne et al., 2020)~~. For example, if people using social media are more likely to be those reporting higher depressive symptoms, that would represent a between-person association between high social media use and increased depressive symptoms. However, if a person has a tendency to use social media a certain amount,

and he or she begins using social media significantly more, which is then associated with the development of higher depressive symptoms, this ~~would~~ represents a within-person association between social media use and depressive symptoms.

When analyzing results, 13 outliers were eliminated, due to ~~being~~ falling more than ~~>~~3.29 SDs from the mean of social media use, leading to a final sample of 487 students. When aged 13, the average time spent using social media was 31-60 minutes daily. Over time, these values increased, and by the time the participants reached "young adulthood," their average daily use of social media more than doubled to approximately 22~~~~ hours daily, with girls reporting more time using social media sites than boys. Girls also reported more depressive and anxiety-related symptoms than boys~~, overall~~ (Coyne et al., 2020).

Between-person results showed both girls and boys ~~reporting~~ reported low amounts of depressive symptoms at age 13, but these increased steadily over the course of their adolescent years (Coyne et al., 2020). Symptoms seemed to peak at 18 years old, and then slightly decreased from there, as participants entered early adulthood. For girls, the initial levels of depression, when compared to social media use, were correlational (between-person), but the rates of change of depressive symptoms and social media use over time were not associated ~~(Coyne et al., 2020)~~. For boys, the opposite was true in that the initial correlation was not present, but the changes in time of social media use and depressive symptoms showed covariance (Coyne et al., 2020). In analyzing within-person results, the amount of social networking use in both boys and girls did not influence future symptoms of depression, and similarly, for the most part, the number of depressive symptoms did not influence the future amount of social media use (exception: at age 16, depressive symptoms actually predicted a decreased usage of social media in the 17-year-old population) (Coyne et al., 2020).

Overall, the between-person portion of this study showed that there is a ~~"moderate"~~ relationship between social media use and depressive symptoms in the adolescent population, both cross-sectionally and longitudinally, however, the within-person portion of the study showed that no within-person relationship between social media use and depressive symptoms can be found (Coyne, et al., 2020).

Strengths of this study include that it is longitudinal with an ~~fairly large~~adequate sample size~~.~~, ~~It had~~ a ~~pretty~~ high retention rate, and it assessed these adolescents over the course of ~~eight~~ 8 years, in which social media use became quite prominent. This study is very valuable in that it is one of the only pieces of literature assessing any sort of screen media and depression over the course of such a long period of time, allowing both between-person and within-person associations to be drawn. This study also utilized a very thorough analytic technique. However, there are limitations to this study. As is the case with many other studies, this study uses self-report as the method for gathering data, allowing susceptibility to error. There is also a limitation in that the type of content was not evaluated, rather it was only the quantity of social media that was evaluated (Coyne et al., 2020). This study solely evaluated social media, rather than screen time.

Kidokoro et al. (2022) conducted a study of elementary and junior high school children in Tokyo, Japan. This will be discussed more in-depth in the third theme. Overall, screen use and its relationship to depressive symptoms varied between age groups and ~~the~~ between sexes of the students. Social media usage of greater than ~~two~~ 2 hours daily had the most significant relationship with increased prevalence of depression, and this occurred in the junior high school age group (both males and females), although data regarding ~~was not available for~~ social media use in the elementary aged students was not available (Kidokoro, et al., 2022). "Newer" types of

screen media (social media, online gaming, and online videos) were more likely to be associated with depressive behavior, in general (Kidokoro et al., 2022). These findings are important to take into consideration when evaluating different types of screen media.

Screen Time and Depression between Males and Females

Twenge and Farley (2020) conducted a cross-sectional study using data collected by the Millennium Cohort Study (MCS) to evaluate the connections between different types of screen media, including social media, internet, gaming, and television and their influences on mental health. A large focus of the study involved differences between boys and girls. The study was conducted in the United Kingdom (U.K.) and used a sample of 11,427 adolescents aged 13-15. The participants were part of the MCS, which includes those in the U.K. born between 2000-2002, and analyzes data collected from the MCS's sixth wave, which occurred in 2015 (Twenge & Farley, 2020). To recruit, ~~they~~ researchers chose residential areas, based on electoral areas, and attempted to recruit all eligible participants within those areas~~, which were based on the electoral areas~~. Intentionally, they over-sampled children growing up in areas of higher economic disadvantage, ethnic minorities, and those living in smaller nations of the United Kingdom ~~(Twenge & Farley, 2020)~~. The MCS was a longitudinal study, but Twenge and Farley, utilizing data from the sixth wave, used the data cross sectionally. Twenge and Farley (2020) analyzed associations between the types of screen media and four different indicators of mental health, including "self-harm behaviors, depressive symptoms, life satisfaction, and self-esteem," while using the results to show similarities and differences between male and female adolescents. The sample was 50% female with an average age of 13.77 (SD=0.45) (Twenge & Farley, 2020).

Participants were asked to self-report their screen usage and answer questions regarding their mental health. Regarding screen time, four categories were selected: less than ~~one~~ 1 hour

daily, ~~between one and two hours~~1-2 hours daily, ~~between two and three~~2-3 hours daily, ~~between three and four hours~~3-4 hours daily, ~~between five and seven hours daily~~5-7 hours daily, and ~~seven~~ 7 or more hours daily. The categories of screen type included TV programs/films/DVDs, gaming on a computer or gaming system, using the internet (including tablet or smartphone use of the internet), and social networking/messaging sites, such as Twitter or Facebook (Twenge & Farley, 2020). The short version of the Mood and Feelings Questionnaire was used to evaluate depressive symptoms. The study also evaluated self-harm behaviors, self-esteem, and life satisfaction. It was found that the more time ~~that~~ adolescents spent on each form of screen media, the worse they reported their mental health (Twenge & Farley, 2020). The percent of adolescents reporting depressive symptoms was adjusted for covariates and utilized an adjusted relative risk ratio (aRRR) and a 95% c~~C~~onfidence i~~I~~nterval (CI). Overall, girls spent more time on screen media than did boys in all categories, except for gaming. When analyzing self-reported depressive symptoms, the group spending less than ~~one~~ 1 hour daily was used as the control (Twenge & Farley, 2020).

For girls, those using social media ~~between one and two~~ 1-2 hours daily were not significantly more likely to experience clinically relevant depressive symptoms (aRRR = 1.10, 95% CI [0.90-1.35]) than the control group (Twenge & Farley, 2020). However, those using social media ~~between two and five hours~~2-5 daily were significantly more likely to report these depressive symptoms (aRRR ~~2.31~~1.44 [~~1.98~~1.22-~~2.70~~1.69]), and girls with ~~five~~ 5 or more hours of social media use daily experienced an even higher prevalence of clinically significant depressive symptoms (aRRR 2.31 [1.98-2.70]). With internet use, significantly more depressive symptoms were found in the group using ~~between two and five~~2-5 hours daily (aRRR 1.50 [1.15-1.97]) and those using ~~five~~ 5 or more hours daily (aRRR 2.66 [2.05-3.46]). It was found that girls

spending greater than ~~one~~ 1 hour gaming daily were associated with increased prevalence of depressive symptoms: those spending 1-2 hours were 28% more likely (aRRR 1.28 [1.10-1.49] to experienced clinically relevant depressive symptoms, those spending ~~between two and five~~2-5 hours per day were 30% more likely (aRRR 1.30 [1.13-1.49]) to experience clinically relevant depressive symptoms, and those spending ~~five~~ 5 or more hours gaming daily were 36% more likely (aRRR 1.36 [1.27-1.89]) to have clinically relevant depressive symptoms than those spending less than ~~one~~ 1 hour gaming daily. For girls watching TV, only those watching ~~five~~ 5 or more hours daily were associated with a significantly increased risk for having depressive symptoms when compared to those spending less than ~~one~~ 1 hour daily watching TV (aRRR 1.43 [1.08-1.59]. Interestingly, those watching ~~between one and two~~ 1-2 hours of TV daily were significantly less likely to report depressive symptoms when compared to the control group watching less than ~~one~~ 1 hour daily (aRRR 0.79 [0.64-0.97]). It is important to note that those at the highest risk of developing clinically relevant depressive symptoms were ~~the~~ girls ~~who were~~ spending ~~large amounts of time~~at least 5 hours daily on the internet, followed by ~~those~~ girls spending ~~large amounts of time~~at least 5 hours daily on social media. (Twenge & Farley, 2020).

According to Twenge and Farley (2020), of boys using social media, only those using ~~five~~ 5 or more hours of social media daily were significantly more likely to have reported depressive symptoms (aRRR 2.05 [1.59-2.64]). Similarly, only the boys using the internet for ~~five~~ 5 or more hours daily were significantly more likely to report clinically relevant depressive symptoms than those using the internet for less than ~~one~~ 1 hour daily (aRRR 1.75 [1.26-2.44]). ~~Again, o~~Only the boys who engage in gaming for ~~five~~ 5 or more hours daily were more likely to report clinically significant depressive symptoms than those using less than ~~one~~ 1 hour daily (aRRR 1.87 [1.41-2.49]), and only the boys ~~engaging in~~using ~~five~~ 5 or more hours of television

daily were significantly more likely than the control group to experience depressive symptoms (aRRR 1.46 [1.06-2.02]). In summary, across all screen media types, the only male groups to report significantly more depressive symptoms include those spending ~~five~~ 5 or more hours on each respective type of screen media, otherwise there was no significant difference. This is an important distinction to make when comparing to the female population, which showed increased depressive symptoms at lower thresholds in all groups, except when isolating TV time as the variable. It is also important to note that the adjusted relative risk for boys using ~~five~~ 5 or more hours of each type of screen media varied, with social media yielding the most risk, followed by gaming, internet, and television, respectively (Twenge & Farley, 2020).

