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# Screen Time and Youth Health Issues: A Literature Review

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**Abstract:** This literature review was undertaken in 2019 with the goal of examining the health effects of screen time exposure on school-aged youth. With the COVID-19 outbreak in early 2020, and the subsequent requirement for many students to learn online, concerns about youth exposure to screens only became more pronounced. Now, more than ever, it is vital that educators—both new and old—consider the effects of screen time exposure. Three databases were accessed for the literature review including EBSCO Education Source, APA (American Psychological Association) PsycNet, and Ovid MEDLINE. The final set of 22 studies were compiled using systematic searches conducted in January 2019 using search terms associated with screen time use among adolescents. The categories of effects that emerged were: (a) physical, (b) behavioural, and (c) psychological. While some of the results of these studies demonstrate small but significant negative correlations between screen time exposure and health effects, and are potentially helpful in understanding screen time associations with the identified factors, in their conclusions authors point out that it is difficult to establish causal connections. Discussion of the results focuses on the potential that familial influences may have in terms of supporting youth in establishing positive screen time behaviours.

**Keywords**: screen time; well-being; technology, social media, cell phone, digital citizenship

**Résumé :** Cette revue de la littérature a été entreprise en 2019 dans le but d'examiner les effets sur la santé de l'exposition à l'écran sur les jeunes d'âge scolaire. Avec l'épidémie de COVID-19 au début de 2020 et l'obligation subséquente pour de nombreux étudiants d'apprendre en ligne, les préoccupations concernant l'exposition des jeunes aux écrans ne font que devenir plus prononcées. Aujourd'hui plus que jamais, il est essentiel que les éducateurs, qu'ils soient nouveaux ou anciens, tiennent compte des effets de l'exposition à l'écran. Trois bases de données ont été consultées pour la revue de la littérature, notamment EBSCO Education Source, APA (American Psychological Association) PsycNet, et Ovid MEDLINE. L'ensemble final de 22 études a été compilé à l'aide de recherches systématiques menées en janvier 2019 à l'aide de termes de recherche associés à l'utilisation du temps d'écran chez les adolescents. Les catégories d'effets qui ont émergé étaient: (a) physiques; (b) comportemental; et (c) psychologique. Bien que certains des résultats de ces études démontrent des corrélations négatives faibles mais significatives entre l'exposition au temps d'écran et les effets sur la santé, et sont potentiellement utiles pour comprendre les associations du temps d'écran avec les facteurs identifiés, dans leurs conclusions, les auteurs soulignent qu'il est difficile d'établir des liens de causalité. La discussion des résultats se concentre sur le potentiel que les influences familiales peuvent avoir pour ce qui est d'aider les jeunes à adopter des comportements positifs à l'écran.

**Mots-clés :** temps d'écran; bien-être; technologie; médias sociaux; téléphone mobile; citoyenneté numérique

## Introduction

Even prior to the onset of the COVID-19 global pandemic, there was concern about the prevalence of technology in the lives of youth. With the expectation that many students will learn online during periods of quarantine, concerns about screen time exposure only increased. Therefore, although this literature review was completed ahead of the COVID-19 pandemic, we view it as an important contribution to our understanding given the context in which many students find themselves needing to use screens to access education online. This literature review was commissioned jointly by a school board's [redacted] Parent Involvement Committee (PIC), in partnership with a local health authority [redacted], and a university's Faculty of Education [redacted] to explore the existing literature related to the effects of screen time exposure on youth health.

Due to their credibility and popularity in academic fields, EBSCO Education Source, APA (American Psychological Association) PsycNet, and Ovid MEDLINE were selected as the databases for this literature review. The final list of studies for review were compiled using systematic searches conducted in January 2019 using search terms associated with screen time use among adolescent youth. Variations in search terms were used to narrow results to those most relevant for this review. Boolean search terms for EBSCO Education Source were "screen time" AND "adolescent"; terms for the APA PsycNet database consisted of "screen time" AND "adolescent"; and terms used for Ovid MEDLINE, a medical database, were "screen time" AND "adolescent" AND "exercise" AND "television" AND "sedentary lifestyle" AND "obesity" AND "video games". The Ovid MEDLINE database search engine mapped the additional aforementioned search terms onto the original term of "screen time" in order to further refine search results, as the original search results before mapping yielded 1599 studies. EBSCO Education Source yielded 13 results; APA PsycNet, 6; and Ovid MEDLINE, 10.

