Nature-Nurture Journal of Psychology (2025)
Volume 4, Issue 2 (NNJP 4:2, 2025)
DOI: 10.53107/nnjp.v4i2.84

RESEARCH ARTICLE Open Access

The Impact of Working Memory on Psychosocial Functioning among Adolescents during COVID-19: Exploring the Mediating Role of Internet Addiction

Sunaina Majeed and Dr. Tamkeen Ashraf Malik

Abstract

Background: The COVID-19 pandemic led to increased internet use among adolescents, raising concerns about its relationship with cognitive functions, such as working memory, and psychosocial functioning. The interactions between these factors, especially in the context of pandemic-related stressors, remain underexplored. This study examined the relationships among internet addiction, working memory, and psychosocial functioning among adolescents during the COVID-19 pandemic. Additionally, it explored the mediating role of internet addiction and the influence of working memory on psychosocial functioning.

Method: This study employed a purposive sampling technique and a cross-sectional research design to recruit a sample of 100 adolescents (56 males and 44 females), aged 11 to 19 years, from various public and private educational institutions in Islamabad and Rawalpindi, Pakistan. Data collection was carried out during the second wave of the COVID-19 pandemic. Data was collected using the Compulsive Internet Use Scale (CIUS), the Pediatric Symptom Checklist-Youth self-report (PSC-Y), and the Corsi Block-Tapping Test (CBTT), adapted into Urdu following WHO guidelines.

Results: Preliminary analyses using chi-square tests revealed significant associations between psychosocial functioning and factors such as working memory, internet addiction, COVID-19 status, relationship with a COVID-19-positive individual, distance learning, internet usage duration, and maternal occupation. Binary logistic regression identified internet addiction, prolonged internet use (5–6 hours), and recovered COVID-19 status as significant predictors of psychosocial functioning. MANOVA indicated a significant multivariate effect of working memory on psychosocial functioning and internet addiction (Pillai's Trace = 0.16, $p < 0.001$), with 16% of the variance explained. Mediation analysis demonstrated that internet addiction partially mediated the relationship between working memory and psychosocial functioning (B = −1.80, 95% CI [−2.76, −1.08]), suggesting that poor working memory contributed to psychosocial difficulties via increased internet addiction.

Conclusions: This study underscores the impact of working memory deficits on increased internet addiction and impaired psychosocial functioning in adolescents during the COVID-19 pandemic. Targeted interventions are needed to reduce internet addiction, enhance cognitive health, and address pandemic-related stressors. These findings provide insights for improving adolescent mental well-being in the digital era.

Keywords: Working memory, internet addiction**,** psychosocial functioning, internet use, adolescents, covid-19, pandemic, mental health.

1. Lecturer, Department of Applied Psychology, Riphah International University, Islamabad, Pakistan
2. Associate Professor: Department of Behavioral Sciences, National University of Science and Technology, Islamabad, Pakistan

Correspondence concerning this article should be addressed to Sunaina Majeed, Department of Psychology, Department of Applied Psychology, Riphah International University, Islamabad, Pakistan. *Email:* sunainamajeed95@gmail.com.

Background

COVID-19, also known as coronavirus, is a highly contagious infection characterized by rapid transmission, high infectivity, susceptibility across all age groups, and significant public health impact (Klinenberg & Leigh, 2024). The latest pandemic followed by the lockdown measures has significantly disturbed normal activities throughout the globe and led to significant risks to people's physical and psychological well-being (Wolf & Schmitz, 2024). COVID-19 is an acute respiratory syndrome whose very first case was diagnosed in December 2019 in Wuhan, China. Some of the individuals were admitted to healthcare facilities where they were assigned a tentative diagnosis of pneumonia. It was contended that the etiology of their infection was associated with the seafood in the city of Wuhan. By the end of January 2020, approximately 571 reported cases of COVID-19 occurred in 25 different provinces of China. Public Health Emergency of International Concern (PHEIC) was declared by the World Health Organization (WHO) on January 30, 2020, because of the drastic spread of COVID-19 to many other countries contributing to 7818 cases worldwide. On March 11, 2020, after approximately 118,000 confirmed worldwide cases and more than 4200 deaths, WHO declared the viral infection a global pandemic (WHO, 2024).

As the COVID-19 vaccine was still under development at the onset of the pandemic, over 100 countries were compelled to implement partial or full lockdowns as preventive measures (Klinenberg & Leigh, 2024). Approximately 3 weeks after the very 1st reported case of COVID-19, China, the epicenter of the outbreak, enforced a partial lockdown that continued till the 2nd week of March 2020 (WHO, 2024). The first few cases were reported in Iran by the end of February 2020. On account of the escalating number of COVID-19 cases, Iran implemented a complete lockdown at the beginning of March 2020 (WHO, 2024). Other countries, including Saudi Arabia, Kuwait, Turkey, and India, enforced extensive lockdowns. Europe reported a large number of COVID-19 cases and it was the 2nd most affected region to be devastated by the viral infection after China (WHO, 2024). Italy and Spain suffered massively during the early periods of the pandemic with more than 224,350 and 219,070 COVID-19 cases respectively (WHO, 2024). Both countries implemented partial lockdowns at the beginning; however, they shifted to more restraining lockdowns that helped reduce the reported cases of COVID-19 (Yee et al., 2024). On February 26, 2020, the first two cases were reported in Pakistan that were diagnosed with COVID-19. By the next two weeks, the cases escalated to 20. By March 23, 2020, cases surged to 892 with 6 causalities. The government decided to take precautionary measures of social distancing as well as lockdown. On March 24, 2020, the lockdown was rendered obligatory throughout the country and lasted for months. The major reasons for the initial cases of COVID-19 in the country were the pilgrims that came back from Iran at Raiwind, Lahore (Noreen et al., 2024). While the preventive measures were critical for public health, they disrupted daily life and had far-reaching implications, particularly for adolescents.

Adolescence is a developmental stage marked by heightened vulnerability to psychosocial difficulties and mental health problems (Chen & Fan, 2024). Psychosocial functioning, defined as the ability to perform daily activities and maintain satisfying interpersonal relationships, was profoundly affected during the pandemic (Zhang et al., 2022). Far-reaching public health arrangements including the closing of schools, colleges, and universities during COVID-19 and social distancing led to negative effects on the psychosocial functioning of adolescents, increasing the global burden of disease (Riany & Morawska, 2023). Recent research studies indicated that adolescents have experienced increased psychosocial problems during the COVID-19 pandemic (Foulkes & Blakemore, 2021; Hussong et al., 2021; Pfefferbaum, 2021). A systematic review of 69 studies by Wolf & Schmitz (2024) revealed a clear pattern of declining psychosocial functioning and an increase in mental health challenges, including heightened stress, anxiety, problematic internet use, and depression among adolescents during the COVID-19 pandemic. The findings suggested that both the intensity of COVID-19 preventive measures and the progression of infection rates were strongly linked to the severity of mental health issues (Wolf & Schmitz, 2024). One of the most significant and widespread changes experienced by adolescents during the COVID-19 pandemic has been the closure of educational institutions. These closures were considered essential globally due to the challenges of maintaining physical distancing in educational institutions, such as limited space, frequent interactions among large groups of students, and the difficulty adolescents face in adhering to hygiene and distancing protocols. According to WHO (2024), these closures have caused an unprecedented disruption in education systems worldwide, impacting nearly 1.6 billion learners across over 190 countries. The social connections of adolescents have likely been negatively impacted during the pandemic, as restrictions on socializing and isolation from friends and extended family members were enforced (Foulkes & Blakemore, 2021; Hussong et al., 2021). Entire families have faced disruptions to their daily routines and heightened pandemic-related stress, leading to increased tensions within households and altered family dynamics in numerous cases (Haleemunnissa et al., 2021; Meade, 2021).