Girls tended to spend more overall time using screen media in all categories, except gaming. For example, regarding social media, 24.1% of girls reported less than ~~one~~ 1 hour daily, while 45.3% of boys reported less than ~~one~~ 1 hour of daily use (Twenge & Farley, 2020). Regarding social media, 26.2% of girls reported ~~five~~ 5 or more hours of social media use, while only 11.9% of boys reported ~~five~~ 5 or more hours of daily social media use. For all types of screen use, a significant difference in the amount of time spent on each faction was witnessed between boys and girls ($p < .001$ for all types). Similarly, girls were simply more likely to report depressive symptoms, in general. For example, 15.3% of girls reporting less than ~~one~~ 1 hour of social media use daily reported depressive symptoms, and 35.3% of girls reporting ~~five~~ 5 or more hours of social media use daily reported depressive symptoms. In comparison, only 6.9% boys reported spending less than ~~one~~ 1 hour on social media reported depressive symptoms, while 14.1% using ~~five~~ 5 or more hours of social media reported clinically relevant depressive symptoms (Twenge & Farley, 2020). Similar trends can be found across each specific type of

screen media, showing that girls are more likely to express clinically significant depressive symptoms.

Strengths of this study include a large sample population, examination of differences between males and females, and a narrow ~~window of~~ age range. Weaknesses of this study include the fact that it is a cross-sectional study, and it was conducted in the U.K., which might provide a different demographic than ~~that~~ is reflected by the U.S. population. The fact that it is cross-sectional limits the ability to claim causation.

The previously discussed study conducted by Robertson et al. (2022), ~~made~~ identified some important distinctions between males and females. In the 9-10-year-old population, boys used significantly more screen time, experienced significantly more suicidal ideation/attempts, and engaged in more self-harm than girls (p = <0.001 for all) (Robertson et al., 2022). 7.6% of girls reported suicidal behavior, compared to 9.7% of boys. 4.6% of girls reported self-harm, while 7.4% of boys reported self-harm. Boys averaged 4.84 hours of screen use daily (SD = 3.79) compared to the girls' average of 4.01 hours daily (SD = 3.57). However, no difference was seen between boys and girls regarding overall depressive disorders (4.8% for girls and 5.3% for boys) (Robertson et al., 2022). In the 9-10-year-old population, girls using more than ~~two~~ 2 hours of total screen time experienced double the likelihood of having depressive disorders (aRR 2.00, 95% CI [1.48-2.77]) when compared to those using less than ~~two~~ 2 hours daily. For boys, those using more than ~~two~~ 2 hours total screen time experienced a 66% increased risk in having depressive disorders (aRR 1.66 [1.22, 2.25]) (Robertson et al., 2022). Thus, those spending more than ~~two~~ 2 hours daily on a screen of any sort were more likely to fit criteria for the diagnosis of a depressive disorder. For girls, total digital media of more than ~~two~~ 2 hours was also associated with nearly double the adjusted relative risk of depressive disorders (aRR 1.96 [1.53, 2.51]), as

was video chat (aRR 1.9 [1.4, 2.56]), while use of TV and mMovies of more than two 2 hours daily was associated with a significant increase in depressive disorders in girls (aRR 1.26 [0.95, 1.66]) (Robertson et al., 2022). For boys, total digital media use of more than two 2 hours daily was associated with double the prevalence of depressive disorders (aRR 2.02 [1.59, 2.56]), and a 53% increase in risk with more than hours of video chat (aRR 1.53 [1.16, 2.03]) (Robertson et al., 2022). There was not a significant correlation between TV and movie use of more than two 2 hours daily and depressive disorders for boys, either. Girls using social media or online video more than two 2 hours daily were associated with an increased risk of depressive disorders (aRR 2.20 [1.13, 4.30] and aRR 1.87 [1.42, 2.47], respectively), while girls engaging in gaming or texting for more than 2 hours daily were not associated with an increased risk (Robertson et al., 2022). In boys, spending more than two 2 hours daily on any single faction of digital media (social media, gaming, texting, or online videos) was associated with increased risk of depressive disorders. It is also important to note that girls spending seven 7 or more hours of screen time daily (when compared to those spending less than one 1 hour) were almost four 4 times more likely to qualify for a depressive disorder, while boys who spend seven 7 or more hours on screens in a day (compared to those spending less than one 1 hour) were twice as likely to have a depressive disorder (Robertson et al., 2022).

The longitudinal study conducted by Vannucci et al.and McCauley Ohannessian (2019), also analyzed differences between sexes when looking at the association between social media use and depression. Although gender differences were not present within the three subgroups, females were more likely to fall into the High Social Media Use Subgroup or the High Instagram/Snapchat Subgroup when compared to boys, meaning they tended to use more social media than boys. However, when girls and boys were isolated, no significant differences were

prevalent, and there were no significant differences when analyzing gender differences (p -> 0.05) for any psychosocial outcome (Vannucci et al.& McCauley Ohannessian, 2019).

Screen Time and Depression between Age Groups

Kidokoro et al. (2022) conducted a cross-sectional study of student ages 8-15 (encompassing groups consisting of elementary [children] and junior high school [adolescents] youth) from the Setagaya ward of Tokyo, Japan with regard toregarding their weekly recreational screen time usage and depressive symptoms. Elementary students were assisted by their parents in completing their questionnaires, while junior high school students completed theirs them individually. The study included 15,726 elementary--aged students and 7,847 junior high school--aged students. *N*=23,573. The recreational screen time questionnaire asked how long they participants spent (weekly) participating in four different categories of screen media, including (1) TV, videos, or DVDs, (2) online videos, (3) social media, and (4) online video games (Kidokoro et al., 2022). They The students were also asked about sleep duration and exercise duration. Symptoms of depression were evaluated using a modified version of a depression questionnaire originally developed by the American Psychiatric Association. Regarding quantifying screen time, four groups were determined to be those using (1) up to 30 minutes, (2) 30-60 minutes, (3) between one and two1-2 hours, and (4) more than two 2 hours daily (Kidokoro et al., 2022).

When comparing screen time and depressive symptoms between age groups, two groups were determined: “Elementary School” (boys aged 9.7 ± 1.6 and; girls aged 9.3 ± 1.7) and “Junior High School” (age 14.0 ± 0.8) ((Kidokoro, et al., 2022)). 3.3% of elementary boys reported depressive symptoms, while 9.5% of junior high school boys reported depressive symptoms (p < θ.001). 2.7% of elementary aged girls were found to have depressive symptoms,

while 8.8% of junior high school girls reported depressive symptoms ($p < .001$). Thus, significant differences were found in depressive symptom prevalence within genders when comparing the different age groups studied. However, boys in elementary school spent significantly more time exercising than did junior high school boys, while elementary girls spent significantly less time exercising than did junior high school girls. For both girls and boys, junior high schoolers slept fewer hours every at night than did elementary aged students (Kidokoro et al., 2022).

When analyzing prevalence of depression between age groups regarding screen media usage (via odds ratios), the control group consisted of those using up to 30 minutes daily of an individual screen media form, and all other groups were compared to the control (Kidokoro et al., 2022). It was found that social media use of more than two 2 hours daily was associated with a higher prevalence of depressive symptoms for the junior high school population of both males and females, however, data was not available regarding social media usage in the elementary aged population, likely because this population spends far less time using social media, overall. Spending more than two 2 hours online gaming daily was associated with a higher risk of depression in junior high school girls, but not in elementary school girls. Elementary boys spending more than two 2 hours daily watching online videos did have a higher prevalence of depression when compared to those spending up to 30 minutes, however, junior high school aged boys who watched >greater than 30 minutes of online videos daily reported significantly fewer depressive symptoms than those not watching online videos, even when watching more than two 2 hours of online videos daily (Kidokoro et al., 2022). For both elementary and junior high school aged boys, those spending >greater than 30 minutes but less than two 2 hours daily watching TV were significantly less likely to experience depressive symptoms. Junior high

school girls watching ~~one~~ 1 or more hours of television daily were less likely to experience depressive symptoms, but this was not seen with elementary school girls. Thirty to ~~sixty~~ 60 minutes of daily online video usage ~~daily~~ in elementary girls showed a lower prevalence of depression, but this was not seen in junior high school girls. More than ~~two~~ 2 hours of daily video game usage in junior high girls was associated with increased prevalence of depressive symptoms, which was not seen in the elementary female population (Kidokoro et al., 2022).

Strengths of this study include ~~the fact that there~~ the presence of ~~is~~ a large sample size, and the study provides a means for identifying differences within genders within age groups~~, based on age group~~. It also ~~takes~~ considers exercise and sleep duration ~~into consideration~~ when analyzing these associations, which could help to eliminate confounding factors. Weaknesses are found within this study, as well, including~~.~~ ~~These include the fact that this is~~ the~~a~~ cross-sectional nature of the study, which does not allow ~~for~~ a claim of causation to be made between increased screen media time and the prevalence of depression. Self-report could provide limitations to the accuracy of the data collection~~Secondly, the authors mention that self-report was used and could decrease the "precision" of the study's results~~. ~~They also~~The authors mention that ~~it~~ the study does not account for the ~~fact that students who experience~~possibility of students ~~increased~~ depression leading to ~~may be less likely to get~~ inadequate sleep or exercise (Kidokoro et al., 2022).

Twenge and Campbell (2018) analyzed research collected via the National Survey of Children's Health (NSCH), which was performed by the U.S. Census Bureau in 2016. In this study, children between the ages of 2-17 were studied. The caregivers of these children were asked about many markers of psychological well-being of their children. The total sample size was quite large, with *N*=40,337. This is~~is~~ a cross-sectional study. Total daily screen time was

analyzed, ~~was examined, which~~ encompassing the use of~~ssed~~ cell phones, computers, electronic devices, electronic games, and television~~s usage~~. The households were randomly contacted via mail. Children with certain chronic conditions were excluded. The final sample ~~(*N*=40,337)~~ was 49.8% male, and~~;~~ 71% were white, 16% Hispanic, 6% B~~b~~lack, and 7% were categorized as "other." Children were placed into four different age groups: 1) Preschoolers (~~between two and five~~ 2-5 years old; *n*=9,361), 2) Elementary Schoolers (~~six to ten years~~6-10 old; *n*=10,668), Middle Schoolers (11-13 years old; *n*=7,555), and High Schoolers (14-17 years old; *n*=12,753). Due to age and developmental stage differences, t~~T~~here was some difference in the questions asked to caregivers of those children less than ~~six~~ 6 years of age when compared to those aged ~~six~~ 6 years ~~or~~ and older~~, due to age and developmental stage~~ (Twenge & Campbell, 2018).