Seven studies were excluded, as they did not meet search criteria vis-à-vis participant selection, resulting in a total of 22 studies to be analyzed. Studies were assessed qualitatively based on evaluation of sample size, population, methodology, analysis, and results. Studies were critically reviewed for data relating specifically to how screen time affects adolescents both positively and negatively.

The selected studies had to meet the following inclusion/exclusion criteria to qualify for this review: (a) participants were adolescent-aged youth under the age of 19; (b) screen time within the context of health is present in primary or secondary research questions; (c) parents, educational professionals, or adolescents were the subjects of research; (d) published in English in a peer reviewed journal; (e) available in full text; and (f) studies with samples from specific populations were excluded so as to maintain generalizability of results. Additional articles found to be relevant to the review but not present in the three main databases were subsequently added on an ad-hoc basis (Bragazzi & Puente, 2014; Hunt et al., 2018; Orben & Przybylski, 2019; Squire & Steinkuehler, 2017).

## Analysis

Screen time is defined in the literature as "the summed exposure to devices capable of displaying video content"; this includes "smartphones, tablets, computers, televisions, and video game consoles" (Sanders et al., 2016, p. 641). While all of these devices contribute to screen time, analysis of time spent watching TV or using a computer (usually but not exclusively within the context of video games) and its possible link to sedentary behaviour appear to be the most common (Cameron et al., 2016; Angoorani et al., 2018; Lowry et al., 2015; Lacy et al., 2012). Studies with more focus on smartphones often connected their usage to mental and not physical health ramifications (Twenge et al., 2018; Bragazzi & Puente, 2014; Hunt et al., 2018). Emergent themes were used to classify effects into three main categories to facilitate analysis. The categories of effects that emerged were: (a) physical, (b) behavioural, and (c) psychological.

## Physical Effects of Screen Time on Adolescents

The majority of the reviewed studies (n=9) were categorized as belonging to the physical effects category, and they were then subdivided by their analysis of dietary behaviours or physical behaviours.

### *Dietary Effects*

Lowry et al.'s (2015) study took a broader approach to dietary analysis and examined associations between physical and sedentary activities and dietary behaviour. They analyzed the self-reported data from a previous cross-sectional study, the National Youth Physical Activity and Nutrition Study (NYPANS), a study conducted in 2010 by the Center for Disease Control (CDC) on high school students aged 14–17 (Lowry et al., 2015). Among their conclusions, they found that students who met the recommended levels of daily physical activity were more likely to consume higher numbers of fruits and vegetables; while those who exceeded the recommended daily screen time were less likely to consume fruits and vegetables. Furthermore, the segment of the sample that did exceed screen time limits was more likely to consume fast-food and sugary drinks (Lowry et al., 2015). However, there were also positive associations found between Daily Physical Exercise (DPA) and sugar sweetened beverages (SSBs). The researchers suggest that "physically active students may feel that drinking SSBs is not a problem because of the calories they burn during DPA" (Lowry et al., 2015, pp. 5–6). This suggests that while there are associations between an unhealthy diet and excessive screen time in adolescents, similar relationships can also be found in those who adhere to limitations on their screen time. This raises issues of causality and necessitates further research to establish more concrete causal links between sedentary behaviours and screen time.