The COVID-19 pandemic and the measures taken to contain it have profoundly transformed the daily lives of adolescents. These changes have disrupted normal developmental processes, heightened stress levels, and reduced access to essential coping mechanisms, support networks, and protective resources. Adolescents are highly susceptible to the ramifications of the pandemic as their physical and psychological capacities are under development (Campos et al., 2023). Similar trends of declining psychosocial functioning were found among adolescents in Pakistan as indicated by the escalated rates of anxiety and depression during the COVID-19 pandemic (Abbass et al., 2023; Gul & Demirci, 2021; Putra et al., 2023).

The increased reliance on digital technologies during the COVID-19 pandemic has heightened concerns about internet addiction, particularly among adolescents (Chen et al., 2021; Fung et al., 2021; Kim & Lee, 2021). Internet addiction is characterized by four key features: (1) an increased involvement in online activities, (2) negative mood changes when offline, (3) a tolerance for the positive effects of internet use, and (4) a denial of problematic internet behavior (Kandell, 1998). Although internet addiction has not been formally classified as a disorder, research suggests

it may require professional treatment in some cases (Talis, 2022). With limited opportunities for in-person interactions due to pandemic-related restrictions, social media platforms such as Instagram, TikTok, and Snapchat became vital tools for staying socially connected. This reliance on digital connectivity, combined with the shift to distance learning, amplified the risk of internet addiction as adolescents spent more time online for academic, social, and entertainment purposes. The lockdowns provided adolescents with fewer alternatives, further encouraging excessive internet use as a primary means of maintaining social connections during isolation. While pre-pandemic research established links between internet addiction and psychosocial difficulties, the unique circumstances of the pandemic magnified these issues, particularly in low-resource settings like Pakistan (Abbass et al., 2023; Al-Mamun et al., 2022; Jahan et al., 2021). Moreover, the psychological distress associated with the pandemic further exacerbated internet addiction, highlighting the complex interplay between the pandemic and internet addiction (Ballarotto et al., 2021; Chen et al., 2021; Fung et al., 2021; Haleemunnissa et al., 2021; Teng et al., 2021).

Working memory, a core component of executive functioning, plays a critical role in regulating behavior, decision-making, and emotional responses (Zhao et al., 2024). Working memory can be defined as a system that is responsible for temporarily storing information while cognitive tasks are performed (Hulme & Mackenzie, 2014). According to Baddeley's model of working memory, this system consists of the central executive, phonological loop, and visuospatial sketchpad, enabling individuals to retain and process limited information (Abidin, 2024). Research has indicated that impairments in working memory are associated with a heightened risk of engaging in addictive behaviors, including internet addiction (Khanbabaei et al., 2022). Research also suggested that deficits in working memory exacerbate the risk of internet addiction (Talis, 2022). Davis's Problematic Internet Use (PIU) model provides a theoretical framework to understand these dynamics (Davis, 2001). According to the PIU model, problematic internet use arises from a combination of cognitive and behavioral vulnerabilities. Central to the theory is the distinction between specific PIU and generalized PIU. Specific PIU refers to compulsive behavior tied to particular online activities, such as gaming or social media use, while generalized PIU involves a broader dependence on internet use for mood regulation and coping (Davis, 2001).

The model posits that maladaptive cognitions, such as distorted beliefs about the benefits of internet use or an overreliance on digital interactions for self-worth, exacerbate vulnerability to PIU. These cognitive vulnerabilities often stem from deficits in self-regulation and executive functioning, particularly working memory. Within this framework, working memory deficits hinder the ability to evaluate long-term consequences of behavior, prioritize tasks, and regulate impulses (Tunney & Rooney, 2023). Adolescents with impaired working memory may struggle to disengage from online activities, increasing their susceptibility to excessive internet use. Over time, this excessive use may escalate into internet addiction, characterized by an inability to control internet use despite negative consequences. Furthermore, internet addiction can perpetuate a cycle of psychosocial dysfunction by worsening emotional regulation, increasing social withdrawal, and amplifying feelings of loneliness or stress (Tunney & Rooney, 2023).

The pandemic's unprecedented circumstances, marked by prolonged social isolation, increased screen time, and heightened psychological stress, offer a unique context to explore these dynamics. Adolescents, already at a critical developmental stage, may be particularly vulnerable to these compounded challenges, making it imperative to examine how cognitive factors like working memory influence their adjustment. This study proposes a mediation model to examine the interplay among working memory, internet addiction, and psychosocial functioning. Specifically, the model hypothesizes that working memory deficits contribute to psychosocial dysfunction indirectly through increased internet addiction. The graphical representation of this model is indicated in Figure 1 to illustrate the proposed pathways. The mediation model emphasizes the central role of internet addiction as a behavioral mechanism linking cognitive impairments to broader psychosocial challenges. Understanding this pathway is critical for developing targeted interventions that address both cognitive vulnerabilities and maladaptive digital behaviors.

By investigating this mediation model, this study seeks to address gaps in the existing literature and provide valuable insights for targeted interventions. By integrating cognitive, behavioral, and psychosocial perspectives, this research aims to articulate a clearer theoretical framework that underscores the interplay of these variables. This approach not only enhances the understanding of adolescent development in the context of global crises but also contributes to the design of effective strategies to mitigate the adverse effects of internet addiction on psychosocial health.

In doing so, this study offers a novel contribution by contextualizing the impact of working memory within the broader psychosocial challenges faced by adolescents during the pandemic. It highlights the importance of cognitive resilience and adaptive digital behaviors as critical factors for promoting healthy adolescent development in an increasingly digital world.

Method

Research design

This study utilized a purposive sampling technique, and a cross sectional research design**.**

Objectives

This study examined the relationships among internet addiction, working memory, and psychosocial functioning among adolescents during the COVID-19 pandemic. Additionally, it explored the mediating role of internet addiction and the influence of working memory on psychosocial functioning.

Research Question

How does working memory impact adolescents' psychosocial functioning during the COVID-19 pandemic, and how does internet addiction affect this relationship?

Hypotheses

Internet addiction will significantly mediate the relationship between working memory and psychosocial functioning among adolescents during the COVID-19 pandemic. Specifically, deficits in working memory will lead to higher levels of internet addiction, which will, in turn, be associated with poorer psychosocial functioning. The

analysis will reveal significant effects of working memory on psychosocial functioning, with internet addiction playing a key role in this relationship.

Sample

This study utilized a purposive sampling technique, and a cross sectional research design to recruit 100 adolescents (56 males and 44 females), aged 11 to 19 years, from various public and private educational institutions in Islamabad and Rawalpindi, Pakistan. Data collection was conducted during the second wave of COVID-19. Including adolescents with and without prior COVID-19 exposure was intentional to explore the pandemic's varying psychosocial impacts. Adolescents with prior COVID-19 infection were included to examine potential associations between their recovery status and psychosocial functioning during the pandemic. A priori power analysis using G*Power (version 3.1) determined the minimum sample size required for adequate statistical power. The analysis was based on medium effect sizes ($w = 0.30$ for chi-square and f^2 for binary logistic regression), a significance level of $\alpha = 0.05$, and a power of $1 - \beta = 0.80$, considering relevant degrees of freedom. The analysis recommended a minimum of 88 participants, and the final sample size of 100 exceeded this requirement, ensuring sufficient power for all planned statistical analyses.