Caregivers were asked ~~how much time~~to quantify the time their child spent on screens on an average weekday. Eight categories of total average daily screen time were identified: ~~(~~N~~N~~one, less than ~~one~~ 1 hour, ~~one~~ 1 hour, ~~two~~ 2 hours, ~~three~~ 3 hours, ~~four~~ 4 hours, ~~five~~ 5 hours, ~~six~~ 6 hours, and ~~seven~~ 7 or more hours ~~daily)~~. In all the groups over 11 years old, very few reported daily screen time as "none." Confounding variables that were controlled for included race, sex, age, household adults' education level, family income, and family structure (Twenge & Campbell, 2018).

Across all ages, the average daily screen time was 3.2 hours daily (SD = 2.4) ~~(Twenge & Campbell, 2018)~~. Overall, older participants used ~~more and~~ more screen time daily, with the most significant increase being between elementary~~-~~-aged children and those in middle school. In the 2-5-year-olds, the average daily screen time was 2.28 hours (SD = 1.72). In the 6-10-year-olds, ~~mean =~~the average daily screen time use was 2.78 hours (SD 1.95). In the 11-13-year-olds, ~~mean~~ the average daily screen time was ~~=~~3.80 hours (SD 2.36). By high school, children were

spending an average of ~~four~~ 4 hours and 35 minutes on screen daily (~~*mean*~~ *M* = ~~=~~4.59 [~~(~~SD = 2.50~~])~~) (Twenge & Campbell, 2018). Although many mental health outcomes were analyzed regarding daily screen time, ~~for the sake of this literature review, the~~this literature review will focus ~~will be~~ on depression. The outcome categories ~~included a~~of a depression diagnosis history, being on medication for depression, and visiting a mental health professional were only evaluated in the middle school and high school groups, due to such low rates of occurrence of these outcomes in the younger groups (Twenge & Campbell, 2018). For the 14-17-year-old population, those spending ~~seven~~ 7 or more daily hours on screens exhibited more than double the risk of ever ~~having a diagnosis of~~being diagnosed with depression, when compared to those using ~~one~~ 1 hour daily (RR = 2.39, 95% CI[1.54, 3.70~~]), reported as (RR [95% CI])~~. ~~They~~ Those using 7 or more hours daily were also far more likely to have ever been ~~seen~~ visited by a mental health professional in the past 12 months (RR = 2.22 [1.62, 3.03]). They were also nearly three times ~~far~~ more likely to have taken medication for a psychological condition in the past 12 months (RR = 2.99 [1.94, 4.62]). It is important to note that moderate (more than ~~four~~ 4 hours) use of screen time in the 14–17-year-old group was also associated with higher levels of depression (RR = 1.61 [1.03, 2.52]) ~~(Twenge & Campbell, 2018)~~. Overall, in the 14–17-year-old group, when compared to those using ~~one~~ 1 hour daily, those using ~~four to seven~~4-7 or more hours daily were significantly more likely to have ever been diagnosed with depression, have taken medication for depression in the past 12 months, and have visited a mental healthcare professional in the past 12 months. In the 11–13-year-old group, only those using ~~seven~~ 7 or more hours of screen time daily were significantly more likely to have ever been diagnosed with depression, have taken medication for depression in the past 12 months, and have visited a mental healthcare professional in the past 12 months. In the adolescent population, depressive

symptoms were not significantly different in low users of screen time when compared to those who did not use any screen time (Twenge & Campbell, 2018).

Although depression was not something directly ~~asked of~~evaluated preschool-aged children, well-being was measured via various questions regarding the child's ability to bounce back, ~~to~~ not lose his or her temper, ~~to~~ stay calm when excited, ~~to~~ switch tasks without anxiety or anger, demonstrate task self-control, play~~ing~~ well with others, and exhibi~~tion of~~ empathy. Few significant data were found in this population regarding the above behaviors and screen time usage. Overall, adolescents were much more likely to have negative associations between screen time usage and depression, but it is also more difficult to quantify depression in the younger populations (Twenge & Campbell, 2018). Adolescents, particularly those in high school, are more likely to use higher volumes of screen media and are more likely to have depression~~,~~ in accordance with an elevation of screen time quantity.

Strengths of this study include the fact that this is a large sample size that encompasses children and adolescents between the ages of 2-17, which is quite a broad age group. It also seems to be ~~fairly representative~~representative of the U.S. child and adolescent populations. The results of this study show that providers might be able to identify those at higher risk for depressive symptoms, based on their daily screen time use, so ~~that they~~ patients can effectively be screened and treated ~~them~~ in an appropriate and timely manner (Twenge & Campbell, 2018). Limitations of this study include ~~that it is~~ cross-sectional nature, which makes it impossible to claim that screen time has a causal effect on well-being. The authors also note that, because the data were reported by caregivers, it is likely that screen time estimates are lower than the actual screen time used by their children (Twenge & Campbell, 2018). ~~It also~~The study ~~did not~~failed to differentiate between specific types of screen time. Only weekday screen time was evaluated,

which could be a confounding factor. Finally, ~~they~~ the authors mention that the response rate for the survey was not 100%, and ~~that~~ some groups (for example, the black population) were underrepresented in this study (Twenge & Campbell, 2018).

Houghton et al. (2018) completed a ~~two~~2-year ~~(six wave)~~ longitudinal study involving 1,749 adolescents (47% female). It consisted of six waves. In Wave 1, there were 276 males and 247 females ages 10-11 (in fifth grade), 371 males and 298 females ages 12-13 (in seventh grade), and 289 males and 268 females ages 14-15 (in ninth grade). These students were studied for ~~two~~ 2 years, meaning that the participants were between the ages of 12-17 years old ~~throughout the duration of the study~~by the end of the study. The aims of the study included identification of possible associations between the trajectories of screen time use and depressive symptoms in adolescents~~, as well as to~~ and to determine if associations were present between screen use and the development of depressive symptoms or the ~~vice versa (~~development of depressive symptoms and subsequent increase in screen use~~)~~ (Houghton et al., 2018). When the first wave began, 30 schools (intended to represent the socioeconomic demographics of Perth, Australia) were recruited, and 25 agreed to participate. However, as the study progressed, participants moved to different school districts or transitioned from secondary school to high school, etc.; thus, by the time the study concluded, 38 schools were included. Some were government-run, and others were not, and the schools were found in a variety of socioeconomic areas (Houghton et al., 2018).

To evaluate screen time usage, participants completed the Screen Based Media Use Scale (SMBUS). This scale was completed online, and it allowed the participants to delineate what type of screen time they had used (ex: iPod Touch, iPad, Mobile Phone, Laptop, TV, etc.). ~~They~~ Participants were asked to report how much time they used ~~on~~ screens on a typical weekday

(including when in school), as well as typical screen use on a weekend, so that ~~they~~ researchers could delineate ~~their~~ particpant weekday use versus weekend use. Screen usage was weighted according to the proportion of weekdays: weekends (5:2 ratio) to determine average screen time use (Houghton et al., 2018). The respondents were also given a list of possible screen activities. Various types of screen time use were clumped into four different categories: (1) gaming, (2) social media use, (3) TV/passive screen use, (4) and web use. To evaluate depressive symptoms, the 12-item Children's Depression Inventory 2 (CDI 2) was used. The raw scores were converted into standardized T-scores, allowing age and sex comparisons ~~to be made~~ (Houghton et al., 2018).

Trajectories regarding depression scores placed participants into three different groups, labeled "Low-Stable," "High-Decreasing," and "Low-Increasing" groups. 79.9% of the sample fit into the "Low-Stable" group, making ~~it~~ it the most common and indicative of those without significant depression at any point throughout the study. The "High-Decreasing" group started out with high CDI 2 T-scores, which decreased over time, indicating improving depression symptoms. The third group ("Low-Increasing"), ~~started~~ began the study with low CDI 2 T-scores, which increased over the course of the study. A total of six collection waves occurred over the ~~two~~ 2 years of the study, which includes the initial data collection. Different cross-lagged models were developed for each of the age groups and for both sexes (Houghton et al., 2018).

The findings are quite interesting. Overall, the reliability was quite good, with Cronbach's alpha being 0.82 for the overall sample with a range of 0.77-0.92 (Houghton et al., 2018). Male participants with Low-Stable depression experienced minimal change in total screen time usage over the course of the study (*M* = ~~mean = 13-minute increase per day (95% CI:~~13

minute daily increase, 95% CI [4 - 23 ~~mins~~], *p* =; ~~p = 0~~.006).~~).~~ Females with Low-Stable depression followed a similar pattern, although their total screen time decreased slightly (21 minutes daily) from the beginning to the end of the study (***p*** = ~~0~~.003). Males with Low-Increasing depression experienced a significant increase in total screen time usage over the course of the study (increasing from ~~three~~ 3 hours and 11 minutes daily to ~~four~~ 4 hours and 58 minutes daily). This equates to an average increase of ~~one~~ 1 hour and 47 minutes daily (***p*** = ~~0~~.001). For females with Low-Increasing depression, a notable increase in total screen time was also seen over the course of the study (increasing from ~~four~~ 4 hours and ~~two~~ 2 minutes daily to ~~five~~ 5 hours and 11 minutes daily). This equates to an average increase of ~~one~~ 1 hour and ~~nine~~ 9 minutes daily (***p*** = ~~0~~.016) (Houghton et al., 2018). For males in the High-Decreasing depression screen time ~~males~~group, the total screen time started comparatively high and stayed mostly consistent throughout the study (started at ~~three~~ 3 hours and 57 minutes daily and progressed to~~to~~ ~~four~~ 4 hours and 19 minutes daily), with an average increase of 21 minutes daily (***p*** = ~~0~~.232). For females in the High-Decreasing depression group, ~~they also~~screen usage started high and was maintained ~~their screen time usage, for the most part~~ (~~four~~ 4 hours and 43 minutes daily, progressing to ~~five~~ 5 hours and ~~three~~ 3minutes daily), with an average increase of 20 minutes daily (***p*** = ~~0~~.138) (Houghton et al., 2018).

