The Mediating Role of Internet Addiction in the Relationship Between Loneliness and Depression Among Adolescents

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ABSTRACT: Loneliness and internet addiction (IA) are risk factors for depression. Internet addiction and depression among adolescents have recently increased in prevalence globally and are expected to continue to increase. However, there is no clear line between internet addiction and depression as to why it occurs. Previous research on the relationship between loneliness and depression in adolescents involved IA as a mediator, and the results of the study showed that IA can be a partial mediator between loneliness and depression. However, in Indonesia, there has been no similar research regarding IA as a mediator and explaining the relationship between these variables. This study aims to investigate the mediating role of internet addiction in the relationship between loneliness and depression among adolescents. The results of a study involving 732 adolescents in Indonesia, shows that there is partial mediation of IA in the relationship between loneliness and depression in adolescents. Loss of control (LoC) is a dimension that is strongly associated with depression and loneliness. The amount of time spent on the Internet is also linked to loneliness and depression. The study found that girls were more likely to experience depression and loneliness compared to boys. These findings provide important information for parents and schools, and interventions related to these findings can be of serious concern.

INTRODUCTION

Depression in adolescents is a serious problem that is still an important mental health issue globally. The global prevalence of self-reported depressive symptoms increased by 34% from 2001 to 2020 (Shorey & Wong, 2022). In Indonesia, the prevalence of depression is 5.1% in adolescents (Suryaputri et al., 2022). Depression is the fourth most significant health issue in terms of disease burden estimates. It is a common problem, with a prevalence rate estimated at 8% among adolescents. Depression among adolescents is associated with poor academic performance, social dysfunction, and substance abuse (Merry et al., 2004).

Disrupted social relationships and limited interpersonal contact are associated with feelings of loneliness and can result in many mental disorders, including the development of depression (Heinrich & Gullone, 2006; Dziedzic et al., 2021). Loneliness comprises negative feelings that arise when a person's social needs are not met by the quantity and quality of their social relationships (Perlman & Peplau, 1981). Loneliness is considered a lack of social relationships in the context of individual needs, which are related to the manifestation of psychological aspects such as depression and anxiety. These relationships are formed most strongly during puberty, and a lack of such

relationships causes a decline in both physical and mental functioning (Dziedzic et al., 2021). Depression, which is associated with loneliness, has negative side effects on health (Kraav et al., 2021).

Loneliness is a significant cause of depression; consequently, adolescents experience depression when they are alone with their problems and distance themselves from everyday life. They feel that no one understands them, which increases loneliness and depression. The need for belonging is seen as a common characteristic in adolescents. Another explanation that can explain the influence of loneliness on depression is a sense of belonging (Erzen & Çikrikci, 2018). Loneliness is usually the result of limited interpersonal contact, while depression is characterised by low mood and lack of satisfaction in all aspects of daily life.

Loneliness is one of the accompanying symptoms for adolescents who suffer from depressive disorders (Dziedzic et al., 2021). Loneliness, in relation to depressive symptoms, is characterised by experiences with negative effects, reduced enjoyment, or a lack of positive aspects. Research suggests that loneliness and depressive symptoms manifest during the adolescence period. Symptoms of loneliness and depression were operationalised as subjectively unpleasant and emotionally distressing experiences (Cacioppo et al., 2006). Loneliness and depressive symptoms are related to interpersonal problems, such as a lack of support from friends (Parker et al., 2006). Depressive symptoms can also occur in response to intrapersonal difficulties, whereas loneliness is seen as a specific form of emotional distress, whereas depressive symptoms are considered a more general form of emotional distress (Spithoven et al., 2017).

The findings of previous studies also show a correlation between loneliness and internet addiction (IA) (Pontes et al., 2014; Saadati et al., 2021; Ge et al., 2023). However, the mechanism by which loneliness and depression correlate with addiction in general or IA remains unclear (Özdemir et al., 2014). Internet addiction (IA) is a predictor of depression (Ostovar et al., 2016; Puri & Sharma, 2016; Ha et al., 2007; Saikia et al., 2019). Previous studies also show that the Covid-19 pandemic caused children and adolescents to be isolated at home and caused perceived loneliness. Loneliness is seen as a factor that influences individual mental health and impacts IA (Taib et al., 2023).

Adolescence is a stage when children are very vulnerable to experiencing feelings of loneliness, which is a critical factor influencing the health and quality of life of adolescents; there is a high correlation between loneliness and depression (Wang et al., 2021). As stated by Demir and Kutlu (2016), loneliness is related to IA and depression. Considering the relationship between loneliness and depression, IA may mediate the relationship between loneliness and depression, where lonely individuals become internet addicts at a higher rate and experience more depressed feelings.

