On the Relationship between Social Media and Adolescent Mental Health

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Part I
Executive Summary

1 Introduction

Is social media a causal factor in the adolescent[1] mental health crisis? This question presumes the existence of such a crisis. In a recent report, U.S. Surgeon General, Dr. Murthy – the leading spokesperson on matters of public health in the U.S. – stated that "...we are experiencing a national youth mental health crisis..." [Office of the Surgeon General (OSG), 2023] What is Dr. Murthy referring to?

1.1 The Adolescent Mental Health Crisis

A universal definition of mental health is difficult to establish. Embedded in any definition are explicit and implicit values that may change across cultures and individuals. With that said, here is some language provided by the National Institute of Mental Health (boldface added),

> Mental health includes emotional, psychological, and social well-being. It is **more than the absence of a mental illness**—it's essential to our overall health and quality of life. - National Institute of Mental Health (NIMH)

This description presents its own challenges – for one might subsequently ask about the nature of emotional, psychological, and social well-being[2] – or even of 'well-being,' for that matter. While it may be difficult to nail down a complete description of what mental health *is*, it may be easier to describe what mental health *is not*. At the bare minimum, mental health should be the absence of mental *illness*. This includes the absence of anxiety and depression, as well as their associated symptoms: self-harm and suicide.

So let me describe the adolescent mental health crisis in terms of how rates of depression, anxiety, self-harm, and suicide have evolved over the past two decades for young people.

1.1.1 Anxiety and Depression

Show in Figure 1 are rates of U.S. undergraduates diagnosed with a mental illness stratified by diagnosis (left) and teenagers with major depression stratified by gender (right). Consider the left panel: **Rates of depression and anxiety among undergraduates have more than doubled since 2010.** Consider the right panel: **Rates of depression among teenage girls have increase 148% since 2010.**

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[1]A young person who has begun puberty but has not yet become an adult... generally occurs between the ages of 10 and 19 years. - National Institute of Health (NIH)

[2]One might conceptualize (1) psychological well-being to be the health of the mind – at a bare minimum – the absence of mental illness; emotional well-being to be our ability to appropriately experience, express, and manage emotions; and (3) social well-being to be the quality of our relationships with those around us.
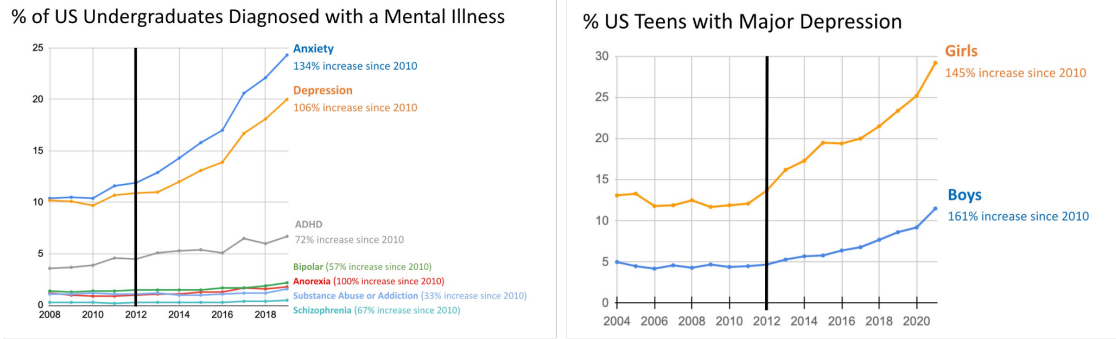
Figure 1: U.S. undergraduates diagnosed with a mental illness stratified by diagnosis (left) and teenagers with major depression stratified by gender (right).
Sources: American College Health Association (ACHA), National Survey on Drug Use and Health (NSDUH).

1.1.2 Self-Harm

Show in Figure 2 are rates of U.S. teenagers admitted to the hospital for non-fatal self-harm (usually cutting) for ages 15-19 (left) and 10-14 (right), stratified by gender. Consider the left panel: **Rates of self-harm have increased 48% and 37% for girls and boys, respectively, aged 15-19 since 2010.** Consider the right panel: **Rates of self-harm young girls ages 10-14 have nearly tripled since 2010.**
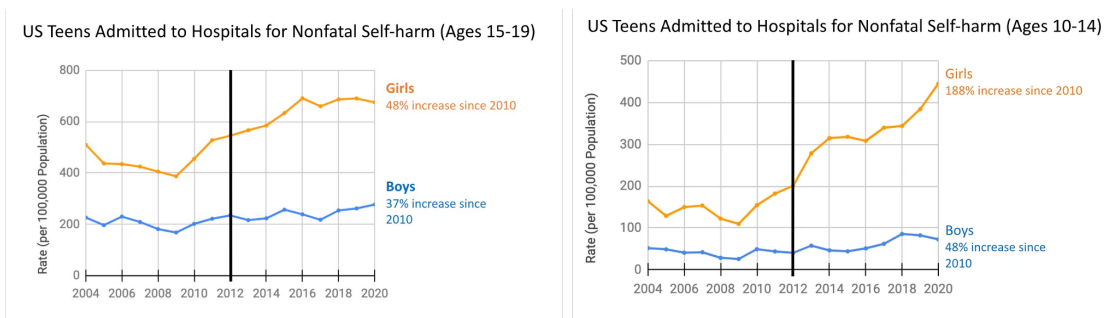