For males with Low-Increasing depression, use of all four types of screen time increased over the course of the study, with the highest volume occurring in year three, at which time ~~their~~ participants' depressive symptoms were most pronounced (Houghton et al., 2018). ~~For m~~Males and females with High-Decreasing depression~~, they~~ tended to use more video gaming, web use, and TV/Passive screen time~~,~~ when compared to the other groups of depressive symptom trajectories. Overall, the Low-Increasing group used the most screen time by the end of the study

(Houghton et al., 2018). The Low-Stable group used screen time the least. All groups reported using more social media at the end of the study when compared to ~~when the study began~~the start, but the most significant increase was found in the Low-increasing depressive trajectory, whose members increased their average social media time from ~~one~~ 1 hour and 29 minutes to ~~two~~ 2 hours and 58 minutes by the end of the study (Houghton et al., 2018).

In summary of the results regarding the association between total screen time and depressive symptoms, there was a significant association between the two, in that an increase in one (either screen time or depressive symptoms) would lead to an increase in the other in subsequent waves of the study (Houghton et al., 2018). ~~For~~ Regarding depression leading to screen use increase (*y*), ***p*** = ~~0~~.003, and for screen use leading to subsequent depression (β), ***p*** = ~~0~~.024. However, th~~e~~is amount was very small: ~~(~~every hour of screen time would yield a 0.76-point increase in the depressive symptom T-score in the subsequent wave, and every 10-point increase in CDI 2 depression T-score would yield a 20 minute increase in total average screen time in the subsequent wave, meaning that it would require 13 or more hours of screen time to ~~move~~ displace a person from "average" [T-score = 50] to clinically depressed [T-score = 60]) (Houghton et al., 2018). Thus, these cross-lagged effects are significant, but small regarding causation between screen time and depression. When screen time was isolated by screen use subgroup, only web use showed a significant relationship, in which time on the web led to subsequent depression (***p*** = ~~0~~.042). For TV/passive screen time, gaming, and social media, there was no significant relationship ~~(Houghton, et al., 2018)~~. Of interest, depression in a former wave was significantly associated with depression in subsequent waves, as was screen use, which shows that those who tend to be depressed continue to be depressed in later waves, and those who tend to use screens more often continue to do so in later waves (Houghton et al., 2018).

Boys were found to ~~have~~ experience a reciprocal relationship between depressive symptoms and both total screen time and time spent on social media. T~~, but t~~his was not found for girls. Boys also had a positive association with the development of depressive symptoms in relation to increased web use (web use led to later depressive symptoms), but this was also not found for females. Based on the results of this study, the authors mention that as people develop depressive symptoms, they tend to use screen media more often, however, for the most part, a causal relationship cannot be firmly established. If screen time does cause depressive symptoms, the effect is quite minuscule. Based on the results, there was no evidence of a "threshold" at which symptoms are seen or disappear (Houghton et al., 2018). The authors mention that "significant increases in screen use time may indicate that a young person's mental health is deteriorating." The authors go on to ~~state~~ speculate that adolescents could be using screen media as a coping mechanism when they are experiencing depression (Houghton et al., 2018). In general, those whose depression increases over time also show a simultaneous increase in screen time use, rather than one leading to the other. Thus, Houghton et al. (2018) mention that rapid increases in screen time by adolescents may be a sign of depressive symptoms and deterioration of mental health. The authors conclude that a claim of causation is not reasonable for this study, due to modest causation found, but nonetheless, the findings showing parallel increases in depressive symptoms and increased screen use are substantial and worth noting (Houghton et al., 2018).

It is important to recognize the strengths and weaknesses of this study. Strengths include a large sample size, particularly for a longitudinal study~~, as well as taking fairly equal numbers of participants from three different cohorts and then collecting data on all of the cohorts over a two-year period of time~~. This allowed for evaluation of data between sexes, across ages, and

from an intrapersonal perspective (Houghton et al., 2018). ~~The fact that the data collection took place from 2013-2015 is a strength, however, it is also important to note that screen media has vastly changed since that time.~~ Finally, this study seems to be strong in that it represents Australia's population quite well. Limitations of the study include the fact that the data came from self-report. The authors note that the "motives" for using screen media were not assessed (Houghton et al., 2018). Because this study took place in Australia, there may be difficulties generalizing findings ~~differences seen when compared~~ to adolescents in the U.S. Overall, this is a very strong study and provides valuable information ~~to the~~concerning association between screen time and depressive symptoms in the adolescent population.

Neville et al. (2021) conducted a study using data from the Growing Up in Ireland Infant Cohort. This study uses a sample of 11,194 children who were born in Ireland between the dates of ~~1~~ December 2007 through ~~30~~ June 2008. This sample ~~is~~ was made to be representative of the nation of Ireland. Recruitment occurred when the child was aged ~~nine~~ 9 months old, and ~~they were~~ follow~~ed~~ up ~~with~~ occurred every ~~two~~ 2 years from that point ~~on~~forward. For this study, the focus ~~is~~ was on the results from ~~waves~~ Waves ~~two through five~~2-5, which occurred between December ~~of~~ 2010 - February ~~of~~ 2018. Thus, collection of data occurred when the children were ages 3, 5, 7, and 9 (Neville et al., 2021). Collection of data was completed through trained officers via face-to-face interviews. Caregivers of the children completed the Strengths and Difficulties Questionnaire (SDQ), which equated to a 10-item (0-20 points) screening for internalizing symptoms and a 10-item (0-20 points) screening for externalizing symptoms. Overall, there are 20 total items ~~total~~ in the SDQ, divided into four categories: (1) emotional symptoms, (2) conduct problems, (3) hyperactivity, and (4) peer relationships. Thus, the researchers combined emotional symptoms and peer relationships into the "internalizing"

category, while conduct problems and hyperactivity were combined into the "externalizing" category. Answers for each prompt were (0) Not True, (1) Somewhat True, and (2) Certainly True. Therefore, ~~externalizing~~externalizing and internalizing components each ~~have~~ exhibited a maximum score of 20 and a minimum score of 0 (Neville et al., 2021). ~~Of course, a~~Although it is not specific to depression, the ~~depressive symptoms would fall within the~~ "internalizing" faction would encompass depressive symptoms. Daily screen time was reported by caregivers, as well. Child sex, family size, regular use of daycare services, caregiver marital status, caregiver marital stress, ethnicity, and socioeconomic status were considered as potential moderators of results in this study (Neville et al., 2021). The aim of the study was to assess both cross sectional and longitudinal associations regarding screen time and both externalizing and internalizing issues in children to determine "directionality." Demographically, there was an even male/female split. Most of the sample was considered "White Irish." At ages 3 and 5 years, the average amount of screen time was ~~two to three~~2-3 hours daily. At age 7, the average was ~~two~~ 2 hours of screen time daily, and at age 9, the average daily screen time was 1.5 hours. Overall, internalizing behaviors were uncommon and remained consistent throughout the course of the study, while externalizing behaviors were higher at first~~,~~ and ~~they~~ progressively decreased over time (Neville et al., 2021).

Of interest, for internalizing behaviors, scores when a child was 3 years old ~~do~~ did not show a significant association with scores at 5 years old. However, ~~they~~ scores began to "stabilize" between ages 5-9 years old (Neville et al., 2021), meaning those with internalizing symptoms at age 5 are significantly more likely to have internalizing symptoms at age 7, and those with internalizing symptoms at age 7 are more likely to have internalizing symptoms at age 9. Screen time trajectories were stable between 3-5 years old, but this trajectory did not carry

over to ages 5-7, but ~~-7 (probably due to this being the time that kids start school), however,~~ the~~se~~ trajectories stabilized again after age 7 (Neville et al., 2021).

When levels of internalizing behaviors were ~~high~~ elevated at age 3, a moderate increase in screen time at age 5 was noted. The reciprocal of this was also true, in that elevated screen time at age 3 was associated with higher internalizing symptoms at age 5 ($p < .05$) (Neville et al., 2021). Thus, a bidirectional relationship between screen time and internalizing behaviors is evident at this age. Higher levels of screen time at age 5 were associated with increased internalizing behaviors at age 7 ($p < .05$) ~~(this was more significant for males when compared to females)~~, but higher levels of screen time at age 7 were associated with a small *decrease* in internalizing behaviors at age 9 ($p < .05$). Other-wise~~than that~~, no longitudinal associations were noted. C~~Those c~~hildren ~~in~~ from larger families also experienced a larger magnitude of depressive symptoms. All the above is regarding within-person associations (Neville et al., 2021). From a between-person standpoint, there is a significant "trait-like" difference between kids who participate in screen time and the presence of internalizing and externalizing behaviors. Overall, kids who tend to spend more time on screens tend to have more internalizing and externalizing behaviors reported ~~(Neville et al., 2021)~~. The authors note that the study's results might show that this timeframe of early childhood would be an important time to focus on preventing ~~"problematic"~~excessive screen time, due to ~~this appearing to~~it potentially being a time where problematic screen use could develop (Neville et al., 2021).

Strengths of this study include the fact that it ~~has~~ includes a large population and is a longitudinal study ~~that represents~~representing Ireland's demographic well. It ~~takes kids~~focuses on children of the same age and follows them over ages in ~~many different ages, at~~ which many milestones are met. Limitations of this study include ~~that~~ the reports ~~were~~ being given by

caregivers, which ~~did~~ provided consistency~~,~~ but ~~it~~ might have ~~lead~~led to inaccuracies. Because the study took place in Ireland, findings may not be precisely applicable to U.S. children. ~~Again,~~ L~~l~~ike other studies, quantity of screen use is studied, rather than the content ~~-~~of the screens being used~~involved regarding screen time~~, which is another limitation (Neville et al., 2021).

Riehm et al. (2019) conducted a longitudinal study to evaluate the effect of daily social media use on future internalizing and externalizing issues within the adolescent population. Participants ~~for~~ of the study were obtained via public-use files of the PATH study, including W~~w~~aves ~~one~~ 1-3~~through three~~, which took place ~~between~~ September 2013 - October 2016. T~~Overall, t~~hose involved in the PATH study were from U.S. households~~, and data was collected in waves over the course of the above-mentioned timeline~~. After exclusion criteria, *N*=6,595; those excluded were those who did not participate in all three waves of data collection. In Wave 1, the 6595 adolescents were aged 12-15, and 51.3% were male (Riehm et al., 2019). Thus, when the study concluded at Wave 3, the students were aged 15-18.