Twenge et al. (2021) shows that adolescent loneliness is linear with smartphone access and internet use, the higher the smartphone and internet use, the lonelier. Loneliness has been shown to correlate with adverse health outcomes which in turn are associated with depression (Solmi et al., 2020). Kraav et al. (2021) also provides suggestions for adding factors that mediate or moderate the relationship between loneliness and depression among adolescents. Individuals who experience deep feelings of loneliness look for various ways to avoid the situation and compensate for their loneliness, this solution is sometimes valid and individuals tend to socialize more to relieve their loneliness, these solutions can sometimes lead individuals into difficult situations such as adopting undesirable habits. When internet use is considered as a solution to the loneliness experienced by individuals, the reasons why lonely individuals prefer the internet can be identified (Demir & Kutlu, 2016).

Caplan (2002) views technology addiction as part of an addictive behavior, Internet addiction displays the core components of addiction (i.e., salience, mood swings, tolerance, withdrawal, conflict, and relapse), Internet use as a way to escape anxious feelings, develops tolerance for the Internet to achieve satisfaction. Both loneliness and internet addiction are risk factors for

depression in adolescents, people with psychological problems will prefer online interaction to face-to-face communication because it is easier to compensate for their lack of social skills (Caplan 2003). Lonely individuals are more drawn to cyberspace due to the increased potential for companionship, changing patterns of social interaction in cyberspace, and to modulate negative moods associated with loneliness (Morahan-Martin & Schumacher, 2003). Lonely people with higher levels of social web activity show a stronger compensatory social use orientation which results in higher pathological Internet use (Reissmann & Lange, 2023). When social technology is used to escape the social world and withdraw from the "social pain" of interaction, feelings of loneliness increase. Loneliness is also a determining factor in how people interact with the digital world, lonely people prefer to use the Internet for social interactions and are more likely to use the Internet in ways that replace time spent in offline social activities (Nowland et al., 2018).

Depressed and lonely individuals adopt more negative perceptions of social competence and social interactions (Caplan, 2003). Young (1998) also suggested that a more negative perception of social competence and social interactions and this in turn leads to compulsive behavior, and using the internet as a psychological escape mechanism to avoid real or perceived problems. Situational factors play a role in the development of internet addiction. Individuals who experience loneliness use online social media to overcome the loneliness they had experience; online friends help to overcome this situation. As a means of coping with the loneliness experienced by a new environment, users may turn to the Internet to fill the time gaps (Young & De Abreu 2010). Depressed and lonely individuals are drawn to the Internet for several qualities, they feel better able to express their true selves with others online than in the real world (Taylor et al., 2017).

Individuals with low social skills believe that online interactions are safer (i.e. more privacy and anonymity), easier (i.e. interactions are less complicated), and more stimulating. Individuals with social skills deficits interact online for reasons of being safer (i.e., more privacy and anonymity), easier (i.e., less complex interactions), and more stimulating. Individuals are given greater flexibility in how they present themselves online compared to face-to-face situations (Taylor et al., 2017).

Given that individual factors have been researched extensively and to gain a deeper and healthier understanding of the phenomenon of depression, this study aims to explore the relationship between loneliness, internet addiction and depression in a group of adolescents in Indonesia. The current study used a survey to collect research data. Considering the possible negative impact of internet addiction on psychological effects, Patient Health Questionnaire-9 (PHQ-9) which has been adapted into Indonesian by Dian et al. (2022). To measure loneliness, we used a scale developed by Hays and DiMatteo (1987) and adapted in the Indonesian version by Hudiyana et al. (2022). To measure internet addiction, we used the IAT test developed by Young and De Abreu (2010) which has been adapted by Siste et al. (2021). Therefore, in this study we ask two important questions related to whether there is an influence the demographic variables of adolescent age, amount of time using the internet and gender are related to loneliness, IA and depression in adolescents, secondly whether Internet addiction mediates the relationship between loneliness and depression in adolescents.

Study Aim and Hypothesis

This study aims to investigate the mediating role of internet addiction in the relationship between loneliness and depression among adolescents in Depok, Jawa Barat. Specifically, this study is designed to achieve the following objectives to determine the correlation between loneliness, internet addiction, and depression among adolescents in Depok, to examine the effect of loneliness on depression among adolescents in Depok, to examine the effect of internet addiction on depression among adolescents in Depok, to analyze the role of internet addiction as a mediator in the relationship between loneliness and depression among adolescents in Depok.

