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Problematic Internet Use and Cyberbullying: Does Executive Function Moderate the Association?

Penggunaan Internet Bermasalah dan Perundungan Siber: Apakah Executive Function Mampu Menjadi Pengendali?

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ABSTRACT
The advancement of information and communication technology, along with increased internet use via social media, has contributed to a shift from traditional bullying to cyberbullying. Cyberbullying frequently occurs among adolescents who regularly access the internet and social media through smartphones or computers. Excessive internet use may disrupt daily functioning and contribute to maladaptive online behavior. This study examined whether executive function moderates the association between problematic internet use and cyberbullying tendencies among adolescents. A quantitative cross-sectional survey was conducted among 316 adolescents aged 15–20 years in South Kalimantan, Indonesia (M = 17.61). Participants were selected using purposive sampling. Data were collected using the Cyberbullying Tendency Scale, the Problematic Internet Use Questionnaire Short-Form (PIUQ-SF-6), and the Executive Skills Questionnaire-Revised (ESQ-R). The data were analyzed using Hayes' PROCESS macro. The results showed that executive function moderated the association between problematic internet use and cyberbullying tendencies. However, executive function was not significantly associated with cyberbullying tendencies, and problematic internet use was not significantly associated with cyberbullying tendencies. Executive function serves as a key variable that can either strengthen or weaken the influence of problematic internet use on cyberbullying tendencies, despite not being directly associated with either construct. These results suggest that cyberbullying prevention strategies may be more effective when focused on enhancing cognitive regulation and digital behavior management, particularly among adolescents at risk for problematic internet use.

Keywords: executive function, problematic internet use, cyberbullying, adolescents

ABSTRAK
Seiring perkembangan teknologi komunikasi informasi dan penggunaan internet melalui media sosial, perilaku perundungan secara tradisional beralih ke perundungan siber. Perundungan siber terjadi pada remaja yang aktif menggunakan internet dan media sosial pada perangkat *smartphone* atau komputer dengan koneksi internet, memungkinkan remaja mengalami permasalahan dalam penggunaan internet secara berlebihan sehingga mengganggu aktivitas penting sehari-hari. Penelitian ini bertujuan untuk menguji peran *executive function* sebagai moderator hubungan penggunaan internet bermasalah dengan perundungan siber. Penelitian ini menggunakan pendekatan kuantitatif teknik survey jenis *cross sectional study,* dengan partisipan remaja 15-20 tahun (*M* = 17,61) di Kalimantan Selatan sebanyak 316 orang. Teknik sampling menggunakan *purposive sampling,* pengumpulan data menggunakan skala kecenderungan perundungan siber, *Problematic Internet Use Questionnaire Short-Form (PIUQ-SF-6),* dan *Executive Skills Questionnaire-Revised (ESQ-R)*. Analisis data dengan teknik *Macro Process Hayes*. Hasilnya adalah (1) *executive function* memberikan efek moderasi pada hubungan antara penggunaan internet bermasalah dengan kecenderungan perundungan siber, (2) *executive function* tidak berkorelasi dengan kecenderungan perundungan siber, dan (3) penggunaan internet bermasalah tidak berkorelasi dengan kecenderungan perundungan siber. *Executive function* berperan penting sebagai variabel yang memperkuat atau melemahkan dampak penggunaan internet bermasalah terhadap kecenderungan perundungan siber,

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meskipun tidak berhubungan langsung dengan keduanya. Hal ini berarti pencegahan perundungan siber akan lebih efektif apabila difokuskan pada peningkatan kemampuan regulasi kognitif dan pengelolaan perilaku digital, terutama pada kelompok remaja yang memiliki risiko penggunaan internet bermasalah.

Kata Kunci: *executive function,* penggunaan internet bermasalah, perundungan siber, remaja

INTRODUCTION

Internet access has become an essential part of contemporary life, including in Indonesia. The Indonesian Internet Service Providers Association reported that Indonesia had 221.6 million internet users out of a total population of 279.7 million in 2023 (Penyelenggara Jasa Internet Indonesia, 2024).The largest proportion of users, 34.40%, are individuals aged 12–27 (Generation Z), who primarily use the internet to access social media (3.31%). This age range includes adolescence and early adulthood. Bencsik et al. (2016) argue that Generation Z has grown up with a strong dependence on digital technology. Consequently, adolescents today are proficient in using computer-based and internet technologies in various aspects of daily life and tend to prefer communicating and socializing through social media.

