


Brief Report

COVID-19 Pandemic and the Burden of Internet Addiction in the United States

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Abstract: Despite the extensive usage of the internet, little is known about internet addiction among Americans during the pandemic. A valid and reliable questionnaire was deployed online via MTurk to recruit a national sample of adult Americans to understand the nature and extent of internet addiction. A total of 1305 individuals participated in the study where the majority were males (64%), whites (78%), non-Hispanic (70%), married (72%), 18–35 years old (57%), employed full time (86%), and with a Bachelor's degree or higher (83%). The prevalence of internet addiction was distributed as no addiction (45%), probable addiction or risk of addiction (41%), and definite or severe addiction (14%). More than a fourth of the population had depression (28%) or anxiety (25%). Despite adjusting for sociodemographic characteristics, definite/severe internet addiction was strongly predictive of depression, anxiety, and psychological distress in multiple regression analyses. Those who were probably addicted or at risk of addiction were also more likely to have depression or anxiety. Compared to estimates before the pandemic, this study suggests an increase in internet addiction among U.S. adults during the COVID-19 pandemic. Population-based interventions and mental health promotion strategies should focus on a reduction in internet consumption and screen time.



Citation: Khubchandani, J.; Sharma, S.; Price, J.H. COVID-19 Pandemic and the Burden of Internet Addiction in the United States. *Psychiatry Int.* **2021**, *2*, 402–409. <https://doi.org/10.3390/psychiatryint2040031>

Academic Editor: Antonio Narzisi

Received: 1 September 2021

Accepted: 2 November 2021

Published: 4 November 2021

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Keywords: addiction; internet; depression; anxiety; psychiatry; behavior; COVID-19

1. Introduction

COVID-19 pandemic disrupted lives, societies, and economies around the world. For many people worldwide, 2020 was defined by widespread lockdowns and shutdown of business and services, social distancing and loneliness, isolation and quarantine, fear and financial instability, social and political upheaval, and loss of family members or friends due to COVID-19 [1–3]. A large number of studies show varying degrees of psychological distress and neuropsychiatric problems in individuals as the detrimental consequences of these events [1–6]. However, certain groups of individuals experienced lower levels of stress and reported a greater sense of wellbeing. These findings could be attributed to a variety of factors such as greater control over life, flexible working conditions, time spent with family, social support, and above all, resilience [4–6]. A study of 15,970 European adults earlier in the pandemic explored resilience and found that good stress response and positive appraisal, specifically of the consequences of the COVID-19 crisis, were strong predictors of good mental health and other psychosocial factors [4]. For many others, however, stress and associated maladaptive coping during the pandemic resulted in various health risk behaviors (e.g., unhealthy diet, sedentary behaviors, alcohol consumption, drug use, sleep problems, excessive media and technology use, etc.) [1–8].

In the 21st century, technology and the internet have been implicated in many maladaptive coping patterns or unhealthy responses to stressors. For example, many investigators have explored internet overuse, online gaming, virtual gambling, social media addiction, electronic device use disorder, binge-watching, and excessive screen time during

the COVID-19 pandemic [9–12]. In many of these studies, primarily conducted in Asia and Europe [2,12], such behaviors were linked to poor physical or mental health. Similar to other parts of the world, millions of Americans were forced to stay home and use technology for professional and personal needs and use the internet for household chores, leisure, to avoid boredom, or to communicate with others [10,11,13,14]. However, little is known about the nature and the extent of internet addiction and the dependence on the online environment in the United States (U.S.) during the pandemic. In this study, we report on a systematic assessment of internet addiction prevalence and impact on adult Americans during the pandemic. A national study was conducted to assess the extent of internet addiction within the past year, and the impact of such addiction was explored by testing the relationship between internet addiction, and depression and anxiety or both.

2. Methods

A multi-item valid and reliable questionnaire was deployed via Amazon Mechanical Turk (MTurk) in May 2021 across the U.S. after approval from the Institutional Review Board. This panel of internet users (i.e., members of Amazon MTurk) has been used extensively for studies during and before the pandemic to assess a variety of health-related perceptions and behaviors [1,6,7,10]. After reading an informed consent form, the individuals who agreed to take the survey were provided with a monetary incentive to participate in the study. Individuals who were 18 years of age or older, could read English at a 6th-grade level or higher, and those who resided in the U.S. were eligible to participate in the study. Participants were assured of anonymity and could withdraw from the study at any point in time while taking the survey.