METHODS

Design

This study used a mediation test approach to examine the role of internet addiction as a mediator in the relationship between loneliness and depression in adolescents in Indonesia. In addition, SPSS was used to test the correlation between variables, and a regression test was used to determine the effect of the independent variable (loneliness) and the mediator variable (internet addiction) on the dependent variable. JASP (JASP Team 2023) was used to analyze the mediating role of internet addiction on the relationship between loneliness and depression in adolescents. SPSS Version 27 (IBM Corp 2020) was also used for descriptive analysis to estimate the demographic descriptions of 732 adolescents.

Participants

Participants in this study were high school students in Depok City, West Java, Indonesia, with the criteria of active internet users, aged 14 to 19 years, living with parents and/or caregivers, and having a mobile phone. Purposive sampling technique was used. The age range of the participants of this present study was 14-19, who were divided into two age groups, namely, 14-16 (early adolescence period) and 17-19 (late adolescence period). Internet usage (IU) was based on the number of hours of Internet use within a range of 1-24 hours and was divided into three categories: Category 1 (1-3 hours), Category 2 (4-7 hours), and Category 3 (>8 hours); moreover, gender differences.

Instruments

To measure internet addiction, loneliness, and depression, questionnaires that had been previously adapted into the Indonesian language were used in the current study. The data collected online were subsequently analyzed using factor analysis to assess the validity of the measurement instruments. Factor analysis was conducted to identify the internal structure of the items and to ensure that the items were interrelated and measured the same construct, thereby confirming that the instruments were valid and reliable. To measure the reliability of the instruments, JASP (JASP Team 2023) has been used to ensure the three instruments are reliable. Before factor analysis was performed, we performed prerequisite, values Kaiser-Meyer-Olkin Measure (KMO) >0.661, X2 =493.728, df=3 p<0.001, which meant that factor analysis tests might be carried out to estimate factor values for all measuring instruments used. Based Levane Test was found, M=33.618 p<.0.01, which can be interpreted as the variance of depression data in adolescents is not homogeneous. Fornell dan Larcker (1981) recommended composite reliability value above 0.6 and an Average Variance Extracted (AVE) value above 0.5. The composite reliability results on the depression test tool (PHQ-9) items have met reliability with a value of CR=0.773. The validity test of the depression test tool produces scores X2=113.863, TLI=0.923, GFI= 0.965, CFI=0.943, NFI=0.927, RMSEA=<0.068, it can be concluded that the depression test tool meets the goodness of fit requirements suggested by Hair et al. (2019) and Hu and Bentler (1999).

Internet addiction test (IAT) the instrument developed by Young (2009) and adapted by Siste et al. (2021) was used in this study. Siste et al. (2021) found that only 18 items were valid for measuring internet addiction in the context of Indonesian adolescent. The composite reliability results on the internet addiction test (IAT) item have met reliability with a value CR=0.773. The IAT consists of 3 factors including: salience, neglect of duty, dan loss of control. The factor test of the internet addiction test tool produced a value of X2=258.795, TLI=0.891, GFI= 0.942, CFI=0.915, NFI=0.897, RMSEA=<0.075, it can be concluded that the IAT has met the goodness of fit requirements.

University of California, Los Angeles loneliness scale (ULS-8 short version) was used to measure loneliness, developed by Hays and DiMatteo (1987) and adapted in the Indonesian version by Hudiyana et al. (2022). Based on the findings, this unidimensional scale only obtained 5 valid items based on factor loading on table 4. Composite reliability was obtained at 0.807 with AVE = 0.461, RMSEA – 0.115, GFI=0.993, TLI=0.916, NFI=0.954, CFI=0.958, X2=53.142, which can be concluded from ULS-5 meet the fit index requirements suggested by Hu and Bentler (1999).

