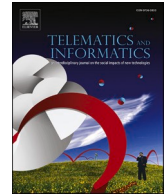




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Facebook addiction and depression: Loneliness as a moderator and poor sleep quality as a mediator

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ABSTRACT

Facebook addiction is considered as one of the potential behavior addictions. Data on Facebook addiction among Facebook users in Vietnam is scarce, although this is a research topic that is increasingly attracting the attention of researchers. This study aims to identify the mediating and moderating effects of poor sleep quality and loneliness in the association between Facebook addiction levels and depression among Vietnamese Facebook users. A cross-sectional study was conducted in October 2020 via an online survey. Participants received an invitation to join the study with a link to the questionnaire via Facebook. A total of 354 Facebook users completed survey about Facebook addiction, sleep quality, loneliness and depression. Results reveal that poor sleep quality partially mediated the association between Facebook addiction and depression ($b = 0.117$, $SE = 0.027$, $CI = [0.066, 0.172]$), and loneliness moderated this relationship ($\beta = 0.023$, $SE = 0.008$, $CI = [0.007, 0.039]$). This research not only enriches the theory of the association between Facebook addiction and depression, but also a basis for the development of intervention programs to prevent depression for Facebook addicts. Accordingly, the intervention should be paid attention to improving the quality of sleep and reducing loneliness for Facebook users.

1. Introduction

The development of communication services has improved people's quality of life, but behavioral addictions such as Internet addiction and social media addiction have become commonplace (Rajesh and Rangaiah, 2020). Social media addiction is referred to excessive use and interest in social media (uncontrollable behavior), so much time and effort spent on social media that negatively affects other important areas of life (Griffiths et al., 2014). Social media addiction has symptoms of Internet addiction because it is a type of Internet addiction (over participation, withdrawal, losing control over mood and usage, and preoccupation about using social media) (Ryan et al., 2016). Social addiction is a term that refers to the abuse of all social networking apps like Facebook, Instagram, Twitter and YouTube. Facebook is a popular social network (Foroughi et al., 2019) and has the largest number of users in the world (Rajesh and Rangaiah, 2020). Using Facebook has a positive effect on the social life of individuals such as maintaining, improving friendship networks, sharing ideas, providing social support, forming new relationships and facilitating learning (Chakraborty, 2016), but overusing can lead to Facebook addiction. Therefore, the behavior of Facebook addiction deserves attention to research. According to Griffiths (2005), Facebook addictive behavior has the following characteristics: relapse, withdrawal, mood modification, conflict, salience and tolerance. There is evidence that Facebook addiction is linked to depression (Zaffar et al., 2015; Mamun and Griffiths, 2019), loneliness (Shettar et al., 2017; Karakose et al., 2016; Satıcı, 2019), poor sleep quality (Wolniczak et al., 2013) and mental

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health (Rahman and Ahmed, 2018). Several studies have investigated the link between Facebook addiction and the development of depressive symptoms (Zaffar et al., 2015; Mamun and Griffiths, 2019). Researchers have less knowledge about the factors that mediate and buffer the link between Facebook addiction and depression in Facebook users. Therefore, studies to examine variables that could mediate or buffer the link between Facebook addiction and depression have important theoretical and practical implications. In order to fill this gap in the literature, this research is going to examine two conceptual models in which poor sleep quality mediates and loneliness moderates the association between Facebook addiction and depression in Facebook users in Vietnam.

1.1. Facebook addiction and depression

Depression is understood as “a mood disorder that affects the way a person feels, thinks or behaves, which impairs social or occupational functioning” (Joffres et al., 2013, p.775). Depression is one of the four serious illnesses, the most common cause of disability from disease (Sarokhani et al., 2013) and the leading cause of death from suicide (Bachmann, 2018). Previous studies identified Facebook addiction as a significant risk factor for developing depression in Facebook users (Siddiqi et al., 2018; Foroughi et al., 2019; Mamun and Griffiths, 2019). Specifically, studies revealed that spending time on Facebook and overusing of Facebook increases users’ symptoms of depression (Wright et al., 2013; Lin et al., 2016). Similarly, Siddiqi et al. (2018) and Foroughi et al. (2019) have revealed that Facebook addiction levels are likely to increase the risk of depression in users. According to the researchers, individuals who are addicted to Facebook may develop feelings of jealousy, which in turn leads to depression or users may become addicted to Facebook if they find that their social attractiveness is lower than that of other users, thereby developing symptoms of depression (Foroughi et al., 2019). Thus, the concepts of jealousy and social competition are the keys to explaining the path from Facebook addiction to depression. On the other hand, Facebook addicts tend to assess their life negatively, have lower self-esteem, and less optimism than non-addicted users (Błachnio and Przepiorka, 2016; Malik and Khan, 2015), which lead to the development of depression symptoms. There is another point of view that Facebook addiction leads to problems in relationships and increases feelings of loneliness and social isolation (Ryan et al., 2016; Saleem et al., 2016) and then creates depression. Therefore, the risk of depression might be reduced if individuals restrict the use of Facebook (Hunt et al., 2018).