Inclusion Criteria

Adolescents were eligible for inclusion in the study if they were aged between 11 and 19 years, enrolled in a public or private educational institution, and were native Urdu speakers, which facilitated accurate comprehension and responses to the translated assessment tools. Additionally, participants were required to have regular access to a laptop to complete the Corsi Block-Tapping Test, which necessitated digital administration. Furthermore, participants needed to have engaged in distance learning during the pandemic, as this factor was central to the investigation of psychosocial functioning and internet addiction.

Exclusion Criteria

Participants were excluded from the study if they lacked access to a laptop, which was essential for completing the Corsi Block-Tapping Test, or if they were not involved in distance learning during the pandemic, as this variable was critical to the study's objectives.

Measures

The following tools were used to collect the data from the participants:

Pediatric Symptom Checklist-Youth Self-Report (PSC-Y)

The Pediatric Symptom Checklist-Youth Self-Report (PSC-Y) originally developed by Jellinek and Murphy (1988), was adapted and translated into Urdu for the current research to assess impairments in the psychosocial functioning of adolescents. This screening tool evaluates a broad spectrum of cognitive, emotional, and behavioral problems through three subscales: (1) attention problems, (2) externalizing problems, and (3) internalizing problems. It comprises 35 items rated on a 3-point Likert scale: 0 (Never), 1 (Sometimes), and 2 (Often). The total score is obtained by summing the scores of all items, with a recommended cut-off score of 28 or higher for adolescents. The PSC-Y demonstrates strong reliability, with high internal consistency (Cronbach's $\alpha = 0.86–0.95$) and moderate to high test-retest reliability ($r = 0.45–0.86$). Its validity is supported by significant correlations with measures such as the Child Behavior Checklist ($\kappa = 0.76$) and its ability to predict psychosocial difficulties (Li et al., 2022).

Compulsive Internet Use Scale (CIUS)

The Compulsive Internet Use Scale (CIUS), developed by Meerkerk et al. (2009), is designed to assess problematic internet use among adolescents. It comprises 14 items, rated on a 5-point Likert scale (0 = 'never' to 4 = 'very often'), which explore the following addiction symptoms related to problematic internet use: preoccupation (behavioral and cognitive), coping/mood modification, withdrawal symptoms, loss of control, and conflict (interpersonal and intrapersonal). The total score is calculated by summing the scores of each item. These criteria are based on the DSM-IV-TR diagnoses for pathological gambling and substance dependence (APA, 2000). CIUS demonstrated strong validity, with significant Pearson correlations between the CIUS and criterion variables. The correlation with time spent online was 0.42, with self-reported problematic internet use was 0.45, and with feeling addicted to the internet was 0.52, all of which were statistically significant ($p \leq 0.001$). The high internal consistency (Cronbach's $\alpha = 0.90$) indicated strong reliability (Meerkerk et al., 2009).

Corsi Block-Tapping Task (CBTT)

CBTT, developed by Corsi in 1972, is a widely used tool designed to assess visuospatial working memory (Gibeau, 2021). It can be used with a wide range of populations ranging from preschoolers to older adults (late 80s). The computerized version of CBTT is used in the present study which is a digital adaptation of the traditional Corsi Block-Tapping Test (CBTT) used to assess visuospatial working memory. In this version, participants interact with a computer interface where blocks are presented in randomized sequences. Participants are asked to replicate the sequence in the same order. The test begins with a sequence of two blocks. After viewing the sequence, the word "go" prompts the participant to replicate the sequence by clicking the blocks in the correct order. If the participant is correct, the sequence length increases. If incorrect, they get one more attempt. If the second attempt is also wrong, the test ends, and the Corsi Block Span score is recorded. Feedback is given via a smiley face for correct responses and a frowny face for mistakes. CBTT is a reliable measure of visuospatial working memory, demonstrating strong validity with reliability coefficients ranging from 0.81 to 0.89. This indicates its consistency in assessing spatial working memory across various settings (Latino et al., 2021).

Psychosocial Functioning

It is measured with PSC-Y in the present study. A total problem score of 28 or higher on the PSC-Y scale indicates impairments in psychosocial functioning. Adolescents with a high score (7 or higher) on the attention subscale indicate difficulty in paying attention to daily tasks. Adolescents with a high score (5 or higher) on internalizing subscale might withdraw from social situations or mention unexplained physical symptoms. Adolescents with a high score (7 or higher) on the externalizing subscale indicate disruptive behaviour.

Visuospatial Working Memory

It involves the maintenance of a visuospatial pattern

and a movement sequence. It is measured with CBTT. A score lower than 6 on the Corsi block-tapping test indicates impairments in visuospatial working memory.

Internet Addiction

It involves the addiction symptoms of preoccupation (behavioral and cognitive), coping/mood modification, withdrawal symptoms, loss of control, and conflict (inter and intrapersonal). It is measured with CIUS. A score equal to or greater than 21 on CIUS indicates internet addiction.

Procedure

This study was approved by the School of Social Sciences and Humanities (S3H) Ethics Committee, National University of Science and Technology, Islamabad, Pakistan, and adhered to the ethical guidelines provided by the American Psychological Association (APA). Written informed consent was obtained from the authors to translate and adapt the measurement tools (CIUS and PSC-Y). Following this, a committee approach was employed to translate the scales from English to Urdu. Three independent bilingual experts provided their translations, and a committee of two bilingual experts and two subject matter experts reviewed these translations. In a subsequent meeting, the committee discussed and finalized the best-suited translations for both scales, ensuring that all necessary adaptations were made according to the WHO guidelines. 100 adolescents were selected from various public and private educational institutions in Rawalpindi and Islamabad, Pakistan. Participants and their parents were assured that their personal information would remain confidential and be used exclusively for research purposes. Written informed consent was obtained from the parents of all adolescent participants before their inclusion in the survey. This process was in line with ethical standards for research involving minors. Participants were then invited to complete the self-administered online survey. The survey, which included the assent form, demographic sheet, and translated questionnaires, was distributed via widely used social media platforms such as Facebook, WhatsApp, and Telegram. The link for CBTT was also shared with the participants for self-administration. In addition, participants were encouraged to share the survey with their peers to enhance the sample's representativeness and ensure a more balanced distribution.

Results

Data analysis plan

The collected data were entered into SPSS and screened for data entry errors, missing values, and outliers. To comprehensively analyze the relationships among working memory, internet addiction, and psychosocial functioning, the following sequence of statistical techniques was employed:

Descriptive Statistics

Descriptive statistics were calculated to summarize the demographic and study variables, including age, gender, marital status, religion, class, region, family income/socioeconomic status (SES), occupation, internet use, working memory, internet addiction, and psychosocial functioning. Measures of central tendency (means) and variability (standard deviations) were reported for continuous variables, while frequencies and percentages were provided for categorical variables.

Preliminary analyses

Chi-square tests of independence were conducted to explore associations between categorical variables, including demographic factors, working memory, internet addiction, and psychosocial functioning. These analyses identified significant relationships and informed subsequent analyses.