Patient Health Questionnaire (PHQ-9) the questionnaire developed by Kroenke et al. (2001) was designed to measure depression using nine statement items. This questionnaire has been adapted into the Indonesian language version by Dian et al. (2020). The Patient Health Questionnaire (PHQ) is a diagnostic instrument for depression, scoring each of the 9 DSM-IV criteria as "0" (not at all) to "3" (nearly every day) (Kroenke et al. 2001). The use of the instrument is based on the adaptation of the instrument by Dian et al. (2020). Before factor analysis was performed, we performed prerequisite, values Kaiser-Meyer-Olkin Measure (KMO) >0.661, X2 =493.728, df=3 p<0.001, which meant that factor analysis tests might be carried out to estimate factor values for all measuring instruments used. Based on the Levene's test, was found, M=33.618 p<.0.01, which can be interpreted as the variance of depression data in adolescents is not homogeneous. Fornell dan Larcker (1981) recommended composite reliability value above 0.6 and an Average Variance Extracted (AVE) value above 0.5. The composite reliability results on the depression test tool (PHQ-9) items have met reliability with a value of CR=0.773. The validity test of the depression test tool produces scores X2=113.863, TLI=0.923, GFI= 0.965, CFI=0.943, NFI=0.927, RMSEA=<0.068, it can be concluded that the depression test tool meets the goodness of fit requirements suggested by Hair et al. (2019) and Hu and Bentler (1999). Normality tests were also carried out before conducting internet addiction mediation tests on the relationship between loneliness and depression, n=732, z skew = 7.43, SE z skew=0.090, z Kurt=1.25, SE z Kurt= 0.180, Shapiro-Wilk >0.965, showed that the data on the PHQ-9 were normal. A linearity test was also carried out, the test results found that the data were linear (df=14, F=0.988, p>0.05). Lavene statistics show that the data distribution was not homogeneous, p<0.001, based median Lavene statistic (41.84, df1=1).

Data Analysis

Prior to conducting the mediation analysis, classical assumption tests were performed as prerequisites. SPSS was used to perform normality and linearity tests before hypothesis testing. JASP was also used to ensure reliability for the three instruments with confirmatory factor analysis. Hypothesis testing was conducted with the help of JASP to examine the role of internet addiction in the relationship between loneliness and depression in adolescents, using a mediation analysis approach. Previously, classic tests including normality, linearity, and multicollinearity were conducted as prerequisites. The scales to be used were also tested for validity and reliability before use. Data were processed with IBM SPSS Statistics 25 for Windows software.

RESULTS AND DISCUSSION

Results

Based on the classical assumption to test the normality of the dependent variable (depression), the Kolmogorov-Smirnov statistic was found to be .106, p<0.01, df=732, SD=5.24, Skew= .669 Kurtosis= .225), which can be interpreted that the research data is not normally distributed, therefore the correlation test was carried out using the Spearman Rho correlation test. While in the linearity test, Deviation from Linearity was found, p<0.05, F= 1.598 which can be interpreted that the data is not linear.

Table 1 shows the results of the descriptive analysis showed that the level of depression based on different tests showed that female adolescents experience more depression (M=1.50, SD=0.50) compared to adolescent boys (M=1.28, SD=0.45), Adolescents who use the internet for 1 – 3 hours were more depressed (M=1.46, SD=0.53) and more depressed than adolescents who use the internet for less than 8 hours, 4 – 7 hours (M=1.40, SD=0.49), and > 8 hours (M=1.46, SD=0.53). Age 17 to 19 years (M=1.59, SD=0.33) more depressed than 14 to 16 years old (M=1.40, SD=0.49). Based on descriptive analysis, it can also be seen that female adolescents are more addicted to the internet (M=1.50, SD=0.50) compared to male (M=1.42, SD=0.49). Internet usage for more than 8 hours (M=1.52, SD=0.46) also more addictive compared to the amount of use between 4 to 7 hours (M=1.44, SD=0.49), and less than 3 hours (M=1.18, SD=0.30). Ages 14 to 16 years are more likely to experience internet addiction (M=1.51, SD=0.49) compared to the 17 to 19 years age group (M=1.47, SD=0.57). Based on the level of loneliness, female adolescents are lonelier (M=4.97, SD=4.52) compared to male adolescents (M=4.22, SD=4.36).

Table 1. A comparison of the levels of depression, IA, and loneliness according to demographic characteristics

	PHQ-9				IAT				ULS-5			
	High	%	M	SD	High	%	M	SD	High	%	M	SD
Male	83	11.3	1.28	0.45	125	17.08	1.42	0.49	105	14.34	4.22	4.36
Female	219	29.9	1.5	0.5	217	29.64	1.5	0.5	190	25.96	4.97	4.52
	302	41.2	2.78	0.95	342	46.72	2.92	0.99	295	40.3	9.19	8.88
1-3 hours	24	3.28	1.56	0.32	17	2.32	1.18	0.3	23	3.14	2.82	2.6
4-7 hours	126	17.21	1.4	0.49	137	18.72	1.44	0.49	122	16.67	4.68	4.42
>8 hours	152	20.77	1.46	0.53	33	4.51	1.52	0.46	150	20.49	5.15	4.57
	302	41.26	4.42	1.34	187	25.55	4.14	1.25	295	40.3	12.65	11.59
14-16	186	25.41	1.4	0.49	205	28.01	1.51	0.49	179	24.45	4.96	4.5
17-19	116	15.85	1.59	0.33	137	18.72	1.47	0.57	116	15.85	6.47	3
	302	41.26	2.99	0.82	342	46.73	2.98	1.06	295	40.3	11.43	7.5

