The Relationship between Problematic Technology Use and Mental Health Problems in the COVID-19 Pandemic: A Meta-Analysis

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Article Info	ABSTRACT
	COVID-19 pandemic has had a negative impact on individuals both psychologically and socially. The current research shows that problematic technology use and mental health problems increased during the pandemic period. In this study, studies examining the relationship between problematic technology use and mental health problems in the COVID-19 pandemic were examined and a meta-analysis was conducted. The present meta-analysis focused on the problematic technology use (i.e., internet addiction, smartphone addiction, social media addiction, and game addiction) and mental health problems in the COVID-19 pandemic. Searches were conducted for relevant studies using the ProQuest, PubMed, Science Direct, Scopus, Web of Science, ERIC, and TR Dizin databases. A total of 56 studies met the inclusion criteria. A total of 53,047 participants were reached in these studies. Rosenthal's classic fail-safe N analysis reveals that the meta-analysis result is statistically significant (p=.000). Moreover, the fact that the Begg and Mazumdar rank correlation is not significant indicates the absence of publication bias (p=0.28). In addition, no missing studies were found in Duval and Tweedie's trim and fill analysis. The results demonstrated that problematic technology use was moderately positively correlated with mental health problems (r=0.33, n=53.047). In addition, the Q statistic (1833.059) examined to control heterogeneity shows that all variables are heterogeneous. The results of the I2 statistic (93.4%) show that a high level of heterogeneity has been achieved. This finding shows that problematic technology use was associated with various mental health problems during the pandemic period.

INTRODUCTION

The COVID-19 pandemic, which emerged in Wuhan, China, affected the entire world in a short period of time. The current data show that there have been approximately 627 million confirmed cases and 6 million deaths due to COVID-19 (World Health Organization, 2022b). Especially during the first period of the pandemic, the lack of a preventive vaccine and information on treatment created fear and anxiety among individuals. Nations took numerous measures to reduce the rate of spread of the pandemic (BBC Turkish, 2020; World Health Organization, 2022a). The aim was to reduce the rate of spread of the virus with a number of implementations such as lockdowns, social distancing, mask wearing, and travel restrictions. Although these measures were successful in reducing the spread of the virus, they caused some problems related to individuals' psychological and social lives (Malesza & Kaczmarek, 2020). During this period, the decrease in individuals' social interactions and physical activities created problems such as spending more time with technological tools, loneliness, depression and stress (Akat & Karataş, 2020; Baltacı, Akbulut & Yılmaz, 2021).

During the COVID-19 pandemic, the amount of time individuals spent with technological tools increased significantly (King, Delfabbro, Billieux & Potenza, 2020; Statista, 2021). The increase in the time spent using technological tools may pose a risk in terms of problematic technology use (Block, 2008), because due to the increase in duration, control over technological tools can be lost and the use of these tools can have a negative impact on daily life (Caplan, 2010). Studies conducted in different countries reveal that during the pandemic period, the prevalence of problematic technology usage behaviors such as internet addiction, game addiction, and smartphone addiction increased (Duan et al., 2020). In a study conducted in China, it was reported that the symptoms of internet addiction and the length of time spent on the internet increased during the pandemic period (Sun et al., 2020). In another study, it was observed that during this period, the rate of internet use among children and adolescents increased and that approximately 36% of participants were problematic internet users (Dong, Yang, Lu, & Hao, 2020). In a study conducted with a Mexican sample, it was observed that 62.7% of participants were at risk of internet addiction (Priego-Parra et al., 2020). In addition to these, studies conducted with samples in Germany (Lemenager et al., 2021), the UK (Fernandes, Maia & Pontes, 2019), Turkey (Baltacı, Akbulut & Zafer, 2020), Indonesia (Siste et al., 2020), Taiwan (M. P. Lin, 2020), India (Prakash, Yadav & Singh, 2020), Spain (Gómez-Galán, Martínez-López, Lázaro-Pérez & Sarasola Sánchez-Serrano, 2020), and Italy (Panno, Carbone, Massullo, Farina & Imperatori, 2020) reported that problematic technology usage behaviors were common during the COVID-19 pandemic. The increase in the prevalence of problematic technology use negatively affected the psychological lives of individuals (Dong et al., 2020).