Predictive analyses

Binary logistic regression was conducted to identify predictors of psychosocial functioning. Independent variables included working memory, internet addiction, and relevant demographic factors. Odds ratios (OR) and confidence intervals (CI) were reported to describe the direction and strength of associations.

Multivariate analysis of variance (MANOVA)

MANOVA was performed to assess the impact of working memory on internet addiction and psychosocial functioning. This analysis allowed for the evaluation of multiple dependent variables i.e. internet addiction and psychosocial functioning. Significant multivariate effects were followed up with univariate analyses as appropriate.

Mediation analysis

Mediation analysis was conducted to examine whether internet addiction mediated the relationship between working memory and psychosocial functioning. The indirect, direct, and total effects were estimated using bootstrapped confidence intervals to test the statistical significance of the mediation effect. All statistical analyses adhered to appropriate assumptions, and adjustments were made for any violations. Results were interpreted at a significance level of $p < .05$, with additional significance thresholds ($p < .01$, $p < .001$) specified where applicable. Analyses were conducted using SPSS (version 26) and PROCESS Macro for SPSS.

Table 1 presents the internal consistency of the PSC-Y and CIUS as assessed using Cronbach's alpha. Both scales demonstrated excellent reliability, with PSC-Y ($\alpha = 0.91$) and CIUS ($\alpha = 0.92$) in the adolescent sample. CBTT is a single-item performance measure, and internal consistency reliability (Cronbach's α) is not applicable. However, previous research has reported acceptable test-retest reliability for this measure, with correlations ranging from $r = 0.81$ to $r = 0.89$ (Latino et al., 2021).

Table 2 shows the demographic characteristics of 100 adolescents who participated in the present study. The participants were aged between 11-19 years, with 34% falling in the 11-14 age group, 32% in the 15-17 range, and the remaining 34% in the 18-19 age group. This indicates a relatively young sample, predominantly made up of adolescents. In terms of gender, 56% of participants were male, while 44% were female. All of the participants identified as Muslim (100%), with no non-Muslim respondents. Regarding marital status, all participants were single, with no married individuals in the sample. When examining the education level, 27% were in primary (5-7 grade), 54% were enrolled in secondary (8-12 grade), and 19% were in higher education (an undergraduate or graduate degree program). As for family income, the income distribution revealed that 40% of families had a monthly income greater than 100,000 Rupees (Higher SES), 56% earned between 40,000 and 100,000 Rupees (Middle SES), and 4% had income lesser than 40,000 (Lower SES). The occupation of participants was predominantly students, accounting for 100%.

Table 1

Psychometric Properties for PSC-Y, CIUS, and CBTT (N = 100)

Scales	*M*	*SD*	Range	Cronbach's α
PSC-Y	33.07	10.87	61	.91
CIUS	35.34	11.46	47	.92
CBTT	3.48	1.71	26	.80

Table 2

Demographic Characteristics of Participants (N = 100)

Characteristics	Frequency (N)	Percentage (%)
Age (years)		
11-14	34	34
15-17	32	32
18-19	34	34
Gender		
Male	56	56
Female	44	44
Class		
Primary	19	19
Secondary	54	54
Higher	27	27
Family Income/Socioeconomic Status (SES)		
>100,000 (Higher SES)	4	4
40,000 - 100,000 (Middle SES)	56	56
<40,000 (Lower SES)	40	40

Table 3

The Overall Pattern and Frequency of Internet Use among Adolescents during the COVID-19 Pandemic (N = 100)

Variables	Frequency (N)	Percentage (%)
Internet Use		
Internet Use (Normal)	10	10
Internet Use (Problematic)	90	90
Time Spent on the Internet		
1-2 hours	20	20
3-4 hours	24	24
5-6 hours	10	10
More than 6 hours	46	46
Time Spent on Education		
0 hours	7	7
1-2 hours	44	44
3-4 hours	33	33
5-6 hours	4	4
More than 6 hours	12	12
Types of Internet Content		
Educational	22	22
Religious	11	11
Entertainment	67	67

Table 4

Descriptive Statistics of Predictor and Outcome Variables (N = 100)

Variables	N	*M*	*SD*	Range	*Skewness*	*SE*	*Kurtosis*	*SE*
Psychosocial Functioning	100	33.07	10.87	61	-.29	.24	.88	.48
Working Memory	100	3.48	1.71	8	.27	.24	.51	.48
Internet Addiction	100	35.34	11.46	47	-.50	.24	-.81	.48

Table 5

Summary of Chi-Square Tests for Demographic and Psychosocial Variables and Psychosocial Functioning (N = 100)

	Psychosocial Functioning			χ^2	*p*
	Normal N (%)	Impaired N (%)	Total N (%)		
Working Memory					
Normal	12 (0.12%)	6 (0.06%)	18 (0.18%)	11.25***	.00
Impaired	21 (0.21%)	61 (0.61%)	82 (0.82%)		
Internet Addiction					
Non-addicted	9 (0.09%)	1 (0.01%)	10 (0.1%)	16.33***	.00
Addicted	24 (0.24%)	66 (0.66%)	90 (0.9%)		
Adolescent's COVID-19 Status					
Negative	31 (0.31%)	38 (0.38%)	69 (0.69%)	14.32***	.00
Recovered	2 (0.02%)	29 (0.29%)	31 (0.31%)		
Relationship With COVID-19 positive Significant Other					
Parent(s)	5 (0.05%)	14 (0.14%)	19 (0.19%)	13.46**	.01
Sibling(s)	0 (0%)	11 (0.11%)	11 (0.11%)		
Extended Family	8 (0.08%)	18 (0.18%)	26 (0.26%)		
Friend(s)	5 (0.05%)	1 (0.01%)	6 (0.06%)		
Distance Learning					
No	12 (0.12%)	6 (0.06%)	18 (0.18%)	11.25***	.00
Yes	21 (0.21%)	61 (0.61%)			

			82 (0.82%)		
Time Spent on the Internet					
1-2 hours	14 (0.14%)	6 (0.06%)	20 (0.2%)	32.01***	.00
3-4 hours	3 (0.03%)	21 (0.21%)	24 (0.24%)		
5-6 hours	8 (0.08%)	2 (0.02%)	10 (0.1%)		
More than 6 hours	8 (0.08%)	38 (0.38%)	46 (0.46%)		
Mother's Occupation					
Housewife	24 (0.24%)	61 (0.61%)	85 (0.85%)	6.59*	.04
Govt. job	8 (0.08%)	6 (0.06%)	14 (0.14%)		
Private job	1 (0.01%)	0 (0%)	1 (0.01%)		

Note. $*p < .05$. $**p < .01$. $***p < .001$.

Table 6

Summary of Binary Logistic Regression Analysis for Variables Predicting Psychosocial Functioning (N = 100)

Variables	*B*	*SE*	*Wald*	Odds Ratio	*p*
Adolescent's COVID-19 Status (1)	-3.65	1.88	3.78	.03	.05
Working Memory (1)	-1.87	.84	4.95	.15	.03
Internet Addiction (1)	-4.33	1.64	7.01	.01	.01
Distance Learning (1)	-2.27	.94	5.80	.01	.02
Time Spent on Internet (1)	-1.96	.95	4.25	.14	.04
Time Spent on Internet (3)	-4.32	1.42	9.22	.01	.00

Table 7

Means, Standard Deviations, and One-Way Multivariate Analysis of Variance for Working Memory, Internet Addiction, and Psychosocial Functioning (N=100)

Working Memory	Normal		Impaired		*F*	*p*	η^2
	M	*SD*	*M*	*SD*			
Internet Addiction	26.39	6.92	37.30	11.34	15.34***	.00	.14
Psychosocial Functioning	30.28	13.15	33.68	10.30	1.45	.23	.02

Note. ***$p < .001$.

