Empirical Article

Clinical Psychological Science
2018, Vol. 6(1) 3–17

DOI: 10.1177/2167702617723376
www.psychologicalscience.org/CPS

Increases in Depressive Symptoms, Suicide-Related Outcomes, and Suicide Rates Among U.S. Adolescents After 2010 and Links to Increased New Media Screen Time

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Abstract
In two nationally representative surveys of U.S. adolescents in grades 8 through 12 (N = 506,820) and national statistics on suicide deaths for those ages 13 to 18, adolescents' depressive symptoms, suicide-related outcomes, and suicide rates increased between 2010 and 2015, especially among females. Adolescents who spent more time on new media (including social media and electronic devices such as smartphones) were more likely to report mental health issues, and adolescents who spent more time on nonscreen activities (in-person social interaction, sports/exercise, homework, print media, and attending religious services) were less likely. Since 2010, iGen adolescents have spent more time on new media screen activities and less time on nonscreen activities, which may account for the increases in depression and suicide. In contrast, cyclical economic factors such as unemployment and the Dow Jones Index were not linked to depressive symptoms or suicide rates when matched by year.

Keywords
depression, sociocultural factors, suicide prevention, interpersonal interaction, mass media

Received 4/25/17; Revision accepted 7/6/17

Depression and suicide are significant public health concerns, with over 40,000 Americans dying by suicide each year (Centers for Disease Control [CDC], 2017). Beyond the lives lost to suicide, death by suicide has significant emotional and economic costs, resulting in approximately $44.6 billion a year in combined medical and work loss costs in the United States alone (CDC, 2017). As such, suicide—and factors that may increase risk for suicide, including depression—is a serious public health concern that warrants extensive empirical investigation.

In recent years, clinicians heading university counseling centers have reported markedly increased caseloads, with many more students seeking help for mental health issues in the years after 2010 compared to a few years prior (Beiter et al., 2015; New, 2017; Novotney, 2014). One analysis found a 30% increase in caseloads between 2009–2010 and 2014–2015 at 93 university counseling centers, especially in mood and anxiety disorders and suicidal ideation (Center for Collegiate Mental Health, 2015). Reports of increases in counseling use among high school students have also surfaced (Anderssen, 2013; Noguchi, 2014). If true, that would mean more young people than in previous years are suffering from mental health issues, putting them at risk for suicide and other negative outcomes (Berman, 2009).

However, these increases in counseling center caseloads could be due to other factors, such as more students

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with already-diagnosed mental health issues enrolling in college, improved outreach by counseling centers, and students being more willing to seek help. As Collishaw (2014) notes in his review of research on trends in the prevalence of psychiatric disorders in child populations, "substantial increases in diagnosis and treatment of child psychiatric disorders in clinical practice do not necessarily reflect changes in population prevalence. Like-for-like comparisons using unselected cohorts are required to test mental health trends" (p. 19).

Thus, it would be useful to determine trends in mental health in general samples of adolescents, preferably with data collected concurrently over several years, rather than retrospectively, to minimize issues with recall (Klerman & Weissman, 1989). Previous studies examining such concurrent samples over time up to the 2000s found incongruent results, with some identifying significant increases in psychopathology (Collishaw, Maughan, Goodman, & Pickles, 2004; Collishaw, Maughan, Natarajan, & Pickles, 2010; Twenge et al., 2010) and others concluding that no changes occurred (Costello, Erkanli, & Angold, 2006; for reviews, see Collishaw, 2014; Twenge, 2011). In some cases, these disparate findings may have been caused by changes in the measurement of mental health issues, emphasizing the importance of using the same measures over time. In addition, research on trends in mental health after 2010, the time when mental health issues were rumored to have increased, is scant (Mojtabai, Olfson, & Han, 2016), though suicide rates appear to have increased (Curtin, Warner, & Hedegaard, 2016).

Furthermore, if mental health issues have increased among adolescents, the reasons are unclear (Collishaw, 2014; Glowinski & D'Amelio, 2016). Some have speculated that increased academic pressure and homework loads are the culprit (Galloway, Conner, & Pope, 2013; Neighmond, 2013), whereas others point to the severe recession of the late 2000s (Cummins, 2016). Continuing changes in family structure (e.g., Brown, Stykes, & Manning, 2016), in patterns of substance misuse (e.g., opioids; but see McCabe et al., 2017), and in obesity rates (e.g., Ogden et al., 2016) may also be implicated.

Another possible reason for the suspected increase in mental health issues is the growing popularity of electronic communication, especially social media. Some studies link frequency of social media use to poor psychological well-being (Augner & Hacker, 2012; Kross et al., 2013; Huang, 2017; Shakya & Christakis, 2017; Tromholt, 2016), although other studies instead find links with positive well-being (e.g., Dienlin, Masur, & Trepte, 2017; Oh, Ozkaya, & LaRose, 2014; Valkenburg, Peter, & Schouten, 2006), with outcomes depending on motivation for using social media (Valkenburg & Peter, 2007) and whether the frequency of use qualifies as addictive (Andreassen et al., 2016). However, most of these studies use convenience samples of adults, with few using nationally representative samples and even fewer including the especially vulnerable population of adolescents.

Examining how adolescents spend their time—including both screen and nonscreen activities—may be especially important, as iGen[1] adolescents in the 2010s spent more time on electronic communication and less time on in-person interaction than their Millennial and Generation X (GenX) predecessors at the same age (Twenge, 2017; Twenge & Uhls, 2017). It is worth remembering that humans' neural architecture evolved under conditions of close, mostly continuous face-to-face contact with others (including nonvisual and nonauditory contact; i.e., touch, olfaction; Baumeister & Leary, 1995; Lieberman, 2013) and that a decrease in or removal of a system's key inputs may risk destabilization of the system (e.g., Badcock, Davey, Whittle, Allen, & Friston, 2017).

In-person social interaction (also known as face-to-face communication) provides more emotional closeness than electronic communication (Sherman, Minas, & Greenfield, 2013) and, at least in some studies, is more protective against loneliness (Kross et al., 2013; cf. Deters & Mehl, 2013). Some research suggests that electronic communication, particularly social media, may even increase feelings of loneliness (Song et al., 2014), and time spent on electronic communication has increased considerably since the smartphone (a mobile phone with Internet access) was introduced in 2007 and gained market saturation around 2012 (Smith, 2017).

These changes in social interaction are especially relevant for suicide and suicide-related outcomes, as posited by the interpersonal theory of suicide. Briefly, the interpersonal theory of suicide (Joiner, 2005; Van Orden et al., 2010) proposes that the desire for suicide results from the combination of two interpersonal risk factors: thwarted belongingness (i.e., social disconnection/alienation, loneliness) and perceived burdensomeness (i.e., feeling as though one is a burden on others). Empirical support for the theory's propositions is considerable. For example, Chu et al. (2017) meta-analyzed work on 122 published and unpublished samples and found support for theory predictions; both perceived burdensomeness and thwarted belongingness displayed robust connections to suicidal ideation (with some evidence for burdensomeness having a stronger connection). Given the recent shifts in adolescent social interaction, increases in both perceived burdensomeness and thwarted belongingness may be particularly salient risk factors for suicide in this population. As such, exploring trends in mental health and examining possible causes (e.g., changes in the mode and quantity

of adolescent social interaction leading to increased perceived burdensomeness and thwarted belongingness) may be an informative avenue of research.