The decrease in social interaction during the pandemic period and the increase in the length of time spent with technological tools caused individuals to be more exposed to the psycho-social effects of the pandemic (Benke, Autenrieth, Asselmann & Pané-Farré, 2020). During this period, mental health experts stressed the importance of interaction with family members, performing physical activities, and engagement within the framework of social skills and hobbies in order to protect and strengthen psychological health, because due to the emergence of the pandemic, uncertainty about the future, catching the disease and deaths from the disease caused individuals to experience depression, anxiety and stress (Baltacı, Akbulut & Yılmaz, 2021; Chen et al., 2020; Jiang, 2020). In a longitudinal study conducted in Spain, it was observed that participants' levels of depression, anxiety and stress increased during the pandemic (Planchuelo-Gómez, Odriozola-González, Irurtia & de Luis-García, 2020). In another study in the UK revealing the prevalence of psychological symptoms before and during the pandemic, the prevalence of psychological symptoms increased from 18.9% to 27.3% (Pierce et al., 2020). These studies can reveal the negative effects of the pandemic on individuals' psychological health. Furthermore, the proliferation of problematic technology usage behaviors, which are a risk factor that can negatively affect mental health during the pandemic period, may cause individuals to

further experience psychological symptoms such as depression, anxiety and stress (Dong et al., 2020; Priego-Parra et al., 2020). Studies have revealed that there are relationships between problematic technology use and psychological factors such as fear of COVID-19 (Elhai, Yang, McKay & Asmundson, 2020; Hashemi et al., 2020), depression (Dong et al., 2020), stress (Chen, Chen, O'Brien, Latner & Lin, 2020), sleep problems (Priego-Parra et al., 2020), symptoms on the SCL-90 checklist (Siste et al., 2020), neuroticism (M. P. Lin, 2020), and loneliness (Alheneidi, AlSumait, AlSumait & Smith, 2021).

If we can look at the relationship between problematic technology use and mental health problems in the COVID-19 pandemic, this can be of benefit to researchers and mental health professionals. Within this scope, studies examining the relationship between problematic technology use and mental health problems in the COVID-19 pandemic have been examined and a meta-analysis has been conducted. Although there are many studies examining the relationship between these two important variables, the lack of any research aimed at meta-analysis of these studies constitutes the strength and originality of this study.

METHOD

The study was carried out by following these steps: selection of the studies, coding of the data, preparation of the data for analysis, determination of the analysis model, and interpretation of the analysis results.

Selection of Studies

In meta-analysis studies, it is important to conduct the literature search process systematically in order to prevent publication bias (Berman & Parker, 2002). In the research, the selection criteria were determined for the selection of the studies, and the studies to be included in the meta-analysis were selected using the PRISMA protocol. In the research, the terms "internet addiction", "problematic internet use", smartphone addiction", "problematic smartphone use", "social media addiction", "problematic social media use", "game addiction" and "Instagram addiction" were used as the variables of problematic technology use. The terms "depression", "stress", "anxiety", and "psychological distress" were used as the variables of mental health problems. The literature search in the study was carried out in the ProQuest, PubMed, Science Direct, Scopus, Web of Science, ERIC, and TR Dizin databases. The following search string was used in the study: (("internet addiction" OR "problematic internet use" OR "smartphone addiction" OR "problematic smartphone use" OR "social media addiction" OR "problematic social media use" OR "game addiction" OR "Instagram addiction") AND (depression OR stress OR anxiety OR "psychological distress") AND (COVID-19 OR coronavirus)). Following the literature search, correlation studies examining the relationship between problematic technology use and mental health problems were selected. In addition, care was taken to ensure that the effect sizes were calculable in these studies. Only studies conducted in English and Turkish were included in the study. The final date of the search was 27 May 2022. After applying these criteria, 56 studies for inclusion in this meta-analysis yielded a total of 121 effect sizes (see Figure 1 for a flow diagram).

Coding of Data and Preparation of Data for Analysis

The 56 different studies to be examined within the scope of the research were coded and prepared for analysis. The coding process was performed with the study name, correlation coefficients and sample size variables. To ensure consistency in the coding process, the researchers held discussions between themselves.

Determination of Analysis Model and Interpretation of Analysis Results

Correlations were utilized to calculate the effect sizes for the relationship between problematic technology use and mental health problems during the COVID-19 pandemic. Within this scope,

numerical data related to individual effect size values, the combined effect size value, and publication bias for all studies included in the analysis were calculated with Comprehensive Meta-Analysis (CMA) software. A random-effects model was used as the meta-analysis model in the study. Begg and Mazumdar rank correlation, Duval and Tweedie's trim and fill, and Rosenthal's classic fail-safe N tests were used to determine the presence or absence of publication bias in the studies (Borenstein, Hedges, Higgins & Rothstein, 2011). In addition, Cochran's Q statistic (1954) and I2 statistic analyses were used to control for heterogeneity. During the analysis process, the correlation values were converted to Fisher Z values and the analyses were performed on these values. In the process of evaluating the analysis findings, these were converted into correlation coefficients and interpretations were made on these values. In the interpretation of correlation coefficients, Cohen et al. (2007) used values and ranges. Accordingly, correlation coefficient effect sizes are interpreted as follows: between .00 and .10 = very small, between .10 and .30 = small, between .30 and .50 = medium, between .50 and .80 = large, and .80 and above = very large.