Table 8

Direct and Indirect Effects of Internet Addiction on Psychosocial Functioning, Mediated by Working Memory (N = 100)

Variables	Predictors	*B*	*p*	95% *CI*	
				LL	UL
Internet Addiction	Working Memory	-2.84***	.00	-4.05	-1.62
Psychosocial Functioning	Internet Addiction	0.63***	.00	0.48	0.79
Psychosocial Functioning	Working Memory	0.17	.76	-0.90	1.23
Psychosocial Functioning	Working Memory through Internet Addiction	-1.80***		-2.76	-1.08

Note. ***$p < .001$.

Table 3 represents the overall pattern and frequency of internet use among adolescents during the COVID-19 pandemic. The findings have shown that 90% of the participants of the study were engaged in problematic internet use indicating internet addiction. On the other hand, 10% of the adolescents were reportedly using the internet within the normal range. Henceforth, it can be stated that most of the adolescents were involved in problematic internet use during the COVID-19 pandemic. The table also represents the frequency of time spent on the internet among adolescents during the COVID-19 pandemic. The statistical data has indicated that 20% of the participants of the study have reportedly spent 1 to 2 hours on the internet within a day. Almost 24% of adolescents have reportedly spent 3 to 4 hours on the internet within a day. On the other hand, approximately 10% of adolescents have reported spending 5 to 6 hours on the internet within a day. Lastly, approximately 46% of the participants of the study have reportedly spent more than 6 hours on the internet within a day. It can, therefore, be inferred that most of the adolescents have spent more than 6 hours on the internet within a day during the pandemic. The table also represents the frequency of time spent on education among adolescents during the COVID-19 pandemic. The statistical data has indicated that 7% of the participants have reportedly spent 0 hours on education within a day. Almost 44% of the adolescents have reportedly spent 1 to 2 hours on education within a day. On the other hand, approximately 33% of adolescents have reported spending 3 to 4 hours on education within a day. In addition, approximately 4% of the participants of the study have reportedly spent 5 to 6 hours on education within a day. Lastly, almost 12% of the adolescents have reportedly spent more than 6 hours on education within a day. Therefore, most of the adolescents have spent 1 to 2 hours on education within a day during the pandemic. The table also represents the frequency of the use of the types of internet content among adolescents in the context of the COVID-19 pandemic. According to the statistical findings, approximately 22% of the participants of the study were reportedly using the internet for educational content. Almost 11% of the adolescents were reportedly using the internet for religious content. Approximately 67% of the adolescents were reportedly using the internet for entertainment purposes.

Table 4 represents descriptive statistics of predictor and outcome variables. The values of skewness and kurtosis have indicated the data distribution scores. The mean, standard deviation, and ranges are also given in the table.

Table 5 is indicative of the summary of the chi-square tests that have been conducted in order to determine the significant relationships among the variables. As a first step, a chi-square test has been done between two categorical variables i.e., working memory and psychosocial functioning. As the p-value is lesser than the significance level (p = .05), it indicates that there is a significant relationship between working memory and psychosocial functioning, χ^2 (1, N = 100) = 11.25, p = .00. In addition, a chi-square test has been done between internet addiction and psychosocial functioning. The findings have indicated a significant relationship among these variables, χ^2 (1, N = 100) = 16.33, p < .001. Likewise, the findings have reported a significant association of adolescent's COVID-19 status, χ^2 (1, N = 100) = 14.32, p < .001; relationship with COVID-19 positive significant other, χ^2 (4, N = 100) = 13.46, p = .01; distance learning, χ^2 (1, N = 100) = 11.25, p = .00; time spent on internet, χ^2 (3, N = 100) = 32.01, p < .001; and mother's occupation, χ^2 (2, N = 100) = 6.59, p = .04; with psychosocial functioning.

Table 6 represents the summary of the binary logistic regression analysis for all of the variables predicting psychosocial functioning. The model chi-square of omnibus tests of model coefficients indicates if the full model is a significant improvement over the null model or not. As the p-value is less than .05; therefore, it can be implied that the full model that includes the full set of predictors is a significant improvement in fit over the null model (the null model does not include the predictors). As the null hypothesis suggests that the models tend to fit equally well, it has been rejected. It is rather implied that the full model is significantly better than the null model. These findings are further corroborated by the model chi-square of the Hosmer and Lemeshow Test that is used to test the fit of the model. However, in this case, the model is considered a good fit if the p-value is non-significant. Henceforth, it can be stated that the non-significance of the model chi-square of Hosmer and Lemeshow Test is an indicator of a good fitting model to the data. The findings have indicated that working memory deficits, internet addiction, distance learning, spending 1-2 hours on the internet, spending 5-6 hours on the internet, and COVID-19 positive but recovered status seem to significantly predict psychosocial functioning. To be specific, a unit change in working memory deficits leads to a 1.87-unit decline in psychosocial functioning. As the odds ratio is less than 1, it further indicates that as the deficits in working memory increase, the odds of improvements in psychosocial functioning decrease. In addition, a unit change in internet addiction leads to a 4.33-unit decline in psychosocial functioning. As the odds ratio is less than 1, it is indicative of the likelihood that as internet addiction increases, the odds of improvements in psychosocial functioning decrease. A unit change in distance learning likely leads to a 2.27-unit decline in psychosocial functioning. As the odds ratio is less than 1, it suggests that as distance learning increases, the odds of improvements in psychosocial functioning decrease. A unit change in spending 1-2 hours on the internet likely leads to a 1.96-unit decline in psychosocial functioning. As the odds ratio is less than 1, it indicates that as the time spent on the internet increases, the odds of improvements in psychosocial functioning decrease. A unit change in spending 5-6 hours on the internet likely leads to a 4.32-unit decline in psychosocial functioning. As the odds ratio is less than 1, it indicates that as the time spent on the internet increases, the odds of improvements in psychosocial functioning decrease. Lastly, a unit change in positive but recovered COVID-19 status of adolescents contributes to a 3.65-unit decline in psychosocial functioning. As the odds ratio is less than 1, it implies that as exposure to COVID-19 increases, the odds of improvements in psychosocial functioning decrease.

A one-way multivariate analysis of variance (MANOVA) was conducted to examine the impact of normal and impaired working memory on two dependent variables: Internet addiction and psychosocial functioning. Descriptive statistics indicated that the impaired group had higher mean scores on both internet addiction (M = 37.30, SD = 11.34) and psychosocial functioning (M = 33.68, SD = 10.30) compared to the normal group (internet addiction: M = 26.39, SD = 6.92; psychosocial functioning: M = 30.28, SD = 13.15). Box's M test revealed a significant violation of the assumption of equal covariance matrices (p = 0.00), particularly for internet addiction. As a result, Pillai's Trace was used for the multivariate analysis, which revealed a significant effect of working memory status on the combined dependent variables, Pillai's Trace = 0.16, F (2, 97) = 9.31, p < 0.001, partial η^2 = 0.16. This indicates that 16% of the variance in the dependent variables was associated with working memory status. Follow-up univariate analyses, with an adjusted alpha level of .03, showed that working memory status significantly affected internet addiction scores, F (1, 98) = 15.34, p < 0.001, partial η^2 = 0.14, but not psychosocial functioning scores,

F (1, 98) = 1.45, p = 0.23, partial η^2 = 0.02. These findings suggest that impaired working memory is associated with higher levels of internet addiction, but has little effect on psychosocial functioning.