Cameron et al. (2016) focused their study more specifically on the relationship between body mass index (BMI) and screen time behaviours, and how that mediates dietary

choices. Their goal was to determine what kind of macronutrients were consumed in a sample of adolescents, and whether or not associations could be drawn between diet and screen time. A sample of adolescents aged 14–18 years with a BMI at, or above, the 95$^{th}$ percentile was used to focus on the dietary habits of sedentary adolescents. Adolescents who reported doing regular exercise more than twice a week were excluded from the sample. Participants were then put into a controlled exercise program, and they recorded their 3-day energy intake and total physical exercise by keeping logs. This was done so that physical activity itself could be a control variable during the study. The researchers found that increased carbohydrate intake mediated relationships between TV and video game use and BMI, though computer use did not (Cameron et al., 2016). They suggest that TV and video game use are less engaging than computer use—therefore, TV and video games provide more opportunities for snacking—though the researchers are unclear as to what kinds of computer programs were being used by the sample. Fat and protein were not found to mediate any relationship with screen time. The authors suggest that, as a result, a reduction in TV viewing and video game use could lead to a reduction in caloric intake, primarily in the form of carbohydrates, and this could lead to a reduction in BMI. The authors state some limitation to their work—they point out that their findings are not consistent with other studies in relationship to the type of macronutrient that is over-consumed; and due to their recruitment style of participants (community advertisement) there may be a response bias. In addition, the data on energy intake was only collected over the course of 3 days. These facts, along with the specific sample chosen—obese adolescents, as opposed to a random sample—make these results difficult to generalize to the broader adolescent population. The authors suggest that a longitudinal study would be necessary to validate their results and to further explore these relationships.

### *Physical Effects*

Biddle et al. (2017) conducted a meta-systematic review and meta-analysis on whether sedentary behaviours are associated with adiposity, or obesity, in youth. They also attempted to find any causal relationships that may exist in the reviewed research. They found that while small associations were found between screen time and obesity through cross-sectional studies, the findings became less consistent when observed longitudinally. The authors state that the longitudinal studies reviewed were too dependent on "the nature of the exposure and outcome variables assessed" and concluded that there was no evidence for an association with obesity for "total sedentary time assessed" (Biddle et al., 2017, p. 13). They suggest that many of the studies reviewed did not adequately control for variables such as physical activity, diet, or maturity. Their analysis of 29 systematic reviews covering over 450 studies involving interventions—some even quite "intense" interventions—showed that any changes in weight status were "quite modest" (Biddle et al., 2017, p. 13). That being said, the most effective among these interventions were those delivered in a non-educational setting, which suggests the importance of family environment in altering sedentary behaviour in youth (Biddle et al., 2017). The authors found associations between a less healthy diet and TV viewing in their reviews, citing that overconsumption and snacking became more likely while engaging in TV viewing. Biddle et al. concluded that "there is no evidence for a causal association between sedentary behaviour and adiposity in youth, although a small dose-response association exists" (2017, p. 1). That being said, they still point out that even a small association could be significant for the public health of a large population. More studies involving the tracking of sedentary behaviour into adulthood are required to better understand the associations present between sedentary behaviour and obesity (Biddle et al., 2017, p. 17).

Nuutinen et al. (2017) analysed clusters of energy balance-related behaviours (EBRBs)—e.g., sleep quality, physical activity, screen time, and food intake—and their associations with being overweight in Finnish adolescents. The data were retrieved from a Finnish national survey of health behaviour in school-aged children. Risks of becoming overweight were found to be higher in girls categorized under the cluster "high screen time, unhealthy lifestyle" than those that fell into the "healthy lifestyle" cluster; the same risks were not present when the same clusters were compared for boys (Nuutinen et al., 2017, p. 934). The authors hypothesize these different results in genders are a result of boys requiring more energy during the growth spurt in adolescence, and any real effects on weight due to unhealthy practices, such as bad diet and excessive screen time, would probably not be seen until early adulthood (Nuutinen et al., 2017, p. 936). The authors found that screen time across both genders exceeded the recommended amount. This study is significant in that it looks at a multitude of behavioural patterns associated with being overweight. "High screen time alone," the authors state, "does not necessarily associate with overweight, since the combination of different EBRBs is what matters" (Nuutinen et al., 2017, p. 936). This study is limited by its cross-sectional nature, and the authors recommend that longitudinal research be conducted to evaluate the long-term consequences of EBRBs on overweight adolescents.