Wave 1 focused on recognizing potential cofounders, which included race, sex, age, parental education, BMI, marijuana use, alcohol use, lifetime internalizing and externalizing issues; these factors were adjusted for analysis. Wave 2 was the “exposure” wave, in which adolescents were asked if they used social media and how much time they spent on social media sites (including Facebook, Google Plus, YouTube MySpace, Linkedin, Twitter, Tumblr, Instagram, Pinterest, and Snapchat) on a given day~~. They were asked how much total time they spent on these social media sites on a given day~~. The different categories of social media use ~~are~~ were as follows: 0-~~up to~~ 30 minutes, 30 minutes - ~~three~~ 3 hours, ~~more than three~~ 3-6 ~~hours - six~~ hours, and more than ~~six~~ 6 hours daily. Wave 3 ~~focused on~~evaluated past-year mental health issues using the Global Appraisal of Individual Needs Short Screener (GAIN-SS), which ~~is~~ was

used to ~~both~~ assess both t~~t~~he presence and the severity of mental health disorders. It ~~is~~ was used to assess externalizing and internalizing mental health disorders, ~~of which~~with depression fitings into the "internalizing" category (Riehm et al., 2019). If at least one symptom in each respective category ~~were~~ was present within the past 2-~~two to~~ 12 months, the response was considered "positive." Low-moderate volumes of symptoms were represented by ~~zero to three~~zero to three symptoms, and high volumes of symptoms were represented by the presence of four or more symptoms. Comorbid problems were considered to be present when all four internalizing and all four externalizing symptoms were present. In this way, social media use in Wave 2 could be studied in association with the presence of internalizing and externalizing disorders in Wave 3 (Riehm et al., 2019).

Results ~~of the study showed that,~~ in Wave 3 showed that~~,~~ 9.1% of participants reported isolated internalizing issues, ~~885~~ 14.0% reported isolated eternalizing problems, and ~~1169~~ 17.7% reported internalizing and externalizing issues, and ~~3930~~ 59.3% reported no problems. In Wave 2, ~~1125~~ 16.8% of participants did not use any social media, ~~2082~~ 31.8% used fewer than 30 minutes daily, ~~2000~~ 30.7% reported 30 minutes - 3~~three~~ hours daily, ~~817~~ 12.3% used ~~three hours to six~~3-6 hours daily, and ~~571~~ 8.4% reported use of more than ~~six~~ 6 hours daily (Riehm et al., 2019). ~~Overall, t~~The control group ~~were~~ included those that used no daily social media. In the adjusted model, adolescents using more than ~~three~~ 3 hours of social media daily were at increased risk of isolated internalizing problems (~~:~~ (~~>~~3~~-~~ ~~hours -~~ ~~<~~6 hours of daily use ~~:~~ RRR ~~=~~ ~~,~~ 1.60, 95% CI [1.11-2.31]~~;~~; greater than ~~>~~6 hours daily use ~~:~~ RRR ~~=~~ 1.78 [~~, 95% CI~~ 1.15-2.77~~).~~]). In the adjusted model, the three top tiers of social media use were associated with a significant risk of comorbid internalizing and externalizing issues (~~>~~30 mins - ~~<~~3 hours daily use~~:~~ RRR ~~=~~ ~~,~~ 1.59~~, 95% CI~~ [1.23-2.05]; ~~;~~ ~~>~~3~~-~~ ~~hours -~~ ~~<~~6 hours daily use ~~:~~ RRR ~~=~~ 2.01 [~~, 95% CI~~ 1.51-2.66]; ~~;~~

greater than >6 hours daily use : RRR = 2.44 , 95% [CI 1.73-3.43]) (Riehm et al., 2019). The authors also mention that a linear trend was noted for both isolated internalizing and comorbid internalizing and externalizing problems: as time using social media increased, the risk of having these issues also increased in proportion. No significant differences were noted when sex of the adolescent was analyzed (Riehm, et al., 2019). Thus, overall, use of adolescent social media is associated with later comorbid internalizing and externalizing issues, as well as isolated internalizing problems in the adolescent population. The authors estimated the impact, based on PAFs (Population Attribuable Fraction), and found estimated that if those using social media for more than 30 minutes daily would begin using social media for fewer than 30 minutes daily, 9.4% fewer high internalizing problems would have occurred (Riehm et al., 2019).

Strengths of this study include the fact that this is a large sample size, particularly for a longitudinal study. Limitations in this study are significant, as well. To begin, this study analyzes internalizing problems, which does include depressive symptoms, but it isare not limited to depression. The authors mention that the benefits of social media use need to be recognized and not forgotten, despite the results of this study (Riehm et al., 2019). Another limitation includes the fact that this study assessed social media use, as a whole, rather than distinguishing between different types and platforms of social media. Another limitation of this study isThis study utilizes self-report by adolescents and via a questionnaire, rather than via interview, which is another limitation. They alsoThe authors note that the validity of the amount of time spent on social media reported in the PATH study is not definitively known, and that social media is something that is constantly changing, and due to this rapid change, the results of the study might not accurately reflect the current trends in social media usage . Finally, there is a possibility that

~~there were unforeseen confounding factors or that somehow, prior mental health issues predisposed the participants to increased levels of social media usage~~ (Riehm et al., 2019).

In the previously discussed study conducted by Robertson et al., children in the 9-10-year-old age group in the U.S. ~~are~~ were more likely to have experienced depressive symptoms, as well as other indicators of poor mental health, if they ~~are~~ were using more than ~~two~~ 2 hours of screen time daily when compared to those using less than 2 hours daily (Robertson et al. (2022).

Self-Harm and Suicide in Relation to Screen Media

Leventhal, et al. (2021) conducted a study over the course of ~~eight~~ 8 years, which analyzed the trends of increasing digital media use and adolescent ~~digital media use~~suicidal behavior. The objective was to determine if the trends in the two are directly associated over many years. ~~They~~ The researchers used data collected by the Youth Risk Behavior Surveillance System (YRBSS) from 2009-2017. This was~~is~~ a cross sectional self-report survey of 72,942 total students ~~(total)~~ over the course of ~~eight~~ 8 years. ~~(Leventhal et al., 2021).~~ These students were from both public and private schools. The questionnaires were given in the classroom, all students participated voluntarily, and all students were considered eligible. ~~This~~ The study was conducted in grades nine through 12, and all races were included, although "multirace/multiethnic" were combined due to low volumes of students. Baseline information was collected in 2009, and data was also collected in 2011, 2013, 2015, and 2017. Total, over the course of 2009-2017, participation rates ranged from 69~~%~~ -~~-~~81%. Suicidal behavior was assessed by asking, over the past year: "did you ever seriously consider attempting suicide?" (yes/no), "did you make a plan about how you would attempt suicide?" (yes/no), and "how many times did you actually attempt suicide?" (zero versus ~~one or more~~one or more) (Leventhal et al., 2021). Thus, suicidal thoughts, suicide plan, and suicide attempts over the past year could be evaluated

at each year of surveillance. Digital media use was assessed by asking, “on an average school day, how many hours do you play video games or use a computer for something that is not schoolwork? (Include activities such as Xbox, PlayStation [other example media platforms]).” However, these platforms were changed every year of surveillance, based on what was popular at that given time (for example, smartphones were specifically mentioned beginning in 2015). Sex, race/ethnicity, and age were also included in the data collection. Eighty-three variables were screened as possible covariates (including diet, physical activity, sexual behaviors, and more). Of these, race/ethnicity, obesity, and school safety concerns met the criteria to be included as covariates. The year 2009 was used as the baseline group for to which other yearly reports to could be compared to (Leventhal et al., 2021).

To summarize the findings of this study, essentially, 2011, 2013, 2015, and 2017 all experienced produced significantly higher prevalence of suicide behavior and of thehigher amount s of digital media usage, when each year was compared to 2009 after covariate adjustment (Leventhal et al., 2021). Based on the data, after adjusting for the current year and the covariates, it was determined that each one point on the 0-6 scale for digital media use ([(0] = no use, [1] = less than <1 hour, [2] = 1-- <2 hours, [3] = 2- - <3 hours, [4] = 3-- <4 hours, [5] = 4-- <5 hours, and [6] = 5 or more+ hours) is associated with an 11% increased odds of any sort of suicide-related behavior across the entire 2009-2017 time period (OR = 1.11, (95% CI [= 1.09, 1.12)] higher odds of any sort of suicide-related behavior across the entire 2009-2017 time period. Overall, an increase in suicidal behavior in relation to digital media use is was not seen until the user surpasses 5+ hours of digital media use daily (Leventhal et al., 2021). The mediation analysis of this study’s results revealed that increased digital media use over the course of 2009-2017 were was related to increasing suicidal thoughts, plans, and attempts by

adolescents in the United States. However, the magnitude of digital media's influence on suicidal behavior is small and accounted for less than <50% of the change in suicide behavior increase over this time frame. The estimated cross-year suicidal behavior increases are mediated a certain percentage by increases in screen time for 2011, 2013, and 2017 ~~vs.~~when compared to 2009, respectively: M = 20.5%, 95% CI [~~(95% = CI~~ 16.2 ,24.8]~~);~~, M= 34.3% [~~(95% = CI~~ 24.5, 44.1]~~)~~, M = 22.8% [~~(95% CI =~~ 17.3, 28.0]~~)~~ and M = 41.4% [~~(95% CI =~~ 33.9, 49.5]~~)~~ (Leventhal et al., 2021). However, it is important to remember that this is the percentage of change that screen time contributes to suicidal behavior, rather than the total increase of suicidal behavior caused by screen time. Across all years, when adjusted for covariates, the association between screen media and suicide behavior is very small, and it is probably not clinically significant unless comparing extreme highs to extreme lows of digital media usage (Leventhal et al., 2021). Although suicide behavior and digital media ~~time~~ use are connected, other factors contribute most of the influence on the increase in suicidal behavior in the adolescent population that has been ~~seen~~ witnessed over time in the United States. It is noted that the amount of influence that digital media has on suicidal behavior is more significant in the female population than the male population ~~when using bivariate association estimates~~ (Leventhal et al., 2021)~~.~~.