Table 2. The correlation between the variables

	Gender	Age	Hours	PHQ-9	ULS	IAT	SL	ND	LoC
Gender	1	0.011	0.051	0.269**	0.127**	0.115**	0.047	0.124**	.145**
Age		1	0.145**	0.053	-0.017	-0.002	0.021	-0.023	-0.012
Hours			1	.106**	0.051	0.143**	.092*	0.175**	.117**
PHQ				1	.547**	.535**	.451**	.453**	.467**
ULS					1	.395**	.365**	.283**	.347**
IAT						1	.886**	.809**	.852**
SL							1	.564**	.604**
ND								1	.597**
LoC									1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 2 shows correlation test results that internet addiction is strongly and significantly correlated with depression (r=0.535), internet addiction is also significantly correlated with loneliness (r=0.395), The correlation between depression and loneliness also showed a strong and very significant correlation (r=0.547). Dimensions of internet addiction were also tested for correlation, showing that the loss of control dimension showed the significant relationship with depression (r= 0.467) among other dimensions, neglect of duty (r=0.453), and salience (r=0.451). Loneliness was also significantly correlated with internet addiction dimensions, salience had the significant correlation (r=0.365), loss of control (r=0.347), dan neglect of duty (r=0.283). Gender is a demographic variable that has a significant correlation with depression (r=0.269), significantly correlated with loneliness (r=0.127) also significantly correlated with internet addiction (r=0.115).

The gender also had a significant correlation with neglect of duty (r=0.124) and loss of control (r=0.145). The amount of time spent accessing the internet was also significantly correlated with depression (r=0.106), internet addiction (r=0.143), neglect of duty (r=0.175), and loss of control (r=0.117), and age was also found to have a relationship with internet usage time (r=0.145).

Regression analysis is run to identify the explained variance of each variable. Table 3 shows the variable that provides the greatest variance explained in depression is internet addiction (R2=0.420, Beta=0.377, p<0.001). Loneliness has an explained variance of R2=0.299, Beta=0.547, p<0.001, From the dimensions of internet addiction to depression, the largest variance is provided by loss of control, R2=0.288, Beta=0.222, p<0.001, while neglect of duty explains the variance explained R2=0.262, Beta=0.291, p<0.001, and salience with explained variance R^2=0.204, Beta=0.451, p<0.001.

Table 3. Regression analysis

Model	R	R^2	Adjusted R^2	S.E Estimate	Beta (β)	F	p
ULS-5	.547[a]	.299	.298	4.393	.547	311.853	<0.001
IAT	.648[b]	.420	.418	4.001	.377	263.516	<0.001
SL	.451[a]	.204	.203	4.683	.451	186.902	<0.001
ND	.512[b]	.262	.260	4.513	.291	129.167	<0.001
LoC	.537[c]	.288	.285	4.434	.222	98.266	<0.001

Hypothetical testing

Table 4 shows the results of the analysis that the regression model path a, namely the direct influence of loneliness on Internet addiction is significant, standardize coefficient path a, Loneliness (X) on Internet Addiction (M) = 0.105, k < 0.001, z-value=11.624, SE = 0.009, LLCI = 0.088 dan ULCI = 0.123. In path b, the influence of the internet addiction mediator variable (IAT) (M) on the dependent variable (Y) is significant. In path b, there is the influence of the mediator variable on depression, standardize coefficients are found = 0.377, k < 0.001, z-value=12.316, SE = 0.005, LLCI= 0.317 dan ULCI = 0.438. On path c' or the direct influence of spiciness on depression, standardize coefficients were found = 0.106, k < 0.001, z-value=12.990, SE = 0.008, LLCI = 0.090 dan ULCI= 0.122. The results of the mediation analysis can be concluded that there is a partial mediation effect of internet addiction on depression (PHQ), the IAT > PHQ and ULS > IAT pathways were both significant (p<0.001).

Table 4. Standardized Path Coefficients

			Estimate	Std. Error	z-value	p	Lower	Upper
IAT	→	PHQ-9	0.377	0.031	12.316	0.000	0.317	0.438
ULS-5	→	PHQ-9	0.106	0.008	12.990	0.000	0.090	0.122
ULS-5	→	IAT	0.105	0.009	11.624	0.000	0.088	0.123

Note. Delta method standard errors, normal theory confidence intervals, ML estimator.

