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Objectively measured digital technology use during the COVID-19 pandemic: Impact on depression, anxiety, and suicidal ideation among young adults

A B S T R A C T

Background: Research suggests that the disruptions introduced by the COVID-19 pandemic have led to increased psychological distress and time spent on digital technology among young people, thus intensifying pre-pandemic concerns regarding the putative effects of digital technology use on mental health. To robustly examine whether increases in digital technology use are associated with increases in psychological distress during the pandemic it is crucial to (1) collect objective data on digital technology use and (2) account for potential confounding caused by pandemic-related stressors.

Methods: We conducted a four-wave panel study of U.S. young adults (N=384; $M_{age} = 24.5 \pm 5.1$; 57% female) from August-November of 2020. Participants provided screenshots of their iPhone "Screen Time" application and completed measures assessing current mental health status (depression, anxiety, and suicidal ideation) and pandemic-related impacts on well-being. We used random-intercept multilevel models to examine the within- and between-person associations between mental health, objective digital technology use, and pandemic-related stressors.

Results: Multilevel analyses revealed that none of the objectively-measured digital technology use variables were positively associated with depression, anxiety, or suicidal ideation at the within- or between-person levels. In contrast, pandemic-related impacts on mental health had by far the largest effects on depression, anxiety, and suicidal ideation.

Limitations: The convenience-based sample and use of single-item measures of pandemic-related impacts are limitations of the study.

Conclusions: Current speculations about the direct harms of digital technology use on mental health may be unfounded and risk diverting attention from a more likely cause: pandemic-related distress.

1. Introduction

Research indicates that stressors introduced by the COVID-19 pandemic have negatively impacted mental health, particularly among young people (Czeisler et al., 2020). Time spent on digital technology (e.g., social media, smartphones) has also increased (Samet, 2020) as schools, workplaces, and social gathering sites have closed, thus intensifying pre-pandemic concerns regarding the putative effects of digital technology use (DTU) on mental health.

Indeed, recent academic and newspaper articles have both directly and indirectly asserted that increased DTU is a source of the heightened psychological distress observed during the pandemic (Browning et al., 2021; Passavanti et al., 2021; Richtel, 2021; Smith et al., 2020).

However, these claims are dubious for two primary reasons. First, these articles rely on self-report measures of DTU, which are inaccurate and prone to systematic bias (Sewall et al., 2020). Second, since the pandemic has impacted both mental health and DTU for many, the observed association between the two may be attributable to a shared common cause, rather than causality. Thus, we investigated the longitudinal associations between objectively measured DTU and mental health while accounting for important pandemic-related effects.

2. Methods

We performed a four-wave online panel study of U.S. residents aged 18-35 years through Prolific, an online survey organization. Data were collected from August—November of 2020, with waves spaced one month apart. To obtain objective DTU data, participants uploaded screenshots of their "Screen Time" application (which passively tracks device usage) at each wave. We manually extracted three elements from the screenshots: (1) past week total Screen Time, (2) past week total time spent on social media, and (3) past week total number of pickups (i.e., opening or unlocking the device). We used Patient-Reported Outcomes Measurement Information System (PROMIS®) six-item adult short-form instruments to measure depressive and anxiety severity, respectively (Pilkonis et al., 2011). We used item nine from the Patient Health Questionnaire (Kroenke et al., 2001) to measure suicidal ideation (SI), which was dichotomized into presence/absence of SI for the statistical analyses. To assess the impacts of the pandemic on well-being, at each wave participants reported whether they experienced ten different pandemic-related stressors (e.g., "lost job or income," "conflict with people I'm living with") and how the pandemic impacted various aspects of their well-being (i.e., mental health, sleep quality, physical activity, and alcohol consumption) over the past month. The ten pandemic-related stressor items were summed to create a per participant per wave sum score. To assess the impacts of the pandemic on DTU, participants reported how much their iPhone use and laptop/desktop use increased/decreased as a result of the pandemic. This study was approved by the University of Pittsburgh ethics board.