Figure 2: U.S. teenagers admitted to the hospital for non-fatal self-harm (usually cutting) for ages 15-19 (left) and 10-14 (right), stratified by gender.
Source: Centers for Disease Control and Prevention (CDC) WISQARS Nonfatal Injury Reports, 2004-2020.

1.1.3 Suicide

Show in Figure 3 are rates of completed suicides among U.S. teens ages 15-19 (left) and ages 10-14 (right), stratified by gender. Consider the left panel: **Rates of completed suicide have increased 64% and 35% for girls and boys aged 15-19 since 2010.** Consider the right panel: **Rates of completed suicide have more than doubled for both boys and girls ages 10-14 since 2010.**

Figures 1-3 only partially reflect the adolescent mental health crisis that the U.S. Surgeon Generally is referring to. Later in his report, he states:
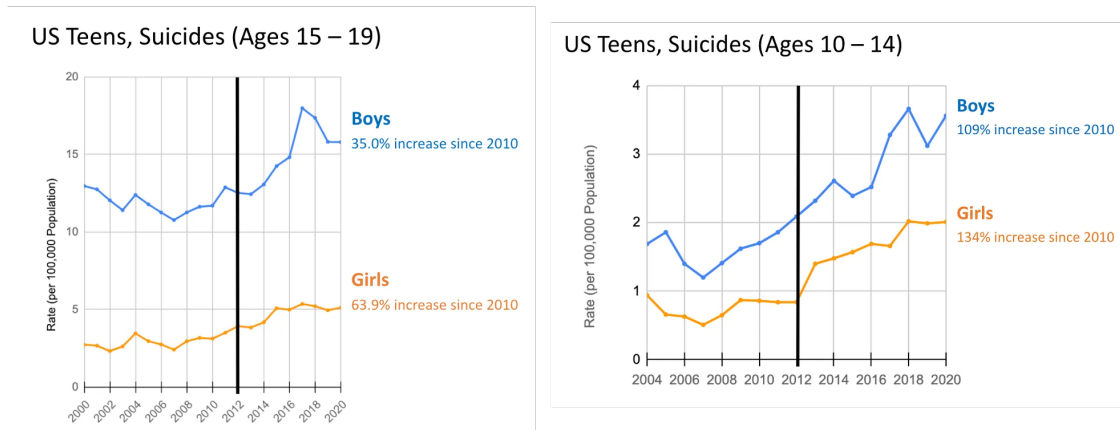
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Figure 3: Left: Suicides among U.S. teens ages 15-19 (left) and ages 10-14 (right), stratified by gender.
Source: Centers for Disease Control and Prevention (CDC) WISQARS Nonfatal Injury Reports, 2000-2020.

> ...while social media may have benefits for some children and adolescents, there are ample indicators that social media can also have a profound risk of harm to the mental health and well-being of children and adolescents. [Office of the Surgeon General (OSG), 2023]

Let's now turn our attention to social media.

1.2 Social Media

Similar to the difficulties with defining mental health, deriving a universal definition of social media presents a challenge. Social media changes rapidly, and a definition that is true today may not be tomorrow. With that said, a technical definition of social media is provided by the American Psychological Association (boldface added),

> Social Media are **interactive technologies** that facilitate the **creation** and **sharing of information, ideas, interests, and other forms of expression** through **virtual communities and networks**. - American Psychological Association (APA)
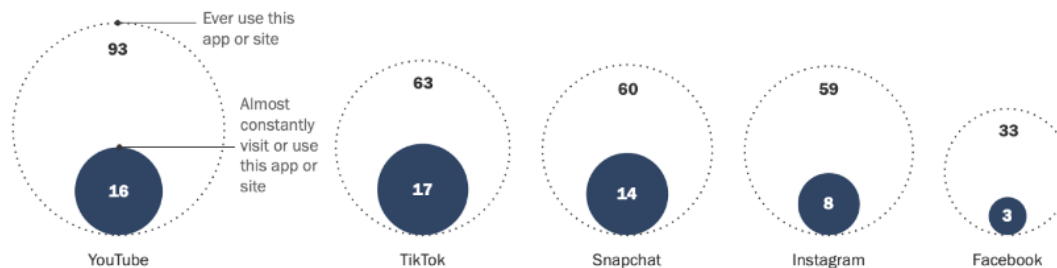
As working examples, the following platforms are currently popular among adolescents: YouTube, TikTok, Snapchat, Instagram, and Facebook.