A mediation analysis was conducted using PROCESS Model 4 (Hayes, 2022) to examine whether internet addiction mediates the relationship between working memory and psychosocial functioning. It was indicated that the relationship between working memory and internet addiction was significant, B = −2.84, SE = 0.61, t (98) = −4.62, p < .001, 95% CI [−4.05, −1.62]. This indicates that lower working memory performance predicts higher levels of internet addiction. Controlling for working memory, internet addiction was a significant predictor of psychosocial functioning, B = 0.63, SE = 0.08, t (97) =7.92, p < .001, 95% CI [0.48, 0.79]. Higher internet addiction was associated with worse psychosocial functioning. The direct effect of working memory on psychosocial functioning was not significant, B = 0.17, SE = 0.54, t (97) =0.31, p = .76, 95% CI [−0.90, 1.23]. The bootstrap analysis revealed a significant indirect effect of working memory on psychosocial functioning through internet addiction, B = −1.80, Boot SE = 0.42, 95% CI [−2.76, −1.08]. The confidence interval does not contain zero, indicating the mediation effect is significant. The results suggest that internet addiction fully mediates the relationship between working memory and psychosocial functioning. Poorer working memory performance is associated with higher levels of internet addiction, which in turn is related to worse psychosocial functioning. The direct effect of working memory on psychosocial functioning was not significant after accounting for the mediator.

Discussion

The findings of this study provide significant insights into the interplay among working memory, internet addiction, and psychosocial functioning among adolescents during the COVID-19 pandemic. The results underscore the critical role of working memory deficits in contributing to internet addiction, which, in turn, adversely affects psychosocial functioning. This discussion integrates the study's findings with existing literature, highlights theoretical implications, and suggests practical interventions.

This study's findings align with previous research indicating that impairments in working memory heighten the risk of engaging in problematic internet use (Khanbabaei et al., 2022; Talis, 2022). Adolescents with deficits in working memory may struggle with self-regulation, impulse control, and decision-making, leading to excessive online engagement. These results are consistent with Davis's Problematic Internet Use (PIU) model, which emphasizes cognitive vulnerabilities such as distorted beliefs and maladaptive behaviors as central to internet addiction (Davis, 2001). By impairing adolescents' ability to evaluate the long-term consequences of online behavior and prioritize tasks, working memory deficits contribute to the development of internet addiction. This study adds to the literature by confirming these associations in the unique context of a global pandemic, where increased screen time and heightened psychological stress may amplify these vulnerabilities.

The results further reveal that internet addiction serves as a significant mediator between working memory deficits and psychosocial functioning. Adolescents who develop internet addiction experience heightened difficulties in maintaining daily activities and interpersonal relationships. These findings align with previous studies that document the adverse effects of internet addiction on emotional regulation, social withdrawal, and stress (Ballarotto et al., 2021; Tunney & Rooney, 2023). The pandemic's enforced lockdowns and reliance on digital platforms for education and socialization likely exacerbated these issues, as adolescents faced limited alternatives for coping with stress and maintaining social connections. This study extends existing knowledge by illustrating how the unique conditions of the pandemic magnified the impact of internet addiction on psychosocial health, particularly in resource-limited settings like Pakistan.

Novel Contributions

The present study looked at how internet addiction and working memory were connected to the overall well-being of teenagers during the COVID-19 pandemic. A sample of 100 adolescents aged 11-to 19-year-old was taken using the Compulsive Internet Use Scale (CIUS), Pediatric Symptom Checklist-Youth self-report (PSC-Y), and Corsi Block-Tapping Test after translation and adaptation from English to the Urdu language following WHO guidelines. The results showed that problems with working memory can lead to higher levels of internet addiction, which in turn can make various aspects of teenagers' social and emotional health worse. The research offers helpful advice for parents of teenagers. It suggests that parents should monitor and limit their children's screen time to help protect their thinking skills and overall well-being. Specifically, parents are encouraged to reduce screen time before school or bedtime. One effective approach could be to use screen time as a reward for positive behavior, encouraging teens to earn their time online.

Theoretical Implications. The mediation model proposed in this study highlights the complex interplay among cognitive, behavioral, and psychosocial factors, emphasizing internet addiction as a behavioral mechanism linking working memory deficits to psychosocial dysfunction. This model integrates insights from Baddeley's working memory framework (Abidin, 2024) and the PIU model (Davis, 2001), offering a comprehensive understanding of how cognitive impairments translate into broader psychosocial challenges. By contextualizing these dynamics within the pandemic, this study contributes to the theoretical framework for understanding adolescent development during global crises. The findings underscore the need for an interdisciplinary approach that combines cognitive, behavioral, and psychosocial perspectives to address the multifaceted challenges faced by adolescents.

Practical implications. The findings of this study have important practical implications for mitigating the adverse effects of working memory deficits and internet addiction on psychosocial functioning. Targeted interventions are needed to strengthen working memory and self-regulation skills among adolescents. Cognitive training programs that enhance working memory capacity could be effective in reducing vulnerability to internet addiction. Additionally, psychoeducational initiatives should focus on promoting healthy digital behaviors and raising awareness about the risks associated with excessive internet use. Schools, families, and community organizations can play a critical role in implementing these interventions by fostering environments that encourage balanced online and offline activities. Moreover, mental health professionals should prioritize addressing internet addiction as part of broader strategies to support adolescents' psychosocial functioning. Counselling programs tailored to adolescents' unique needs during the pandemic, including stress management, emotional regulation, and social skills training, can help mitigate the impact of internet addiction. Policymakers should also consider implementing regulations to limit excessive screen time and provide resources for promoting digital well-being.

Limitations and Future Directions

While this study provides valuable insights, several limitations warrant consideration. The cross-sectional design limits the ability to establish causal relationships among the variables.

Longitudinal studies are needed to confirm the proposed mediation model and explore the long-term effects of working memory deficits on internet addiction and psychosocial functioning. Another limitation is the relatively small sample size, which may constrain the statistical power and robustness of the findings. Future studies with larger, more representative samples could offer deeper insights into these dynamics. Additionally, this study focused on adolescents in Pakistan, which may limit the generalizability of the findings to other cultural and socioeconomic contexts. Future research should replicate this study in diverse settings to validate the findings and explore potential cultural variations in the relationships among working memory, internet addiction, and psychosocial functioning. Furthermore, this study relied on self-reported measures, which may introduce biases such as social desirability and recall errors. Future studies could incorporate objective assessments of working memory and internet use to enhance the validity of the findings. Investigating other cognitive and environmental factors that may influence psychosocial functioning, such as family dynamics and peer relationships, would also provide a more comprehensive understanding of the challenges faced by adolescents during the pandemic.