1.2. Poor sleep quality as a mediator

Sleep accounts for one third of a person’s life and it is important for attention, learning, memory and emotional balance (Kootesh et al., 2016). If the quality of sleep is poor, both the body and mind are impaired, leading to some changes in behaviors (Çelebioğlu et al., 2020). Previously, many studies reported that pathological Internet use or Internet addiction was associated with short sleep duration (Li et al., 2010; Alimoradi et al., 2019), insomnia (Younes et al., 2016; Fazeli et al., 2020), tendency to sleep late (Van den Bulck, 2004), sleep disturbances (Tan et al., 2016) and drowsiness during the day (Lin et al., 2011). Similarly, problematic social media use was associated with poor sleep quality (Wong et al., 2020; Lin et al., 2020), insomnia (Lin et al., 2020) and daytime sleepiness (Lin et al., 2020). According to Garrett et al. (2018), using social media for longer period of time and spending more time with social media causes the quality of sleep of users to decrease. Levenson et al. (2016) reported that individuals with higher social media use volume and frequency had higher odds of having sleep disturbance. There is research revealing that Facebook use and Facebook addiction have been associated with poor sleep quality (Wolniczak et al., 2013; Bowler and Bourke, 2019; Atroszko et al., 2018). Previous studies indicated that Facebook addiction was associated with poor sleep quality (Wolniczak et al., 2013; Atroszko et al., 2018). According to Wolniczak et al. (2013), the mechanisms of this association are diverse: First, the abuse of Facebook makes sleep habits frequently interrupted when logging in late at night and interrupting the sleep–wake balance of Facebook users; Second, exposure to light at the wrong time of day can cause changes in sleep start time, delay in the onset of sleep, altering the circadian rhythm of sleep, and causing insomnia and difficulty falling asleep; Third, Facebook addicts can develop feelings of loneliness and social isolation, which has also been linked to sleep fragmentation (Wolniczak et al., 2013). Today, electronic devices (smartphones, tablets) are increasingly portable and lighter, making it possible for people to use Facebook in bed or before bed. Using electronic devices while in bed will cause users to suffer cognitive, emotional or physiological stimulation, thus deteriorating the quality of sleep (Bruni et al., 2015). Poor quality of sleep has negative effects on an individual’s physical and mental health (Hu et al., 2020). Several studies investigating the association between sleep quality and depression have reported that the poorer the quality of sleep, the higher the risk of depression (Supartini et al., 2016; O’Leary et al., 2017; Liu et al., 2019). There are several possible explanations for the link between poor sleep quality and depression. Specifically, O’Leary et al. (2017) have indicated that poor sleep quality reduces the ability to regulate emotions and leads to an increase in symptoms of depression over time. However, some studies suggest that sleep disturbances may be an early sign of depression (Alcántara et al., 2016; Kalmbach et al., 2017). Y. Zhang, Peters and Chen (2018) explained that individuals with poor sleep quality increase their perceived stress experience, which in turn contributes to the development of depressive symptoms. The above analysis shows that poor sleep quality can lead to the development of depression through many different mechanisms. Therefore, based on the above discussion, we form the Hypothesis 1:

H1. Facebook addiction will indirectly affect depression through poor sleep quality (Facebook addiction will positively impact poor sleep quality and poor sleep quality positively affects depression).