The adoption of social media among adolescents is nearly universal. Shown in Figure 4 are the percentage of U.S. teens ages 13-17 who say they use ever use this app or site (dotted circles) and who say they almost constantly visit or use this app or site (dark circles). **Nearly 1 in 5 teens report being on YouTube or TikTok 'almost constantly.'**

Shown in Figure 5 are the percentage of U.S. teens ages 13-17 who say they use ever use this app or site 'almost constantly', stratified by gender (left) and the distribution of time-spent on social media on a typical day for teens aged 13-19 as measured in hours-per-day

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Nearly 1 in 5 teens say they're on YouTube, TikTok 'almost constantly'

% of U.S. teens ages 13 to 17 who say they ...

Ever use this app or site

Almost constantly visit or use this app or site

YouTube	TikTok	Snapchat	Instagram	Facebook
93	63	60	59	33
16	17	14	8	3

Note: Those who did not give an answer or gave other responses are not shown.
Source: Survey of U.S. teens conducted Sept. 26-Oct. 23, 2023.
"Teens, Social Media and Technology 2023"

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Figure 4: Percentage of U.S. teens ages 13-17 who say they use ever use this app or site (dotted circles) and who say they almost constantly visit or use this app or site (dark circles) median = 4 hours.
Source: Pew Research Center (2023) [Gottfried, 2023]

(right). Consider the left panel: **Girls are more likely than boys to report being on social media 'almost constantly' for most platforms, especially TikTok.** Consider the right panel: **Only 1% of teens aged X-X report using social media for <1 hour per day. In contrast, nearly 30% report spending more than 6 hours per day on social media.** More than half of U.S. teens use social media for more than 4 hours per day (median = 4 hours). Note that these figures are only for social media use and do not capture broader notions of 'screen time,' which may include using computers for doing homework, watching TV, etc.

Social media use is nearly universal among adolescents, and heavy social media use (e.g., more than 4 hours per day) is common. There are around 42 million adolescents in the U.S. ages 10-19.[3] Multiplying 4 hours per day by the population of adolescents results in roughly 168 million adolescent-hours spent on social media *every day*. **This is a significant exposure**. With such universal exposure, **even small risks can produce significant effects when compounded by tens of millions of teenagers over the decade of their adolescence**.

So let us examine the evidence. As a reminder, our goal is to examine for causal evidence towards the following question: Is social media **a causal factor** in the adolescent mental health crisis? There are many factors that influence mental health. Some are biological and may include individual or genetic factors – and some are environmental and may include familial, communal, and societal factors [Office of the Surgeon General (OSG), 2021]. The list of unique factors that affect one's mental health is perhaps uncountable, and it may change across cultures and individuals. This report aims to shed light on whether social media is one of them, and if it contributes to the adolescent mental health crisis.

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[3]See https://opa.hhs.gov/adolescent-health/adolescent-health-data/americas-diverse-adolescents

Teen girls far more likely than boys to say they use TikTok almost constantly

% of U.S. teens ages 13 to 17 who say they visit or use the following apps or sites almost constantly

	Boys	Girls	U.S. teens
TikTok	12	22	17
YouTube	15	18	16
Snapchat	12	17	14
Instagram	7	10	8
Facebook	1	4	3

Note: Those who did not give an answer or gave other responses are not shown.
Source: Survey of U.S. teens conducted Sept. 26-Oct. 23, 2023.
"Teens, Social Media and Technology 2023"

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Nearly 30% of teens report using social media more than 6 hours per day
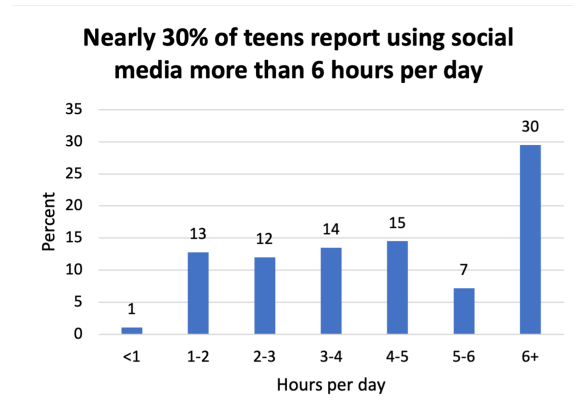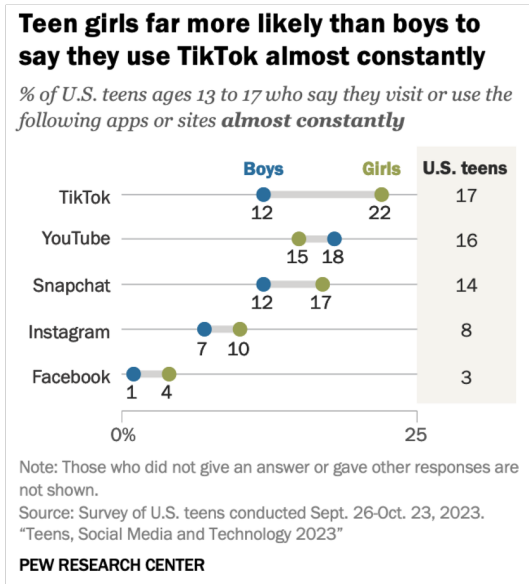
Figure 5: Percentage of U.S. teens ages 13-17 who say they use ever use this app or site 'almost constantly', stratified by gender (left) and the distribution of time-spent on social media on a typical day for teens aged 13-19 as measured in hours-per-day (right).
Source: Pew Research Center (2023) [Gottfried, 2023], Gallup Poll (2023) [Rothwell, 2023]