Adolescents use the internet for a variety of activities. Yuniarrahmah and Adiyanti (2019) reported that 63.21% of adolescent participants spent more than three hours per day online. Their online activities included peer communication, social media use (such as Facebook, Instagram, and Twitter), video streaming (such as YouTube), internet browsing, online gaming, e-commerce, music streaming, movie streaming, and blogging. Social media also enables adolescents to express emotions, opinions, frustration, joy, and excitement. This engagement can influence behavioral development, personality formation, educational processes, and learning outcomes. Internet use may therefore support adolescents' adaptation to the digital era by facilitating learning, information access, knowledge sharing, and communication.

Despite these benefits, internet technology exposes adolescents to several risks. These risks include cyberbullying, sexting, sexual predation, privacy violations, and exposure to harmful content (Rudi, 2017). This study focuses on cyberbullying as a major psychosocial risk associated with adolescent internet and social media use. Patchin and Hinduja (2010) define cyberbullying as repeated online behavior that mocks, harasses, or harms others through email, text messages, or unwanted digital content. Cyberbullying commonly involves teasing, insulting, intimidating, or humiliating peers through mobile phones, social media, or other digital technologies. When both the perpetrator and the victim are adolescents, the behavior is classified as cyberbullying. When one party is an adult, the behavior is more commonly categorized as cybercrime, cyberstalking, or cyberharassment (Kowalski et al, 2012).

Cyberbullying negatively affects the psychological development of all parties involved, including perpetrators, victims, and bystanders. Perpetrators are at risk of developing maladaptive behaviors or engaging in criminal acts into adulthood. They may also exhibit difficult personalities, destructive or deviant behaviors, antisocial attitudes, low levels of prosocial behavior, psychological maladaptation, emotional regulation problems, hyperactivity, peer relationship issues, increased substance use, and school-related difficulties such as feeling unsafe, poor academic performance, frequent headaches, and heightened risk of depression and suicidal ideation, which are impacts similar to those experienced by victims (Estévez et al., 2019; Gradinger et al., 2009; Hinduja & Patchin, 2008; Kowalski & Limber, 2013). Victims of

cyberbullying often experience powerlessness, isolation, fear, sadness, depression, social anxiety, and school avoidance (Estévez et al., 2019; Raskauskas & Stoltz, 2007; Weber & William, 2014). Additional effects include difficulty adjusting, learning challenges such as trouble concentrating during lessons (Weber & Pelfrey, 2014), and increased risk of suicidal thoughts or behaviors (Iranzoa et al., 2019; Patchin & Hinduja, 2010).

Cyberbullying is defined as aggressive behavior characterized by verbal violence and actions intended to harm others through digital platforms. From a theoretical perspective, cyberbullying can be understood using Albert Bandura's social cognitive theory, which asserts that behavior emerges from the interaction between internal and external factors. Internal factors refer to personal characteristics developed over time, including cognitive and affective abilities as well as biological influences. In contrast, environmental factors encompass both the physical environment, such as home conditions, food availability, temperature, and air quality, and the social environment, including family, peers, and broader society (Feist et al., 2013). Bandura also emphasizes that individuals learn behavior through observation and imitation. Individuals may observe behaviors exhibited by others and cognitively assess these actions. Individuals observe others' actions, evaluate their consequences, and adopt behaviors that receive reinforcement or social acceptance. In contrast, behaviors that do not receive reinforcement are less likely to be repeated (Feist et al., 2013).

Executive functions refer to the cognitive processes that enable individuals to interpret and respond to observed events. These functions encompass cognitive processes, emotional regulation, and social behavior skills. They are essential for directing, controlling, and managing behavior, including planning, problem-solving, working memory, attention, inhibition, and, at the highest level, self-monitoring and self-assessment. Impairments in executive function can disrupt reasoning, problem-solving, and social interaction (Zillmer et al., 2008). Poor executive function is also associated with careless and poorly regulated behavior (Diamond, 2013).