The current research has two goals. First, we seek to determine if the prevalence of depressive symptoms, suicide-related outcomes (i.e., suicidal ideation, plans, and attempts), and suicide deaths has increased in nationally representative samples of U.S. adolescents in recent years and whether these birth cohort trends[2] differ by gender, race, age, region, and socioeconomic status (SES). Second, we examine possible causes behind trends in adolescents' mental health, primarily focusing on shifts in adolescents' use of leisure time in these same nationally representative samples. We examine correlations between mental health and a wide array of activities including new media screen time (e.g., electronic device use, social media), older media screen time (TV watching), and nonscreen activities (e.g., in-person social interaction, sports/exercise, homework, attending religious services). We also examine the role of economic factors at the group level, including cyclical economic trends (unemployment, stock index performance) and income inequality, as economic hardships have been linked with depression (Zhai et al., 2016) and income inequality has been linked to lower overall happiness (Oishi, Kesebir, & Diener, 2011).

Identifying the mechanisms underlying trends in mental health is necessarily difficult as experimental trials are not possible: Adolescents cannot be randomly assigned to experience different eras. Thus, we must turn to correlational research to provide evidence. At minimum, possible causes must meet two criteria. First, they must be linked to mental health indicators in a population of individuals. For example, more frequent use of new media might be correlated with higher levels of depressive symptoms. Second, the variable must change over the years in parallel with trends in mental health indicators.

In this paper, we take these two steps, drawing on data from two large, nationally representative surveys of U.S. adolescents conducted since 1991 (the Monitoring the Future [MtF] survey and the Youth Risk Behavior Surveillance System [YRBSS]) and the U.S. CDC data on suicide deaths since 1999. These three sources allow a time-lag design that holds age constant while birth cohort and time period vary, allowing for the examination of cultural change across three generations of adolescents (GenX, Millennials, and iGen) disentangled from age effects. After determining trends in depressive symptoms, suicide-related outcomes, and suicide rates, we applied a two-step process to rule in or out possible causes. First, we examined which activities (e.g., electronic device use, social media, in-person social interaction, homework time) were correlated with depressive symptoms and suicide-related outcomes. Second, we determined whether the temporal trends in adolescents' screen and nonscreen activities and group-level economic factors paralleled the trends in depressive symptoms, suicide-related outcomes, and suicide rates.

Method

Samples

MtF is a nationally representative survey of 8th, 10th, and 12th graders administered every year since 1991 (Johnston, Bachman, O'Malley, Schulenberg, & Miech, 2016). All procedures of the survey are annually reviewed and approved by the University of Michigan Institutional Review Board. For the items used here, n = 388,275.

The YRBSS is a nationally representative sample of high school students (9th, 10th, 11th, and 12th graders) administered by the CDC every other year since 1991. The YRBSS protocol was approved by the CDC Institutional Review Board (CDC, 2016). For the items used here, n = 118,545.

Suicide deaths per 100,000 population for the age group corresponding to the MtF and YRBSS respondents (ages 13 to 18) were calculated from the online version of the CDC Fatal Injury Reports, which has data available from 1999 to 2015 (CDC, 2017). This site provides custom age ranges and breakdowns by sex, race/ethnicity, and region for suicide rates in each year.

Assessments

Depressive symptoms. MtF included six items from the Bentler Medical and Psychological Functioning Inventory depression scale (Newcomb, Huba, & Bentler, 1981): "Life often seems meaningless," "I enjoy life as much as anyone" (reverse scored), "The future often seems hopeless," "I feel that I can't do anything right," "I feel that my life is not very useful," and "It feels good to be alive" (reverse scored). Response choices ranged from 1 (*disagree*) to 5 (*agree*). After recoding the two reverse-scored items, item-mean scores were computed (α = .86).

Suicide-related outcomes. This section on the YRBSS included four items: "During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing some usual activities?" "During the past 12 months, did you ever seriously consider attempting suicide?" "During the past 12 months, did you make a plan about how you would attempt suicide?" Response choices for these three items were "yes" or "no." Another item, "During the past 12 months, how many times did you actually attempt

suicide?" was recoded to 0 times = "no" and one time, two or three times, four or five times, or six or more times = "yes." Participants who responded "yes" to any of the four items were recorded as having at least one suicide-related outcome (α = .75).

Electronic device use. In 2009, YRBSS asked, "On an average school day, how many hours do you play video or computer games or use a computer for something that is not school work? (Include activities such as Nintendo, Game Boy, PlayStation, Xbox, computer games, and the Internet.)" In 2011, "On an average school day, how many hours do you play video or computer games or use a computer for something that is not school work? (Include activities such as Xbox, PlayStation, Nintendo DS, iPod touch, Facebook, and the Internet.)" In 2013 and 2015, "On an average school day, how many hours do you play video or computer games or use a computer for something that is not school work? (Count time spent on things such as Xbox, PlayStation, an iPod, an iPad or other tablet, a smartphone, YouTube, Facebook or other social networking tools, and the Internet.)" Response choices were recoded as follows: "I do not play video or computer games or use a computer for something that is not school work" = 0; "less than 1 hour per day" = .5; "1 hour per day" = 1; "2 hours per day" = 2; "3 hours per day" = 3; "4 hours per day" = 4; and "5 or more hours per day" = 6.

Social media use. MtF asked beginning in 2009, "How often do you do each of the following? Visit social networking websites (like Facebook)." Response choices were *never* = 1, *a few times a year* = 2, *once or twice a month* = 3, *at least once a week* = 4, and *almost every day* = 5.

Internet news. The MtF 8th and 10th grade surveys asked, "How often do you use each of the following to get information about news and current events? The Internet." Response choices were *never* = 1, *a few times a year* = 2, *once or twice a month* = 3, *at least once a week* = 4, and *almost every day* = 5.

TV watching. The MtF 8th and 10th grade surveys asked two questions on TV watching. First, "How much TV do you estimate you watch on an average weekday?" Response choices were recoded to *none* = 0, *half-hour or less* = .25, *about 1 hour* = 1, *about 2 hours* = 2, *about 3 hours* = 3, *about 4 hours* = 4, and *5 hours or more* = 6. Second, "How much TV do you estimate you watch on an average WEEKEND (both Saturday and Sunday combined)?" Response choices were recoded to *none* = 0, *an hour or less* = .5, *1–2 hours* = 1.5, *3–4 hours* = 3.5, *5–6 hours* = 5.5, *7–8 hours* = 7.5, and *9 or more hours* = 10. We multiplied the weekday estimate by 5, added the weekend estimate, and divided the total by 7 to obtain a daily estimate.

YRBSS asked, "On an average school day, how many hours do you watch TV?" Response choices were recoded as "I do not watch TV on an average school day" = 0, "Less than 1 hour per day" = .5, "1 hour per day" = 1, "2 hours per day" = 2, "3 hours per day" = 3, "4 hours per day" = 4, and "5 or more hours per day" = 6.

Homework. MtF asked, "About how many hours do you spend in an average week on all your homework including both in school and out of school?" with response choices recoded to *0 hours* = 0, *1–4 hours* = 2.5, *5–9 hours* = 7, *10–14 hours* = 12, *15–19 hours* = 17, *20–24 hours* = 22, and *25 or more hours* = 30.

