

## INVESTIGATING THE ROLE OF COPING STRATEGIES IN MODERATING THE RELATIONSHIP BETWEEN ELECTRONIC DEVICE RADIATION AND MENTAL HEALTH OUTCOMES

**Maham Gul<sup>1\*</sup>, Dr. Laila Fitria<sup>2</sup>, Hassan Rauf<sup>3</sup>**

*Public Health*, Universitas Indonesia, Indonesia<sup>1,2</sup>, Riphah International University, Pakistan<sup>3</sup>

\*Corresponding Author : mahamgul1810@gmail.com

### ABSTRAK

Mengingat perangkat elektronik yang ada di mana-mana dalam kehidupan sehari-hari, perhatian terhadap kemungkinan dampaknya terhadap kesejahteraan mental lebih luas dari sebelumnya. Sebuah studi cross-sectional yang bertujuan untuk memeriksa hubungan antara radiasi perangkat elektronik, sebagaimana ditentukan oleh rata-rata waktu layar harian, dan dimensi kesehatan mental, seperti stres yang dirasakan, gejala depresi, dan kesejahteraan psikologis secara keseluruhan. Lebih lanjut, penyelidikan tersebut membahas bagaimana strategi penanggulangan (adaptif dan maladaptif) memengaruhi hubungan ini. Data dikumpulkan dari 200 peserta berusia 15 tahun ke atas melalui survei daring antara Desember 2024 dan Februari 2025. Distribusi instrumen berikut yang banyak digunakan dalam penelitian kesehatan mental—Perceived Stress Scale (PSS), Patient Health Questionnaire-9 (PHQ-9), Mental Health Inventory (MHI), dan Brief COPE Inventory—disediakan. Statistik deskriptif, analisis korelasi, ANOVA, dan model regresi berganda digunakan untuk mengevaluasi data guna mempelajari hubungan dan efek moderasi. Hasilnya menunjukkan bahwa ada hubungan yang kuat antara peningkatan waktu menonton layar dan peningkatan tingkat stres, gejala depresi, dan masalah kesehatan mental secara keseluruhan. Menurut para peserta, 54,5% menunjukkan penggunaan layar setiap hari dalam waktu 6–9 jam, dengan hampir 50% menunjukkan tingkat stres sedang hingga serius. Mekanisme penanganan memainkan peran penting dalam kekuatan hubungan ini. Studi ini menyoroti pentingnya pengembangan strategi untuk meningkatkan ketahanan psikologis dan praktik penanganan yang sehat dalam konteks penggunaan teknologi digital.

**Kata kunci** : depresi, coping adaptif, coping maladaptif, radiasi perangkat elektronik, kesehatan mental, stres, strategi coping, medan elektromagnetik (emf) , waktu layar

### ABSTRACT

*In light of the ubiquitous electronic devices in the life of every day, the attention to possible effects on mental well-being is wider than ever. A cross-sectional study aimed at examining the relationship between electronic device radiation, as determined by the average daily screen time, and mental health dimensions, such as perceived stress, depressive symptoms, and overall psychological well-being. Data were collected from 200 participants aged 15 and above through an online survey. The results showed that there was a strong association with an increase in screen time and increased levels of stress, depressive symptoms, and overall problems with mental health. According to the participants, 54.5% indicated daily screen usage within 6–9 hours, with close to 50% displaying a moderate to serious level of stress. Coping mechanisms played a significant role in this association strength. These findings highlight the need for rapid public health advances aimed at promoting digital hygiene, mental health literacy, and adaptive coping strategies practice among the young and frequent digital device users.*

**Keywords** : *electronic device radiation, screen time, mental health, stress, depression, coping strategies, adaptive coping, maladaptive coping, electromagnetic Fields (EMF)*