Deficits in executive function may increase vulnerability to aggressive behavior. Adolescents with weaker executive function may misinterpret social situations or fail to generate effective problem-solving strategies. Unpleasant online interactions may therefore trigger impulsive or aggressive responses (Krämer et al., 2011). Poor inhibitory control can also reduce adolescents' ability to resist impulses that conflict with social norms or personal goals. In addition, limited problem-solving ability can impair adolescents' capacity to produce appropriate responses during interpersonal interactions, thereby increasing the risk of social conflict and aggression (Fatima & Sheikh, 2017).

Previous studies have linked executive function to physical and mental health, academic achievement, and cognitive, social, and psychological development across the lifespan. Poor executive function is associated with a range of adverse outcomes, including diminished physical and mental health, reduced quality of life, lower school readiness, decreased academic performance, and compromised public safety, such as increased risk of criminal behavior, violence, reckless actions, emotional outbursts, and difficulties in managing behavior during social interactions. Individuals with impaired executive function may also experience interpersonal problems and aggressive tendencies (Fatima & Sheikh, 2016). These difficulties can appear as socially inappropriate behavior, weak planning, poor problem-solving, impulsivity, distress, poor judgment, and memory-related problems (Romero-López et al., 2017).

Cyberbullying is closely connected to internet use because digital communication technologies provide the main medium for such behavior. Agatston et al. (2007) found that cyberbullying frequently occurs among students who actively use the internet, social media, smartphones, and home computers.

Excessive internet and social media use may disrupt daily routines and increase the risk of internet-related behavioral problems. This pattern is commonly discussed as problematic internet use.

Problematic internet use is a multidimensional syndrome characterized by maladaptive emotional, behavioral, and cognitive symptoms that interfere with daily functioning when individuals are offline (Caplan, 2003). The concept of problematic internet use extends beyond the duration or frequency of internet access. It also concerns how individuals perceive the internet, regulate internet use in daily routines, and experience psychological consequences of online behavior (Caplan, 2003; Koronczai et al., 2011; Meerkerk et al., 2009).

Problematic internet use may contribute to cyberbullying tendencies among adolescents. Adolescents who spend more time online have greater opportunities to engage in digital interactions that may involve cyberbullying (Handono et al., 2019). Previous research has also identified problematic internet use as a significant predictor of cyberbullying behavior among adolescents (Erdur-Baker, 2010; Kircaburun & Bastug, 2016; Nartgün & Cicioğlu, 2015).

This study, therefore, examined whether executive function moderates the relationship between problematic internet use and cyberbullying tendencies. The study also investigated the direct associations between executive function and cyberbullying tendencies and between problematic internet use and cyberbullying tendencies. The alternative hypothesis (Ha) posited that executive function moderates the relationship between problematic internet use and cyberbullying tendencies.

RESEARCH METHOD

This study used a quantitative survey design. A cross-sectional approach was applied to collect data from participants at a single point in time. This design was selected because it allows researchers to examine multiple variables simultaneously within a defined population or representative sample (Sugiyono, 2010).

Participants

This study involved 316 adolescents aged 15–20 years who lived in South Kalimantan, Indonesia (M = 17.61). Participants were eligible if they were high school students or undergraduate students in their first to fifth semester. Participants also had to report active mobile phone or internet use for at least two years. This study used purposive sampling to select participants who met the predefined characteristics of the target population. Data were collected online through a Google Forms questionnaire distributed via social media platforms, including WhatsApp and Instagram.

Measurement Tools

Data were collected using three instruments: the Cyberbullying Propensity Scale, the Problematic Internet Use Questionnaire Short-Form (PIUQ-SF-6), and the Executive Skills Questionnaire-Revised (ESQ-R). The Cyberbullying Propensity Scale was developed to assess behaviors that reflect key characteristics of cyberbullying. These characteristics include repetition, power imbalance, intention to harm, anonymity, and publicity (Fernández-Antelo and Cuadrado-Gordillo, 2018; Kowalski et al., 2012; Ovejero et al., 2016). The scale consists of 25 items, including 15 favorable and 10 unfavorable statements. Participants responded using four options: always, often, rarely, and never. One example item is, “I would send a message containing abusive language via social media if I were angry at someone.”