Conclusion This study explores the intricate relationships among working memory, internet addiction, and psychosocial functioning among adolescents during the COVID-19 pandemic. The key findings indicate that working memory deficits significantly contribute to internet addiction, which, in turn, adversely affects psychosocial functioning. Internet addiction was identified as a mediator, highlighting its role in linking cognitive impairments to broader psychosocial challenges. These findings are particularly relevant in the context of the pandemic, where increased screen time and psychological stress exacerbated vulnerabilities. The implications of this study are twofold. Theoretically, it integrates cognitive, behavioral, and psychosocial perspectives to provide a nuanced understanding of adolescent development during crises. Practically, it underscores the need for targeted interventions, including cognitive training programs to enhance working memory, psychoeducational initiatives to promote healthy digital habits, and clinical strategies to address internet addiction. Policymakers are encouraged to support these efforts through regulations and awareness campaigns to promote digital well-being.

Despite its contributions, the study has limitations, including its cross-sectional design, small sample size, reliance on self-reported measures, and focus on adolescents in Pakistan, which may limit generalizability. Future research should adopt longitudinal designs, incorporate objective assessments, and explore cultural and contextual variations to build on these findings. In conclusion, this study sheds light on the critical interplay among cognitive vulnerabilities, digital behaviors, and psychosocial functioning in adolescents. By addressing these challenges, stakeholders can foster healthier developmental outcomes for adolescents in an increasingly digital and crisis-prone world.

Ethical Considerations

The study was reviewed and approved by the Ethics Review Committee of the Department of Behavioral Sciences, National University of Science and Technology (NUST), Islamabad, Pakistan. Written informed consent was obtained from all participants before data collection, ensuring voluntary participation. Participants were informed of their right to withdraw from the study at any stage without any consequences. The study adhered to the ethical principles outlined in the Declaration of Helsinki (2013) and followed the ethical guidelines established by the American Psychological Association (APA, 2017). All collected data were anonymized and kept confidential, ensuring compliance with data protection regulations.

Acknowledgments

The author extends sincere gratitude to the Department of Behavioral Sciences, National University of Science and Technology (NUST), Islamabad, Pakistan, for their valuable support and guidance throughout this study. The present article is an excerpt from my MS thesis. Special appreciation is given to the study participants for their time and willingness to contribute to this research.

Funding Statement

The research received no external funding.

Availability of Data and Materials

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request, ensuring compliance with data-sharing policies.

Authors' Contributions

Sunaina Majeed conducted the research, data collection, and analysis under the supervision of Dr. Tamkeen Ashraf Malik, who provided guidance in conceptualization, methodology, and manuscript preparation. Both authors contributed to the final manuscript and approved its submission.

Competing Interests Statement

The authors declare no conflicts of interest regarding the publication of this article.

COPE Compliance Statement

This study complies with the ethical standards outlined by the Committee on Publication Ethics (COPE). The authors affirm that the work is original, free from fabrication, falsification, and plagiarism. All necessary permissions for data collection and participant inclusion were obtained, and the study does not involve any unethical practices.

Corresponding Author

For any correspondence regarding this study, please contact: Sunaina Majeed
Email: sunainamajeed95@gmail.com

Received: 8 November 2024 | **Accepted:** 5 February 2025 | **Published Online:** 10 February 2025

References

Abbass, K., Basit, A., Niazi, A. A. K., Mufti, R., Zahid, N., & Qazi, T. F. (2023). Evaluating the social outcomes of COVID-19 pandemic: empirical evidence from Pakistan. *Environmental science and pollution research*, *30*(22), 61466-61478.

Abidin, N. A. Z., Yassin, A. I. M., Ali, M. S. A. M., Mansor, W., Azhan, M. N. M., Rozlan, M. F. R. M., ... & Eskandari, F. (2024). Working Memory Models and Assessment Methods: A Review. In *2024 20th IEEE International Colloquium on Signal Processing & Its Applications (CSPA)* (pp. 90-95). IEEE. https://doi.org/10.1109/CSPA60979.2024.10525366.

Aqeel, M., Abbas, J., Shuja, K. H., Rehna, T., Ziapour, A., Yousaf, I., & Karamat, T. (2022). The influence of illness perception, anxiety and depression disorders on students mental health during COVID-19 outbreak in Pakistan: a web-based cross-sectional survey. *International*

Journal of Human Rights in Healthcare, *15*(1), 17-30. https://doi.org/10.1108/IJHRH-10-2020-0095.

Aqeel, M., Rehna, T., Shuja, K. H., & Abbas, J. (2022). Comparison of students' mental wellbeing, anxiety, depression, and quality of life during COVID-19's full and partial (smart) lockdowns: a follow-up study at a 5-month interval. *Frontiers in Psychiatry*, *13*, 835585. https://doi.org/10.3389/fpsyt.2022.835585.

Campos, A. P. S. D., Seabra, A. G., & Carreiro, L. R. R. (2023). Executive functions and mental health in students during COVID-19 pandemic. *Revista Psicopedagogia*, *40*(122), 159-167. https://doi.org/10.51207/2179-4057.20230014.

Chaman, A., & Shaheen, T. (2024). A Longitudinal Study on University Students' Coping Strategies and Psychological Symptoms during COVID-19 Full and Partial Lockdowns Over a 5-Month Interval. *Nature-Nurture Journal of Psychology*, *4*(1), 31–46. https://doi.org/10.53107/nnjp.v4i1.75.

Chaman, A., Shuja, K. H., & Rani, M. (2022). A web-based cross-sectional survey of coping mechanisms, psychological symptoms, and mental health in Pakistan during the covid-19 outbreak. *Nature-Nurture Journal of Psychology*, *2*(2), 1-10. https://doi.org/10.53107/nnjp.v2i2.26.

Chen, I. H., Chen, C. Y., Pakpour, A. H., Griffiths, M. D., Lin, C. Y., Li, X. D., & Tsang, H. W. (2021). Problematic internet-related behaviors mediate the associations between levels of internet engagement and distress among schoolchildren during COVID-19 lockdown: A longitudinal structural equation modeling study. *Journal of behavioral addictions*, *10*(1), 135-148. https://doi.org/10.1556/2006.2021.00006.

Chen, Y. A., & Fan, T. (2024). Adolescents' mental health, problematic internet use, and their parents' rules on internet use: A latent profile analysis. *Computers in Human Behavior*, *156*, 108232. https://doi.org/10.1016/j.chb.2024.108232.

Davis, R. A. (2001). A cognitive-behavioral model of pathological Internet use. *Computers in human behavior*, *17*(2), 187-195. https://doi.org/10.1016/S0747-5632(00)00041-8.

Foulkes, L., & Blakemore, S. J. (2021). Individual differences in adolescent mental health during COVID-19: The importance of peer relationship quality. *Neuron*, *109*(20), 3203-3205.

Fung, X. C., Siu, A. M., Potenza, M. N., O'Brien, K. S., Latner, J. D., Chen, C. Y., ... & Lin, C. Y. (2021). Problematic use of internet-related activities and perceived weight stigma in schoolchildren: a longitudinal study across different epidemic periods of COVID-19 in China. *Frontiers in psychiatry*, *12*, 675839. https://doi.org/10.3389/fpsyt.2021.675839.

Gibeau, R. (2021). The corsi blocks task: Variations and coding with jspsych. *The Quantitative Methods for Psychology*, *17*(3), 299-311. https://doi.org/10.20982/tqmp.17.3.p299.

Gul, M. K., & Demirci, E. (2021). Psychiatric disorders and symptoms in children and adolescents during the COVID-19 pandemic: A review. *Eurasian Journal of Medicine and Oncology*, *5*(1), 20. https://doi.org/10.14744/ejmo.2021.14105.