Survey validity was established by a variety of strategies [1,5–7,10,15]. First, we conducted a comprehensive review of the literature and created the draft survey using items from existing scales and studies (i.e., to establish face validity). Subsequently, a panel of experts ($n = 3$) was asked to review the final questionnaire to establish content validity. The panel of experts suggested changes that were made after discussion among authors. The two core study measures were psychological distress and internet addiction. To estimate psychological distress in the study population, the highly valid and reliable Patient Health Questionnaire-4 (PHQ-4) was used to assess clinical levels of depression (PHQ-2), anxiety (GAD-2), and severe psychological distress (i.e., symptoms of both depression and anxiety) [1,10,15]. In addition, several internet use scales were reviewed to create an internet addiction scale for this study (e.g., Pathological Internet Use scale and Compulsive Internet Use scale) [16–18]. The final 9-item Internet Addiction Scale assessed internet usage-related behaviors during the past year (i.e., specifically during the pandemic) (Table 1). Individuals could score from 9 to 45 on this scale, with higher scores indicating greater addiction. While studies suggest a score of 22 as the cutoff for problematic internet use, such low scores may not be clinically relevant to detect true addiction [16–18]. Therefore, we designed three groups from the final pool of respondents: not addicted (score = 9–21), probably addicted or at risk of addiction (score = 22–30), and those who had definite or severe addiction (score = 31–45). To assess the reliability of the study scales, Cronbach alphas were computed for the PHQ-4 and Internet Addiction Scale from the final sample of respondents in this study, and the internal consistency reliability was found to be high for these two scales used for the study ($\alpha = 0.81$ and 0.90 , respectively) [1,10,15–18]. The final section of the survey asked participants about their sociodemographic information.

Table 1. Distribution of Responses to Internet Addiction Questions Among Study Participants (N = 1305).

During the Pandemic or in the Last Year(March 2020–April 2021)	Once a Month or Less (Score 1)	Few Times Every Month (Score 2)	Once Every Week (Score 3)	Some Days Every Week (Score 4)	Every Day Last Year (Score 5)	Mean Sample Score (\pm S.E)
	N (%)	N (%)	N (%)	N (%)	N (%)	
I used internet devices longer than I planned to.	260 (20)	404 (31)	344 (26)	202 (16)	95 (7)	2.60 (0.33)
I routinely cut short my sleep to spend more time online.	280 (22)	416 (32)	302 (23)	205 (18)	102 (8)	2.56 (0.04)
I felt restless, tensed, frustrated, or irritated when I could not use the internet or use it as long as I wanted	319 (24)	332 (25)	341 (26)	255 (20)	58 (5)	2.54 (0.33)
I neglected household chores/work to spend more time online	311 (24)	389 (30)	345 (27)	194 (15)	66 (5)	2.48 (0.32)
I tried to spend less time online but was not able to do so	344 (26)	362 (28)	325 (25)	196 (15)	78 (6)	2.47 (0.34)
I felt depressed, moody, or nervous when I was not on the internet and these feelings stopped once I was back online?	348 (27)	365 (28.5)	349 (27)	183 (14)	183 (5)	2.42 (0.32)
I was told that I spent too much time online by people in the family/household	386 (30)	351 (27)	310 (24)	177 (14)	81 (6)	2.40 (0.34)
I tried to conceal/hide the amount of time spent online	386 (30)	356 (27)	304 (23)	201 (15)	58 (5)	2.38 (0.32)
I got into arguments with a significant other or family member over being online	413 (32)	325 (25)	331 (25)	176 (14)	60 (5)	2.35 (0.32)

N (%) indicates the number of participants in each response category and percentages. Mean populations scores for each question are arranged in descending order. Response options range from once a month or less (score = 1) to every day (score = 5), with higher scores indicating greater addiction. Total scale score range = 9–45.

Data were analyzed using SPSS 24. First, we computed descriptive statistics (i.e., frequencies, percentages, and mean scores) to describe the study population based on sociodemographic characteristics and understand the distribution of responses to the internet addiction questions (Tables 1 and 2). Next, a series of Chi-square tests were conducted to assess group differences in categories of internet addiction based on sociodemographic characteristics (Table 2). Finally, logistic regression analyses were conducted to explore the relationship between internet addiction and psychological distress. Depression, anxiety, or symptoms of both, were the outcome variables while internet addiction was treated as the predictor variable (with the ‘no addiction’ category considered as a reference or comparison group versus ‘probable’ and ‘definite’ addiction). Odds ratios (OR with 95% confidence intervals) were computed for the probability of psychological distress based on the internet addiction category (Table 3). Statistical significance was assumed at an alpha level of $p < 0.05$.