1.3. Loneliness as a moderator

Previous studies have shown the positive association between loneliness and depression. Wei, Russell and Zakalik (2005) has found that students with high levels of loneliness tend to increase the risk of depression because of discomfort with self-disclosure and lack of

social inefficiency. In the same vein, some studies have shown that loneliness was positively correlated with depression scores (S. Cacioppo et al., 2015; Matthews et al., 2016; Moeller and Seehuus, 2019). According to Swami et al. (2007), loneliness not only directly causes symptoms of depression but also indirectly affects depression through health, meaning that lonely people often experience poorer health and in turn lead to a risk of depression. L. Liu, Gou, and Zuo (2016) explained that lonely individuals often lack of social support, which in turn leads to a higher risk of experiencing depression. The above analysis shows that the mechanism of the path from loneliness to depression is complex; at the same time, individuals with lower levels of loneliness have a lower risk of depression. On the other hand, a lot of evidences have shown that Facebook addiction is strongly correlated with the development of depressive symptoms (Siddiqi et al., 2018; Foroughi et al., 2019; Mamun and Griffiths, 2019). Therefore, it is assumed that the effect of Facebook addiction on depression will be stronger among individuals with high loneliness. Based on this logic, we propose the following the Hypothesis 2:

H2. The positive association between Facebook addiction and depression will be stronger for individuals with high loneliness.

2. Methods

2.1. Participants

The data was collected in October 2020 through an online survey. Convenience sampling and purposive sampling techniques are used in our study to select participants. Participants are Vietnamese who are using Facebook. 361 undergraduates and staffs at a university in central region of Vietnam received an invitation to join the study with a link to the questionnaire via Facebook. This university has 107 staffs and 3,000 undergraduates. According to the formula of Slovin (1960), with a total population of 3107 and an error rate of 5%, the sample size required for our study is from 352 participants or more. In total, there are 354 valid questionnaires with an efficiency rate of 98.06%. In this sample, 36.2% of the participants are from rural areas and 53.9% are female. Participants' ages ranged from 15 to 49 years, M age = 25.13, SD = 7.234. In terms of time using Facebook, 38.4% of participants use Facebook <1 h/day, 35.3% of participants use it from 1 to 3 h/day, 14.1% of participants use it from 3 to 5 h/day and 12.1% of participants use it from 5 to 8 h/day (see Table 1). In this study, the rate of Vietnamese users who are addicted to Facebook was 33.6%. All the participants volunteered to answer the questionnaire and after completing the questionnaire, each participant received 50,000 VND.

2.2. Measures

Bergen Facebook Addiction Scale (BFAS): In this study, the BFAS (Andreassen et al., 2012) was applied to evaluate the risk of Facebook addiction among Vietnamese users. The BFAS is a self-reporting scale consisting of 6 items (e.g. sample items such as "you feel an urge to use Facebook more and more") rated on a 5-point Likert scale from 1 to 5 (very rarely to very often). Total scores fluctuated from 1 – 30 with higher scores indicating higher levels of Facebook addiction. The BFAS is adapted and used in Vietnam. Chương et al. (2020) reported that the internal reliability of the BFAS was 0.86. In this study, the scale has good reliability and validity (α = 0.814, X^2/df = 2.516, CFI = 0.977, GFI = 0.978, NFI = 0.963, $AGFI$ = 0.950, IFI = 0.978 and $RMSEA$ = 0.066).

The UCLA loneliness scale version 3: To evaluate loneliness of Vietnamese Facebook users, the UCLA Loneliness Scale, version 3 (Russell, 1996) was applied. The UCLA loneliness scale is a self-reporting scale consisting of 20 items (e.g. sample items such as "how often do you feel that you lack of companionship") to measure a participant's subjective feelings of social isolation and loneliness. For each item, participants needed to provide answers on a 4-point Likert scale ranging from 1 to 4 ("never" to "often"). The total loneliness score ranges from 1 to 80 with higher scores indicating higher levels of loneliness. In Vietnam, Tran and Cao (2018) reported that the internal reliability of the UCLA loneliness scale was 0.85. In our study, this scale has good internal reliability (α = 0.866).

The Pittsburgh Sleep Quality Index (PSQI): To evaluate sleep quality of Facebook users in Vietnam, 18 questions of the PSQI were applied. This instrument was used to determine 7 components of sleep quality (sleep latency, daytime dysfunction, sleep disturbances, subjective sleep quality, habitual sleep efficiency, sleep duration and use of sleeping medication). This scale includes both open and closed questions. Sample closed questions include "Cannot get to sleep within 30 min" and "Cannot breathe comfortably". Answers to

Table 1
Socio-demographic characteristics of subjects (N = 354).