Discussion

Descriptive analysis was carried out to estimate the demographic description of 732 adolescent. The results of the descriptive analysis showed that the level of depression based on different tests showed that female adolescents experienced more depression than male adolescents. This finding correlates with Marciano's (2022) findings that being female and having an Internet-connected mobile device contributed to higher rates of baseline depressive symptoms while having good family relationships is a protective factor. The evolutionary view argues that internet usage (IU) duration harms well-being through a variety of mechanisms. Although internet usage (IU) does not directly increase or decrease (offline) social relationships with friends, it can interfere with other offline social or non-social activities, such as physical activity, sleep, and quality time with family members, with consequences for mental well-being (Marciano et al., 2022).

Consumption of social media content encourages social comparison mechanisms, whereby most female users associate themselves with ideal representations of others, creating dysfunctional beliefs about themselves (McCarthy & Morina, 2020).

Furthermore, 41.2% of adolescents were found to have depressive disorders, with females experiencing more depression than males. The observations align with Liang et al.'s (2016) findings that women have a higher prevalence of depression and greater vulnerability to depression due to interactions concerning biological changes and psychosocial factors. The physical, psychological, and social changes of adolescence make this life transition a high-risk period for the development of major depressive disorder (MDD) (Cicchetti & Toth, 1998). In an analysis of gender differences in the development of depressive symptoms, Gjerde (1995) showed that early antagonistic personality traits and behaviours were predictive of depressive symptoms in male adolescents and excessive feminine role socialisation and introspection in female adolescents. 46.72% of adolescents were diagnosed with Internet addiction (IA) without significant differences between male and female adolescents. This finding aligns with Dufour et al. (2016), where the prevalence of IA in adolescents reached 43%, an alarming level. Teenage girls use social networks intensively, while boys use more multiplayer online role-playing games, online games, and adult sites.

The prevalence of loneliness was 40.3%, Puri and Sharma (2016) found that IA positively correlates with depression, loneliness, and social isolation. Morahan-Martin (1999) conveyed that loneliness is an important factor when considering IA. Individuals with psychological problems are inherently at risk for IA as they prefer online interactions over face-to-face communication (Özdemir et al., 2014). People use the Internet in various ways according to their personal preferences (Amichai-Hamburger & Ben-Artzi, 2003). The prevalence of IA in this study is comparable to previous reports, as 3.2% and 61% of the sample of Indonesian adolescents had problems with the Internet (Pratama & Widyanti, 2019). Adolescents who used the Internet for 1-3 hours were more depressed than adolescents who used the Internet for < 8, 4-7, and > 8 hours. Higher IU duration increases depression, and, to a lesser extent, higher levels of depression increase IU duration. Adolescents who use the Internet for 6-8 hours a day have a higher likelihood of experiencing depressive symptoms (Wu et al., 2022; Salmela-Aro et al., 2017).

This study found that 17-19-year-olds were more depressed than 14-16-year-olds. Depressive disorders are extremely common among adolescents (Hauenstein, 2003). This finding is in line with Salmela-Aro et al. (2017) findings that females suffer more depressive symptoms than males in late adolescence. This finding is in line with Thaparet et al. (2012) findings that depression in adolescent girls tends to increase sharply after puberty. Moreover, the strongest risk factor for depression during late adolescence is a family history of depression and exposure to psychosocial stress, inherited risks, developmental factors, sex hormones, and psychosocial adversity.

Teenage girls were also found to be more addicted to the Internet than boys. Mari et al. (2023) explain that gender is a key factor in explaining why people are addicted to the Internet in different ways. Men and women have some of the same risk factors for IA, such as impulsivity or sensation seeking. Gender differences in internet users are a potential element that could influence the increase in IA. Although several studies have been conducted to address this issue, online gaming addiction seems to be more dominant among men. Men typically spend more time playing online games than women, and this finding has been observed in various countries, both in adult and adolescent samples. In contrast, recent research shows that women spend more time on social media than men. In fact, adolescents appear to show a greater tendency to experience IA symptoms associated with social media use and are, thus, more susceptible to developing an online social media addiction. A possible explanation is that, when assessing IA, men are judged for online gaming, whereas women tend to be judged for social media. Addiction to social media is more common in men. In fact, in several studies, males show higher levels of social media addiction than females (Mari et al., 2023).

Internet usage (IU) durations of > 8 hours also caused more IA than 4-7 and < 3 hours. Those aged 14-16 were more likely to experience IA than those aged 17-19. In terms of loneliness, female adolescents are lonelier than male adolescents (Chemnad et al., 2023). Adolescents aged 15-16, especially boys, are most vulnerable to IA (Karacic & Oreskovic, 2017) as this age group has a greater level of independence, and parents have lesser control over their free time and social activities.