Table 2. Demographic Characteristics, Internet Addiction, and Psychological Distress.

Variable	Total Sample N (%)	No Addiction (Score = 9–21) N (%)	Probable Addiction (Score = 22–30) N (%)	Definite Addiction (Score = 31–45) N (%)	<i>p</i> Value
All Participants	1305 (100)	589 (45)	539 (41)	177 (14)	
Sex					0.18
Male	840 (64)	364 (43)	356 (42)	120 (15)	
Female	465 (36)	225 (48)	183 (39)	57 (13)	
Age Group					0.006
18–25 years	164 (13)	62 (38)	78 (48)	24 (14)	
26–35 years	570 (44)	251 (44)	232 (41)	87 (15)	
36–45 years	269 (21)	112 (42)	120 (45)	37 (13)	
46–60 years	221 (17)	113 (51)	87 (39)	21 (10)	
≥61 years	79 (6)	50 (63)	22 (28)	7 (9)	
Race					0.001
White	1021 (78)	439 (43)	449 (44)	133 (13)	
African-Americans	158 (12)	84 (53)	56 (35)	18 (11)	
Asian	86 (7)	40 (47)	26 (30)	20 (23)	
Other	40 (3)	26 (65)	8 (20)	6 (15)	
Ethnicity					<0.001
Hispanic	386 (30)	138 (36)	173 (45)	75 (19)	
Non-Hispanic	919 (70)	451 (49)	366 (40)	102 (11)	
Marital Status					<0.001
Single/never married	277 (21)	159 (57)	86 (31)	32 (12)	
Married	944 (72)	375 (40)	432 (45)	137 (15)	
Engaged/living with a partner	41 (3)	26 (64)	12 (29)	3 (7)	
Divorced/separated/widow	43 (3)	29 (67)	9 (21)	5 (12)	
Education					<0.001
<College degree	219 (17)	143 (65)	61 (28)	15 (7)	
Bachelor's degree	818 (63)	332 (41)	376 (46)	110 (13)	
≥Master's degree	268 (20)	114 (43)	102 (38)	52 (19)	
Current Employment Status					<0.001
Full-time	1124 (86)	479 (43)	484 (43)	161 (14)	
Part-time	110 (8)	57 (52)	44 (40)	9 (8)	
Not employed	71 (5)	53 (75)	11 (16)	7 (9)	
Area of Residence					<0.001
Rural	394 (30)	162 (41)	182 (46)	50 (13)	
Urban	649 (50)	265 (41)	278 (43)	106 (16)	
Suburban	262 (20)	162 (62)	79 (30)	21 (8)	
Depression (PHQ-2)					<0.001
No	940 (72)	498 (53)	377 (40)	65 (7)	
Yes	365 (28)	91 (25)	162 (44)	112 (31)	
Anxiety (GAD-2)					<0.001
No	976 (75)	503 (52)	404 (41)	69 (7)	
Yes	329 (25)	86 (26)	135 (41)	108 (33)	
Severe Psychological Distress (PHQ-4)					<0.001
No	1149 (88)	549 (48)	506 (44)	94 (8)	
Yes	156 (12)	40 (26)	33 (21)	83 (53)	

N (%) indicates the number of participants in each response category and percentages. *p*-value indicates statistical significance for group differences in Chi-square tests.

Table 3. Regression Analyses to Predict Psychological Distress Based on Internet Addiction Group.

Outcome	No Addiction Reference	Probable Addiction		Definite Addiction	
		Model 1 OR (95%CI)	Model 2 AOR (95%CI)	Model 1 OR (95%CI)	Model 2 AOR (95%CI)
Depression	1	2.35 (1.76–3.15) *	2.39 (1.77–3.23) *	9.43 (6.45–13.76) *	9.75 (6.58–14.45) *
Anxiety	1	1.96 (1.45–2.64) *	1.91 (1.40–2.60) *	9.16 (6.27–13.37) *	9.27 (6.25–13.72) *
Severe Psychological Distress (both anx & dep)	1	0.65 (0.90–1.44)	0.94 (0.57–1.53)	12.12 (7.84–18.75) *	13.54 (8.48–18.90) *

* indicates $p < 0.05$. OR = odds ratios, AOR = adjusted odds ratios, 95%CI = confidence intervals. The binary outcomes were depression, anxiety, and severe psychological distress (yes vs. no). The predictor variable was internet addiction (groups= no addiction, probable addiction, definite addiction). No addiction group served as the reference group for comparison with probable and definite addiction groups for risk of psychological distress. Model 1 shows unadjusted regression analysis to predict psychological outcomes based on the internet addiction category via odds ratios and 95% confidence intervals (OR, 95%CI). Model 2 shows multiple regression analysis to predict psychological outcomes associated with various internet addiction categories after adjusting for all the sociodemographic characteristics from Table 2 (AOR = adjusted odds ratios and 95%CI).