	Participants
Gender	
Female, n (%)	192 (54.2)
Male, n (%)	162 (45.8)
Age, $M \pm SD$	25.13 \pm 7.234
Permanent residence	
Rural, n (%)	129 (36.4)
Urban, n (%)	225 (63.6)
Online time	
<1 h / day, n (%)	136 (38.4)
1–3 h/ day, n (%)	125 (35.3)
3–5 h/ day, n (%)	50 (14.1)
5–8 h/ day, n (%)	43 (12.1)

closed questions are usually based on a 4-point Likert scale ranging from 0 (not during the past month or very good) to 3 (three or more times a week or very bad). The sleep quality score was computed as the sum of the 7-component score. Global sleep quality scores ranged from 0 to 21, with total score of 5 or higher identified poor sleep quality (Buysse et al., 1989). Therefore, higher PSQI scores indicates poorer sleep quality (L. Zhang et al., 2020). In Vietnam, To and Nguyen (2015) reported that the reliability coefficient α was 0.789. In our study, this scale has good internal reliability ($\alpha = 0.713$).

Depression Anxiety Stress Scales 21 (DASS 21): DASS 21 is a shortened version of DASS (consisting of 42 items). It is a 21 self-assessment items scale to measure participants' symptoms of depression, anxiety, and stress. In this study, the depressive symptoms of Facebook users in Vietnam were measured by the depression sub-scale. The sub-scale of depression includes 7 items. Sample items include "I couldn't seem to experience any positive feeling at all" and "I was unable to become enthusiastic about anything". For each item, participants needed to provide answers on a 4-point Likert scale ranging from 0 to 3 ("did not apply to me at all" to "applied to me very much"). The score on the depression sub-scale will need to be multiplied by 2 to calculate the final score. Depression scores ranged from 0 to 42, with total score of 10 or higher identified as having depression. In the sample of Vietnamese university students, Ho, Li and Gu (2020) revealed that the reliability coefficient α was 0.797. In our study, this scale has good internal reliability ($\alpha = 0.883$).

2.3. Data analysis

After data is collected, all information is encoded with numerical indicators. The information was then analyzed using SPSS 20.0, Amos 20.0 and Process macro v3.5 for SPSS. SPSS 20.0 was used to calculate the mean and standard deviation of the studied variables. In order to investigate the mediating effect of poor sleep quality and the moderating effect of loneliness in the association between Facebook addiction and depression, the study used Process Macro Model 4 and Model 1 (Hayes, 2018). In the mediation model, the Facebook addiction was independent variable, depression was dependent variable, poor sleep quality was the mediator variable, age and gender were control variables. In the moderation model, the Facebook addiction was independent variable, depression was dependent variable, loneliness was the moderator variable, age and gender were control variables.

3. Results

3.1. Preliminary analysis

According to Table 2, Facebook addiction is positively correlated with poor sleep quality ($r = 0.290, p < 0.01$), loneliness ($r = 0.239, p < 0.01$), and depression ($r = 0.318, p < 0.01$). Depression is positively correlated with poor sleep quality ($r = 0.497, p < 0.01$) and loneliness ($r = 0.608, p < 0.01$). Loneliness is positively correlated with poor sleep quality ($r = 0.420, p < 0.01$).

3.2. Test of the mediation model of poor sleep quality

According to Table 3, the mediation model showed acceptable fit statistics: $\chi^2/df = 4.484, GFI = 0.901, NFI = 0.860, CFI = 0.887, AGFI = 0.874, RMSEA = 0.070$.

According to regression results in Table 4, Facebook addiction positively predicted poor sleep quality $\beta = 0.266^{***}, SE = 0.041, p < 0.001, CI = [0.127, 0.288]$ as well as poor sleep quality positively predicted depression $\beta = 0.440^{***}, SE = 0.120, p < 0.001, CI = [0.869, 1.341]$. Facebook addiction positively predicted depression $\beta = 0.182^{***}, SE = 0.096, p < 0.001, CI = [0.168, 0.545]$. The indirect effect was significant $b = 0.117, SE = 0.027, CI = [0.066, 0.172]$. These results indicated that poor sleep quality partially mediated the association between Facebook addiction on depression (Fig. 1).

3.3. Test of the moderation model of loneliness

Table 5 indicated that loneliness significantly moderated the association between Facebook addiction and depression $\beta = 0.023, SE = 0.008, p < 0.001, CI = [0.007, 0.039]$. As shown in Fig. 2, Vietnamese Facebook users with higher levels of Facebook addiction reported higher levels of depression. This relation was stronger when Facebook users have high loneliness $\beta = 0.602, SE = 0.118, p < 0.001, CI = [0.370, 0.833]$ and this association was not statistically significant when Facebook users have low loneliness $\beta = 0.156, SE = 0.113, p > 0.05, CI = [-0.066, 0.378]$. These results suggest that high loneliness increases the positive effects of Facebook addiction on depression among Vietnamese Facebook users.