The PIUQ-SF-6 consists of six items that measure three dimensions of problematic internet use: obsession, neglect, and control disorder (Demetrovics et al., 2016). Participants responded using five options: never, rarely, sometimes, often, and always.

One example item is, “How often do you spend time online instead of sleeping?”

The ESQ-R consists of 25 items that assess five aspects of executive function: plan management, time management, organization, emotional regulation, and behavioral regulation (Dawson & Guare, 2014). Participants responded using four options: never or rarely, sometimes, often, and very often. One example item is, “I have difficulty determining the time needed to complete a task.”

Before data collection, a panel of 10 experts evaluated the content validity of the three instruments. The experts assessed the alignment between the items, indicators, and target variables. They also provided feedback on the wording of the items. The expert assessments were analyzed using Aiken’s V to quantify content validity. Construct validity was further examined using average variance extracted (AVE). The AVE values were 0.677 for the Cyberbullying Propensity Scale, 0.576 for the PIUQ-SF-6, and 0.634 for the ESQ-R.

Reliability was assessed using composite reliability (CR) and Cronbach’s alpha (α). The Cyberbullying Propensity Scale showed strong reliability, with a CR of 0.943 and an α of 0.931. The PIUQ-SF-6 showed acceptable reliability, with a CR of 0.800 and an α of 0.618. The ESQ-R also demonstrated strong reliability, with a CR of 0.907 and an α of 0.904.

Research Procedure

The research procedure followed a systematic sequence: problem identification and goal setting; instrument development; data collection; pilot testing; validity and reliability testing; distribution to participants; data processing using statistical tools; and interpretation of the analysis results, culminating in the formulation of conclusions.

The Cyberbullying Propensity Scale was developed to reflect cyberbullying behaviors based on characteristics identified in previous literature. The instruments for executive function and problematic internet use were adapted from established scales. The content validity of all instruments was evaluated by 10 expert reviewers. These reviewers assessed whether each item represented the relevant indicators and variables. Their assessments were analyzed using Aiken’s V. Further validity was examined using AVE, whereas reliability was tested using CR and Cronbach’s alpha.

Following the completion of instrument development, data collection was conducted by distributing the research questionnaire via Google Forms to participants. The data were analyzed using statistical software in accordance with the established research hypotheses. The analysis results were interpreted to address the research questions and assess the validity of the hypotheses. These conclusions provide a foundation for theoretical development and offer insights into the research variables.

Data Analysis

Quantitative data were analyzed using Hayes’ PROCESS macro. Bootstrapping was applied to examine the conditional effect of executive function on the relationship between problematic internet use and cyberbullying tendencies. Bootstrapping was also used to estimate confidence intervals and effect sizes. All statistical analyses were conducted using IBM SPSS Statistics 27 for Windows.

RESULTS

Descriptive Statistics

The sample consisted of 316 adolescents aged 15–20 years. Participants were high school students and undergraduate students in their first to fifth semester in South Kalimantan, Indonesia. Table 1 presents the demographic characteristics of the participants.

Descriptive analysis was conducted to summarize the distribution of scores for each study variable. Table 2 presents the descriptive statistics for cyberbullying tendencies, problematic internet use, and executive function.

Table 1 Description of Participants

Participant Data	*N*	(%)
Age	(*M* = 17,61; *SD* = 1,472)	-
Sex		
- Male	65	20.57
- Female	251	79.43
Total	316	100
Education Level		
- Tenth grade	46	14.55
- Eleventh grade	53	16.77
- Twelfth grade	38	12.02
- First-semester college student	111	35.12
- Third-semester college student	61	19.30
- Fifth-semester college student	9	2.84
Total	316	100
Internet Usage Duration		
- 1-3 hours	35	11.07
- > 3-6 hours	88	27.84
- > 6 hours	193	61.09
Total	316	100