3. Results

A total of 1305 individuals participated in the study. The three internet addiction statements that received the highest agreement and scores from the study participants were: 'I used internet devices longer than I planned to'; 'I routinely cut short my sleep to spend more time online'; and 'I felt restless, tensed, frustrated, or irritated when I could not use the internet or use it as long as I wanted' (Table 1). The majority of the study participants were males (64%), whites (78%), non-Hispanic (70%), married (72%), 18–35 years old (57%), employed full time (86%), and with a Bachelor's degree or higher (83%). The prevalence of depression, anxiety, and severe psychological distress as assessed by the PHQ-4 were: 28%, 25%, and 12%, respectively (Table 2). For internet addiction, the responses were distributed as: no addiction = 589 adults (45%), probable addiction or risk of addiction = 539 adults (41%), and definite or severe addiction = 177 adults (14%). Those who had definite/severe internet addiction were significantly more likely to be Asians (23%), Hispanics (19%), married individuals (15%), those 26–35 years of age (15%), urban dwellers (16%), and employed full-time (14%). Definite internet addiction was significantly higher in those with depression (31%), anxiety (53%), or severe psychological distress (53%), compared with those who did not have these negative psychological outcomes (Table 2).

Logistic regression analyses were conducted to assess the association between psychological outcomes and various levels of internet addiction (with 'no addiction' serving as a comparison group) (Table 3). In unadjusted analysis (model 1), probable addiction was associated with depression and anxiety but not severe psychological distress. However, definite addiction was associated with depression, anxiety, and psychological distress. Despite adjusting for all the sociodemographic characteristics (model 2), those with probable addiction had statistically significantly higher adjusted odds of depression (AOR = 2.39) and anxiety (AOR = 1.91). Those with definite addiction had the highest probability of depression (AOR = 9.57), anxiety (AOR = 9.27), and severe psychological distress (AOR = 13.54) (Table 2, AOR indicates adjusted odds ratios).

4. Discussion

At the anniversary of the pandemic, to our knowledge, this is the largest and first study in the U.S., identifying groups with higher levels of internet addiction (urban, college-educated, employed, married, and 18–35-year-olds). Furthermore, to ensure concurrent validity, we also used the PHQ-4 scale to assess the psychological impact of internet addiction. Media reports with comparatively smaller samples have shown that during the pandemic, screen time usage increased for more than half of the U.S. adults; and more than a third reported attending more work-related meetings, were working longer hours remotely, experienced mental exhaustion from video calls, or felt exhausted and stressed

after continuous virtual interactions [11,13,14]. Beyond work, Americans also consumed excessive social and mass media, used internet devices for entertainment and daily needs, gathered COVID-19 information using technology and media, and communicated more via the internet during the pandemic [10,11,13,14,19]. In this study, the internet addiction statement that received the highest agreement score from the participants was 'I used internet devices longer than I planned to' (Table 1). As a result, despite our rigorous scoring methods for internet addiction, this study shows that more than a tenth of adult Americans (14%) have definite or severe internet addiction. Few national studies estimated the prevalence of internet addiction in the U.S. before the pandemic. These studies suggested that before the pandemic, the prevalence of internet addiction in the U.S. could be in the range of 1–10% (with one major review indicating that the national average rate of internet addiction was 8%) [16,20,21]. This would suggest that the pandemic led to an increase in the burden of internet addiction among U.S. adults. The media and public polls provide further credibility to our assumption of an increase in internet addiction [11,13,14,19]. For example, a Harris NortonLifeLock Poll of 1000 U.S. adults found that over one-half (53%) of the participants had a significant increase in the amount of time spent in front of a screen outside of school/work. The majority (66%) admitted they were spending way too much time looking at screens, while almost one-fifth (21%) believed that this had negatively impacted their mental health during the pandemic [19]. While these reports support our study results indicating an increase in internet addiction, such polls/reports did not systematically and specifically assess the national burden of internet addiction during the pandemic by using previously validated and reliable measures (e.g., screen time could also include watching TV) [11,13,14,19]. Furthermore, the psychological impact of internet addiction was also not measured systematically in such polls and reports.