In-person social interaction. MtF asked six items about different types of in-person social interaction. Four items were asked in the same section beginning "How often do you do each of the following?": "get together with friends, informally"; "go to parties or other social affairs"; "ride around in a car (or motorcycle) just for fun"; or "go to a shopping mall." Response choices were *never* = 1, *a few times a year* = 2, *once or twice a month* = 3, *at least once a week* = 4, and *almost every day* = 5. Another item asked about going out: "During a typical week, on how many evenings do you go out for fun and recreation? (Don't count things you do with your parents or other adult relatives)" with response choices recoded to *less than one* = .25, *one* = 1, *two* = 2, *three* = 3, *four or five* = 4.5, and *six or seven* = 6.5. Less than one was recoded as .25 instead of .50 because "none" was not a response choice on this item. Another asked about dating: "On average, how often (if ever) do you go out with a date?" with choices recoded to *never* = 0, *once a month or less* = .12, *2 or 3 times a month* = .58, *once a week* = 1, *2 or 3 times a week* = 2.5, and *over 3 times a week* = 4. The calculations for the first two recodes were as follows: once a month or less = .50 times a month, divided by 4.3 (the average number of weeks in a month) = .12; 2 or 3 times a month = 2.5, divided by 4.3 = .58. The six items were *z*-scored, added together, and divided by 6 (α = .68).

Print media. The MtF 8th- and 10th-grade surveys asked, "How often do you do each of the following? Read magazines. Read newspapers." Response choices were *never* = 1, *a few times a year* = 2, *once or twice a month* = 3, *at least once a week* = 4, and *almost every day* = 5. Responses were *z*-scored, added, and divided by 2 (α = .59).

Sports or exercise. MtF asked, "How often do you do each of the following? Actively participate in sports, athletics, or exercising." Response choices were *never* = 1, *a*

few times a year = 2, *once or twice a month* = 3, *at least once a week* = 4, and *almost every day* = 5.

YRBSS asked, "During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? (Add up all the time you spent in any kind of physical activity that increased your heart rate and made you breathe hard some of the time.)" Response choices were recoded to *0 days* = 0, *1 day* = 1, *2 days* = 2, *3 days* = 3, *4 days* = 4, *5 days* = 5, *6 days* = 6, and *7 days* = 7.

Religious services. MtF asked, "How often do you attend religious services?" Response choices were *never* = 1, *rarely* = 2, *once or twice a month* = 3, and *once a week or more* = 4.

Paid job. The MtF 8th- and 10th-grade surveys asked, "On average over the school year, how many hours per week do you work in a paid job?" Those who answered anything but "none" were coded as having a paid job.

Demographic moderators and controls. Both surveys assessed grade, sex (male vs. female), and race (Black, White, and Hispanic in MtF, with Hispanic measured only for 2005 and later; Black, White, Hispanic, and other in YRBSS). MtF also assessed region (Northeast, Midwest, South, and West) as well as mother's and father's highest level of education, a proxy for SES; we used mother's education as it had less missing data than father's education. The CDC suicide death data can be separated by sex, age, region, and race/ethnicity, with race recorded as Black, White, American Indian/Alaska Native, Asian/Pacific Islander, and other (filtered to all be non-Hispanic), and Hispanic (of all races).

Economic factors. We gathered yearly statistics on the (a) unemployment rate, (b) the change in the Dow Jones Industrial Average (DJIA), and (c) the GINI index of income inequality from publicly available sources such as the Bureau of Labor Statistics.

Statistical analyses

For our analyses of trends over time in depressive symptoms, suicide-related outcomes, and suicide rates, we separated the older data into 5-year intervals (e.g., 2000–2004) to provide a compromise between specificity and breadth, dividing at the decade and half-decade marks to enable references to specific time periods (e.g., "the early 2000s," for 2000–2004). For the years 2010 and later, we display the year-by-year data. Due to the large sample sizes, we focus primarily on percentage change or effect sizes rather than statistical significance in the change over time analyses. Depressive symptoms are reported as item means and as the percentage of adolescents with item means over 3 (which is the midpoint of the scale and about 1 *SD* above the mean). Suicide-related outcomes are presented as the percentage who reported at least one outcome, and the suicide rate is reported as deaths per 100,000 population.

We examined correlations between the mental health indicators (depressive symptoms and suicide-related outcomes) and screen and nonscreen activities. In MtF, these analyses were limited to 8th and 10th graders as the depressive symptoms and social media items were not asked of the same participants on the 12th grade survey. We first present bivariate correlations, followed by partial correlations controlling for sex, race/ethnicity, grade, US region, and SES (using dummy codes for race/ethnicity, grade, and region), and correlations for boys and girls separately. We also report partial correlations for depressive symptoms controlling for in-person social interaction (to capture the unique effects of activities on depressive symptoms apart from in-person social interaction) and examine levels of depressive symptoms among those low and high (±1 *SD*) in in-person social interaction and low and high in social media use (low = never; high = use almost every day). As the survey designs include different participants every year (a time-lag design), we were only able to examine concurrent correlations between activities and mental health; thus, lagged analyses examining the time course of activities and mental health (such as those used in longitudinal designs following the same participants) were not possible. We focused on 2009 through 2015, as the question on social media was first asked in 2009. As suggested by the survey administrators, the YRBSS data were weighted using the "weight" variable.

To examine the co-occurrence of adolescent mental health issues with economic factors and new media screen time, we matched the means of these variables by year, an established method for exploring cultural change at the group level (Grossmann & Varnum, 2015; Twenge, Campbell, & Carter, 2014; Varnum & Grossmann, 2016). Because means vary less than individuals, these ecological correlations are often high; to compensate, the *df* is the number of years rather than the number of individuals. We matched the means for depressive symptoms, suicide-related outcomes, and suicide rates by year with the unemployment rate, DJIA change, and the GINI measure of income inequality. To provide a direct comparison with new media screen time, we also matched the mental health indicators by year with smartphone adoption rates (Smith, 2017; these statistics were available beginning in 2011, and smartphones were introduced in 2007, so we assumed linear growth between 2007 and 2010) and with mean frequency of