Table 2 Research Data Description

Variable	Hypothetical Data				Empirical Data			
	Score		Mean	SD	Score		Mean	SD
	Max	Min			Max	Min		
Trends in cyberbullying	60	15	37.5	7.5	58	15	20.48	7.16
Problematic Internet Use	30	6	18	4	30	7	18.46	4.44
Executive function	72	0	36	12	72	7	35.32	11.65

Note: SD = Standard Deviation, Max = Maximum Value, Min = Minimum Value

Table 3 Categorization of research variables

Variable	Low *N* (%)	Moderate *N* (%)	High *N* (%)	Total *N* (%)
Trends in cyberbullying	274 (86.71)	41 (12.97)	1 (0.32)	316 (100)
Problematic Internet Use	47 (14.88)	188 (59.49)	81 (25.63)	316 (100)
Executive function	47 (14.87)	213 (67.41)	56 (17.72)	316 (100)

Participants were then classified into categorical levels based on their scores for each research variable. Table 3 presents the distribution of participants across these categories.

As shown in Table 3, most participants reported low levels of cyberbullying tendencies (86.9%). A smaller proportion reported moderate levels (12.8%), and only 0.3% reported very low levels. For problematic internet use, most participants were in the moderate category (59.49%). The remaining participants were classified into the high category (25.63%) and the low category (14.88%). For executive function, most participants were in the moderate category (69.3%), followed by the low category (16.2%) and the high category (14.5%).

Hypothesis Testing

Hypothesis testing was conducted using Hayes' PROCESS macro with a significance level of 0.05. Table 4 presents the results of the moderation analysis.

Table 4 Results of statistical hypothesis testing

N	316			
	Coeff	***p*-value**	**LLCI**	**ULCI**
PIB > KPS	-0.405	0.124	-0.921	0.111
EF > KPS	-0.171	0.221	-0.446	0.104
Int_1	0.014	0.057	0.000	0.028

The analysis demonstrates that the interaction between the lower limit confidence interval (LLCI) and upper limit confidence interval (ULCI) does not cross the zero threshold. Therefore, executive function (EF) serves as a moderator in the relationship between problematic internet use (PIB) and cyberbullying tendencies (KPS), although the moderating effect is minimal given the *p*-value is greater than or equal to 0.05. Additionally, no significant relationships were found between PIB and KPS ($p > 0.05$) or between EF and KPS ($p > 0.05$).

DISCUSSION

The Moderating Role of Executive Function

The results of this study demonstrate that executive function moderates the relationship between problematic internet use and cyberbullying tendencies. These findings indicate that the impact of problematic internet use on cyberbullying tendencies varies according to an individual's cognitive regulatory capacity. Specifically, problematic internet use is more strongly associated with cyberbullying among individuals with lower executive function, who exhibit reduced ability to inhibit impulsive urges, assess behavioral consequences, and regulate social responses (Jia et al., 2024). Several previous studies corroborate these results, showing that executive function moderates bullying aggression (Fatima & Sharif, 2017; McQuade, 2017). Furthermore, Li et al. (2023) report that low self-control, a dimension of executive function, contributes to increased problematic behaviors in children, including cyberbullying.

This interpretation is consistent with theoretical models that define executive function as a cognitive control system. Executive function includes inhibition, working memory, cognitive flexibility, planning, and self-monitoring. These processes help individuals regulate goal-directed behavior and adjust responses to social situations. In online settings, these cognitive processes may help adolescents evaluate the consequences of aggressive behavior before engaging in cyberbullying. Deficits in executive function may therefore increase vulnerability to impulsive and aggressive online responses, particularly when internet use becomes excessive or poorly regulated (Pichardo et al., 2021).

These findings are also consistent with recent studies showing an association between problematic internet use, cyberbullying, and executive functions in adolescents, emphasizing the importance of interventions targeting self-regulation and executive functions, as both factors can reduce cyberbullying, cybervictimization, and anxiety related to problematic internet use. A systematic review by Real-Fernández et al. (2025) also indicated that deficits in executive function, particularly inhibitory control, were associated with involvement in bullying and cyberbullying among children and adolescents.