Strengths of this study include the fact that it takes place over a period of ~~eight~~ 8 years, and it ~~has~~ includes a large sample size, which represents the U.S. high school population well. However, a limitation~~s~~ include~~s~~ ~~that~~ it ~~is~~ cross-sectional nature, which ~~means that~~inhibits any claim of causation ~~causation cannot be claimed~~. It also does not delineate between types of digital media, which ~~may be a factor in the~~could be significant regarding the prevalence of past-year suicidal behavior. Also, the wording from the YRBSS varied by year, based on the popular types of digital media, ~~opening the door to~~possibly yielding inconsistencies ~~. There could also be~~

~~some unmeasured confounds contributing or unnoticed bias within the YRBSS items~~ (Leventhal et al., 2021).

The previously discussed study by Robertson et al. (2022) ~~-~~also analyzed suicidal behavior and self-harm~~,~~ in relationship to screen time and ~~the~~ different factions of screen time. This study focused on ~~in~~ the 9–10-year-old population. ~~For suicide attempts and ideation, t~~Those using greater than ~~two~~ 2 hours of screen time daily were 65% more likely to have suicidal ideation or ~~an~~ attempt suicide (aRR = 1.65, 95% CI [1.32, 2.05]) than those using less than 2 hours daily. Significant risk was also noted with spending ~~>2~~more than 2 hours on each subtype of screen time daily. Those using greater than ~~two~~ 2 hours of screen time daily were 45% more likely to engage in self-harm (aRR = 1.45 [1.09, 1.93]), and again, the same was true for spending more than ~~two~~ 2 hours daily on each subtype of screen time (Robertson et al., 2022).

In the previously discussed study ~~conducted~~ by Twenge & Farley (2020), self-harm and ~~was analyzed with regard to~~ its association with different types of screen time was evaluated. For girls, spending ~~2~~ 2 or more hours on any type of screen media ~~was~~was associated with significant increases in self-harm, with the exception of TV use, in which a significant increase was not ~~seen~~ witnessed until ~~5~~5 or more~~+~~ hours daily ~~was~~ were used. The most significant risk ~~increase~~ for girls ~~were~~ involved those using the internet and those using social media. For boys, a significant increased risk for self-harm was only seen in those using ~~5~~5 or more~~+~~ hours daily of either social media or the internet, but gaming and TV use were~~as~~ not associated with an increased risk of self-harm in boys (Twenge & Farley, 2020).

Discussion

The associations between daily screen time and the mental health of the youth population are important to both clinical practice and patient education. Of course, a child's age, sex, and

the type of screen ~~time~~ use in which they are engaging ~~in~~ are factors to consider, as well. But what exactly is the connection between screen time and depression in the youth population? Furthermore, how much screen time is too much, what types of screen time are worse~~e~~, ~~is the effect~~are the effects of screen time different between males and females, do the effects of screen time on depression change at various stages of childhood, and does screen time have an association with suicidality in the pediatric population? These are all important questions when evaluating the effects of screen time ~~on~~ and mental health in this population.

With such vast access to screens and multiple ~~different~~ platforms in which to engage in screen time, it is important to assess if differences are found between different types of screen time and their association with depression. Robertson et al. (2022) demonstrated that 9–10-year-olds were more likely to meet criteria for depressive disorders when they engaged in greater than ~~two~~ 2 hours of total screen time daily, but differences were ~~seen~~ identified when ~~breaking down~~dividing total screen time into different factions based on platform. Total digital media time and video chat time greater than ~~two~~ 2 hours daily ~~was~~ were also associated with depression, but TV and movie time greater than ~~two~~ 2 hours daily was not. When digital media was broken down into factions, boys were significantly more likely to experience depression when using greater than ~~two~~ 2 hours of any faction, while girls' results were only significant when they used greater than ~~two~~ 2 hours of daily ~~of~~ social media or online videos (Robertson et al., 2022). Twenge and Farley (2020) found similar results in the adolescents aged 13-15: ~~in that~~ larger amounts of screen time were associated with worse mental health, however this effect was found to be largest in those engaging in high amounts of social media and/or internet use (particularly those using at least 5 hours daily), while smaller associations were found with those gaming or watching television (Twenge & Farley, 2020). In the study conducted by Kidokoro, et al. (2020),

screen use and depression varied by age groups and sex, and "newer" types of screen time (i.e. social media, online gaming, and online videos) were more likely to be associated with depression, with social media use greater than ~~two~~ 2 hours daily having the most significant association with depression in junior high school aged students in Japan (Kidokoro et al., 2020). Kim et al. (2020) grouped screen media into "active" (video gaming, chatting, working on a computer, or using a smartphone) or "passive" (watching TV, videos, or YouTube) categories. They found ~~that when~~ a person ~~was~~ using at least ~~four~~ 4 hours of "passive" screen time daily, he or she experienced nearly triple the likelihood of having experienced a major depressive episode within the last ~~six~~ 6 months, when compared to those using fewer than ~~two~~ 2 hours daily. However, no significant association was noted between any amount of "active" screen time and depression (Kim et al., 2020). These cross-sectional studies lend important information as to what types of screen time depressed pediatrics tend to use ~~more~~most. Due to the nature of being cross-sectional, these studies are unable to lend insight into any volume or type of screen media leading to later depression. However, based on these results, it seems that social media use in high volumes, as well as internet use in high volumes has the strongest association with depression in children of various ages. The findings do differ in the work of Kim et al., in that passive screen media was associated with increased depression, while active screen media was not. However, the research of Kim et al. did not further break down the type of passive and active screen media~~, while the other studies did~~. As a whole, the conclusion can be drawn that high amounts of screen time use (particularly social media and internet use) tend to be ~~seen~~ present in those who are more depressed.

Although the cross-sectional studies mentioned are important and significant, no claims of causation can be made, due to the cross-sectional nature of these studies. Longitudinal studies

utilized in this literature review ~~are able to~~can lend more insight into the presence of a causal relationship between various types of screen use and the presence of depression in the youth population. Boers, et al. (2019) found ~~that~~, over the course of the ~~four~~4-year study encompassing children between seventh and 11th grade, ~~when children were initially evaluated in grade seven and lastly evaluated in grade eleven, it was seen~~ that video gaming was not associated with any increase in depressive symptoms, from both within-person and between-person standpoints. However, when analyzing computer use in this population, each hour increase in computer use was associated with a 0.69 unit increase on the Brief Symptoms Inventory (from a between-person perspective), but no increase was noted from a within-person perspective, meaning that those who tended to use more computers tended to score more highly on the BSI, and thus, tended to have more symptoms of depression. Notably, those who started using computers more when compared to their baseline did not develop increased depressive symptoms, which is an important distinction to make (Boers et al., 2019). Social media, on the other hand, was significantly associated with symptoms of depression in both between-person and within-person analysis, meaning that over the course of the ~~four~~ 4 years, those who used social media more tended to have higher depression scores, and those who began using social media more than their prior baseline went on to develop more depressive symptoms. In the work by Boers et al., it was also found that those who spent more time watching television tended to have fewer depressive symptoms (between-person), but those who increased their TV watching over their baseline, tended to develop more depressive symptoms (within-person). Boers et al. ~~-~~lend some helpful insight into the causation of different types of screen media and their effects on depression in this population in that social media has both between-person and within-person effects on depression, while other sources of screen time have variable effects (Boers et al., 2019).

Riehm et al. (2019) found similar results, although in this study, social media use was exclusively analyzed, it was found that the use of social media was associated with later isolated internalizing disorders, as well as comorbid internalizing and externalizing disorders. Of course, ~~this~~ internalizing disorders include~~s,~~ but ~~is~~ are not exclusive to depression~~, but still significant in that internalizing disorders do include depression~~ (Riehm et al., 2019). Similarly, Coyne et al. (2020) completed an ~~eight~~8-year longitudinal study, which also focused on social media use, exclusively. They found that the between-person results showed that those who use more social media are more likely to be depressed. However, they found that no within-person results were significant, in that people who began using ~~more~~ social media ~~,~~ above their personal baseline ~~,~~ were not disposed to later increased development of depression (Coyne et al., 2020). This is an important consideration to make, in that Coyne, et al. found no significant causal relationship, rather a correlational relationship between social media use and depression~~:,~~ ~~in that~~ those who tend to be more depressed tend to use social media~~, without~~ and there is no evidence that social media use leads to the development of depression. Vannucci~~, et al.~~ and McCauley Ohannessian (2019) lent further insight into the association between social media and depression ~~,~~ when they studied seventh and eighth graders in a longitudinal setting. However, this was done over the course of only ~~six~~ 6 months. They found that those who fell into the High Social Media Use subgroup experienced significantly more depressive symptoms than those using low amounts of social media and those who used primarily Instagram and Snapchat. However, these students also tended to use the most social media, overall, making it difficult to isolate the content that they were consuming. They also found no statistically significant depressive differences between those who used large amounts of primarily Snapchat and Instagram and those who used low amounts of social media, as a whole (Vannucci ~~et al.~~& McCauley Ohannessian, 2019). Babic et

al. (2017) completed a longitudinal randomized controlled trial, in which the study spanned only ~~six~~ 6 months. They found that total recreational screen time had a negative association with both physical self-concept and psychological well-being. Computer use was also associated with worse psychological well-being, and the use of tablets and mobile phones was associated with poorer physical self-concept. Interestingly, increased TV and DVD use was associated with higher amounts of psychological difficulties (Babic et al., 2017). Houghton et al. (2019) discovered that elevation in total screen time was significantly associated with later depressive symptoms, however, they estimated that it would take 13 or more hours of total screen daily time to displace a youth reporting an average CDI depression score to a clinically depressed CDI depression score. It is also important to realize that this relationship was reciprocal. Of note, they also found that web use was associated with later depressive symptoms, but social media, gaming, and TV/passive screen time were not (Houghton et al. (2019).