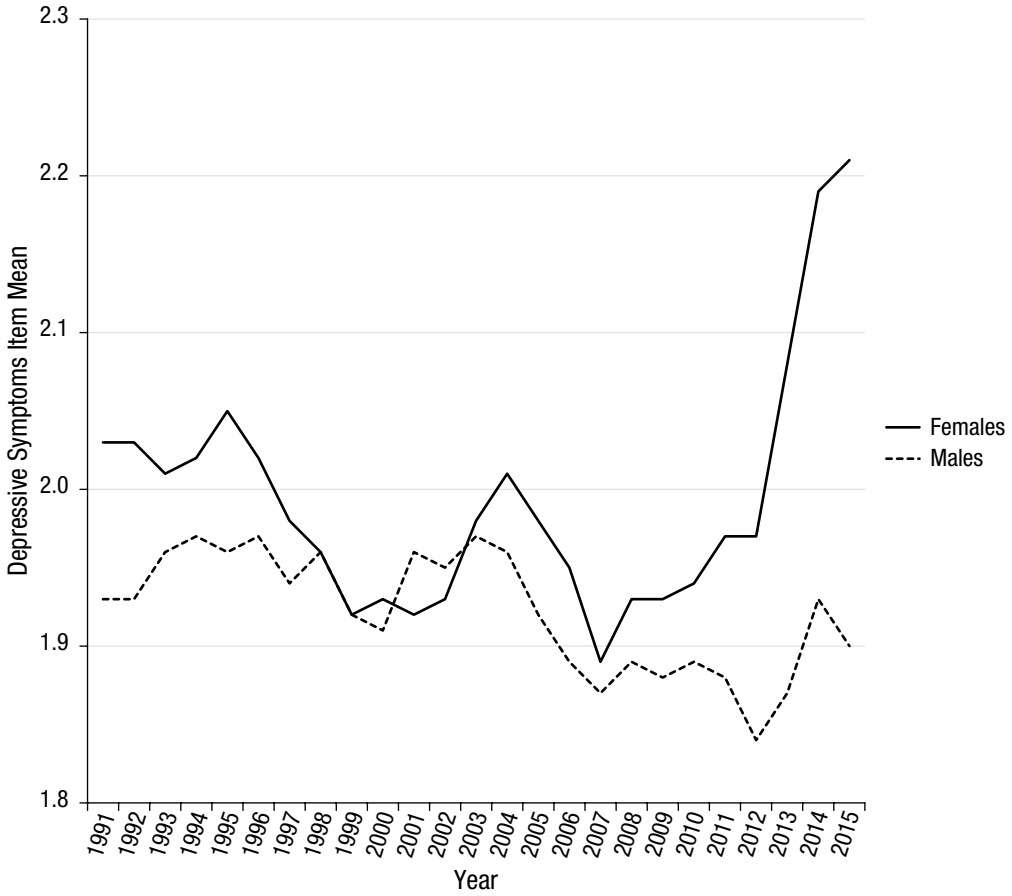

Fig. 1. Depressive symptoms (item mean), 8th, 10th, and 12th graders, by sex, MtF, 1991–2015.

social media use from the MtF dataset (see Table S1 in the Supplemental Material available online). Because the items on suicide-related outcomes were asked only every other year, these analyses are based on a smaller number of years and thus should be interpreted with caution.

Results

Trends in mental health indicators

Depressive symptoms, suicide-related outcomes, and suicide deaths among adolescents all rose during the 2010s. These increases follow a period when mental health issues were declining or stable (see Table 1). Between 2009/2010 and 2015, 33% more adolescents exhibited high levels of depressive symptoms (item mean of 3 or over; 16.13% in 2010, 21.48% in 2015), 12% more reported at least one suicide-related outcome (31.93% in 2009, 35.80% in 2015; 5% more since 2011, 34.21%), and 31% more died by suicide (5.38 per 100,000 population in 2010, 7.04 in 2015).

The increase in depressive symptoms and suicide-related outcomes was driven almost exclusively by females (see Table 1 and Fig. 1). Between 2009/2010 and 2015, 58% more females scored high in depressive symptoms (16.74% in 2010, 26.40% in 2015) and 14% more reported at least one suicide-related outcome (39.82% in 2009, 45.39% in 2015; 12% more since 2011, 40.67%). The increase in suicide rates among adolescents also appeared among males but was larger among females, rising 65% between 2010 and 2015 (from 2.93 to 4.21) and more than doubling between the late 1990s and 2015 (from 1.99 to 4.21; see Table 1 and Fig. S1 in the Supplemental Material). The increases in depressive symptoms and suicide-related outcomes were fairly similar among Hispanics, Blacks, and Whites, with more variation in suicide rate trends by race or ethnicity. Increases in depressive symptoms were similar among those of lower and higher SES and were larger in the West and among 12th graders. The recent increase in suicide rates appeared only in the Midwest, South, and West, but not in the Northeast (see Table 1).

The effect size for the rise in depressive symptoms among females in 2010 through 2015 was $d = .27$, which falls between a small and medium effect size. However, this change must be understood in the context of the brief 5-year period over which it occurred. The change

here corresponds to d = .054 per year, an unusual amount of change for a short period of time. On average, birth cohort shifts are around d = .015 to d = .02 per year in national samples (Twenge & Foster, 2010). Thus, this yearly rate of change is more than twice as large as many previously identified birth cohort differences.

Correlations with screen and nonscreen activities

Next, we examined possible causes of the increase in depressive symptoms and suicide-related outcomes among adolescents. First, we examined links between depressive symptoms/suicide-related outcomes and an array of adolescent activities. Adolescents who spent more time on screen activities were significantly more likely to have high depressive symptoms or have at least one suicide-related outcome, and those who spent more time on nonscreen activities were less likely. These nonscreen activities included print media, suggesting that only some types of media use (e.g., screens) were associated with higher risk. Time spent on homework was negatively correlated with depressive symptoms. The correlations were similar when controlled for sex, race, grade, SES, and region (see Table 2). The correlations between mental health and new media screen activities were higher among girls than among boys; for example, social media use was significantly correlated with depressive symptoms among girls, $r(37{,}830) = .06$, $p < .001$, but not among boys, $r(36{,}291) = .01$, $p = .08$ (with demographic controls). When examined individually, the four suicide-related outcomes were all significantly correlated with electronic device use: feeling sad or hopeless, $r(59{,}115) = .11$, $p < .001$; seriously considering suicide, $r(59{,}102) = .10$, $p < .001$; making a suicide plan, $r(58{,}805) = .09$, $p < .001$; and making a suicide attempt, $r(53{,}602) = .07$, $p < .001$.

Overall, the results show a clear pattern linking screen activities with higher levels of depressive symptoms/suicide-related outcomes and nonscreen activities with lower levels. All activities associated with higher depressive symptoms or suicide-related outcomes involved screens, and all activities associated with lower depressive symptoms or suicide-related outcomes did not involve screens (see Fig. S2 in the Supplemental Material). In terms of relative risk, adolescents using electronic devices 3 or more hours a day were 34% more likely to have at least one suicide-related outcome than those using devices 2 or fewer hours a day, and adolescents using social media sites every day were 13% more likely to report high levels of depressive symptoms than those using social media less often.

Electronic device use showed a clear exposure-response relationship with having at least one suicide risk factor, in both bivariate analyses and those including demographic controls (see Fig. 2). Risks became elevated after 2 hours or more a day of electronic device use, when 33% of adolescents had at least one suicide-related outcome, compared to 29% of those using electronic devices 1 hour a day. Among those who used electronic devices 5 or more hours a day, 48% had at least one suicide-related outcome. Thus, adolescents using devices 5 or more hours a day (vs. 1 hour) were 66% more likely to have at least one suicide-related outcome.