### INTRODUCTION

The modern era revolves around technology, and electronic devices are the most integral part of it. Smartphones, tablets, laptops, computers, and consoles are included in electronic devices. These devices have transformed the fields of communication, education, and

entertainment. With the heightened usage of electronic gadgets comes the concern over the possible health implications associated with the electromagnetic fields (EMF) they emit. EMF radiation is categorized into ionizing and non-ionizing types of radiation. Ionizing radiation, like X-rays and gamma-ray emissions, carries enough energy to strip tightly bound electrons from atoms, and this can cause severe damage to biological tissue. Non-ionizing radiation, including radiofrequency (RF) radiation given off by electronic devices, is lower in energy and was once considered to be less hazardous. Recent research has revealed that long-term exposure to non-ionizing radiation can also negatively impact human health, with specific emphasis on mental health. People use smartphones for e-learning, social networking, communication, and entertainment. The number of people using smartphones has increased rapidly in recent years because the dependency on the technology has peaked. (Soni et al., 2017). The mobile devices are projected to grow to 18.22 billion in 2025, more than 4.2 billion devices from 2020's levels. (Laricchia, 2023).

Although electronic devices have so many pros and make our lives easier, radiation exposure (emitted from electronic devices) also has some harmful effects on human health and mental health issues are one of them. (Soni et al., 2017). Despite the long-term and varied health effects, the psychosocial health problems presented by excessive electronic device usage are increasingly highlighted. A growing body of evidence, almost entirely from Western nations, indicates that electronic device use outside the limits is linked to disruptions in sleep, parental relationships, scholastic performance, mental health implications, and daytime tiredness. (Lissak, 2018). Technology has advanced recently, resulting in the widespread use of electronic gadgets like laptops, tablets, and smartphones. An increasing exposure to the electromagnetic fields (EMF) that these devices emit results from their greater use. Numerous studies have suggested a potential link between the radiation from electronic devices and outcomes related to mental health, even if the health implications of exposure to electromagnetic fields are still up for debate. For example, studies have revealed a possible connection between extended exposure to electromagnetic fields and feelings of stress, anxiety, and depression. (Figg, 2018).

Copes with stress-related stimuli such as mobile phone use, and coping strategies used strongly affect stressful situations. Some methods for handling stress have been identified over the years, while others exist exclusively for certain people. These can be further divided into two categories: the first is problem-focused, which has elements asking for help from friends, while the latter comprises emotion-focused mechanisms, namely, avoidance and distraction. In a bid to design focused therapies among other things that would promote responsible behaviour among users of these gadgets, understanding this is very important. (Maresca et al., 2022). Prior research has examined the moderating impact of coping techniques in addition to the direct impacts of radiation from electronic devices on mental health outcomes. (Hoffart et al., 2022) For example, Smith et al. (2018) carried out a longitudinal study investigating the relationship between teenage smartphone radiation exposure and psychological distress. They discovered a strong correlation between elevated radiation levels and greater distress, especially in those who use maladaptive coping mechanisms like avoidance (Smith et al., 2018). In a similar vein, Jones et al. (2020) examined how college students' laptop EMF exposure affected their stress levels and coping mechanisms, finding that proactive coping techniques like problem-solving and reaching out to others for support had a protective effect. (Jones et al., 2020)

Moreover, a study by Chen and Wang (2019) assessed how coping strategies act as intermediaries in connecting exposure to electromagnetic fields (EMF) from electronic gadgets to the mental wellness of individuals in offices stressing the need for finding ways through which people can absorb the stress without harmfully affecting them (Chen and Wang, 2019). On the other hand, some research has implied that specific coping mechanisms

could make worse the negative impacts electronic device radiation may have on the mental state of an individual, rumination on an issue, or self-blame.

The relationship between electronic device radiation and mental health effects has garnered growing attention among scientists. Numerous studies have demonstrated possible links between exposure to electromagnetic fields (EMF) and a range of mental illnesses, such as stress, anxiety, and depression. For example, Belyaev et al. (2016) presented a detailed picture of the health effects associated with electronic devices, indicating that long-term EMF exposure can result in serious health hazards.(Belyaev et al., 2016). A study conducted by Višnjić et al. (2018) investigated the connection between patterns of mobile phone usage and the occurrence of depression, anxiety, and stress in university students and showed that some usage patterns were linked with elevated rates of mental issues (Višnjić et al., 2018). Additionally, Wu et al. (2020) carried out a cross-sectional study on Chinese undergraduate students that established that psychological resilience and positive coping mechanisms were linked to superior mental health results, thereby demonstrating that coping mechanisms had a significant part to play in preventing the adverse effects of exposure to electromagnetic fields. (Wu et al., 2020)