We estimated separate random-intercept multilevel models for each mental health outcome (depression, anxiety, and SI) using Mplus version 8. To identify how variable groups explained outcome variance at the within-person and between-person levels, models were estimated in a hierarchical manner in the following sequence: 1.) Unconditional model, 2.) Demographic variables, 3.) Objective DTU variables, 4.) pandemic-related stressor variables, 5.) pandemic-related impact on

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well-being variables, and 6.) pandemic-related impact on DTU variables. See online Supplement (https://osf.io/y3pvf/) for additional methodological details.

3. Results

A total of 384 young adults participated in this study (Mage = 24.5 ± 5.1; 57% female; 54% white; 48% Bachelor's degree education or above). Overall, participants averaged 47.5 hours of Screen Time, 677 pickups, and 15.5 hours of social media over the past week. On average, participants reported experiencing between 4-5 pandemic-related stressors per wave. Mean depression and anxiety T-scores were 54.6 and 56.7, respectively, and nearly 29% of participants reported past-week SI at least once—indicating that this sample had higher than average rates of psychological distress.

Results of the multilevel analyses (see Fig. 1) revealed that none of the objectively-measured DTU variables were positively associated with depression, anxiety, or SI at the within- or between-person levels. Within-person effects for the DTU variables on depression (screen time b = -0.006, 95% CI: [-0.03, 0.02]; social media b = 0.009, 95% CI: [-0.05, 0.07]; pickups b = -0.075, 95% CI: [-0.24, 0.09]), anxiety (screen time b = -0.019, 95% CI: [-0.04, 0.01]; social media b = 0.047, 95% CI: [-0.02, 0.11]; pickups b = 0.078, 95% CI: [-0.09, 0.24]), and SI (screen time b = 0.007, 95% CI: [-0.01, 0.02], social media b = -0.022, 95% CI: [-0.06, 0.02], pickups b = 0.084, 95% CI: [-0.03, 0.21]) were small and non-significant. Between-person effects for screen time and social media on depression (screen time b = 0.018, 95% CI: [-0.03, 0.06]; social media b = -0.008, 95% CI: [-0.09, 0.07]), anxiety (screen time b = 0.029, 95% CI: [-0.01, 0.07]; social media b = -0.017, 95% CI: [-0.09, 0.06]); and SI (screen time b = 0.01, 95% CI: [-0.02, 0.04], social media b = -0.007, 95% CI: [-0.07, 0.05]) were also small and non-significant, but pickups was *negatively* associated with depression (b = -0.326, 95% CI: [-0.60, -0.05]) and anxiety (b = -0.240, 95% CI: [-0.46, -0.02]) and unrelated to SI (b = -0.109, 95% CI: [-0.28, 0.05]). Together, the objective DTU variables explained, at most, 2.8% of the within- or between-person variance in any of the mental health outcomes (see eTable 3 of online Supplement for detailed results).

In contrast, pandemic-related impacts on mental health had by far the largest within- and between-person effects on depression (within b = 0.651, 95% CI: [0.46, 0.85]; between b = 2.715, 95% CI: [2.26, 3.17]), anxiety (within b = 0.605, 95% CI: [0.34, 0.87]; between b = 2.840, 95% CI: [2.26, 3.42]), and SI (within b = 0.284, 95% CI: [0.16, 0.45]; between b = 0.698, 95% CI: [0.46, 1.02]). Together, the pandemic-related impacts on well-being predictors accounted for about 9%/45% of the within-/between-person variance in depression and anxiety, and 21%/28% of the within-/between-person variance in SI.

4. Discussion

In summary, among a sample of young adults—a population with high rates of DTU (Vogels, 2019) and COVID-19-related distress (Czeisler et al., 2020)—we found that objectively-measured DTU did not contribute to increases in depression, anxiety, or SI—refuting the popular notion that increases in DTU may be contributing to young peoples' psychological distress during the pandemic. Rather, depression, anxiety, and SI were driven mostly by pandemic-related impacts on well-being. The convenience-based sample, retrospective (past week) assessments of mental health outcomes, and single-item measures of COVID-19-related impacts are limitations of the study. Nevertheless, results indicate that current speculations about the direct harms of DTU on mental health may be unfounded and risk diverting attention from a more likely cause: pandemic-related distress.