Haleemunnissa, S., Didel, S., Swami, M. K., Singh, K., & Vyas, V. (2021). Children and COVID19: Understanding impact on the growth trajectory of an evolving generation. *Children and youth services review*, *120*, 105754. https://doi.org/10.1016/j.childyouth.2020.105754.

Hayes, A. F. (2022). Counterfactual/potential outcomes "causal mediation analysis" with treatment by mediator interaction using PROCESS. *Canadian Centre for Research Analysis and Methods Technical Report.*

Hulme, C., & Mackenzie, S. (2014). *Working memory and severe learning difficulties (PLE: Memory)*. Psychology Press. https://doi.org/10.4324/9781315795737.

Hussong, A. M., Benner, A. D., Erdem, G., Lansford, J. E., Makila, L. M., Petrie, R. C., & SRA COVID-19 Response Team. (2021). Adolescence amid a pandemic: Short-and long-term implications. *Journal of Research on Adolescence*, *31*(3), 820-835.https://doi.org/10.1111/jora.12671.

Jahan, I., Hosen, I., Al Mamun, F., Kaggwa, M. M., Griffiths, M. D., & Mamun, M. A. (2021). How has the COVID-19 pandemic impacted internet use behaviors and facilitated problematic internet use? A Bangladeshi study. *Psychology research and behavior management*, 1127-1138.

Jellinek, M. S., Murphy, J. M., Robinson, J., Feins, A., Lamb, S., & Fenton, T. (1988). Pediatric Symptom Checklist: Screening school-age children for psychosocial dysfunction. *The Journal of pediatrics*, *112*(2), 201-209. https://doi.org/10.1016/S0022-3476(88)80056-8.

Kandell, J. J. (1998). I**nternet addiction** on campus: The vulnerability of college students. *Cyberpsychology & behavior*, *1*(1), 11-17. https://doi.org/10.1089/cpb.1998.1.11.

Keles, B., McCrae, N., & Grealish, A. (2020). A systematic review: the influence of social media on depression, anxiety and psychological distress in adolescents. *International journal of adolescence and youth*, *25*(1), 79-93. https://doi.org/10.1080/02673843.2019.1590851.

Khanbabaei, S., Abdollahi, M. H., & Shahgholian, M. (2022). The predictive role of working memory and impulsivity in internet addiction, an investigation about the mediating role of time perception. *Personality and Individual Differences*, *185*, 111280. https://doi.org/10.1016/j.paid.2021.111280.

Kim, D., & Lee, J. (2021). Addictive Internet Gaming Usage among Korean Adolescents before and after the Outbreak of the COVID-19 Pandemic: A Comparison of the Latent Profiles in 2018 and 2020. *International Journal of Environmental Research and Public Health*, *18*(14), 7275. https://doi.org/10.3390/ijerph18147275.

Klinenberg, E., & Leigh, J. K. (2024). On our own: Social distance, physical loneliness, and structural isolation in the COVID-19 pandemic. *Social Problems*, *71*(4), 1216-1230. https://doi.org/10.1093/socpro/spad003.

Latino, F., Cataldi, S., & Fischetti, F. (2021). Effects of a coordinative ability training program on adolescents' cognitive functioning. *Frontiers in Psychology*, *12*, 620440. https://doi.org/10.3389/fpsyg.2021.620440.

Li, N., Tan, M., Thuma, P. E., & Grigorenko, E. L. (2022). Pediatric symptom checklist-17. *European Journal of Psychological Assessment*. https://doi.org/10.1027/1015-5759/a000707.

Meade, J. (2021). Mental health effects of the COVID-19 pandemic on children and adolescents: a review of the current

research. *Pediatric Clinics*, *68*(5), 945-959.

Meerkerk, G. J., Van Den Eijnden, R. J., Vermulst, A. A., & Garretsen, H. F. (2009). The compulsive internet use scale (CIUS): some psychometric properties. *Cyberpsychology & behavior*, *12*(1), 1-6. https://doi.org/10.1089/cpb.2008.0181.

Pfefferbaum, B. (2021). Challenges for child mental health raised by school closure and home confinement during the COVID-19 pandemic. *Current psychiatry reports*, *23*(10), 65.

Putra, P. Y., Fithriyah, I., & Zahra, Z. (2023). **I**nternet addiction and online gaming disorder in children and adolescents during COVID-19 pandemic: a systematic review. *Psychiatry Investigation*, *20*(3), 196. https://doi.org/10.30773/pi.2021.0311.

Riany, Y. E., & Morawska, A. (2023). Financial and work burden, psychosocial functioning, and family interactions during the COVID-19 pandemic in Indonesia: Effects on child outcomes. *Child Psychiatry & Human Development*, *54*(2), 340-351.

Talis, G. (2022). Internet addiction. *Substance and Non-Substance Related Addictions: A Global Approach*, 99-107.

Teng, Z., Pontes, H. M., Nie, Q., Griffiths, M. D., & Guo, C. (2021). Depression and anxiety symptoms associated with internet gaming disorder before and during the COVID-19 pandemic: A longitudinal study. *Journal of Behavioral Addictions*, *10*(1), 169-180. https://doi.org/10.1556/2006.2021.00016.

Tunney, C., & Rooney, B. (2023). Using theoretical models of problematic internet use to inform psychological formulation: A systematic scoping review. *Clinical child psychology and psychiatry*, *28*(2), 810-830. https://doi.org/10.1177/13591045221104569.

World Health Organization. (2024). *COVID-19 dashboard*. World Health Organization. https://data.who.int/dashboards/covid19/cases. [Accessed: 29 December 2024].

Wolf, K., & Schmitz, J. (2024). Scoping review: longitudinal effects of the COVID-19 pandemic on child and adolescent mental health. *European child & adolescent psychiatry*, *33*(5), 1257-1312.

Yee, R., Carranza, D., Kim, C., Trinidad, J. P., Tobias, J. L., Bhatkoti, R., & Kuwabara, S. (2024). COVID-19 Vaccination Site Accessibility, United States, December 11, 2020–March 29, 2022. *Emerging Infectious Diseases*, *30*(5), 947. https://doi.org/10.3201/eid3005.230357.

Zhang, X., Yang, H., Ma, H., Teng, C., Wang, H., Diao, K., & Zhang, N. (2022). Development of a psychosocial functioning questionnaire for patients with major depressive disorder. *General Psychiatry*, *35*(1). https://doi.org/10.1136/gpsych-2021-100527.

Zhao, Q., Wang, X., Li, S. F., Wang, P., Wang, X., Xin, X., ... & Mao, L. J. (2024). Relationship between physical activity and specific working memory indicators of depressive symptoms in university students. *World Journal of Psychiatry*, *14*(1), 148. https://doi.org/10.5498/wjp.v14.i1.148.

Publisher's Note

The *Nature-Nurture Journal of Psychology* upholds a commitment to academic integrity and ethical publishing practices. The journal maintains a neutral stance concerning jurisdictional claims in published maps, institutional affiliations, and geopolitical boundaries. The views and opinions expressed in published articles are solely those of the authors and do not necessarily reflect the official policy or position of the *Nature-Nurture Journal of Psychology* or its editorial board. The journal adheres to the guidelines of the Committee on Publication Ethics (COPE), ensuring transparency, integrity, and the highest ethical standards in scholarly publishing.