Because social media is a social activity, we also examined its links to in-person social interaction and their interaction in predicting depressive symptoms. Likely due to individual differences in sociability, adolescents who spent more time interacting with friends in person also spent more time on social media, $r(110{,}603) = .27$, $p < .001$ (with demographic controls included). In-person social interaction was the only nonscreen activity correlated > .20 with social media use,[3] creating the possibility of additive or suppressive effects. Thus, the third column in Table 2 reports correlations between activities and depressive symptoms controlled for in-person social interaction (as well as the demographic controls). The correlation between depressive symptoms and social media use increases to $r(75{,}371) = .06$, $p < .001$, when in-person social interaction is controlled—with $r(37{,}829) = .08$, $p < .001$ for girls, and $r(36{,}290) = .04$, $p < .001$ for boys. In a regression equation including social media use, in-person social interaction, and their cross-product to predict depressive symptoms, both social media use ($\beta = .07$, $p < .001$) and in-person social interaction ($\beta = -.09$, $p < .001$) were significant predictors, as was the cross-product ($\beta = .02$, $p < .001$). Adolescents low in in-person social interaction and high in social media use reported the highest levels of depressive symptoms (see Fig. S3 in the Supplemental Material). Among those low in in-person social interaction, social media use had a significant effect on depressive symptoms, $F(1, 8{,}906) = 165.41$, $p < 001$, but among those high in in-person social interaction, social media did not have a significant effect, $F(1, 12{,}078) = 2.16$, $p = .14$.

Over the same time period that depressive symptoms and suicide-related outcomes increased, screen activities such as electronic device use, social media use, and reading Internet news increased and nonscreen activities decreased (see Table S1 and Fig. S4 in the Supplemental Material). Thus, the only activities that both (a) predicted higher depressive symptoms or suicide-related outcomes and (b) increased at $d \geq .05$ since 2011/2012 are electronic device use, social media use, and reading Internet news. The only activities that (a) predicted lower depressive symptoms and (b) decreased at $d \geq .05$ since 2011/2012 are in-person

Table 1. U.S. adolescents' depressive symptoms (8th, 10th, and 12th graders; MtF), suicide-related outcomes (9th–12th graders; YRBSS), and suicide rates (ages 13–18; CDC Data), 1991–2015

Group	*N*	1991–1994	1995–1999	2000–2004	2005–2009	2010	2011	2012	2013	2014	2015	*d* or % change: Earliest to 2009–2010	*d* or % change: 2009–2010 to 2015
Depressive symptoms (mean)													
All adolescents	388,275	1.99 (0.90)	1.97 (0.91)	1.96 (0.91)	1.92 (0.91)	1.92 (0.92)	1.93 (0.92)	1.91 (0.92)	1.98 (0.96)	2.07 (1.01)	2.06 (1.00)	–0.08	0.15
Females	198,415	1.99 (0.93)	1.96 (0.92)	1.94 (0.93)	1.96 (0.94)	1.94 (0.94)	1.97 (0.96)	1.97 (0.97)	2.08 (1.02)	2.19 (1.06)	2.21 (1.06)	–0.05	0.27
Males	181,313	1.95 (0.87)	1.95 (0.88)	1.95 (0.90)	1.89 (0.88)	1.89 (0.89)	1.88 (0.89)	1.84 (0.86)	1.87 (0.88)	1.93 (0.92)	1.90 (0.90)	–0.07	0.01
Hispanic	24,496	—	—	—	2.04 (0.92)	2.01 (0.91)	2.03 (0.94)	2.04 (0.93)	2.08 (0.96)	2.18 (0.98)	2.16 (0.98)	–0.03	0.16
Black	43,949	1.90 (0.86)	1.90 (0.85)	1.87 (0.84)	1.87 (0.85)	1.86 (0.83)	1.93 (0.87)	1.87 (0.86)	1.90 (0.84)	1.96 (0.90)	2.00 (0.93)	–0.05	0.16
White	241,619	1.96 (0.90)	1.94 (0.90)	1.92 (0.91)	1.87 (0.90)	1.86 (0.91)	1.88 (0.92)	1.86 (0.91)	1.92 (0.96)	2.01 (1.02)	2.00 (1.00)	–0.11	0.15
Lower SES	134,474	2.05 (0.92)	2.04 (0.92)	2.05 (0.94)	2.03 (0.95)	2.02 (0.94)	2.03 (0.94)	2.05 (0.98)	2.11 (0.99)	2.21 (1.03)	2.20 (1.01)	–0.03	0.18
Higher SES	223,443	1.91 (0.87)	1.90 (0.88)	1.87 (0.88)	1.83 (0.87)	1.83 (0.88)	1.84 (0.89)	1.82 (0.87)	1.90 (0.94)	1.96 (0.98)	1.97 (0.97)	–0.09	0.15
Northeast	76,806	1.98 (0.91)	1.99 (0.92)	1.96 (0.92)	1.90 (0.90)	1.91 (0.93)	1.87 (0.90)	1.87 (0.91)	1.95 (0.95)	2.04 (1.02)	2.01 (1.00)	–0.08	0.10
Midwest	96,687	1.98 (0.90)	1.97 (0.91)	1.94 (0.91)	1.91 (0.91)	1.92 (0.92)	1.93 (0.93)	1.87 (0.89)	1.93 (0.95)	2.02 (1.00)	2.04 (0.99)	–0.07	0.13
South	134,886	1.97 (0.90)	1.95 (0.90)	1.92 (0.90)	1.92 (0.91)	1.91 (0.90)	1.93 (0.91)	1.93 (0.94)	2.00 (0.96)	2.06 (1.00)	2.05 (1.00)	–0.07	0.15
West	79,896	2.02 (0.90)	1.99 (0.91)	2.03 (0.93)	1.94 (0.91)	1.95 (0.93)	1.96 (0.94)	1.95 (0.92)	2.04 (0.98)	2.15 (1.01)	2.16 (1.00)	–0.08	0.22
8th Grade	164,039	2.00 (0.92)	1.98 (0.92)	1.96 (0.94)	1.93 (0.95)	1.94 (0.95)	1.92 (0.94)	1.90 (0.95)	1.98 (0.98)	2.07 (1.03)	2.05 (1.03)	–0.07	0.11
10th Grade	168,007	1.99 (0.90)	1.98 (0.91)	1.97 (0.91)	1.92 (0.90)	1.91 (0.91)	1.94 (0.92)	1.93 (0.91)	2.01 (0.97)	2.08 (1.01)	2.08 (0.99)	–0.09	0.18
12th Grade	54,712	1.93 (0.85)	1.91 (0.84)	1.89 (0.84)	1.87 (0.82)	1.87 (0.83)	1.89 (0.87)	1.89 (0.85)	1.90 (0.85)	2.01 (0.93)	2.04 (0.90)	–0.07	0.20
Percentage high in depressive symptoms													
All adolescents	388,275	16.96	17.06	16.98	16.01	16.13	16.69	15.98	18.46	21.21	21.48	–4.89	33.17
Females	198,415	17.79	17.51	16.89	16.75	16.74	17.93	17.87	21.85	25.44	26.40	–5.90	57.71
Males	181,313	15.90	16.40	17.00	14.94	15.08	15.33	13.77	14.65	16.61	16.37	–5.44	8.55
Hispanic	24,496	—	—	—	18.94	17.70	19.32	19.35	20.29	23.03	24.10	6.55	36.16
Black	43,949	14.73	14.67	13.46	13.80	12.80	15.41	14.01	14.72	17.20	18.55	–13.10	44.92
White	241,619	16.14	16.17	16.01	14.85	15.02	15.71	14.92	17.28	19.81	19.56	–6.94	30.23
Lower SES	134,474	18.93	18.90	19.78	19.15	18.61	19.54	19.90	21.82	25.62	25.74	–1.69	38.31