Table 2

Pearson correlations, mean, and standard deviations among study variables.

	Mean	SD	Facebook addiction	Depression	Loneliness
Facebook addiction	14.42	4.577			
Depression	9.97	8.972	0.318**		
Loneliness	43.92	9.661	0.239**	0.608**	
Sleep quality	7.34	3.568	0.290**	0.497**	0.420**

Notes: ** $p < 0.01$.

Table 3
Model fit statistics.

	χ^2/df	GFI	NFI	CFI	AGFI	RMSEA
Reference standard	<5	>0.85	>0.80	>0.80	>0.80	<0.08
Mediation model	4.484	0.901	0.860	0.887	0.874	0.070

Table 4
Bias-corrected bootstrap test on mediating effects.

Paths	β	SE	95%CI	
			Low	High
Facebook addiction - Depression	0.182***	0.096	0.168	0.545
Facebook addiction - Poor sleep quality	0.266***	0.041	0.127	0.288
Poor sleep quality - Depression	0.440***	0.120	0.869	1.341
Facebook addiction - Poor sleep quality -Depression	0.117***	0.027	0.066	0.172
The total effect	0.299***	0.103	0.384	0.788
Age - Poor sleep quality	-0.069	0.026	-0.086	0.017
Gender - Poor sleep quality	0.087	0.366	-0.097	1.342
Age - Depression	-0.035	0.059	-0.159	0.072
Gender - Depression	-0.004	0.825	-1.685	1.559

Notes. N = 354. CI = confidence interval (5000 bootstrap samples). *** p < 0.001.

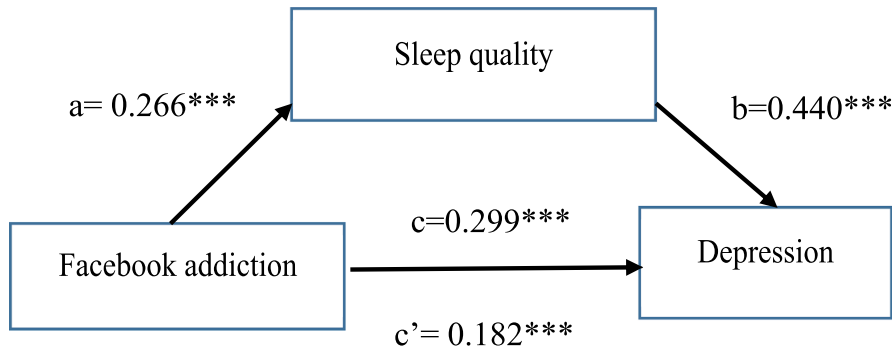


Fig. 1. Mediation model of the indirect effect of Facebook addiction on the depression. For the Facebook addiction - depression pathway, the c values represent the total effect and the c' values represent the direct effect.

Table 5
Regressions testing loneliness as a moderator in the relationship between Facebook addiction and depression.

Regression Models	β	SE	T value	95% CI	R ²	F value
Facebook addiction	0.379	0.085	4.458***	[0.212, 0.546]	0.417	49.769***
Loneliness	0.515	0.040	12.896***	[0.437, 0.594]		
Facebook addiction * Loneliness	0.023	0.008	2.864**	[0.007, 0.039]		
Gender	0.585	0.741	0.790	[-0.872, 2.043]		
Age	0.027	0.054	0.499	[-0.079, 0.133]		
Conditional effects	Loneliness value	Effect	se	p	LLCI	ULCI
	Low loneliness	0.156	0.113	0.168	-0.066	0.378
	High loneliness	0.602	0.118	0.000	0.370	0.833

Notes: **: Correlation is significant at the 0.01 level (2-tailed), ***: Correlation is significant at the 0.001 level (2-tailed), LL = lower limit, CI = confidence interval, UL = upper limit.