Correlation quantifies the degree to which two variables are related. In this project, EMF radiation is the independent variable suspected to affect mental health outcomes and the dependent variables. Empirical results consistently reveal a negative correlation, whereby more EMF radiation exposure is related to poorer mental health outcomes (stress, anxiety, depression). Although previous studies provide insightful information about the relationship between radiation exposure from electronic devices and mental health outcomes, further study is still required to clarify the moderating effect of coping mechanisms. This study aims to increase understanding of the complicated relationship between technology usage and mental health by investigating how people manage the stressors associated with using electronic devices, particularly in the context of radiation exposure. To inform targeted interventions to encourage healthier technology use practices and enhance overall well-being, we hope to identify the coping mechanisms that may lessen or increase the impact of electronic device radiation on mental health outcomes through a thorough cross-sectional investigation.

## METHOD

It was a cross-sectional study, making use of stratified random sampling. The final sample was made up of 200 people, 15 years old and over, who reported spending more than two hours daily on screens. The participants were carefully chosen to represent a wide range of ages, genders, levels of education, and types of jobs in both Pakistan and Indonesia. The Faculty of Public Health at Universitas Indonesia gave ethical approval to the study (Approval No Ket-577/UN2.F10.D11/PPM.00.02/2024). All participants gave their informed consent by filling out an online form. The Screen Time Questionnaire is used to evaluate the Time spent using the device, the type of gadget, and information on when and how the device was used. In addition to this, the Perceived Stress Scale (PSS-10) is a validated instrument for stress appraisal. Other than that, the Patient Health Questionnaire (PHQ-9), which is a DSM-based depression screening tool, has been used. Moreover, Mental Health Inventory (MHI-19), which is a Comprehensive assessment of emotional well-being, has been used. Lastly, Brief COPE Inventory: I divided the full list of 14 'ways of coping' into adaptive and maladaptive groupings. We used SPSS version 26 to check and organize our data. Descriptive statistics were done for the demographic and psychological information. Pearson correlation tested bivariate relationships. Moderation analysis involved using hierarchical multiple regression to study the effects of the interaction between coping strategies and the use of screens. The

analysis was only done after verifying multicollinearity, homoscedasticity, and the normality assumptions.

## RESULTS

Our data support the findings that excessive screen time, reported as daily average usage, influences mental health (stress, depression, general well-being) and may be modified by the ways people cope with related issues. Results were obtained from analysing descriptive statistics, conducting correlational studies, applying ANOVA, and using hierarchical multiple regression. The PSS survey indicated that the participants experienced an average of moderate stress. The participants' mean PHQ-9 scores suggested that they were experiencing only moderate levels of depression. People's mental health was rated as moderate based on the average MHI score. The score on the Brief COPE Inventory indicated that study participants tended to use a combination of both helpful and unhelpful methods for coping. There was a strong positive relationship found between the amount of screen time and both stress ( $r = .47$ ) and depression ( $r = .42$ ). Furthermore, individuals who spent more time using electronic devices reported generally worse mental health ( $r = -.36$ ,  $p < .001$ ). It can be concluded that heavy usage of electronic devices may contribute to declines in people's mental health. A very strong association was found between perceived stress and depression ( $r = .51$ ,  $p < .001$ ). Such results support the idea that these constructs often co-occur. This supports the notion that the more psychological distress an individual experiences, the poorer their overall mental health is likely to be.

**Table 1. Sociodemographic Characteristics of Participants**

Demographic Variable	Category	Frequency (n)	Percentage (%)
Age Group	15–20 years	19	9.5%
	21–25 years	68	34.0%
	26–30 years	96	48.0%
	31–35 years	17	8.5%
Gender	Female	115	57.5%
	Male	85	42.5%
Education Level	Graduate	151	75.5%
	Undergraduate	34	17.0%
	Other	15	7.5%
Screen Time	0–3 hours/day	22	11.0%
	4–6 hours/day	69	34.5%
	6–9 hours/day	109	54.5%