Online communication has a strong influence on adolescents' developmental stages. Adolescents share their experiences through new forms of communication. They seek their position in the group and view their friends as a great source of social support, even greater than their parents. Parents of middle-aged teens have less parental control, such as limiting the time their children spend online, compared to younger teens. In a study of adolescents with IA symptoms, most parents in this group did not limit IU (Chen et al., 2020).

Internet addiction (IA) had the highest average based on the mean values between the variables. The level of depression was also higher than the level of loneliness. Among the dimensions of IA, Loss of control (LoC) had the highest mean. Lack of control over activities on the Internet is said to accompany IA. Items assessing control typically ask about efforts to reduce use (Van Rooij & Prause, 2014). Loss of control (LoC) over IU is a persistent desire and failure in attempts to control, reduce, or stop IU (Tao et al. 2010). Laboratory experiments have found that individuals with problematic IU have problems with self-regulation. Poor control-related decision-making has been demonstrated in problematic Internet game players. This poor control is due to internet addicts' relatively increased sensitivity to rewards (Van Rooij & Prause, 2014). Van Rooij and Prause (2014) further explained that control of addictive behaviours in IA and various other addiction models is often referred to as the main diagnostic factor. In addition to the perception of LoC, it is important to point out that, even in the presence of valuable alternative reinforcers, IA behaviours cannot actually be stopped. Adolescents with IA often experience LoC, feelings of anger, symptoms of distress, social withdrawal, and family conflicts. Apart from that, IA is associated with more severe clinical conditions, such as dysthymic, bipolar, or affective disorders, social anxiety, and severe depression (Cerniglia et al., 2017).

The correlation test results show that IA strongly and significantly correlates with depression. Internet addiction (IA) also significantly correlates with loneliness. There is a strong and very significant correlation between depression and loneliness. Al Shawi et al. (2022) reported a significant correlation between IA and depression, while Saadati et al. (2021) found that individuals with IA have much higher loneliness scores. Loneliness is a cause of IA; lonely individuals prefer to increase their communication through social networks to meet their emotional needs (Sheldon, 2008), and lonely individuals prefer using the Internet as they can find ways to overcome their loneliness by interacting with other people on the Internet. They are also attracted to some forms of online interactive activities due to the possibility of connectedness, friendship, and community (Morahan-Martin, 1999).

The maladaptive role of IA becomes increasingly apparent as time goes by, as the increase in IA appears to be accompanied by an increase in depressive symptoms. Initial IA has some benefits, which are compensated for when IA is uncontrolled and continues to increase over time. This effect is likely due to other negative consequences associated with increasing levels of IA, for example, reduced pleasure from everyday activities and social contact (Tóth-Király et al., 2021). IA dimensions were also tested for correlation and revealed that the LoC dimension had the strongest correlation with depression. The neglect of duty (ND) and salience (SL) dimensions also correlated significantly with loneliness, followed by lack of control (LoC) and ND (Neglect of Duty).

According to Ha and Hwang (2014), gender is the demographic variable that is significantly correlated with depression, loneliness, and IA. Teenage girls tend to use the Internet as a tool for social networking and establishing interpersonal relationships, while boys tend to use the Internet for entertainment and recreation. Gender also significantly correlates with ND and LoC. Internet

usage (IU) duration also significantly correlates with depression, IA, ND, and LoC. Age was also found to correlate with IU duration. The correlation between IA and depression depends on gender. According to Liang et al. (2016), men and women have different behavioral patterns and motivations for IU (internet usage). Men are more likely to use the Internet for fun and less likely to surf the Internet for information than women. Although boys and girls tend to surf the Internet alone, boys are more likely to surf the Internet with friends than girls.

The analysis results show that the Path A regression model, namely the direct influence of loneliness on IA, was significant. In Path B, the influence of the IA mediator variable (IAT) on the dependent variable (Y) was significant. In Path B, the influence of the mediator variable on depression was found to be significant and had an influence. In Path C (the direct effect of spiciness on depression), the results indicate a significant effect. The mediation analysis results revealed that IA partially mediates depression (PHQ-9) as the paths IAT > PHQ-9 and ULS-5 > IAT were both significant. These findings are in line with those of Wang et al. (2021). The results of the structural equation model showed that the path coefficient of loneliness to depression was significantly positive. The explanation is that lonely adolescents always have negative perceptions of various things, are vulnerable to negative emotions, and often show hostility, which significantly correlates to depression. Students who are affected by short-term loneliness and long-term loneliness are more likely to experience depression and refuse to communicate with other people. If these students do not find appropriate outlets for catharsis, this situation may worsen and not improve. Long-term loneliness has a negative impact on blood pressure and immunity, causing poor health and emotional disorders, such as depression (Dai 2017). Similarly, Demir and Kutlu (2016) found a positive correlation between depression and loneliness. Loneliness positively and significantly predicts IA, and IA predicts depression in the same way. IA can partly explain the link between loneliness and depression.