Toward the goal of causal evidence, we will first examine correlational evidence. Even as recently as 2019, the existence of mere correlation between social media and mental health was debated – though as we will discuss, today, there is common ground. Then we will examine longitudinal evidence. Were social media a causal factor in one's mental health, then changes in social media must come *before* changes in mental health. This temporal ordering is a necessary but not sufficient condition for causality. Finally, we will examine the experimental evidence, which has the strongest claims to causality.

2 High-level Summary of the Course of Study

This section is a high-level summary of the Course of Study. For a critical assessment of each artifact, see Part **??**.

2.1 Correlational Studies

Shown in Table 1 is an overview of the seven correlational studies examined in this report organized by whether or not they indicate an association between social media use and negative mental health outcomes.

We can narrow down our discussion by filtering out studies with samples unrepresentative of the population of U.S. adolescents: [Woods and Scott, 2016] and [Beyens et al., 2020] study small samples in Scotland and Netherlands, respectively; [Berryman et al., 2018] examine a small sample of undergraduates from a single university in southeast U.S.; and [yi Lin et al., 2016] though examining a nationally representative sample, focus on young adults

Studies that indicate an association	Studies that indicate little/no association
[yi Lin et al., 2016] (see **??**)	[Berryman et al., 2018] (see **??**)
[Woods and Scott, 2016] (see **??**)	**[Orben and Przybylski, 2019a]** (see **??**)
[Twenge et al., 2018] (see **??**)	**[Orben and Przybylski, 2019b]** (see **??**)
	[Beyens et al., 2020] (see **??**)

Table 1: Correlational studies organized by whether they indicate an association between social media use and negative mental health outcomes (left) or little/no association (right).

aged 19-32 – mostly beyond the scope of adolescence. This leaves us with [Twenge et al., 2018], [Orben and Przybylski, 2019a], and [Orben and Przybylski, 2019b].[4]

Coincidentally, Twenge and Orben are highly influential figures in this research space, and much of our understanding of the relationship between social media and adolescent mental health can be found by following the work of these two prominent researchers. When delving into the research of Orben and Twenge, specifically:

1. [Orben and Przybylski, 2019a] The association between adolescent well-being and digital technology use

2. [Twenge et al., 2020] Underestimating digital media harm

3. [Orben and Przybylski, 2020] Reply to: Underestimating digital media harm

4. [Orben, 2020] Teenagers, screens and social media: A narrative review of reviews and key studies

5. [Twenge and Martin, 2020] Gender differences in associations between digital media use and psychological well-being: Evidence from three large datasets

6. [Twenge et al., 2022] Specification curve analysis shows that social media use is linked to poor mental health, especially among girls

7. [Orben et al., 2022] Windows of developmental sensitivity to social media

...we uncover a captivating narrative. **Initially approaching the subject with skepticism, Orben has progressively amassed a compelling body of both correlational and longitudinal evidence that supports the notion that social media plays a significant role in the ongoing adolescent mental health crisis.**

Here is a brief breakdown of this narrative. The discrepancy among researchers partly arises from variations in their analytical language. Dr. Orben predominantly employs correlation coefficients (r), slopes (β), and explained variance (R^2), which are standard in psychological research. Conversely, Twenge articulates findings in terms of relative risk (RR), representing the risk of outcomes given heavy exposure versus little to no exposure, which are more common in medicine.

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[4]The latter two are largely the same study, the primary difference being the measure of exposure used: in [Orben and Przybylski, 2019a] it was *self-reported* digital technology use, while in [Orben and Przybylski, 2019b] is was time-diary-based digital technology use. Both reach similar conclusions.

- [Orben and Przybylski, 2019a] use a new and advanced statistical technique called Specification Curve Analysis (SCA) to run tens of thousands of analyses across three large datasets to investigate the association between adolescent technology use and mental health/well-being. The paper concluded that an association exists but is tiny, with median betas between 0.01 and 0.04. This association was reported to be smaller than links between mental health and various innocuous variables in the datasets such as eating potatoes, and therefore to be of "no practical significance," and later "too small to merit substantial scientific discussion" [Orben and Przybylski, 2019b].