This study found that internet addiction was associated with anxiety, depression, or symptoms of both (i.e., psychological distress), measured by clinical screening tools (i.e., PHQ-4). As noted earlier, while the polls across the nation report the negative mental health impact of both the pandemic and screen time usage, we tested these relationships comprehensively. For example, to assess the impact of internet addiction during the pandemic, we adjusted our analyses for multiple sociodemographic factors that are known to be associated with poor mental health. Earlier nationwide studies have found that more than a quarter of Americans may have anxiety and depression symptoms [1,10,13,19]. Another recent study of adults in the U.S. suggested that greater media and information consumption related to COVID-19 was associated with depression and anxiety symptoms (but this could also be TV or radio news related to COVID-19) [10]. Our study specifically delineated the psychological impact of excessive internet usage during the past year and across multiple levels of internet addiction. Compared with those who did not have an internet addiction, those who had probable addiction were more likely to have depression (2.39 times) and anxiety symptoms (1.91 times). However, individuals with probable addiction were not more likely to have both depression and anxiety. In contrast, compared with those without internet addiction, individuals who had definite or severe addiction were significantly more likely to have depression (9.75 times), anxiety (9.27 times), or both (13.54 times), indicating a graded psychological impact of internet addiction (i.e., higher severity of internet addiction associated with higher symptom burden of anxiety, depression, or both anxiety and depression).

Given the results of this study and the previous research, a few strategies to combat severe internet addiction and its psychological impact during the pandemic are: setting boundaries between work and home life, spending time with family members, establishing a healthy routine, being conscious of and regulating technology use, reducing the duration and frequency of internet consumption, limiting social and mass media information uptake, having pre-scheduled technology-free periods or activities, avoiding emotional states such as boredom and loneliness, working mindfully and avoiding multitasking, finding balance and practicing healthy coping techniques for stress, learning and using relaxation and mindfulness techniques, limiting ownership and purchase of gadgets, and

improvement in lifestyle behaviors such as sleep hygiene, eating healthy, and exercise routines [1,2,4–7,9,10,12,16]. However, given the emerging mental health crisis associated with pandemic-related stressors, internet addiction, and excessive media consumption, clinical care and behavioral health services should be sought with urgency by those individuals experiencing coping problems or serious psychological distress.

5. Conclusions

The results of this study should be considered in light of their potential limitations. The validity of our findings must account for the constraints traditionally associated with survey study designs (e.g., reliance on self-reported behaviors, recall bias in participants, and the inability to establish cause-and-effect relationships) [1,5–7,10,15]. Another threat to the external validity of our study is the sample selection limited to those with access to the internet and some understanding of the online survey environment. Furthermore, a sizable proportion of the study population had a college education and worked full-time. This in turn could have influenced internet usage in study participants. Despite these limitations, this study is one of the earliest and largest nationwide assessments to explore the burden of internet addiction among U.S. adults during the pandemic (14% of adults with definite/severe addiction indicating a potential increase in internet addiction compared with rates before the pandemic) [16,20,21]. Also, we used conservative estimates and high cutoff scores to classify individuals with definite or severe addiction, the actual burden of severe addiction could be higher. Furthermore, in assessing the relationships between internet addiction and psychological outcomes, we adjusted for multiple sociodemographic factors. Still, we found that with an increase in internet addiction scores, there is a higher probability of depression, anxiety, or both depression and anxiety. Finally, our novel approach to the categorization of internet addiction (i.e., no addiction, probable addiction, and definite addiction) adds a unique dimension to the efforts to understand the burden and graded impact of internet addiction and identify the groups at risk. Additional and prospective studies are needed to understand the long-term impact of internet addiction not only as it relates to poor mental health but also concerning other health problems based on varying degrees of internet overuse and addiction. While some experts have questioned whether the excessive usage of the internet and social media are a pandemic coping mechanism or a psychological necessity [2,9,12,13], we believe that the complex psychological and neurobiological basis of internet addiction warrants that population mental health promotion strategies during and after the pandemic should emphasize on the reduction of internet and technology use.

Author Contributions: Conceptualization, J.K., S.S. and J.H.P.; data collection, J.K. and S.S.; data analysis, J.K.; writing—original draft preparation, S.S. and J.K.; writing—review and editing, S.S. and J.H.P. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Institutional Review Board at Ball State University, USA.

Informed Consent Statement: Informed consent was ascertained if the participants read the consent forms online and agreed to take the survey. Participants could not be identified by the investigators.

Data Availability Statement: Data will be provided to interested individuals upon requests made to investigators along with a statement of purpose sent to the corresponding author.

Conflicts of Interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this paper.

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