4. Discussion

Facebook is the most commonly used social networking site for people to communicate and interact with friends every day (Nida Tabassum Khan and Sohail Ahmed, 2018). Despite Facebook’s promising advantages, there are growing concerns about Facebook users’ addiction. The aim of this research is to find the role of poor sleep quality and loneliness in the path from Facebook addiction to

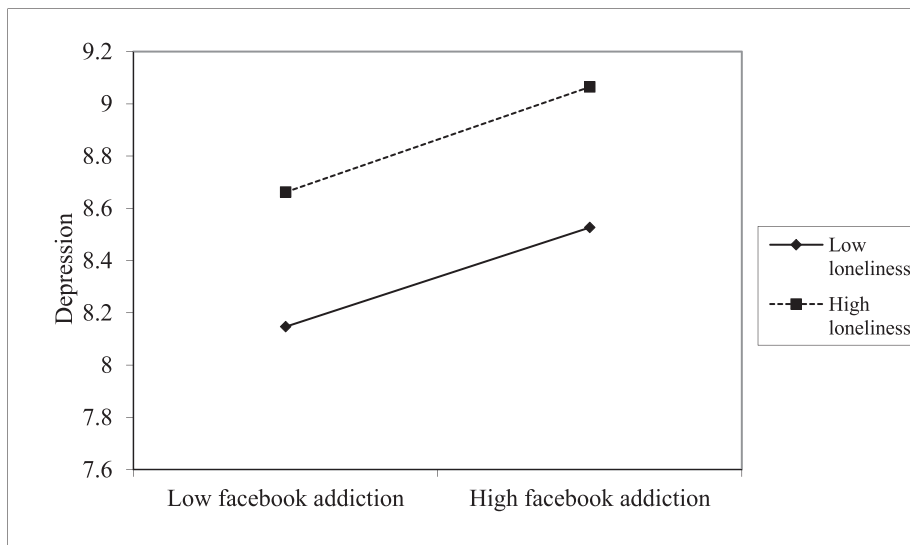


Fig. 2. Loneliness as moderator of the relationship between Facebook addiction and depression.

depression. The findings of this study have important theoretical and practical implications.

Consistent with the Hypothesis 1, we found that poor sleep quality partly mediated the association between Facebook addiction and the development of depression symptoms. This study indicates that Facebook addiction is positively correlated with poor sleep quality, which supports previous findings about addiction (Wolniczak et al., 2013; Bowler and Bourke, 2019; Atroszko et al., 2018). It can be explained that individuals who used Facebook for long periods of time got disrupted sleep, disrupting sleep-wake schedules. During using Facebook, the impact of bright light from electrical devices has changed the circadian rhythm of sleep, thereby causing individuals to lose sleep, sleep difficulty and poor sleep quality. Moreover, the abuse of Facebook can stimulate cognizance, emotion, or physiology and develop feelings of loneliness in users, thereby reducing sleep quality. This study also showed that poor sleep quality was strongly associated with depression levels in Vietnamese Facebook users, which is in line with previous findings (Supartini et al., 2016; O'Leary, Bylisma, & Rottenberg, 2017; Liu et al., 2019). Consistent with previous findings (O'Leary et al., 2017; Y. Zhang et al., 2018), we suggest that poor sleep quality increases individuals' perception of stress and reduces their ability to regulate emotions, thereby increasing their risk of depression. The above discussion demonstrates that Facebook addiction has an indirect effect on depression through poor sleep quality. This may explain the important role of poor sleep quality in translating Facebook addiction into symptoms of depression in Vietnamese Facebook users.

As expected, this study found that loneliness moderated the association between Facebook addiction and the development of depression symptoms, which is consistent with Hypothesis 2. Simple slope analysis revealed that the positive correlation between Facebook addiction and depression becomes stronger in users with high levels of loneliness, and vice versa, this positive association becomes weaker and is not statistically significant for users with low loneliness. The explanation for these findings is as follows: Prior studies have highlighted that Facebook addiction increases the risk of individuals experiencing depression (Siddiqi, Islam, Siddiqi, & Haider, 2018; Foroughi et al., 2019; Mamun and Griffiths, 2019). Consistent with earlier findings, this study revealed that Facebook addiction was positively correlated with the development of depressive symptoms. Regarding the mechanism of the path from Facebook addiction to depression, unlike previous studies (Błachnio and Przepiorka, 2016; Malik and Khan, 2015; Foroughi et al., 2019), this study suggests that high Facebook addiction correlates with poor sleep quality and increased depression. On the other hand, there is evidence that individuals with feelings of loneliness are more likely to experience depression (S. Cacioppo, Grippo, London, Goossens, and Cacioppo, 2015; Matthews et al., 2016; Moeller and Seehuus, 2019). In line with prior studies, this study found that loneliness is positively correlated with the development of depressive symptoms. From the above analysis, it is found that individuals with high levels of Facebook addiction and loneliness have the highest risk of depression; in contrast, individuals with low levels of Facebook addiction and loneliness have the lowest risk of depression (see Fig. 2).