Lacy et al. (2012) looked at the associations of screen time and physical activity on the quality of life of Australian adolescents using self-reported survey data. Their exploration of cross-sectional relationships between quality of life, screen time, and physical activity revealed that the highest levels of physical activity were associated with higher quality of life; exceeding 2 hours of screen time was associated with lower quality of life scores. Adolescents who reported high screen time and high physical activity scored higher in quality of life than those with high screen time and lower levels of activity (Lacy et al., 2012, p. 1096). The researchers found that several

relationships between low physical activity and high screen time and quality of life were, "comparable to those previously observed between chronic disease conditions and HRQoL [health-related quality of life]" (Lacy et al., 2012, p. 1085). It is suggested that due to the low level of physical activity that was reported in the survey—20% of males and 25% of female adolescents were either active one night per week or not at all after school—there should be more efforts to produce opportunities for students to engage in physical activity after school, though the researchers point out that more research is needed to establish whether or not this would significantly increase adolescent quality of life (Lacy et al., 2012, p. 1097).

Olds et al. (2012) evaluated whether any relationships exist between physical activity and how adolescents use their time. In their cross-sectional survey, they sought to examine the "cross-elasticity relationships in a cross-sectional survey" (Olds et al., 2012, p. 733). The researchers used cross-elasticity, an economic principle that defines the "degree to which the consumption of one commodity varies as the price of another varies," and applied it to how adolescents use their time (Olds et al., 2012, p. 732). Screen time was found to be highly elastic; with every hour committed to physical activity, adolescents spent 32 minutes less on screens. Additionally, in obese adolescents, this number increased to 56 minutes less time spent on screens (Olds et al., 2012, p. 734). The researchers point out that this study can help inform intervention strategies that would target elastic behaviours, thereby offering a greater chance of success (Olds et al., 2012, p. 736).

Wen et al. (2010) analysed the relationship between weight status, modes of travel to school, and screen time in youth aged 10–13 years old. In analyzing the cross-sectional data obtained from a 2006 survey (Central Sydney Walk to School Research Program), they found that being driven to school daily was associated with obesity, though not with being generally overweight (Wen et al., 2010, p. 58). Echoing research cited

previously in this review (Nuutinen et al., 2017), the researchers found that excessive screen time was associated with obesity, though physical activity was not associated with screen time (Wen et al., 2010, p. 61). The researchers note that even though these associations were present, further longitudinal research is needed as only 3% of the sample of adolescents were classified as obese (Wen et al., 2010, p. 62). Being conducted in an urban centre like Sydney, this data is skewed towards people who live within relatively close distances to their schools and have access to public transportation. As such, this study's results are difficult to generalize to rural populations, whose sole means of transportation is often privately owned vehicles.

Thorne et al. (2014) examined relationships between video game genre preferences in adolescent boys, physical activity, and screen time. The participants were 320 boys aged around 13 years old from 14 school districts in low-income areas in Australia (Thorne et al., 2014, p. 1345). The participants were measured to establish body type, and then surveyed on their screen time and video game habits. The researchers found an association between video game genre preferences and physical activity, citing that adolescents who preferred sports and racing games were more likely to be physically active. Conversely, preferences for strategy and role-playing games were associated with higher screen time both on weekdays and weekends. This is unsurprising, as role-playing games often lead the user to engage in more playtime due to game mechanics involving long hours of in-game exploration, while sports and racing games usually have more defined in-game sessions based around the timing of a particular match.

Marques et al. (2015) examined the relationship between screen-based behaviours, physical activity, and health complaints such as headaches, irritability, and nervousness. In their sample of 4462 participants aged 11–16, they found that girls engaging in excessive screen time reported having more headaches, feeling more nervous, and feeling more irritable; boys reporting higher screen time reported being

more irritable (Minges et al., 2015, p. 150). Physical activity was found to be negatively associated with reports of nervousness among girls and boys; additionally, reports of headaches, "feeling low," and irritability were negatively associated with physical activity among boys (Marques et al., 2015, p. 150). The authors suggest that these associations may exist due to the duration of screen time being experienced by the participants rather than the type of screen time. This coincides with other findings that suggest frequent computer use was associated with shorter sleep time and neck, shoulder, and lower back pain (Marques et al., 2015; Nuutinen et al., 2014; Hakala et al., 2010, 2012).