(Continued)

Table 1. (*Continued*)

Group	*N*	1991–1994	1995–1999	2000–2004	2005–2009	2010	2011	2012	2013	2014	2015	*d* or % change: Earliest to 2009–2010	*d* or % change: 2009–2010 to 2015
Higher SES	223,443	14.54	14.84	14.32	13.27	13.79	14.16	13.26	16.12	18.09	18.70	–5.16	35.61
Northeast	76,806	16.85	17.58	17.10	15.41	16.38	15.08	14.83	17.15	20.74	20.19	–2.79	23.26
Midwest	96,687	16.60	17.43	16.54	15.94	16.29	17.21	15.34	16.82	19.60	20.31	–1.87	23.99
South	134,886	16.84	16.33	16.07	16.19	15.83	16.32	16.77	19.12	21.21	21.30	–6.00	34.55
West	79,896	17.77	17.36	18.99	16.37	16.24	18.01	16.24	20.05	23.14	24.35	–8.61	49.94
8th Grade	164,039	17.76	17.72	17.60	17.03	17.43	16.52	16.48	19.00	21.41	21.23	–1.86	21.80
10th Grade	168,007	17.17	17.31	17.27	15.88	15.78	17.39	16.11	19.32	21.98	22.08	–8.10	39.92
12th Grade	54,712	14.19	14.17	13.69	13.24	13.22	15.02	14.35	14.08	18.06	20.01	–6.84	51.36
Suicide-related outcomes (% with at least one suicide risk factor)													
All adolescents	118,545	—	36.22	36.41	33.48	—	34.21	—	35.17	—	35.80	–5.55	4.65
Females	58,870	—	44.67	43.50	41.40	—	40.67	—	43.96	—	45.39	–8.95	11.61
Males	59,337	—	27.80	29.09	25.72	—	28.02	—	26.28	—	26.35	–0.79	–5.96
Hispanic	19,066	—	43.69	44.31	40.33	—	39.45	—	41.82	—	40.66	–9.70	3.07
Black	14,703	—	36.48	34.33	35.35	—	32.89	—	35.14	—	34.25	–9.84	4.13
White	72,308	—	32.58	34.03	30.80	—	31.94	—	32.07	—	33.58	–1.96	5.13
Other	10,748	—	44.77	44.89	36.95	—	39.63	—	40.38	—	39.75	–11.48	0.30
9th Grade	33,095	—	36.18	16.90	34.10	—	34.15	—	34.90	—	34.23	–5.39	0.23
10th Grade	30,556	—	38.63	37.59	33.68	—	34.82	—	34.64	—	35.67	–9.86	2.44
11th Grade	27,958	—	34.06	36.09	34.01	—	35.05	—	36.84	—	37.99	–2.91	8.39
12th Grade	26,300	—	35.71	34.17	31.67	—	32.70	—	34.22	—	35.62	–8.43	8.93
Suicide rate (per 100,000)													
All adolescents	—	—	5.63	5.34	5.04	5.38	5.88	6.00	6.13	6.63	7.04	–4.44	30.86
Females	—	—	1.99	2.27	2.30	2.55	2.93	3.19	3.35	3.70	4.21	28.14	65.10
Males	—	—	9.08	8.25	7.64	8.07	8.68	8.68	8.78	9.43	9.76	–11.12	20.94
Hispanic	—	—	3.94	3.93	3.74	3.93	3.98	4.17	3.86	4.51	4.11	–0.25	4.58
Black	—	—	3.93	3.17	3.01	3.04	3.36	3.43	3.82	3.45	4.12	–22.65	35.53
White	—	—	6.31	6.11	5.81	6.37	7.24	7.39	7.60	8.35	8.94	0.95	40.35
Asian/Pacific Islander	—	—	3.94	3.60	3.38	3.19	3.31	3.65	3.64	4.20	4.91	–19.04	53.92
American Indian/ Alaska Native	—	—	16.35	15.21	19.36	23.44	19.14	16.74	19.23	17.79	22.67	43.36	–3.28
Other	—	—	6.59	6.08	6.55	6.76	6.01	5.83	6.17	6.34	7.64	2.58	13.02
Northeast	—	—	3.81	4.06	3.30	4.50	4.81	4.24	4.45	4.94	4.49	18.11	–0.22
Midwest	—	—	6.10	5.96	5.99	6.71	7.00	7.35	7.15	7.79	8.08	10.00	20.42
South	—	—	5.93	5.22	4.94	4.71	5.34	6.00	5.94	6.55	6.69	–20.57	42.04
West	—	—	6.12	5.89	5.62	5.85	6.46	6.06	6.71	6.93	8.49	–4.41	45.13
Ages 13–14	—	—	2.26	2.40	2.02	2.46	2.57	2.84	3.50	3.70	3.76	8.85	52.84
Ages 15–16	—	—	5.36	5.19	4.97	5.16	5.89	6.16	6.25	6.68	6.88	–3.73	33.33
Ages 17–18	—	—	9.28	8.48	8.03	8.32	9.00	8.89	8.61	9.51	10.44	–10.34	25.48

Note: Values in parentheses are standard deviations. Hispanic ethnicity was measured in MtF in 2005 and later only. *N*s are not given for the suicide rates as they are based on a complete sample of the population. Percentage change was calculated using the formula percentage1 – percentage2 / percentage1 or rate1 – rate2 / rate1. This captures the percentage increase in the number of people affected. SES = socioeconomic status; MtF = Monitoring the Future survey; YRBSS = Youth Risk Behavior Surveillance System.

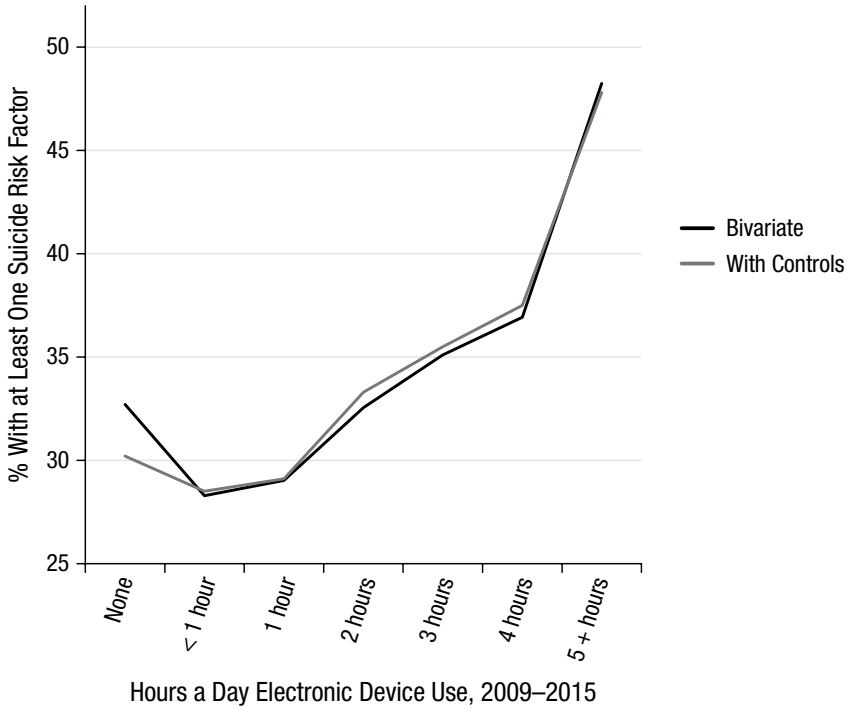

Fig. 2. Exposure-response relationship between electronic device use and having at least one suicide-related outcome, bivariate and with demographic controls for race, sex, and grade, 9–12th graders, Youth Risk Behavior Surveillance Survey (YRBSS), 2009–2015.