RESULTS

Scope of the Studies

A total of 121 effect size values were calculated from the 56 different studies included in the meta-analysis. A total of 53,047 participants were reached in these studies. The studies were conducted in 21 different countries: Bangladesh, Brazil, Canada, China, Egypt, Germany, Iran, Israel, Italy, Jordan, Lithuania, Malaysia, Pakistan, Poland, Saudi Arabia, Thailand, Tunisia, Turkey, the United Kingdom, the United Arab Emirates, and the United States. All of the studies employed appropriate statistical methods.
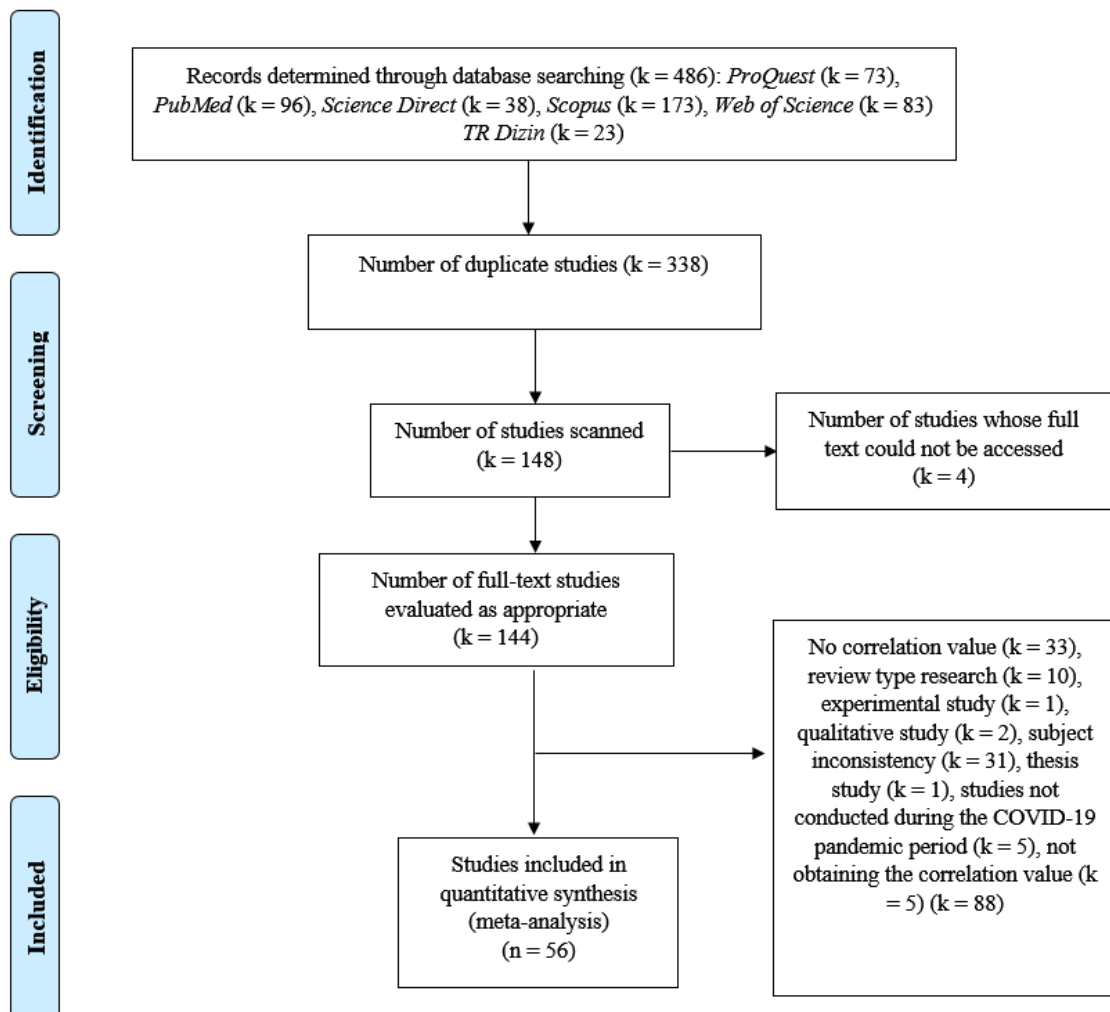

Figure 1. *PRISMA flow diagram of study selection*

Publication Bias

Following Rosenthal's classic fail-safe N, Begg and Mazumdar rank correlation, and Duval and Tweedie's trim and fill analyses, which were performed to determine the presence or absence of publication bias in the studies, it was seen that there was no publication bias. Table 1 shows the results of the confidence tests performed to evaluate the existence of publication bias in the studies.