## Behavioural Effects of Screen Time on Adolescents

Behavioural effects of screen time and media usage were subcategorized as influencing prosocial behaviour (Padilla-Walker et al., 2015), sexual behaviour (Barr et al., 2014), and smoking (Barr et al., 2014). Screen time in this section is mostly associated with television viewing and not social media or online learning.

### *Social Behaviour*

In their study, Padilla-Walker et al. (2015) explore the relationship between and influence of prosocial TV content on adolescent behaviour. The authors define prosocial behaviour as "voluntary behaviour meant for the benefit of another" (Padilla-Walker et al., 2015, p. 1317). This longitudinal study took place over the course of two years—the longest of its kind at the time. The researchers found that adolescents viewing prosocial content on TV directly predicted lower levels of aggression and "marginally higher levels of prosocial behaviour" two years later (Padilla-Walker et al., 2015, p. 1324). The quantity of prosocial content viewed had no effect on this association; that is, the observed lower levels of aggression and prosocial behaviour remained the same regardless of time spent watching the prosocial content. The inverse was found to be true as well, "early exposure to aggressive TV content predicted lower levels of

prosocial behaviour" (Padilla-Walker et al., 2015, p. 1324). While the association was found, the authors concede that this is a small relationship. There are issues of causality that the researchers raise; mainly, the fact that research suggests adolescents who are more prosocial in their personality and behaviour to begin with will be more inclined to engage in prosocial media. Though, they posit that the additional viewing of prosocial media can "help cement their existing prosocial and moral personality and identity" (Padilla-Walker et al., 2015, p. 1325).

### *Sexual Behaviour*

Barr et al. (2014) analysed the impact that screen time has on adolescent sexual behaviour in middle school. This study is unique in that it looked at general screen time as opposed to specifically sexual or non-sexual media use during screen time. Since general screen time is easier for researchers to accurately measure, this study should offer results that are more consistent with the reality of adolescent screen use. The study included traditional media as well as computer and video game use—though it only stratified computer use into school versus non-school use. As a result, we are unable to know how much of that computer time would have been spent on social media use, etc. The researchers found that general screen time exceeding 3 hours per day, a figure considered to be high screen time in this study, was associated with a number of sexual behaviours. Participants reporting high television and recreational computer use were found to have a 31% and 43%, higher change of having sex as an adolescent. Users reporting very high screen time (6+ hours per day) were found to have a 54% higher chance of having sex as an adolescent. The authors hypothesize that this is due to the "prevalence of sexual images and content in media" (Barr et al., 2014, p. 10). The results of this study suggest that there is a relationship between sexual behaviour and screen time regardless of the content being viewed; though, as the authors state, there is a likelihood that social media plays a role in this and may "[lead] to even greater [self-]

misrepresentations and hence a greater influence on sexual behaviours than traditional media" (Barr et al., 2014, p. 11). While these results are concerning, the authors note the limitations of the study: the sample is relatively small, consisting of only three school districts, of which only grades 7 and 8 were surveyed. All of the data also came from a self-reported survey—the subjects themselves. One can speculate that the more sexual content one of these participants had seen, the more biased their own answer may be, regardless of their actual behaviour.

### *Smoking*

Morgenstern et al. (2013) investigated the relationship between smoking, socio-economic class, and media consumption in adolescent Europeans. The researchers found significant associations between ever smoking and exposure to images of smoking in movies (Morgenstern et al., 2013). The data was adjusted for family affluence and ethnicity, and they found that those variables did not moderate the "relationship between movie smoking and adolescent smoking" (Morgenstern et al., 2013, p. 2589). Their data found that there was a lower number of smokers and risk factors—"better grades, lower TV screen times, fewer friends and family members that smoked"—associated with more affluent students, though they found a positive correlation between family affluence and movie smoking exposure (Morgenstern et al., 2013, pp. 2592–2593). The authors suggest that this is due to the more frequent visits to the movie theatres or higher likelihood of DVD ownership that higher affluence may afford. Though these associations were significant, the correlations themselves were small (Morgenstern et al., 2013, p. 2591). Unsurprisingly, the highest correlation found was between peer smoking and lifetime smoking, indicating a strong social factor in the development of a smoking habit.