The findings of this study have theoretical and practical implications. Theoretically, the important contribution of this study is to extend the existing theories by exploring poor sleep quality and loneliness as factors that influence the effects of Facebook on the development of depressive symptoms. More importantly, this study's findings also suggest that there is a need to develop programs to prevent depression by using Facebook properly, improving sleep quality and reducing loneliness experiences. Specific interventions include: First, raising awareness and focusing on education about Facebook addiction, loneliness and sleep quality. To implement this measure, researchers or educators can organize short seminars to analyze the negative effects of Facebook addiction, loneliness and poor sleep quality. Second, on the basis of analyzing negative effects, researchers can recommend measures that can help Facebook users reduce loneliness (e.g., training and improving social skills, providing social support resources and implementing cognitive-related interventions), improve sleep quality (e.g., reducing blue light exposure in the evening, listening to music and exercising or yoga) and reducing Facebook addiction level (e.g., cognitive reconstruction and supporting techniques). Like other studies, this study

has the following limitations: Firstly, it is not possible to deduce a causal relationship from findings because this is a cross-sectional study. Therefore, it is necessary to have long-term studies to further examine the causes and consequences of Facebook addiction. Secondly, the findings of this study is heavily depended on a self-reporting method that required participants to recall their experiences; therefore, the answers may be inaccurate because they may be subject to recall biases. Therefore, future studies should use other assessment methods that do not rely on participants' recall such as experience sampling. Thirdly, the target sample of this study is quite young, so caution should be exercised when generalizing the findings of this study to other age groups. Therefore, future studies need to examine relationships between the variables studied in other age groups. Finally, the study was conducted in central Vietnam, so caution should be exercised when generalizing research results to other regions.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