Table 1. *Results of confidence tests for analysis of publication bias*

Confidence Tests	Confidence Test Data	
Rosenthal's classic fail-safe N	Z-value for observed studies	104.75425
	P-value for observed studies	0.00000
	Alpha	0.05000
	Tails	2.00000
	Z-value for alpha	1.95996
	Number of observed studies	121.00000
	Number of missing studies that would bring p-value > alpha	-5526.00000
Begg and Mazumdar rank correlation	Tau	-0.06643
	Z-value for tau	1.07982
	P-value (1-tailed)	0.14011
	P-value (2-tailed)	0.28022
Duval and Tweedie's trim and fill	Studies trimmed	0
	Point estimate	0.33525
	Lower limit	0.31347
	Upper limit	0.35668
	Q value	1833.05891

Rosenthal's classic fail-safe N analysis reveals that the meta-analysis result is statistically significant (p=.000). Moreover, the fact that the Begg and Mazumdar rank correlation is not significant indicates the absence of publication bias (p=0.28). In addition, no missing studies were found in Duval and Tweedie's trim and fill analysis. These results show that there is no publication bias in the meta-analysis results.

In addition to these, clues about publication bias can be obtained with a funnel plot. In Figure 2, it can be seen that the individual effect sizes of the studies examined within the scope of the meta-analysis are mostly clustered inside the funnel and symmetrically. In addition, it can be seen that the overall effect size of the studies is clustered around the middle line. The funnel scatter plot shows that there is no publication bias related to the studies examined within the scope of the research. In sum, the results show that there is no publication bias.
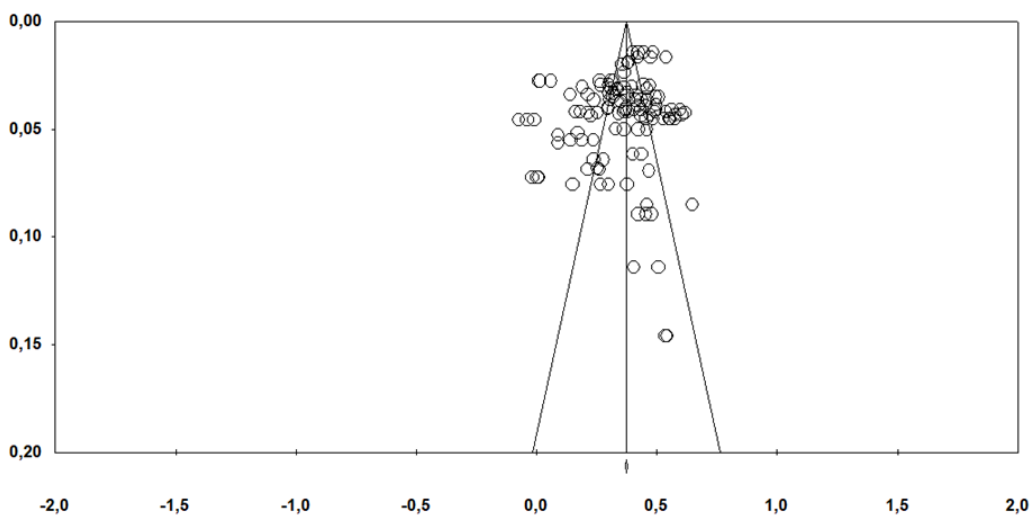

Figure 2. *Funnel plot*

Results of meta-analysis

The values in Table 2 were found in the meta-analysis performed to examine the relationship between problematic technology use and mental health problems in the COVID-19 pandemic. Table 2 shows the total number of independent correlation coefficients (k), total sample size (N), mean weighted effect size (r), and homogeneity statistics for relationships between problematic technology use and mental health problems.

Table 2. *Results of the meta-analysis for relationships between problematic technology use and mental health problems*

Variable	k	N	r	95% CI	Q	I^2 (%)
Mental health problems	121	53047	0.34	[0.32, 0.37]	1833.059	93.4

k: number of study outcome; N: total sample size; r: effect size; CI: confidence interval; Q: Cochran's homogeneity statistic; I^2: Measure of heterogeneity.