- Shortly after, [Twenge et al., 2020] issued a reply in which they claimed that [Orben and Przybylski, 2019a] "made **six analytical decisions** that resulted in lower effect sizes, and their conclusions are in stark contrast with the practically important differences identified in other analyses of the same datasets, especially for social media use among girls." For example, using the same dataset [Orben and Przybylski, 2019a] described as "the highest-quality dataset we examined," researchers found that twice as many heavy users of social media (versus non-users) had clinically relevant symptoms of depression. Similar patterns were found ([Twenge and Martin, 2020]) when examining the other two large datasets used in [Orben and Przybylski, 2019a]. Two of the six limitations identified were (1) the conflating of social media use with other forms of digital technology and (2) combining the effects for boys and girls.

- [Orben and Przybylski, 2020] issued a reply-to-the-reply in which they corrected/argued away three of the six limitations, which did increase the size of the effects from median betas between [0.01 and 0.04] to [0.03 and 0.07]. However, they did not address the social media or gender limitations.

- Later, Orben conducted a narrative review of existing reviews [Orben, 2020], primarily centered on digital technology. However, she acknowledges Twenge's perspective by stating, "I will, however, also supplement this review by examining evidence specifically pertaining to **social media usage**." She concludes, "The associations between social media use and [adolescent] well-being therefore range from about $r = 0.15$ to $r = 0.10$." Note that these are not the 'median betas' reported above, but correlation coefficients. Here are three examples to put these correlations into perspective: the correlation between wearing a seat belt and dying in a car accident is $r = 0.07$, between calcium intake and bone mass in premenopausal women is $r = 0.08$, between childhood lead exposure and adult IQ is $r = 0.09$. **Public health interventions that correlate with their intended outcome at r = 0.10 have an enormous impact when applied over a large population, cumulatively over many years.** [Twenge et al., 2022]

- In [Twenge et al., 2022], researchers took it upon themselves to address the remaining limitations identified in the original Specification Curve Analysis study ([Orben and Przybylski, 2019a]), by specifically focusing on social media and stratifying the analysis by gender. As a reminder, the reported median betas for digital technology use and adolescent well-being (for both genders) varied between [0.01 and 0.04]. When some of the limitations were addressed, the range of betas increased to between [0.03 and 0.07].

Finally, when all limitations were addressed by focusing specifically on social media and stratifying the analysis by gender, the median betas increased again. Among girls, the median betas varied between [0.11 and 0.24]. Using the same code and dataset lauded as "the highest-quality dataset we examined," the median beta for social media use and mental health among girls was 0.20. The study concludes, "These associations were stronger than links between mental health and binge drinking, sexual assault, obesity, and hard drug use..." suggesting that these associations may have substantial practical significance.

- In light of these recent discoveries, Orben more carefully examined the relationship between social media and adolescent mental health (operationalized as 'life satisfaction') by assessing how this link evolved over a human lifespan. [Orben et al., 2022] consisted of a correlational and longitudinal study; we will examine the former here and the latter in the next section. First, [Orben et al., 2022] found monotonic, negative associations between social media use and life satisfaction that only existed during adolescence and were stronger for girls. See Figure 6 ages 11-14. Orben notes, "females reporting very high social media use scored substantially lower on life satisfaction than males." Looking more closely at the adolescent population and breaking down life satisfaction into its components (appearance, friends, family, school, schoolwork, and life) – see Figure 7 – we observe that some of the strongest negative correlations occur between 10-15-year-old girls (e.g., r as large as 0.22 for 14-year-old girls), and the component of life satisfaction which is hit the hardest is satisfaction with one's appearance.[5]

This is the correlational evidence of the association between social media use and adolescent mental health. Our findings can be summarized as follows: **heavy social media use is consistently associated with negative mental health outcomes, particularly among adolescents, and especially for girls.**

2.2 Longitudinal Studies

Table 2 shows the longitudinal studies examined in this report. These studies address the question: Does social media use at time 1 predict anything about mental health outcomes at time 2? The studies are categorized according to whether or not they indicate an effect at time 2. As a reminder, this temporal ordering is a necessary but not sufficient condition for causality.

As before, we can filter those studies which do not examine adolescents ([Verduyn et al., 2015], [Shakya and Christakis, 2017], and [Burke and Kraut, 2016]) as well as those with outdated data ([Coyne et al., 2020]), leaving us with [Boers et al., 2019] and [Orben et al., 2019].