Like many of the other studies found in this review, the cross-sectional nature of the study design poses some limitations in terms of questions of causality, though the

authors point out that they were more interested in making "differential associations" between groups of adolescents rather than addressing the causal nature of smoking and screen time (Morgenstern et al., 2013, p. 2593). The data is also self-reported, lending to concerns about the validity of the data. All this being said, the authors still maintain that a reduction of exposure to "images of smoking in movies would change the risks of smoking on a broad level, not only for specific groups of adolescents" (Morgenstern et al., 2013, p. 2593).

## Psychological Effects of Screen Time on Adolescents

Several subcategories related to the psychological effects of screen time emerged during analysis including well-being, personality traits, and self-concept.

### *Psychological Well-Being*

Twenge et al. (2018) sought to document "trends in adolescents' psychological well-being" and possible mechanisms at work behind these trends (Twenge et al., 2018, p. 765). Two separate studies were conducted: The first study focused on trends in adolescents' psychological well-being, while the second focused on the possible causes of these trends.

Data sets for the first study came from national surveys dating back to 1976 and administered until 2016—1.1 million students in grades 8, 10, and 12 were surveyed on topics related to self-esteem, happiness, and life satisfaction (Twenge et al., 2018). The researchers note that after a gradual rise in overall happiness and well-being starting around the 1990s, adolescent psychological well-being started to decline around the time the smartphone started gaining popularity in 2011 (Twenge et al., 2018). The largest decline in "satisfaction with life as a whole, friends, amount of fun, self, and personal safety" was shown to be between 2012–2016; however, satisfaction with government, parents, and safety of property increased over the same period of time

(Twenge et al., 2018). This corresponds to the release of the iPhone 4 in 2012, which is also the year that Verizon, a large American telecommunications company, started to subsidize the cost of smartphones in exchange for signing up to long-term contracts. The researchers describe this as "an unusual amount of change for such a short period of time," citing that it is roughly two times larger than previously measured changes amongst birth cohorts (Twenge et al., 2018, p. 767). It is important to note, however, that the decline in psychological well-being in 2011 also maps closely onto the major economic crisis of 2008 and an increase in exposure of climate change information, among other factors.

The second study sought to "explore possible mechanisms" behind the previously described decreases in psychological well-being (Twenge et al., 2018, p. 767). The authors link prior research into this phenomenon citing that adolescents reported less interpersonal social time, but more time spent online, on social media, and on their smartphones—the resulting increase in antisocial behaviour corresponds with reported decline in psychological well-being in the first study (Twenge et al., 2019; Twenge et al., 2018). Researchers examined correlations between measured well-being and adolescents' time spent on screen-related activities, social interactions, and other non-screen related behaviours in order to discover what factors played a significant role in the measured drop in well-being. Next, researchers measured psychological well-being scores against "broader cultural indicators," which included smartphone adoption rates, economic performance, income inequality, and college enrollment rates (Twenge et al., 2018, p. 768). The researchers found that adolescents who spent an average of 3–5 hours a week on social media were more likely to be happier than those who spent no time at all; they were also happier than those who spent more than 40 hours a week on social media. The same trend was true for internet use (Twenge et al., 2018). Adolescents who self-reported experiencing lower in-person social contact and high

screen time were less happy than those who reported the opposite conditions. While the conclusions of this study show a link between unhappiness and screen time, the results are correlational and, therefore, do not provide causal findings. Nevertheless, they conclude that electronic communication is most likely "the cultural force leading to lower well-being among adolescents since 2012" (Twenge et al., 2018, p. 776).