Author statement

Craig J.R. Sewall: Conceptualization (lead), methodology, formal

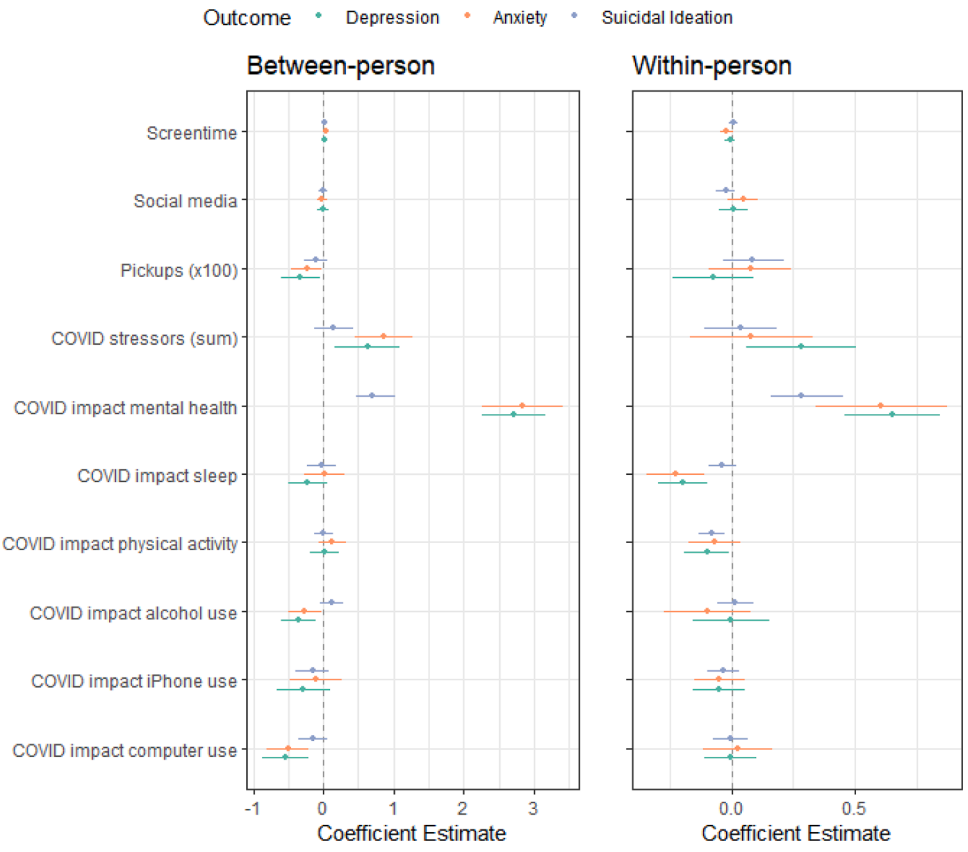

Fig. 1. Coefficient plots for fully adjusted within- and between-person models.
Note: Circles and lines are point estimates and 95% confidence intervals, respectively. For the suicidal ideation results, which were computed using Bayesian estimation, point estimates are the median of the posterior distribution and lines are 95% credibility intervals. Coefficients are unstandardized. Also included in the models (not shown) were demographic control variables gender, race/ethnicity, and education.

analysis, investigation, data curation, writing—original draft preparation, writing—review & editing, visualization.

Tina R. Goldstein: Conceptualization, supervision, writing—review & editing.

Daniel Rosen: Conceptualization, supervision, writing—review & editing.

Declaration of Competing Interest

Craig J.R. Sewall and Daniel Rosen have no conflicts of interest or financial disclosures to report. Tina R. Goldstein has received research support from NIMH, the American Foundation for Suicide Prevention (AFSP), the University of Pittsburgh Clinical and Translational Science Institute, and The Brain and Behavior Foundation, as well as royalties from Guilford Press.

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