- [Boers et al., 2019] presents a compelling study, conducted over four years, annually assessing adolescents' self-reported social media use and depressive symptoms. The

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[5]As a side note, the mental health crisis appears to begin around 2012. Coincidentally, this was the same year Apple released the iPhone 4 – the first phone with a front-facing camera.
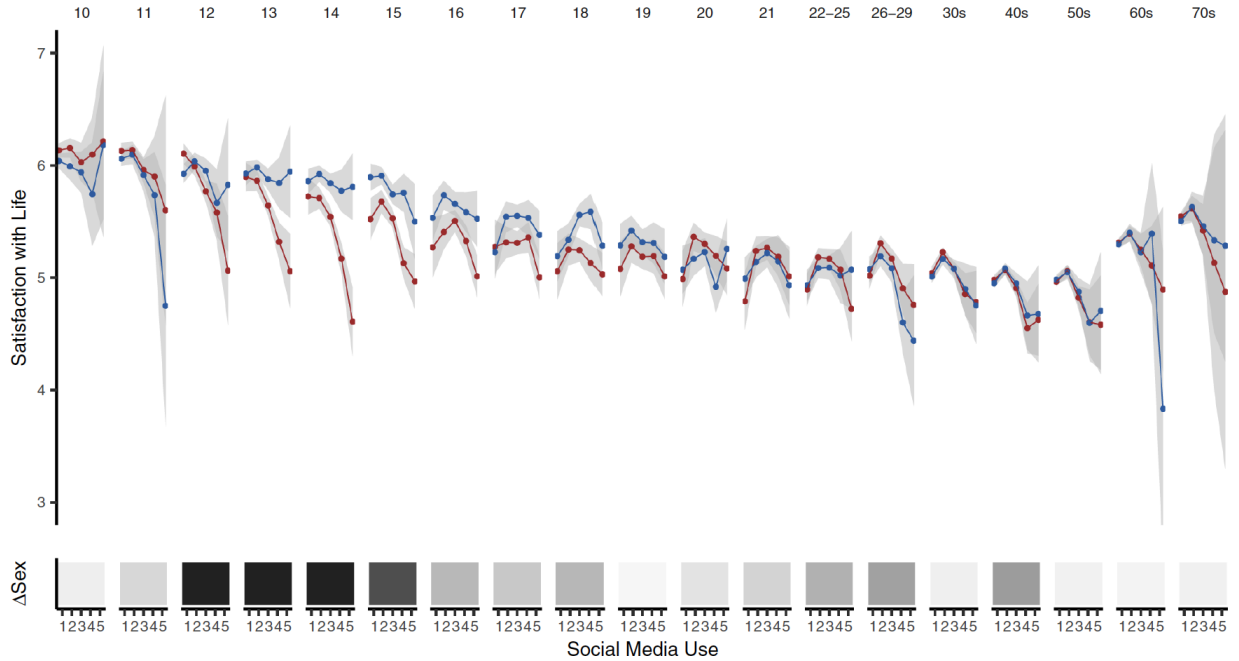
Figure 6: Social media use and life satisfaction over a lifetime, by age and gender. Red =
Girls, Blue = Boys.
Source: [Orben et al., 2022]

Studies that indicate an effect at time 2	Studies that indicate little/no effect at time 2s
[Verduyn et al., 2015] (see **??**)	[Burke and Kraut, 2016] (see **??**)
[Shakya and Christakis, 2017] (see **??**)	**[Orben et al., 2019]** (see **??**)
[Boers et al., 2019] (see **??**)	[Coyne et al., 2020] (see **??**)

Table 2: Longitudinal studies organized by whether or not social media use at time 1 predicts
anything about mental health at time 2.

researchers highlight significant within-person associations, indicating that each addi-
tional hour of social media use correlates with a 0.41-unit increase in depressive symp-
toms within the same year. Additionally, their findings support the notion of upward
social comparison rather than displacement hypothesis, as both between-person and
within-person associations between screen time (including social media and TV, ex-
cluding video games) and exercise, and self-esteem were observed. For a more detailed
analysis, refer to Section **??**.