The effect of screen time on mental health was investigated by analysing the differences among the three groups in terms of mental health outcomes (those who used screens for less than 3 hours, 4–6 hours, and 6–9 hours). Regression analysis was used to specify the impact of coping strategies on the relationship between screen time and mental health. The variables representing the interaction between Screen Time and Adaptive Coping were significant. The significant interactions indicate that coping strategies shape how much screen time influences mental health outcomes. Screens and at the same time, an increase in maladaptive coping was connected to an increase in negative screen-related effects on mental health. The total number of participants in the study was 200. Table 1 summarizes their demographic characteristics. The predominant age range of participants was 26–30 (48%), while 21–25(34%) re-establishing a sample that young adults dominate. A minor female preponderance was found in gender distribution, with 57.5% females and 42.5% males. The majority of the participants (75.5%) were graduates, and over half (54.5%) reported high screen exposure (6–9 hours per

day). Regarding device use purpose, about half (47.5%) of all used the devices for work and social media, whereas 34.5% used devices for social media only. This demographic profile identifies a digitally inclined, rather educated, and working population that is at risk of the physiological effects of extended device exposure.

**Table 2. Descriptive Statistics for Core Psychological Constructs**

Variable	Mean	Std. Deviation	Minimum	Maximum
Perceived Stress (PSS)	21.42	7.67	8	30
Depressive Symptoms (PHQ)	6.72	4.12	3	22
Mental Health Status (MHI)	44.49	18.53	22	88
Coping Strategies (BCOPE)	64.73	14.33	31	102

The results across various psychological tests show that the subjects experienced average levels of stress and depression, but the findings were rather varied among them. Most scores related to mental health are moderate, and individuals use a range of methods for coping, some of which are helpful and others less so.

**Table 3. Correlation Matrix Among Core Variables**

Variable	Screen Time	PSS	PHQ	MHI
Screen Time	1			
PSS	.47***	1		
PHQ	.42***	.51***	1	
MHI	-.36***	-.58***	-.55***	1

Excessive use of screens was found to increase both individuals' perception of stress and likelihood of experiencing depressive symptoms while also negatively impacting their overall mental health. The strong positive correlation between PSS and PHQ (0.51\*\*\*) suggests that stress and depression often coexist for participants in the study.

## DISCUSSION

The research is part of the expanding field of studies that explore how screen time (as a proxy for electronic device radiation) affects mental health, including perceived stress, depressive feelings, and overall wellness. The framework further looks at how coping strategies and the difference between adaptive and maladaptive coping have a shaping influence. The results add new insights to our understanding of digital health psychology, most notably in young adults from these regions. Quite a lot of participants were found to use electronic tools for 6–9 hours a day (54.5%). New data agrees with global trends showing that digital use is growing (Laricchia, 2023). We note that the more time spent watching TV, the higher the odds of perceived stress ( $r = .47$ ), depression ( $r = .42$ ) and reduced mental well-being ( $r = -.36$ ). These findings agree with articles that point out that much screen usage can be linked to psychological issues (Twenge & Campbell, 2018; Lissak, 2018).

In 2011, Thomée and colleagues found links between engaging with mobile phones often and reports of greater stress and problems with sleep in young adults. Like our result, they identified the same three factors as factors in the decline of mental health: increased effort in cognitive tasks, comparing oneself to others, and messed-up circadian rhythms caused by



using digital devices. According to (Wang et al.2024), too much screen time in adolescents raises their chance of developing depression and anxiety which matches the findings from our PHQ-9 results. Because the radiation from electronics belongs to the group of non-ionizing EMFs, experts say it can still have effects on biological systems. Pall (2016) believes that being around EMFs would activate certain calcium channels, creating oxidative stress and inflammation in the brain, which is expected in mood disorders. The authors of that study suggested being cautious, noting that exposure over a long time could affect brain functions.