When Table 2 is examined, it can be seen that problematic technology use is moderately positively correlated with mental health problems (r=0.34). In addition, the Q statistic (1833.059) examined to control heterogeneity shows that all variables are heterogeneous. The results of the I^2 statistic (93.4%) show that a high level of heterogeneity has been achieved.

DISCUSSION

Together with the emergence of the COVID-19 pandemic, a great many studies have been conducted on the psychological and social impacts of the pandemic. In the literature, there are many studies examining the relationship between problematic technology use and mental health problems during this period (Arpaci et al., 2022; Bottesi et al., 2022; Chang et al., 2022; Hao, Jin, Huang, & Wu, 2022). In the current study, a meta-analysis of studies examining the relationships between problematic technology use (i.e., internet addiction, problematic internet use, smartphone addiction, problematic smartphone use, social media addiction, game addiction, and Instagram addiction) and mental health problems (i.e., depression, anxiety, stress, and psychological distress) during the pandemic period has been carried out. The research is among the first studies aiming to carry out a meta-analysis of the relationship between these two variables during the pandemic period. The study includes 56 different studies and 53,047 individuals.

In the study, it was found that problematic technology use (i.e., internet addiction, problematic internet use, smartphone addiction, problematic smartphone use, social media addiction, game addiction, and Instagram addiction) was moderately positively correlated with mental health problems (i.e., depression, anxiety, stress, and psychological distress) (r=0.33). This finding shows that there was a significant relationship between problematic technology usage behaviors and mental health problems during the COVID-19 pandemic. Studies conducted prior to the pandemic revealed positive and significant relationships of internet addiction, smartphone addiction and social media addiction with depression, anxiety and stress (Akın & Iskender, 2011; Y. J. Lin, Hsiao, Liu & Yen, 2019). In a meta-analysis study conducted by Ho et al. (2014), relationships between internet addiction and psychiatric comorbidity were examined. In their study, it was observed that mental health problems such as alcohol addiction, attention deficit and hyperactivity, depression and anxiety were associated with internet addiction. In a different meta-analysis study, a significant moderate positive relationship was found between internet addiction and depression and loneliness (Tokunaga, 2017). Together with the emergence of the pandemic, individuals' social interactions in their daily lives decreased and they began to spend more time with technological tools (Statista, 2021). This situation created a risk in terms of individuals' problematic technology usage behaviors (Duan et al., 2020). Negative psycho-social effects, both caused by the pandemic and resulting from problematic technology use, had a significant impact on individuals' psychological lives (Dong et al., 2020). Therefore, it can be said that there may

be stronger relationships between problematic technology use and mental health problems in this period compared to the pre-pandemic period. The finding of a significant moderate positive relationship between problematic technology usage behaviors and mental health problems in our study supports the literature.

Conclusion

In the study, a significant moderate positive relationship was observed between problematic technology usage behaviors and mental health problems during the COVID-19 pandemic. The finding regarding the prevalence of problematic technology usage behaviors during the pandemic period and the fact that these behaviors have an important relationship with mental health problems can be of significant benefit to mental health professionals. It is important to implement intervention and prevention programs for individuals of all age groups in the post-pandemic period. Furthermore, by bringing together 56 studies examining the relationship between problematic technology use and mental health problems during the pandemic period and carrying out a meta-analysis, it is thought that the research can contribute to the literature and be of benefit to researchers.

Limitations, Implications, and Future Research

This study is unique in that it carries out a meta-analysis of studies examining the relationship between problematic technology use and mental health problems during the pandemic period. However, the study has some limitations. Firstly, only research articles published in English and Turkish were examined in this study. However, there may be different research articles or postgraduate theses other than those in English and Turkish, in which the relationship between the two variables is examined. Secondly, although the scanning process of the research was carried out from the university database, there may be some studies that could not be accessed in the relevant databases. Thirdly, incomplete data and selective reporting of results of studies in the analysis may have led to an overestimation of mean effect size. Fourthly, frequently studied variables of problematic technology usage behaviors and mental health problems were examined in the research. Therefore, it is recommended that other researchers focus on problematic technology usage behaviors and mental health problems that are not discussed in this study. Despite these limitations, this study provides important information on the relationship between problematic technology use and mental health problems during the COVID-19 pandemic. Considering that problematic technology use is associated with mental health problems, it can be said that it may be important to provide effective guidance and psychological counseling services aimed at preventing problematic.

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