- It's crucial to contextualize [Orben et al., 2019] within its publication timeframe, as it
  predates Orben's shifted perspective. Categorized under 'finds little/no effect at time
  2', it's noted not for finding 'no effect' but for indicating 'little effect.' The authors
  report small reciprocal within-person effects in females, where increases in social media
  use predict decreases in life satisfaction, and vice versa. This cyclic relationship aligns
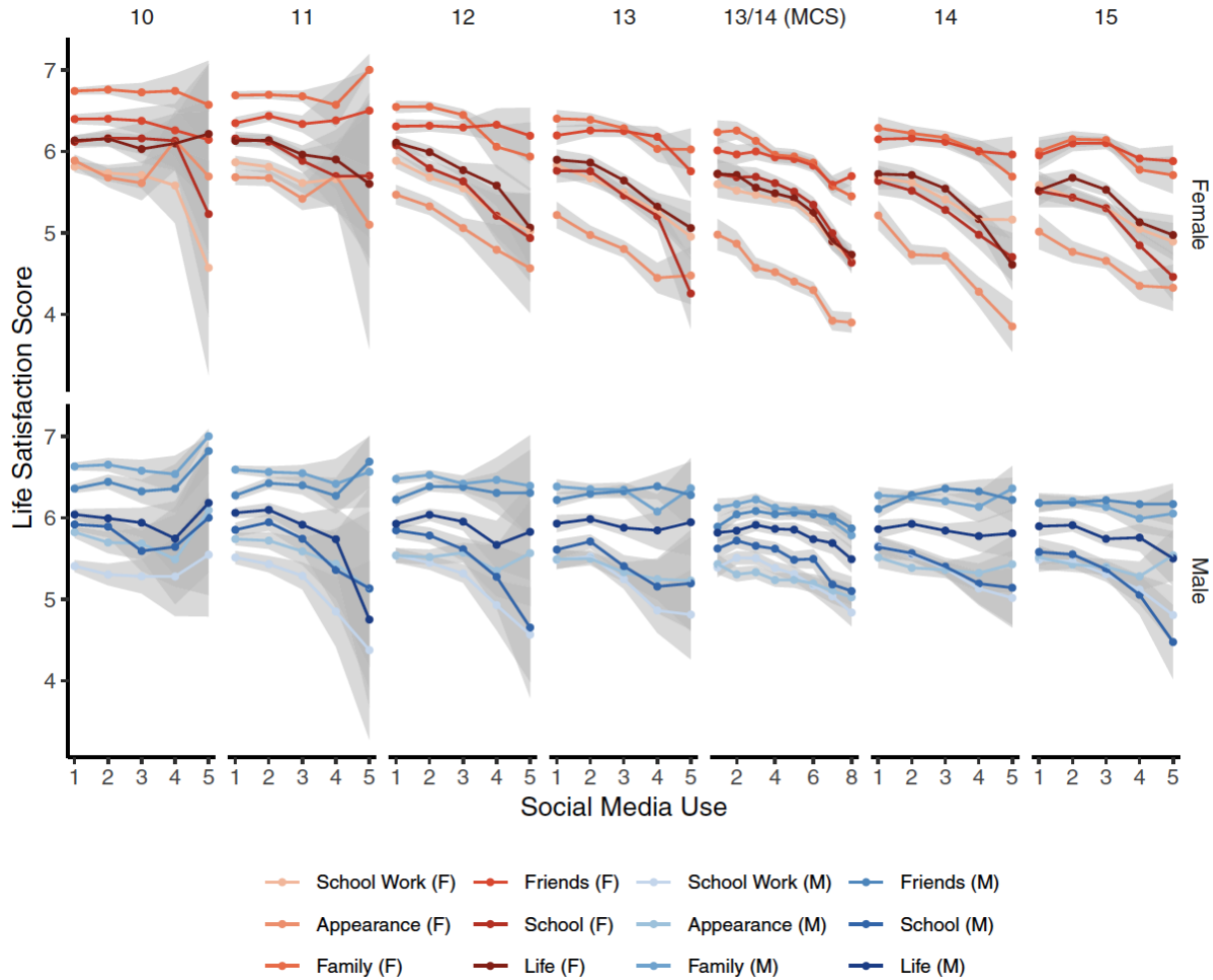 with findings from [Boers et al., 2019]. **They observe that the pathway from**

Figure 7: Social media use and six different life satisfaction measurements, by age and gender (ages 10–15).
Source: [Orben et al., 2022]

social media to life satisfaction is stronger than the reverse pathway and is moderated by age and gender, unlike the reverse pathway. For example, for girls ages 10-14, the regression coefficient for SM -> LS may be as large as 0.22, but only 0.03 for the reverse direction (see Table 1 in [Orben et al., 2022]) – **suggesting that the causal pathway from social media to life satisfaction is much stronger than the reverse pathway, particularly for young girls**.

- Subsequent work by Orben strengthens these findings. [Orben et al., 2022] reports: "Longitudinal analyses of 17,409 participants (10–21 years old) suggest distinct developmental windows of sensitivity to social media in adolescence, when higher estimated social media use predicts a decrease in life satisfaction ratings one year later (and vice-versa: lower estimated social media use predicts an increase in life satisfaction ratings). These windows occur at different ages for males (14–15 and 19 years old) and females (11–13 and 19 years old). Decreases in life satisfaction ratings also predicted

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subsequent increases in estimated social media use, however, these were not associated with age or sex."

This is the longitudinal evidence examined in this report regarding the relationship between social media and adolescent mental health. To summarize: **(1) higher social media use at time 1, consistently predicts lower adolescent mental health (when measured 1 year later). (2) These effects appear during different stages of adolescence for boys (ages 14-15, and 19) and girls (11-13, and 19). And (3) the relationship is reciprocal, although the reverse direction (mental health -> social media) is weaker and neither moderated by age nor gender.**

2.3 Experimental Studies

Finally, we arrive at the experimental studies. Shown in Table 3 are the experiments examined in this work organized according to whether or not they indicate a causal effect between social media use and negative mental health outcomes.