Table 2. Correlations Between Screen and Nonscreen Activities and Depressive Symptoms (8th and 10th Graders; MtF) and Suicide-Related Outcomes (9th–12th Graders; YRBSS), 2009–2015

	Bivariate *r*	Controlled for sex, race, SES, grade, and region	Controlled for sex, race, SES, grade, and region and in-person social interaction	Girls (controlled for race, SES, grade, and region)	Boys (controlled for race, SES, grade, and region)
MtF (correlations with depressive symptoms)					
Screen activities					
Social media use	.05*	.03*	.06*	.06*	.01
TV viewing	.04*	.02*	.03*	.03*	.02*
Internet news use	.00	.00	.01*	.01	−.02
Nonscreen activities					
In-person social interaction	−.07*	−.08*	−.09*	−.08*	−.09*
Religious services attendance	−.15*	−.14*	−.14*	−.16*	−.13*
Sports or exercise	−.22*	−.19*	−.18*	−.20*	−.19*
Homework hours	−.06*	−.05*	−.06*	−.06*	−.04*
Print media use	−.11*	−.10*	−.09*	−.12*	−.08*
Having a paid job	.00	.01	.02*	−.01	.02*
YRBSS (correlations with suicide-related outcomes)					
Screen activities					
Electronic device use	.12*	.13*	—	.14*	.12*
TV viewing	.03*	.02*	—	.02	.03*
Nonscreen activities					
Exercise	−.12*	−.08*	—	−.08*	−.08*

Note: Youth Risk Behavior Surveillance System (YRBSS) items are not controlled for SES, region, or in-person interaction as these factors were not reported in the dataset. Religious service attendance is not controlled for region as this item was not asked in California. In the third column, in-person social interaction is instead controlled for social media use. Monitoring the Future (MtF) survey analyses include only 8th and 10th graders because the depressive symptoms and social media items were not asked of the same participants on the 12th grade survey.
*$p < .001$.

social interaction, print media use, sports/exercise, and religious service attendance. Thus, the increases in new media screen activities and the decreases in nonscreen activities may explain why depression and suicide increased among U.S. adolescents since 2010: Teens have spent more time on activities associated with increased risk of mental health issues and less time on activities associated with decreased risk of mental health issues.

Economic factors and new media by year

Next, we considered whether economic factors might be possible mechanisms for the increase in mental health issues. The most data were available for depressive symptoms, which were collected every year since 1991. When matched by year, depressive symptoms (among 8th, 10th, and 12th graders) were not significantly correlated with any of the economic factors, including unemployment, $r(25) = -.12$, $p = .57$; Dow Jones Index change, $r(25) = .22$, $p = .30$; or the GINI index of income inequality, $r(25) = -.10$, $p = .64$. Suicide-related outcomes were negatively related to the unemployment rate, $r(9) = -.67$, $p = .05$, but were not significantly correlated with Dow Jones Index change, $r(9) = -.08$, $p = .84$, or the GINI index of income inequality, $r(9) = -.11$, $p = .79$. Suicide rates were not significantly correlated with unemployment, $r(17) = .15$, $p = .57$, or Dow Jones Index change, $r(17) = .08$, $p = .76$, but were significantly correlated with the GINI index of income inequality, $r(17) = .69$, $p = .002$. Thus, the mental health indicators were mostly unconnected to cyclical economic factors, although suicide-related outcomes were higher when unemployment was lower, in direct opposition to the idea that economic hardship might be connected to more mental health issues. In contrast, the indicators of poor mental health rose in tandem with smartphone adoption: for depressive symptoms, $r(9) = .87$, $p = .002$; for suicide-related outcomes, $r(5) = .78$, $p =. 12$; and for suicide rates, $r(9) = .97$, $p < .001$. The mental health indicators were also linked to mean frequency of social media use when matched by year: for depressive symptoms, $r(7) = .87$, $p = .01$; for suicide-related outcomes, $r(4) = .97$, $p = .03$; and for suicide rates, $r(7) = .96$, $p < .001$.

Discussion

After declining or staying stable for several decades, depressive symptoms, suicide-related outcomes, and suicide deaths became more prevalent among American adolescents between 2010 and 2015, especially among females. Thus, in these nationally representative samples, iGen adolescents reported experiencing more mental health issues than Millennial and GenX adolescents did at the same age, and more committed suicide. For the most part, the increases in mental health issues appeared across groups regardless of race/ethnicity, SES, region, and age/grade. Since 2010, adolescents spent more time on social media and electronic devices, activities positively correlated with depressive symptoms and suicide-related outcomes. Over the same years, adolescents spent less time on nonscreen activities such as in-person social interaction, print media, sports/exercise, and attending religious services, activities negatively correlated with depressive symptoms. If the rise in screen time caused the declines in nonscreen activities, new media screen time may be both directly and indirectly responsible for the increase in depressive symptoms and suicide-related outcomes. Thus, the rise in caseloads at high school and university counseling centers may be caused by greater numbers of iGen adolescents experiencing mental health issues, perhaps due to the profound shifts in how adolescents spend their leisure time. Thus, new media screen time should be understood as an important modern risk factor for depression and suicide.

The rise in depressive symptoms and suicide-related outcomes was exclusive to females. This suggests that screen time, perhaps especially social media, may have larger effects on adolescent girls' mental health than on boys' (and that is indeed what we found, with social media significantly correlated with depressive symptoms only among girls in some analyses and stronger correlations in others). The pattern for males, with increases in suicide deaths but not in depressive symptoms or suicide-related outcomes, suggests that boys' suicide deaths may be driven by other disorders and risk factors not assessed here (cf. Joiner, Buchman-Schmitt, & Chu, 2017).

Some have speculated that academic pressure and increased homework loads may be making students vulnerable to stress (Galloway et al., 2013; Neighmond, 2013) and thus at higher risk for developing mental health issues. However, adolescents who spent more time on homework had lower depressive symptoms, in effect ruling homework out as a possible direct cause. In addition, homework time declined slightly from 2012 through 2015, when depressive symptoms increased. Television watching was positively correlated with depressive symptoms and suicide-related outcomes but decreased since 2010 and thus is unlikely to be a current driving cause.