Orben and Przybylski's (2019) recent study offers criticisms of past and current research on the effects of screen time on adolescents, and it forms conclusions that differ from the majority of previous research. Their study focused on the relationship between digital engagement and psychological well-being. The authors point out that there is "little clear-cut evidence" that screen time is detrimental to adolescents' well-being, and that most current research centers around exploratory methodologies and single-country data sets that rely on "inaccurate but popular" self-reported data (Orben & Przybylski, 2019, p. 1). They began with large-scale data from three countries (Ireland, the U.K., and the U.S.A.) with 17,247 participants. The data set for this phase of research was taken from The Millennial Cohort Study (MCS), a longitudinal study of British adolescents (n=11, 884). Orben and Przybylski found a small but significant negative association between technology use and well-being, but they point out that, in comparison to other adolescent activities that can influence well-being, this association is "miniscule" and these effects are therefore "too small to merit substantial scientific discussion" (Orben & Przybylski, 2019, p. 12). This led to their conclusion that, overall, they found "little substantive statistically significant and negative associations between digital screen engagement and well-being" (Orben & Przybylski, 2019, p. 12). While this study is more rigorous than most and offers new standards of exploring screen engagement effects on adolescents, the authors do state that some of the data used came from time-use diaries—a method that may not be as accurate as wanted. They point out that the results are correlational and not directional; therefore, inferring causality of the

results is impossible. Despite these drawbacks, this study holds the promise of establishing more objective means of evaluating the effects of screen time. The authors reiterate that it is important to be critical of the multitude of screen time studies published—many of which do not provide objective or replicable results—and that as the "influence of psychological science on policy and public opinion increase, so must our standards of evidence" (Orben & Przybylski, 2019, p. 13).

A study by Hunt and colleagues (2018) was added after the literature search was completed and despite having a population slightly older than the target adolescent aged students. This decision was made because this was one of the few experimental studies found that reported a causal link between reductions in social media use and decreased levels of loneliness and depression (Hunt et al., 2018, p. 766). The researchers monitored social media use in 143 undergraduate students. To establish a baseline, the students were first given one week to use social media as they normally would. For the following three weeks, two groups were randomly assigned: one group of students—the control group—was asked to continue usage as normal while the other group—the treatment group—was asked to limit social media (specifically, Facebook, Instagram, and Snapchat) use to 30 minutes per day. They were surveyed weekly on measures including social support, fear of missing out, loneliness, anxiety, depression, self-esteem, autonomy, and self-acceptance (Hunt et al., 2018). At the end of the study, Hunt et al. (2018) described that the treatment group reported "clinically significant declines in depressive symptoms" (Hunt et al., 2018, p. 761). Participants in the treatment group also reported that by not using social media, they stopped comparing themselves to others, resulting in a "stronger impact" than expected, feeling "a lot more positive", and assigning less importance to social media (Hunt et al., 2018, p. 765). Both groups showed a small, but significant, decline in fear of missing out and anxiety. The researchers attribute this to the self-monitoring required by the participants to complete

the study, and this resulted in an impact on how aware users were of their social media use (Hunt et al., 2018). This study is the first study to collect objective use data—in the form of application usage screenshots from participants' smartphones—instead of self-reported data. However, researchers only monitored social media on users' phones and, as such, it is difficult to account for possible usage on computers or other peoples' phones. Moreover, only certain applications were monitored, leaving many other social media platforms unaccounted for. Follow-up surveys to the treatment group were not possible due to a significant proportion of participants (79%) dropping-out before data could be collected. Thus, researchers were not able to assess "maintenance of gains in well-being" in the experimental group after the intervention phase (Hunt et al., 2018, p. 765). Researchers recommend more research be done with a larger and more diverse population and the inclusion of more social media platforms.

### *Personality Traits*

Allen et al. (2017) conducted a systematic review of the literature regarding personality and sedentary behaviour. While this study's main goal did not center around screen time itself, the relationships between personality, sedentary behaviour, and screen time were explored to some degree. Researchers found that extraversion had negative associations with screen time and computer gaming, while neuroticism positively associated with social media use (Allen et al., 2017). Low levels of conscientiousness were associated with "sedentary behaviour (for screen-based activities)," though the researchers note that this conclusion is derived from research that does not include data from studies involving academic study time in adolescents (Allen et al., 2017, p. 260). Presumably, sedentary screen time generated as a result of studying would reflect a higher level of conscientiousness. Interestingly, people who reported higher levels of extroversion spent more time on social media yet less time sitting compared to those who spent the equivalent screen time with computer games (Allen et al., 2017, p. 260).