The present findings suggest that cyberbullying prevention should not rely solely on restricting internet access. Prevention programs should also strengthen adolescents' self-regulation, response inhibition, decision-making, problem-solving, and emotional regulation. These skills may reduce the likelihood that problematic internet use develops into aggressive online behavior.

However, because the moderation effect in this study was only marginal, future research should examine this conditional relationship using larger samples, longitudinal designs, and dimension-specific measures of executive function.

Executive Function Was Not Significantly Associated with Cyberbullying Tendencies

The analysis showed that executive function was not significantly associated with cyberbullying tendencies. This finding indicates that differences in executive function did not directly explain differences in adolescents' cyberbullying tendencies. Cyberbullying may therefore involve mechanisms beyond individual cognitive regulation.

Theoretically, cyberbullying is not solely a consequence of poor self-regulation. Cyberbullying is also a social behavior shaped by peer dynamics, social norms, online anonymity, perceived social rewards, and reinforcement within digital environments. Adolescents with strong executive function may still engage in cyberbullying when digital aggression serves relational or social motives. These motives may include revenge, status seeking, peer approval, or group conformity (Yuniarrahmah et al., 2022). Executive function may therefore be insufficient as a direct predictor of cyberbullying tendencies when social and contextual influences are more prominent.

Recent literature also shows inconsistent evidence regarding the direct relationship between executive function and cyberbullying. Real-Fernández et al. (2025) reported associations among problematic internet use, executive function, anxiety, and cyberbullying. However, this relationship appears multifactorial rather than linear. Caetano et al. (2024) also found that the role of executive function in bullying behavior varies across studies. These variations may depend on the executive function dimension measured, the characteristics of the sample, and the type of aggressive behavior examined.

Methodological factors may also explain the absence of a significant association. Self-report measures of executive function and cyberbullying capture respondents' subjective perceptions rather than objective cognitive performance or observed aggressive behavior. In addition, cyberbullying is strongly shaped by digital contexts. Factors such as social media intensity, peer norms, empathy, moral disengagement, and prior victimization may be more directly associated with cyberbullying tendencies than executive function alone (Real-Fernández et al., 2025).

These findings suggest that cyberbullying prevention should address more than cognitive regulation. Interventions should also target digital literacy, peer norms, empathy, moral reasoning, and moral disengagement. Although executive function remains important for psychological adjustment, it does not fully explain adolescents' tendency to engage in cyberbullying (Real-Fernández et al., 2025).

Problematic Internet Use Was Not Significantly Associated with Cyberbullying Tendencies

The data analysis indicates that problematic internet use does not correlate with a tendency toward cyberbullying. This result differs from previous studies that identified risky internet use, excessive internet use, or internet addiction as predictors of cyberbullying perpetration (Barlett *et al*., 2018; Duarte *et al*., 2018; Handono *et al*., 2019).

Problematic internet use refers to excessive or poorly regulated internet engagement that disrupts psychological, social, academic, or daily functioning. Caplan, (2002) described problematic internet use as a pattern of maladaptive internet-related cognition and behavior that interferes with essential activities. Demetrovics et al. (2016) identified three major dimensions of problematic internet use: obsession, neglect, and control disorder. Obsession refers to a persistent preoccupation with the internet. Neglect refers to the disregard of daily responsibilities or essential needs.

Control disorder refers to difficulty regulating the urge to use the internet.

These findings suggest that variations in terminology and specific characteristics associated with problematic internet use have led to the development of diverse measurement tools, even when assessing the same underlying construct. Such differences may influence research outcomes and contribute to inconsistent findings across studies. Moreover, the context during data collection may have affected the observed relationship between problematic internet use and cyberbullying tendencies. During the data collection period, COVID-19 pandemic-related restrictions required all participants to engage in online learning and limited their offline social interactions.

Contextual factors during data collection may also have influenced the findings. COVID-19 pandemic-related restrictions required many adolescents to rely on the internet for learning, communication, and social connection. As a result, extended internet use may have reflected functional necessity rather than maladaptive or aggressive online behavior. Open-ended responses supported this interpretation. Many participants (61.09%) reported using the internet for more than six hours per day, primarily for social interaction, information seeking, and educational purposes. In this context, internet use may have functioned as an adaptive response to restricted offline interaction.