Indicators of economic recession (high unemployment and negative Dow Jones Index change) were not positively correlated with depressive symptoms, suicide-related outcomes, or suicide deaths when matched by year (in contrast to smartphone adoption and social media use, which were positively correlated with mental health indicators when matched by year). The only

significant correlation for economic factors went in the other direction, with higher suicide-related outcomes when unemployment was lower. This pattern likely occurred because these economic indicators bottomed out in 2007 through 2009 (the years of the Great Recession), whereas mental health issues did not begin to increase until after 2011, when the U.S. economy was improving. It is possible that economic hardship may have a delayed effect on adolescent mental health, in which effects do not appear until several years later. In this case, that would mean a delay of approximately 4 years (from 2008 to 2012) between the financial crisis and the increase in mental health issues among adolescents. It is possible that economic factors affect adults first and then take several years to affect adolescents. Perhaps future research will more precisely model delay times between these two variables and discover if they differ this much for adult versus adolescent populations. Finally, there is some evidence that income inequality is related to the rise in mental health issues, particularly suicide; this is consistent with previous research finding links between income inequality and lower happiness (Oishi et al., 2011).

The timing of the uptick in mental health issues, beginning around 2011–2012, is also worth noting. Smartphones were used by about half of Americans by late 2012. By 2015, 92% of teens and young adults owned a smartphone (Smith, 2017). Thus, smartphones were used by the majority of teens the year that depressive symptoms began to increase and by nearly all teens when depressive symptoms peaked. Another study found that major depressive episodes among teens ages 12 to 17 increased beginning in 2011 (Mojtabai et al., 2016). Although screen time was increasing and nonscreen activity time was decreasing for several years before 2011, the mental health effects of the shifts in adolescents' time use seems to have reached a tipping point around 2011–2012.

Screen time does not seem to displace in-person social interaction among individuals, likely due to individual differences in sociability. However, screen time does seem to have displaced in-person social interaction and other nonscreen activities on average over time, perhaps leading to the increase in mental health issues. Adolescents low in in-person social interaction and high in social media use reported the highest levels of depressive symptoms, suggesting this group is the most in need of intervention.

Of course, without experimental evidence, we cannot be certain that the increase in new media screen time is the cause of the increase in mental health issues after 2011. It is possible, for example, that mental health issues increased for some other unknown reason and depressed teens were more likely to spend time on screens. However, three previous studies provide evidence that screen time, particularly social media use, may cause depressed mood rather than vice versa, at least among adults. One study using a longitudinal daily diary method found that the more participants used Facebook, the more negative mood they later felt. In contrast, negative mood did not lead to more Facebook use (Kross et al., 2013). Second, an experiment randomly assigned adults to either continue their usual Facebook use or to give up Facebook use for a week. Those who gave up Facebook reported fewer depressive symptoms at the end of the week than those still using Facebook, suggesting that Facebook use causes higher depressive symptoms (Tromholt, 2016). A third study using three longitudinal assessments each a year apart found that Facebook use lowered psychological well-being among adults but in-person social interaction increased it (Shakya & Christakis, 2017). These studies suggest that at least some of the causal arrow points from social media use to mental health issues. In addition, a well-characterized and empirically validated treatment for depression involves the routinization of the nonscreen activities examined here (e.g., in-person social interaction, exercise, and attending of communal events like religious services; e.g., Cuijpers, van Straten, & Warmerdam, 2007).

The current study has other strengths and limitations worth noting. The use of nationally representative samples suggests that the results should generalize to the population of 13- to 18-year-olds in the United States. However, we cannot know if these trends are similar among adolescents in other countries. The measures of depressive symptoms and suicide-related outcomes are based on self-report and thus carry the usual limitations of that method. However, previous research suggests that changes in socially desirable responding do not explain trends in reports of mood disorder symptoms (Twenge et al., 2010). However, the measure of suicide-related outcomes may be subject to more underreporting, with nonresponders more likely to have suicide risk factors (Podlogar et al., 2016). That may be one reason why the rise in suicide-related outcomes was smaller than that for depressive symptoms. However, suicide death rates, which are not subject to reporting biases, showed roughly the same magnitude of change as depressive symptoms, suggesting that the rise is not due to reporting bias.

The time use items in these surveys also have limitations. First, they are retrospective, asking participants to reflect on past activities, rather than contemporaneous time-diary studies, the gold standard in time use research. Fortunately, comparisons of survey responses and experience sampling in the same individuals find that survey estimates are consistent with experience sampling results, especially for regularly occurring

activities (Sonnenberg, Bettina, Michaela, Cornelia, & Wagner, 2012). The social media item here is especially limited given its use of broad categories such as "almost every day," especially given that a sizable majority of adolescents now use social media every day. Nevertheless, it produces similar, though smaller, correlations than the electronic device item, which was instead asked in terms of hours per day. Finally, we do not know if adolescents who are depressed display more recall bias about their activities.

Another measurement-related limitation is that the syndromal coverage of the depressive symptoms measure used here was incomplete. Although symptoms like anhedonia and low self-esteem were assessed, other key symptoms such as insomnia and anergia were not. Insomnia and/or reduced sleep time may be of particular interest, as previous research has linked screen time to reduced sleep (Hysing et al., 2015) and short sleep duration is a risk factor for depression and suicide (Glozier et al., 2010; Zhai, Zhang, & Zhang, 2015). Future research should explore whether the increase in screen time has led to a decrease in total sleep time, which could in turn be at least partially responsible for the increases in mental health issues.

In conclusion, adolescent mental health issues rose sharply since 2010, especially among females. New media screen time is both associated with mental health issues and increased over this time period. Thus, it seems likely that the concomitant rise of screen time and adolescent depression and suicide is not coincidental.

Author Contributions

J. M. Twenge developed the study concept and study design. J. M. Twenge and G. E. Martin analyzed the data. T. E. Joiner and M. L. Rogers contributed to the interpretation of the findings. J. M. Twenge, T. E. Joiner, and M. L. Rogers drafted the manuscript. All the authors approved the final version of the manuscript for submission.

Declaration of Conflicting Interests

The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

Notes

1. The generations represented here include GenX (born approximately 1965–1979), Millennials (1980–1994), and iGen (1995–2012). The birth year cutoffs for generations are arbitrary and not necessarily scientific (Twenge, 2014, 2017), so we will use them only to discuss the results and not as groupings for analyses.

2. The databases here employ a time-lag design (samples of the same age during different years). This design eliminates age effects, but any differences can be due to either birth cohort (year of birth) or time period (year of the survey). A birth cohort effect impacts only those born at a certain time, but a time period effect impacts those of all ages (Campbell, Campbell, Siedor, & Twenge, 2015). We rely on the term birth cohort trends for the sake of brevity, but these effects could also be appearing among adults as well (a time period effect).

3. Of the nonscreen activities in MtF, sports/exercise had the second highest correlation with social media use, $r(110{,}603) = .11$, $p < .001$, and was also correlated with in-person social interaction, $r(120{,}227) = .24$, $p < .001$. A regression equation including social media use, in-person interaction, sports/exercise, and the demographic factors showed significant effects for all three activities on depressive symptoms: for social media use, $\beta = .07$, $p < .001$; for in-person social interaction, $\beta = -.05$, $p < .001$; and for sports/exercise, $\beta = -.19$, $p < .001$. Thus, among these three activities, sports/exercise was the strongest predictor of depressive symptoms. However, sports/exercise changed less between 2012 and 2015 ($d = -.07$) than in-person social interaction ($d = -.18$) or social media use ($d = .19$; see Table S1 in the Supplemental Material), suggesting shifts over the years in all three may have played a role in the increase in depressive symptoms.

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