~~With regard to~~Regarding types of screen media and their effects on depression in the youth, the results are somewhat mixed and are variable between studies. Cross-sectionally, it seems that those who spend more time on screens tend to have more symptoms of depression, consistent with a correlation between overall screen time use and depressive symptoms. Of the types of screen time, social media use tends to have the largest correlation with depressive symptoms in the youth population, followed by internet online video use. Watching TV/movies and gaming seem to have the least correlation with depression~~, and internet use and online video use seem to have mixed results between studies but appear to be significant regarding the presence of depressive symptoms~~. When evaluating the causal effect of various types of screen time and the development of depressive symptoms, the results are mixed. Unfortunately, much of the research tended to focus on social media use, which is important in that social media seems

to have the most correlational association with depression in the youth, but it does narrow the ability to differentiate between different types of screen time in the longitudinal setting. The ~~2019~~ study conducted by Coyne et al. (2020) probably lends the most reliable insight into the effects of social media over the long-term.~~, in that the study spanned eight years.~~ It showed that social media use tends to be higher in those who are more depressed, but increasing social media use does not necessarily predispose users to increased depression in the future (Coyne et al., 2019). This is important in that it diminishes the ability to claim that social media use is a causative force in the development of depression, rather they seem to parallel one another and fluctuate in accordance with one another. In summary, the type of screen use is important~~, in that:~~ social media and internet use seem to have the most association with depression; however, when causation of depressive symptoms by any type of screen time was found, ~~witnessed,~~ the effects were very small. Findings do suggest that increased screen use and depression seem to occur simultaneously, and those using high amounts of screen time, particularly internet and social media, are more likely to be depressed.

When sex differences were analyzed, some important distinctions were made. Robertson et al. (2022) found that 9–10-year-old boys tended to use more screen time, overall. ~~However, girls experienced increased risk of depressive symptoms when they used greater than two hours of daily total screen time and digital media when compared to boys, but boys experienced significant increased risk of depressive symptoms when using greater than two hours daily of any type of digital media, while girls only experienced those results with online video use and social media.~~ When using ~~seven~~ 7 or more hours of screen time daily, girls demonstrated a four-fold risk of depression (when compared to those using fewer than ~~one~~ 1 hour daily), while boys only experienced a two-fold risk increase (Robertson et al., 2022). Boers et al. (2022) noted that girls

and those in a lower socioeconomic class experienced the most severe symptoms of depression. ~~Interestingly,~~ Coyne et al. (2020) found ~~that~~, for both girls and boys, social media use did not cause later symptoms of depression, and ~~that~~ current depression symptoms did not cause future increases in social media use~~;~~, however it showed that both girls and boys who used higher amounts of social media also tended to experience more symptoms of depression. The study ~~did~~ showed that girls reported more social media use and experienced more symptoms of depression than boys (Coyne et al., 2020). Twenge and Farley (2020) found that girls aged 13-15 spent more time on all forms of screen media, except for gaming. They also found that girls seemed to have coinciding increases in depression when using most types of screen media for a smaller amount of time, when compared to boys (i.e., with internet use, girls using ~~two to five~~2-5 hours daily were significantly more likely to experience depression, while this change was seen in boys using ~~five~~ 5 or more hours daily) (Twenge & Farley, 2020). It was also found that the highest risk groups for girls were those using large amounts of internet and social media, while the highest risk groups for boys were those using high levels of social media and gaming (Twenge & Farley, 2020). The study completed by Vannucci ~~et al.~~ and McCauley Ohannessian (2019) showed that, although individual differences were not noted between males and females within the same subgroup, females tended to fall into the subgroups of High Social Media use and High Instagram/Snapchat use~~, meaning females tended to use more social media (including Instagram and Snapchat) than boys~~. The High Social Media subgroup tended to experience worse depressive outcomes than each of the other two groups (Vannucci ~~et al.~~& McCauley Ohannessian, 2019). Perhaps the soundest piece of research regarding differences between sexes was found in the longitudinal work by Houghton et al. (2018), which found that (when both boys and girls were examined together) both total screen time and web use had a positive relationship

with the development of depressive symptoms in the following wave of study~~, as did web use~~. However, use of social media, gaming, and TV/passive use were not directly implicated in this relationship. When broken down between males and females, however, statistically significant reciprocal cross-lagged effects were noted between both total screen time and social media in boys, but this was not the case for girls; furthermore, a positive association was found between web use and development of later depressive symptoms for boys but not for girls. In the study by Houghton et al. (2018), it would seem that boys are more likely to experience negative depressive effects due to increased total screen time, social media, and web use, even if girls tend to be comparatively more depressed and use more screen time, as a whole. It is important to realize, however, that even though the causal relationship between total screen time and depression is significant, it is quite small (Houghton et al., 2018).

To summarize differences in sex, girls tend to use more screen time, as a whole, particularly as they enter early adolescence and adolescence, although Robertson et al. (2022) found that in the 9–10-year-old population, boys used more screen time. However, a vast majority of the other research points to girls using more total screen time, social media, and most other categories of screen time, except for online gaming, which tends to be dominated by males. It may be that boys use more screens at a younger age, but girls tend to use more as they grow older. When looking at depression, girls tended to report higher volumes ~~of~~ and more extreme symptoms of depression. However, in the longitudinal, within-person setting, males were more likely to experience significant effects ~~from~~ due to exposure to screen time, web use, and social media ~~use~~ in association with the development of later depressive symptoms. These effects were minor and only found in one study. Overall, it seems that girls are more likely to use high volumes of screen time, particularly social media and the internet ~~use~~, while boys are more likely

to use less screen time and are more likely to engage in gaming. Girls exhibit a higher prevalence of depression and more extreme depressive symptoms, however, based on this research, it is not reasonable to claim causation between screen time and depressive symptoms when analyzing the differences between sexes.

When studying members of the pediatric population, it is essential to consider the age of the person. Twenge & Campbell (2018) produced the soundest research regarding the amount of time spent on screens for each age group. In Twenge and Farley's study of more than 40,000 pediatrics, children tended to use more screen time as they grew older. In the 2–5-year-old population, the average daily screen time was 2.28 hours, in those 6-10 years old, the average daily screen time was 2.78 hours, in the ~~11-13 year-olds~~11–13-year-olds, the average daily screen time was 3.80 hours, and finally, in the high school (14-17 year old) aged group, the average daily screen time was 4.59 hours (Twenge & Campbell, 2018). This finding, especially from such a large sample size, provides an important framework for analyzing the relationship between screen use and depression. It is important to realize that the largest increase in screen use occurred between elementary and middle school (Twenge & Campbell, 2018). Robertson et al. (2022) showed that 9–10-year-old boys spent more time on screens, but studies on older pediatrics showed that girls tended to use more screens than boys. Robertson, et al. (2022) found that this age group used quite low volumes of social media; however, those using any volume of social media were more likely to have symptoms of depression (Robertson et al., 2022). Kidokoro et al. (2022) found similar results as Robertson in that few elementary students used social media, and they also found that junior high school students were more likely to report depressive symptoms than elementary students. It was also found that depression was more likely to be correlated with increased use of various screens in junior high school when

compared to elementary school (Kidokoro et al., 2022). Neville et al. (2021) found interesting results in the elementary population~~:~~ in ~~that between the~~children ages ~~of~~ 3-5, a bidirectional relationship existed over time regarding screen time and internalizing behaviors (increased screen use at age 3 led to increased internalizing behaviors at age 5 and vice versa). They also found that increased screen time at age 5 led to increased internalizing behaviors at age 7, however, the opposite of this was true between ages 7-9, in which screen time elevation at age 7 led to decreased internalizing behaviors at age 9. It is important to note that internalizing behaviors were uncommon between the ages of 3-9 (Neville et al., 2021).

A common theme found in the research showed that as children aged, they tended to report more depressive symptoms. Boers et al. (2019) found that, when studying 7th-11th grade students, as the children aged, average social media and TV use increased, while video game usage decreased slightly, and computer use remained fairly constant (Boers et al., 2019). Vannucci ~~et al.~~and McCauley Ohannessian (2019) studied children between the ages of 11-14 and found that the younger adolescents tended to fall into the subgroup of low social media use, while older adolescents were more likely to fall into the groups using more social media (Vanucci et al., 2019). Coyne et al. (2020) found that social media use steadily increased over time between the ages of 13-20, and depressive symptoms peaked at age 18~~, which is an important finding, in that the the study focused on the same population over the course of eight years, lending vast insight into trends of social media use over adolescence~~. Twenge & Campbell (2018) ~~found~~ discovered that those who were 11-13 years of age required ~~seven~~ 7 or greater hours of daily screen time to be at higher risk to have ever ~~been~~ received a diagnosed ~~with~~ of depression, taken a medication for depression, or ever visited a healthcare professional for depression, while in the 14-17 year old population, a significant increased risk was witnessed in

those using greater than ~~four~~ 4hours of screen time daily, implying that a lower "threshold" was seen in those in the older group (Twenge & Campbell, 2018).

In summary of the differences between age groups, elementary and preschool aged children tend to use a different variety of screens when compared to adolescent and high school aged children. Social media use tends to increase during childhood, as does total screen time. At the same time, depressive symptoms tend to be rare in those in elementary school, and prevalence of depressive symptoms increases throughout childhood, likely peaking approximately when children are graduating high school. However, it is very difficult to attribute changes in mental health to the use of screens, just as it is difficult to attribute the use of screens to prior increased depression. These results are nonetheless significant when considering and caring for pediatric patients of different ages.

When analyzing the effects that screen time has on the mental health of the youth population, it is important to discuss the implications that screen time has on self-harm and suicidal activity. Robertson et al. (2022) found that those 9–10-year-olds using screen time more than ~~two~~ 2 hours daily were significantly more likely to engage in suicidal thoughts, attempts, and self-harm activities. Twenge & Farley (2022) concluded that girls using ~~two~~ 2 or more hours daily of any form of screen time (except for TV use) exhibited increased the prevalence of self-harm, with the most significant risk being associated with internet use and social media use. For boys, however, elevated risk of self-harm was only witnessed in those partaking in ~~five~~ 5 or more hours of social media or internet use (not TV or gaming) (Twenge & Farley, 2020). Similar to the results found by Twenge and Farley regarding males, Leventhal et al. (2021) found that an elevation in suicidal behavior was not witnessed until users consume ~~five~~ 5 or more hours of daily digital media, but the use of these large amounts of digital media accounts for a relatively

small amount of the changes seen in suicidal behavior. However, the effects were more significant for females than for males (Leventhal et al., 2021). In summarizing the effects of screen media on suicidal activity and thoughts, as well as self-harm, it seems that ~~very~~ high levels (approximately 5 or more hours) of screen use ~~are~~ were correlated with increased risk of suicidal and self-harm behaviors. However, based on this research, it is not possible to make a claim of causation regarding their association, primarily since the research on this topic is largely cross-sectional in nature. ~~Like depression~~Similar to those who experience depression associated with screen use, it seems that those who tend to use screen time more frequently also tend to ~~think about~~contemplate suicide, ~~or~~ attempt suicide, or engage in self harm, but the relationship between the two is largely unclear.