Studies that indicate a causal effect	Studies that indicate little/no causal effect
[Sagioglou and Greitemeyer, 2014]	[Vanman et al., 2018]
[Hunt et al., 2018]	[Hall et al., 2021]
[Kleemans et al., 2018]	[Przybylski et al., 2021]
[Sherlock and Wagstaff, 2019]	
[Allcott et al., 2020]	
[Braghieri et al., 2022]	

Table 3: Experimental studies organized by whether or not they indicate a causal effect between social media use and negative mental health outcomes.

Filtering studies with underpowered experimental groups (e.g., [Hall et al., 2021] had a treatment group with as few as 17 participants), leaves us with six experimental studies that indicate a causal effect ([Sagioglou and Greitemeyer, 2014], [Hunt et al., 2018], [Kleemans et al., 2018], [Sherlock and Wagstaff, 2019], [Allcott et al., 2020], and [Braghieri et al., 2022]) and two that do not ([Vanman et al., 2018] and [Przybylski et al., 2021]). Very briefly:

- (causal effect) [Sagioglou and Greitemeyer, 2014] randomly exposed young adults to 20-mins of active Facebook use and found a significant decrease in positive mood immediately afterward.

- (causal effect) [Hunt et al., 2018] randomly limited undergrads to 20-minutes of social media per day (Facebook, Snapchat, and Instagram) for **4 weeks** and found significant improvements in loneliness and depressive symptoms.

- (causal effect) [Kleemans et al., 2018] and [Sherlock and Wagstaff, 2019] are similar in that both randomly subjected girls and young women to idealized Instagram photos and found significant decreases in body image ([Kleemans et al., 2018]) and self-rated attractiveness ([Sherlock and Wagstaff, 2019]) immediately afterward.

- (causal effect) [Allcott et al., 2020] randomly asked participants to deactivate their Facebook accounts for **4 weeks** and found significantly improved measures of happiness, life satisfaction, depression, anxiety, and overall subjective well-being.

- (causal effect) [Braghieri et al., 2022] leveraged a unique natural experiment and causal inference to find that the roll-out of Facebook across colleges increased symptoms of poor mental health – especially depression.

- (mixed) [Vanman et al., 2018] randomly assigned adults to abstain from Facebook for **5 days** and found a decrease in stress but also a decrease in subjective well-being.

- (no effect) [Przybylski et al., 2021] randomly assigned adults to abstain from social media for **1 day** and found it had no measurable impact on well-being.

We can organize these studies by those that (1) remove/limit some form of social media exposure and those that (2) introduce some form of social media exposure. In doing so, two patterns quickly emerge:

1. The effect of limiting or removing social media exposure on well-being depends on how long afterward well-being is assessed. For both studies that found no effects, well-being was measured very soon after decreased exposure (5 days for [Vanman et al., 2018] and 1 day for [Przybylski et al., 2021]). If social media were addictive, then removing it might lead to withdrawal-like symptoms. Indeed, most (more than 50%) participants in [Przybylski et al., 2021] were reluctant to cooperate with abstaining from Facebook – even for just 1 day. However, for those studies which examined well-being at least 4 weeks after reducing social media exposure (e.g., [Hunt et al., 2018] and [Allcott et al., 2020]) the results consistently showed significant improvements to well-being.

2. For those studies in which social media exposure is introduced – e.g., 20 minutes of Facebook in [Sagioglou and Greitemeyer, 2014], idealized Instagram photos in [Kleemans et al., 2018] and [Sherlock and Wagstaff, 2019], or the natural roll-out of Facebook in [Braghieri et al., 2022] – the effect is immediate and consistently results in decreased mental health outcomes.

This concludes the experimental evidence examined in this report. To summarize: **(1) The impact of limiting or removing social media exposure on well-being appears to depend on the timing of well-being assessments, with studies showing no effects shortly after decreased exposure (indicative of withdrawal symptoms) but significant improvements in well-being observed at least 4 weeks later. (2) Studies introducing social media exposure, such as through brief Facebook use or exposure to idealized Instagram photos, consistently result in immediate decreases in mental health outcomes.**

3 Conclusions

Is social media a contributing factor in this adolescent mental health crisis? The growing body of evidence would suggest that of all the factors that might contribute to the adolescent

mental health crisis, social media remains a prime suspect. A slightly different question might be posed: *Is social media harmful to adolescents?* From the evidence examined in this report, we can say that: it depends. Certain usage patterns of social media can be harmful to some adolescents – however, this is balanced by numerous benefits. Now consider this question: Is social media safe for adolescents? This one is perhaps a bit easier to answer. The U.S. Surgeon General's report concludes with the following:

> At this time, we do not yet have enough evidence to determine if social media is sufficiently safe for children and adolescents. We must acknowledge the growing body of research about potential harms, increase our collective understanding of the risks associated with social media use, and urgently take action to create safe and healthy digital environments that minimize harm and safeguard children's and adolescents' mental health and well-being during critical stages of development. [Office of the Surgeon General (OSG), 2023]

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