One implication of this finding could be that not all screen time is necessarily associated with sedentary behaviour.

### *Self-Concept*

Suchert et al. (2016) examine the relationship between screen time, weight status, and adolescents' self-concept of physical attractiveness. They found that screen time is associated with "adolescent overweight, abdominal obesity, and body dissatisfaction" (Suchert et al., 2016, p. 11). The authors emphasized that screen time not only has negative associations with adolescents' physical state of well-being, but also their mental health—adolescents who reported high screen time in the administered survey were shown to have "more negative self-concept of physical attractiveness" (Suchert et al., 2016, p. 15). Weight status did not moderate this relationship—regardless of BMI levels, those who reported high screen time thought less of themselves in terms of physical attractiveness. This could be due in part to the increased exposure to photos and the social comparisons that may result while using social media (Suchert et al., 2016). Establishing this relationship can be important as perceived weight status has been found to be a "predictor for depressive symptoms," regardless of weight status—though body weight levels may be a "multiplier" for these effects (Suchert et al., 2016, p. 15). While this study did have a large sample size (n=1228), it is self-reported data. There is also the inability to draw any causal conclusions from the data as it is cross-sectional in nature.

## Conclusion

While some of the results of the reviewed studies demonstrate small but significant negative correlations between screen use and health factors, and are potentially helpful in understanding screen time associations with physical, behavioural, and psychological factors, some authors point out that, due to the cross-sectional nature of the data collected for most of these studies, it is difficult to establish causal connections

in their conclusions (Sanders et al., 2016; Domoff et al., 2019; Badura et al., 2017; Lowry et al., 2015; Nuutinen et al., 2017; Orben & Przybylski, 2019). Also, the self-reported nature of the data in many of these studies leads one to question the rigorousness of the conclusions that can be drawn (Angoorani et al., 2018; Barr et al., 2014; Morgenstern et al., 2013; Padilla-Walker et al., 2015; Olds et al., 2012; Thorne et al., 2014; Marques et al., 2015; Twenge et al., 2018; Suchert et al., 2016; Orben & Przybylski, 2019).

Overall, the limitations of the studies in this literature review center on the relatively nascent nature of this field. New and contradictory research is constantly emerging, and researchers are still exploring different methods to address concerns about screen time exposure. It is noteworthy that the only experimental study was Hunt et al. (2018), and while the study concluded that a causal link between lower social media use and a reduction in depression exists, the relatively small sample size necessitates replication on a larger scale to improve the statistical power of the sample before we can firmly establish causality. However, the study does show promise in establishing a replicable experimental design that can be used by future screen time researchers.

In their case study, *The Problem with Screen Time*, Squire and Steinkuehler (2017) approach the issue of screen time from a different perspective. They offer a counter-point to the type of quantitative screen time research that is popular in the field—that is, research that is centered around the analysis of one's consumption of technology and reducing items such as literacy, empathy, or obesity to "some measurable variable that goes up or down as a result" (Squire & Steinkuehler, 2017, p. 2). The majority of the research covered in this review would qualify as being part of this category.

While cross-sectional research involving measures like self-reported screen time usage can help us see its relative effects on a population at a given time, it can be "problematic when used as the basis of policy and parenting recommendations" (Squire & Steinkuehler, 2017, p. 1). These authors contend that "constructs such as screen time

quantity distract us from other, more exploratory constructs such as productive practice, critical consumption, developmental progressions" (Squire & Steinkuehler, 2017, p. 1).

This 2019 literature review supports the identification of physical, behavioural, and psychological effects on adolescent screen use. While the effects measured were small, they were nonetheless present. No research directly relating to online learning was found and, thus, more work must be done in order to draw firmer causal conclusions, create actionable policies concerning this complex social phenomenon, and bring research in-line with the challenges of a post-COVID-19 world.

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