This interpretation aligns with previous pandemic-related findings. Paulus et al. (2022) i reported increased internet use and problematic internet use among adolescents during the COVID-19 pandemic. Their longitudinal study, conducted in Siegen-Wittgenstein, Germany, followed participants for 1.5 years from the onset of the pandemic. Of the 1,268 participants, 57.89% reported increased digital media use, while 43.69% exhibited symptoms of problematic internet use. Increased time spent on online activities was identified as a risk factor for the development of problematic internet use in adolescents. In contrast, Kamolthip et al. (2022) conducted a literature review indicating that although adolescent internet use increased in several countries during the COVID-19 pandemic, this was not consistently associated with problematic internet use. Instead, adolescents often use the internet as a coping strategy to reduce stress, maintain social relationships, and support academic activities.

The dimension-level pattern of problematic internet use may provide additional insight. In this study, the control disorder dimension showed the highest total score among the PIUQ-SF-6 dimensions. This finding suggests that many participants had difficulty regulating internet use. However, difficulty controlling internet use does not necessarily indicate engagement in harmful online behavior. Meerkerk et al. (2006) suggested that problematic internet use may be more likely to emerge when individuals use the internet for activities such as online gaming, pornography, or other maladaptive purposes. In contrast, this risk may be lower when the internet is used for constructive purposes, such as academic information seeking, communication, and educational activities. Reinaldo and Sokang (2016) similarly reported that students use the internet for diverse activities, including social media communication, chatting, online shopping, seeking academic and non-academic information, email, music streaming, gaming, and video streaming.

This study has several limitations. The analysis did not examine each dimension or aspect of the multidimensional measurement tools separately, such as the PIUQ-SF-6 scale (used to measure problematic internet use) and the ESQ-R (used to measure the executive function variable). As a result, the discussion of alternative research hypotheses that were not supported remains less comprehensive. Without per-dimension analysis, it is unclear which specific aspect most strongly influences the cyberbullies studied. For example, the observed positive relationship between executive function and the tendency toward

cyberbullying among perpetrators suggests that higher executive function is associated with a greater tendency toward cyberbullying. However, this explanation relies on possibilities derived from previous research rather than a detailed dimension-by-dimension analysis of the executive function scale. Identifying which dimension scores are more dominant or deficient would strengthen the explanation for the observed phenomena; therefore, future studies should analyze measurements separately for each dimension. Similarly, regarding the finding of no association between problematic internet use and cyberbullying tendencies among perpetrators, it remains unclear which PIUQ-SF-6 dimension might influence the correlation results when analyzed by dimension.

CONCLUSIONS

This study examines the moderating role of executive function in the relationship between problematic internet use and cyberbullying tendencies among adolescents. It further investigates the direct effects of executive function and problematic internet use on cyberbullying tendencies. Executive function is conceptualized as a protective factor that may influence whether problematic internet use results in online aggressive behavior. Factors predicted to affect cyberbullying tendencies may yield varying outcomes depending on specific conditions, including data-collection methods, variations in behavioral patterns within similar behaviors, unique participant circumstances such as the COVID-19 pandemic, and other unmeasured influences. In this study, executive function and problematic internet use are not directly associated with cyberbullying tendencies. Instead, cyberbullying behavior appears to be better explained by a combination of social, affective, and context-specific factors related to digital media use.

Indicators or criteria for problematic internet use, even when assessed using the same measurement construct, may produce varying results depending on participant conditions or measurement methods. During data collection, the COVID-19 pandemic prompted increased internet usage as individuals relied on online platforms for daily activities due to restrictions on offline interactions. As a result, certain indicators or criteria for problematic internet use were not applicable to study participants given these unique circumstances. The findings of this study can inform the development of training programs that promote positive skills and character traits essential for children's personality development in the digital era. Furthermore, future researchers are encouraged to conduct more detailed analyses of each dimension within the measurement tools, particularly when using multidimensional instruments, to generate additional data that can strengthen the arguments supporting research findings.

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