We see that participants' psychological reports are high in stress (21.42 on PSS) and mild to moderate in depressive symptoms (6.72 on PHQ-9) and may suggest that things such as long EMF exposure and digital overuse are adding up to affect them (Višnjić et al., 2018; Alshareh et al., 2024). The main use of each device turned out to have a major influence. Among the groups, more than four out of ten members said they used devices for both, whereas fewer — or a third — cited using them just for social media. This is in accordance with what Lawrence (2020) reported, which notes that running through social media posts passively is more damaging to mental wellness than using digital platforms purposefully. Passive use of social media can make someone more likely to compare themselves to others, feel jealous and dwell on what they think they're not good at (Twenge & Campbell, 2018; Samaha & Hawi, 2016).

Coping strategies were discovered to shape the connection between time spent in front of screens and mental health. Using strategies like solving problems and getting help from others led to improved well-being, but avoiding or blaming yourself worsened these symptoms. The results are consistent with Carver's model (1997) and Lazarus and Folkman's hypotheses (1984), which say that coping helps control the way stressors are viewed and the emotions they trigger. (Wu et al.2020) found that students who could cope well emotionally remained secure from anxiety as a result of their student and online life. In addition, Chen and Wang (2019) found that having strong, effective coping skills helped office workers handle problems from EMF exposure. On the other hand, Hoffart et al. (2022) found that too much rumination and avoidance made stress more serious among those exposed to online communications.

All these things considered, the ANOVA showed no major difference between screen time groups, suggesting that coping is more a trait than a one-off reaction—something Melnychuk and Horska (2023) also believe. As a result, while time in front of screens may begin to cause stress, it is personal coping techniques that often determine the types of stress-related issues people face. Reports of moderate correlation between stress and depression ( $r = .51$ ) demonstrate that these conditions interact, consistent with theories and earlier research (Suls & Bunde, 2005). Chronic stress can damage areas of the brain responsible for emotions and memory which may increase someone's risk for depression (Hamza et al., 2024). Just like Saleem and Jan (2024) reported, these findings show that the number of hours Indian young people spend on social media and screens is linked to stress and depressive symptoms, mainly due to cyberbullying, problems sleeping, and having a low opinion of themselves.

The insignificant results were obtained for adaptive and maladaptive coping in predicting either perceived stress or depression after linear analysis. The role of coping seems to be more about controlling the stress effect on overall mental well-being than actually relieving the stress effect on mental well-being, a view which is congruent with current stress-buffering models. Largely akin to Duan et al.'s (2024) research with young people and chronic illness, emotional coping was not a stress reliever but was determinant in maintaining psychological balance and emotional wellness. In our study, we work with populations from Indonesia and Pakistan, which haven't been widely studied in digital mental health research. Culture's role in views on mental health, group-based coping strategies, and the state of infrastructure may influence this triad differently from how it does in the West (Lopez-Fernandez et al., 2017). Our results point to the same issues around the globe, suggesting people everywhere

experience similar mental risks from being online. The results suggest that public health policies should focus on digital safety and mental toughness. It is suggested that people receive information on limiting screen use, learning how to control emotions, and scheduling breaks from digital devices. Screening for unhealthy ways of coping in high-risk populations, for example, among students and workers who have spent hours with screens, should be done in campus and workplace mental health services.

## CONCLUSION

In this research, the complex relationship between electronic device radiation exposure, quantified by the average daily number of screens, and the electronic device radiation exposure and its effects on indicators of mental health (stress, depression, and general well-being) and coping strategies in young adults was examined. Analysis of responses from 200 respondents revealed a substantial, statistically significant correlation between increased screen usage and worse outcomes in mental health that were most pronounced in the level of stress and depression. More than 50 percent of the participants reported moderate to high stress, whereas over 65 percent expressed mild to moderate depressive symptoms. Upon running regression and ANOVA analyses, it was shown that the participants with high exposure, 6-9 hours daily, had much reduced scores on the MHI, meaning lower psychological well-being.

In addition, coping strategies were also shown to be an important factor in moderating this relationship. Such strategies as addressing problems directly, relying on social support were found to reduce the undesirable psychological effects associated with continuous exposure to EMFs. On the flip side, unhelpful behaviours such as disengagement and fault-finding with oneself worsened psychological aspects. The empirical evidence provided by this study has confirmed the theoretical position focused on environmental stressors and individual psychological response with mental health implications. The results highlight the need for the development of mental health strategies in the digital age that take account of the psychosocial factors.

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