Implications

The findings of this study highlight the urgent need for targeted interventions to address internet addiction (IA), depression, and loneliness among adolescents, particularly adolescent girls who appear more vulnerable to these issues. The strong correlation between IA and depressive symptoms suggests that excessive internet use is not only a coping mechanism but also a contributor to worsening mental health. The mediating role of IA in the relationship between loneliness and depression indicates that digital behaviors must be integrated into psychosocial models of adolescent well-being. Given that loss of control (LoC) is the most prominent dimension of IA associated with depression, prevention strategies should focus on improving adolescents' self-regulation skills and providing structured guidance on internet use. Educational and mental health institutions should collaborate to implement psychoeducational programs that increase awareness about healthy digital habits, particularly for at-risk age groups (14–16 years old) and for those spending more than 6–8 hours online daily. Gender-specific patterns in IA, where girls lean toward social media overuse and boys toward gaming, also call for differentiated intervention strategies. Furthermore, the protective role of family functioning and parental involvement should be emphasized in efforts to buffer adolescents from the adverse effects of excessive internet use. Future research is recommended to explore longitudinal pathways and culturally specific risk factors using mixed-methods or qualitative approaches to deepen the understanding of digital mental health risks.

Limitations and Further Research

This study provides important insights into the relationship between internet addiction, depression, and loneliness among adolescents; however, it also has several limitations. First, the cross-sectional design restricts the ability to draw causal conclusions, highlighting the need for

longitudinal studies to explore the directionality of these relationships. Second, the reliance on self-reported data may introduce social desirability bias or recall errors; therefore, data triangulation using parental reports or behavioral tracking is recommended. Third, the specific cultural and educational context limits the generalizability of the findings, and cross-cultural studies are suggested to enhance external validity. Moreover, this study did not examine the psychosocial mechanisms underlying gender differences in internet addiction. Future research using qualitative or mixed-methods approaches could offer a deeper understanding of these dynamics. Additionally, potential confounding variables such as family structure, parental supervision, academic pressure, and socioeconomic status were not controlled. Future research should employ multivariate frameworks to gain a more comprehensive understanding of the impact of internet addiction on adolescent well-being.

CONCLUSION

The current research tries to explain the role of internet addiction as a mediator between the relationship between loneliness and depression in adolescents. The findings show that internet addiction plays a role in mediating the relationship between loneliness and depression, even though it is partial. Female students were found to have higher depressive symptoms than male students, 41.2% of adolescents were found to suffer from depressive disorders. As many as 46.72% of adolescents were diagnosed with internet addiction (IA) without significant differences between male and female adolescents. The prevalence of loneliness is 40.3%. Adolescents who use the internet for 1-3 hours are more likely to experience depression. Higher duration of internet use (IU) increases depression, and to a lesser extent, higher levels of depression increase duration of internet use (IU). Research also finds that children aged 17-19 years' experience more depression. Teenage girls were also found to be more addicted to the internet than boys. Internet addiction (IA) has the highest average based on the average value between variables, the level of depression is also higher than the level of loneliness. Among the dimensions of internet addiction (IA), Loss of control (LoC) had the highest mean. The correlation test results show that internet addiction (IA) is strongly and significantly correlated with depression. Internet addiction (IA) is also significantly correlated with loneliness. There is a strong and very significant correlation between depression and loneliness. The IA dimensions were also tested for correlation and revealed that the LoC dimension had the strongest correlation with depression. The dimensions neglect of duty (ND) and salience (SL) were also significantly correlated with loneliness, followed by lack of control (LoC) and ND (Neglect of Duty).

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AUTHOR CONTRIBUTIONS STATEMENT

This research was conducted under the supervision of Prof Madya Nor Ba'yah and Dr Siti Marziah Zakaria, both of whom are lecturers at the Centre for Psychology and Human Well-being Studies (PsiTra), University Kebangsaan Malaysia. Both contributors played a major role in providing input related to the research, starting from the idea of the background of the problem, input related to the methods used and providing input related to the conclusions of the research, including proof reading in this manuscript, or reviewing and editing the manuscript. The statistical data processing application uses IBM SPSS version 27 to process descriptive data and uses JASP to test the research hypothesis.

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