Some common limitations found in many studies included the fact that most of the data was collected via self-report, which could decrease accuracy of results and decrease objectivity. Many of the studies were cross-sectional, limiting the ability to claim causation. Although confounding factors were accounted for in nearly all the studies, it is impossible to account for all ~~possible~~ potential confounds. Some of the studies focused exclusively on social media in various forms, which is important research, but may exclude important data that would be found if a wider range of screen time was evaluated, instead. Some research focused on internalizing disorders, rather than strictly on depression, which could cause some findings nonspecific to depression. Finally, the content that is viewed by users is evaluated in none of the research: although many focus on the platform used, the content viewed or ~~/~~used on each platform is not evaluated. ~~,~~Evaluation of the content consumed by children and adolescents~~which~~ could lend significant insight into the relationship between screen use and depression.

Conclusion and Applicability to Clinical Practice

Depression in the youth population is certainly ~~something~~ a topic that requires diligent thought and consideration by both parents and healthcare providers. As smartphones and other forms of screen time have become a staple of society in the United States and other countries, it is important to analyze the associations between screen use and ~~its relation to~~ depression. Furthermore, it is important to delineate if screen use is a causative factor in the development of depressive symptoms in children. Based on the current body of evidence, it appears that there is a definitive correlational association between screen use and depression, which tends to become more pronounced as children enter preadolescence and adolescence. However, this association is more ~~pronounced~~ significant with use of certain types of screen media: social media use and use of the internet tend to correlate with increased levels of depression. However, when screen use was analyzed regarding its ability to cause depression in the youth, the results are not clear. ~~.~~ Suicidal ideation, self-harm actions, and suicide attempts also seem to be exhibit correlational relationship with ~~increased~~ screen use. ~~, however, no research has been completed to determine if screen time is causative of depression in the pediatric population.~~ As a whole, it appears that different studies garner slightly differing results, but~~;~~ essentially, if a causative factor between screen time and the development of later depression is present, the effect is quite small. Rather, depression and screen use might be better thought of as entities that tend to fluctuate together, meaning those who tend to be more depressed tend to use more screen time and vice-versa. Perhaps, a sudden increase in the use of screen media would be a sign that a child's mental health is ~~deteriorating~~ worsening, ~~and~~ which would prompt ~~rapid~~ the consideration for intervention. Finally, those using ~~very~~ high amounts of screen time (i.e. 5 or more hours) warrant particularly careful scrutinization regarding their mental health, as these individuals are most significantly associated with elevated risk for depressive symptoms, self-harm, and suicidal

thoughts or ~~/~~acts. For practitioners, it would be important to identify youth patients consuming 5 or more hours of screen time daily. Further investigation may be needed to identify the type of screen time used by the patient and to explore the patient's current depressive symptoms. ~~-~~

Girls and boys require different consideration when evaluating screen use and depression. Primarily, this seems to relate to the type of screen time that each sex tends to use. ~~As a whole,~~ T~~t~~he current body of research shows that girls tend to use more social media, and they tend to report more depressive symptoms. Boys tend to use more online gaming that girls, which is not surprising. It is also important to realize that boys use more screen time at a younger age, but girls tend to use more screen time as they advance into preadolescence and adolescence, which might be due to the changes in types of screen time typically used at different ages (social media and internet use tend to increase as the child ~~goes~~ ages into and through adolescence). As a whole, girls tend to use the internet and engage in social media more than boys, and they are also more likely to experience ~~increased~~ elevated severity of depressive symptoms. Girls also tend to engage in more thoughts and ~~/~~attempts at self-harm, but again, there is no identifiable causative factor that has been found. They consume more overall screen time that boys, however, the literature is not definitive in determining if any of these tendencies are causative ~~in~~ to the comparatively higher depressive symptoms found in female youth. For practitioners, it would be beneficial to keep these tendencies in mind, particularly if females are using excessive amounts of screen time, particularly if they are engaging in social media and internet use.

~~Given that pediatrics are developing rapidly, it is essential to determine changes regarding screen time and depressive symptoms. As a whole,~~ T~~t~~otal screen time and social media use increas~~es~~es as children age~~, and social media use also increases as the child ages~~.
Concurrently, depressive symptoms increase throughout the pediatric life, peaking as ~~they~~ youth

leave adolescence and enter early adulthood. However, based on the current body of evidence, there is no ability to determine that these changes are causative of one another. Even if there is a causative (either unidirectional or reciprocal) relationship, it is quite small, and these changes are almost certainly multifactorial, making the true cause of these changes very difficult to identify. It is quite likely that many factors contribute to both the use of screen media and the development of depression. A connection between screen use and depression certainly seems to exist, but the exact relationship remains difficult to identify.

In summary, different types of screen time require different considerations, in that some are more likely to be associated with depressive symptoms; those that are the most likely to be associated with depression are social media and internet use. ~~Increased~~ High volumes of screen time, particularly when levels reach ~~five~~ 5 or more hours daily, are also associated with worse mental health. Children tend to report both increased depressive symptoms and increased use of screens, including increased social media and internet use, as they age and progress through their childhood. Females tend to use the types of screen media most associated with depression (social media and internet) when compared to boys, and they also tend to use more total screen time, except when ~~the~~ children are quite young. In general, high screen time volumes likely have a causative or reciprocal relationship with depressive symptoms, but these ~~variables~~ interactions (in isolation) are quite small~~, in that extremely high volumes of screen use would be required to cause a pediatric patient to develop depression~~. This is not to imply that high levels of screen time are not harmful, rather it is quite difficult to isolate the depressive effect that screen use bestows upon children and adolescents. The recommendation to limit youth screen use to 2 hours daily seems quite reasonable, in that depressive symptoms seem to be consistently more prevalent in those using more than 2 hours daily. However, the body or research also

demonstrates that the type of screen time used by youth patients might warrant evaluation and discussion with patients and their parents. Furthermore, recognizing patients using excessive amounts of screen time might be an important aspect of identifying patients who are experiencing depression and/or a decline in their mental health.

References

Abzug, M. J., Bunik, M., Hay, W. W., & Levin, M. J. (2022). *Current diagnosis & treatment: Pediatrics*. (26th ed.). McGraw-Hill Education.

American Academy of Child & Adolescent Psychiatry. (2020). Screen Time and Children. https://www.aacap.org/AACAP/Families_and_Youth/Facts_for_Families/FFF-Guide/Children-And-Watching-TV-054.aspx

Babic, M. J., Smith, J. J., Morgan, P. J., Eather, N., Plotnikoff, R. C., & Lubans, D. R. (2017). Longitudinal associations between changes in screen-time and mental health outcomes in adolescents. *Mental Health and Physical Activity*, *12*, 124–131. https://doi.org/10.1016/j.mhpa.2017.04.001

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

Coyne, S. M., Rogers, A. A., Zurcher, J. D., Stockdale, L., & Booth, M. C. (2020). Does time spent using social media impact mental health?: An eight year longitudinal study. *Computers in Human Behavior*, *104*, 106160. https://doi.org/10.1016/j.chb.2019.106160

Hill, D., Ameenuddin, N., Chassiakos, Y. (L.) R., Cross, C., Radesky, J., Hutchinson, J., Levine, A., Boyd, R., Mendelson, R., Moreno, M., & Swanson, W. S. (2016~~, November 1~~). *Media use in school-aged children and adolescents*. American Academy of Pediatrics.

Houghton, S., Lawrence, D., Hunter, S. C., Rosenberg, M., Zadow, C., Wood, L., & Shilton, T. (2018). Reciprocal relationships between trajectories of depressive symptoms and screen media use during adolescence. *Journal of Youth and Adolescence*, *47*(11), 2453–2467. https://doi.org/10.1007/s10964-018-0901-y

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*. https://doi.org/10.3389/fped.2021.822603

Kim, S., Favotto, L., Halladay, J., Wang, L., Boyle, M. H., & Georgiades, K. (2020). Differential associations between passive and active forms of screen time and adolescent mood and anxiety disorders. *Social Psychiatry and Psychiatric Epidemiology*, *55*(11), 1469–1478. https://doi.org/10.1007/s00127-020-01833-9

Leventhal, A. M., Cho, J., Keyes, K. M., Zink, J., Riehm, K. E., Zhang, Y., & Ketema, E. (2021). Digital Media use and suicidal behavior in U.S. adolescents, 2009–2017. *Preventive Medicine Reports*, *23*, 101497. https://doi.org/10.1016/j.pmedr.2021.101497

Neville, R. D., McArthur, B. A., Eirich, R., Lakes, K. D., & Madigan, S. (2021). Bidirectional associations between screen time and children's externalizing and internalizing

behaviors. *Journal of Child Psychology and Psychiatry*, *62*(12), 1475–1484. https://doi.org/10.1111/jcpp.13425

Riehm, K. E., Feder, K. A., Tormohlen, K. N., Crum, R. M., Young, A. S., Green, K. M., Pacek, L. R., La Flair, L. N., & Mojtabai, R. (2019). Associations between time spent using social media and internalizing and externalizing problems among US youth. *JAMA Psychiatry*, *76*(12), 1266. https://doi.org/10.1001/jamapsychiatry.2019.2325

Roberston, L., Twenge, J. M., Joiner, T. E., & Cummins, K. (2022). Associations between screen time and internalizing disorder diagnoses among 9- to 10-year-olds. *Journal of Affective Disorders*, *311*, 530–537. https://doi.org/10.1016/j.jad.2022.05.071

School selection and role – ABCD study (2022). Retrieved from https://abcdstudy.org/educators/school-selection-and-role/

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., & Farley, E. (2020). Not all screen time is created equal: Associations with mental health vary by activity and gender. *Social Psychiatry and Psychiatric Epidemiology*, *56*(2), 207–217. https://doi.org/10.1007/s00127-020-01906-9

Vannucci, A., & McCauley Ohannessian, C. (2019). Social media use subgroups differentially predict psychosocial well-being during early adolescence. *Journal of Youth and Adolescence*, *48*(8), 1469–1493. https://doi.org/10.1007/s10964-019-01060-9