- Alcántara, C., Biggs, M.L., Davidson, K.W., Delaney, J.A., Jackson, C.L., Zee, P.C., Redline, S., 2016. Sleep Disturbances and Depression in the Multi-Ethnic Study of Atherosclerosis. *Sleep* 39 (4), 915–925.
- Alimoradi, Z., Lin, C.-Y., Broström, A., Bülow, P.H., Bajalan, Z., Griffiths, M.D., Ohayon, M.M., Pakpour, A.H., 2019. Internet addiction and sleep problems: A systematic review and meta-analysis. *Sleep Med. Rev.* 47, 51–61. <https://doi.org/10.1016/j.smrv.2019.06.004>.
- Andreassen, C.S., Torsheim, T., Brunborg, G.S., Pallesen, S., 2012. Development of a Facebook Addiction Scale. *Psychol. Rep.* 110 (2), 501–517. <https://doi.org/10.2466/02.09.18.PR0.110.2.501-517>.
- Atroszko, P.A., Balcerowska, J.M., Bereznowski, P., Biernatowska, A., Pallesen, S., Schou Andreassen, C., 2018. Facebook addiction among Polish undergraduate students: Validity of measurement and relationship with personality and well-being. *Comput. Hum. Behav.* 85, 329–338. <https://doi.org/10.1016/j.chb.2018.04.001>.
- Bachmann, S., 2018. Epidemiology of suicide and the psychiatric perspective. *Int. J. Environ. Res. Public Health* 15 (7), 1425.
- Blachnio, A., Przepiorka, A., 2016. Personality and positive orientation in Internet and Facebook addiction. An empirical report from Poland. *Comput. Hum. Behav.* 59, 230–236. <https://doi.org/10.1016/j.chb.2016.02.018>.
- Bowler, J., Bourke, P., 2019. Facebook use and sleep quality: Light interacts with socially induced alertness. *Br. J. Psychol.* 110 (3), 519–529. <https://doi.org/10.1111/bjop.12351>.
- Bruni, O., Sette, S., Fontanesi, L., Baiocco, R., Laghi, F., Baumgartner, E., 2015. Technology Use and Sleep Quality in Preadolescence and Adolescence. *J. Clin. Sleep Med.* 11 (12), 1433–1441. <https://doi.org/10.5664/jcsm.5282>.
- Buyssse, D.J., Reynolds III, C.F., Monk, T.H., Berman, S.R., Kupfer, D.J., 1989. The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Res.* 28 (2), 193–213. [https://doi.org/10.1016/0165-1781\(89\)90047-4](https://doi.org/10.1016/0165-1781(89)90047-4).
- Cacioppo, S., Grippo, A.J., London, S., Goossens, L., Cacioppo, J.T., 2015. Loneliness: Clinical Import and Interventions. *Perspect. Psychol. Sci.* 10 (2), 238–249. <https://doi.org/10.1177/1745691615570616>.
- Çelebioğlu, A., Aytekin Özdemir, A., Küçükoğlu, S., Ayran, G., 2020. The effect of Internet addiction on sleep quality in adolescents. *J. Child. Adolesc. Psychiatr. Nurs.* 33 (4), 221–228. <https://doi.org/10.1111/jcap.12287>.
- Chakraborty, A., 2016. Facebook Addiction: An Emerging Problem. *Am. J. Psych. Residents' J.* 11 (12), 7–9. <https://doi.org/10.1176/appi.ajp-rj.2016.111203>.
- Chuong, L.T., Minh, Đ.Đ., Thảo, M.P., 2020. Độ tin cậy và tính giá trị của thang điểm đánh giá tình trạng nghiện Facebook của Đại học Bergen phiên bản tiếng Việt. *Nghiên Cứu Y Học* 1 (24), 138–144.
- Fazeli, S., Mohammadi Zeidi, I., Lin, C.-Y., Namdar, P., Griffiths, M.D., Ahorsu, D.K., Pakpour, A.H., 2020. Depression, anxiety, and stress mediate the associations between internet gaming disorder, insomnia, and quality of life during the COVID-19 outbreak. *Addict. Behav. Rep.* 12, 100307.
- Foroughi, B., Iranmanesh, M., Nikbin, D., Hyun, S.S., 2019. Are depression and social anxiety the missing link between Facebook addiction and life satisfaction? The interactive effect of needs and self-regulation. *Telematics Inform.* 43, 101247. <https://doi.org/10.1016/j.tele.2019.101247>.
- Garett, R., Liu, S., Young, S.D., 2018. The relationship between social media use and sleep quality among undergraduate students. *Inf. Commun. Soc.* 21 (2), 163–173. <https://doi.org/10.1080/1369118X.2016.1266374>.
- Griffiths, M., 2005. A 'components' model of addiction within a biopsychosocial framework. *J. Subst. Use* 10 (4), 191–197. <https://doi.org/10.1080/14659890500114359>.
- Griffiths, M.D., Kuss, D.J., Demetrovics, Z., 2014. In: *Behavioral Addictions*. Elsevier, pp. 119–141. <https://doi.org/10.1016/B978-0-12-407724-9.00006-9>.
- Hayes, A.F., 2018. *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (2nd editio). The Guilford Press, New York.
- Ho, T.T.Q., Li, C., Gu, C., 2020. Cyberbullying victimization and depressive symptoms in Vietnamese university students: Examining social support as a mediator. *Int. J. Law Crime Justice* 63, 100422. <https://doi.org/10.1016/j.ijlcj.2020.100422>.
- Hu, Z., Zhu, X., Kamina, A.C., Zhu, T., Nie, Y., Xu, H., 2020. Association between poor sleep quality and depression symptoms among the elderly in nursing homes in Hunan province, China: a cross-sectional study. *BMJ Open* 10 (7), e036401. <https://doi.org/10.1136/bmjopen-2019-036401>.
- Hunt, M.G., Marx, R., Lipson, C., Young, J., 2018. No More FOMO: Limiting Social Media Decreases Loneliness and Depression. *J. Soc. Clin. Psychol.* 37 (10), 751–768. <https://doi.org/10.1521/jscp.2018.37.10.751>.
- Joffres, M., Jaramillo, A., Dickinson, J., Lewin, G., Pottie, K., Shaw, E., Gorber, S.C., Tonelli, M., 2013. Recommendations on screening for depression in adults. *Can. Med. Assoc. J.* 185 (9), 775–782. <https://doi.org/10.1503/cmaj.130403>.
- Kalmbach, D.A., Arnedt, J.T., Song, P.X., Guille, C., Sen, S., 2017. Sleep Disturbance and Short Sleep as Risk Factors for Depression and Perceived Medical Errors in First-Year Residents. *Sleep* 40 (3).
- Kootesh, B.R., Raisi, M., Ziapour, A., 2016. Investigation of relationship internet addict with mental health and quality sleep in students. *Acta Medica Mediterranea* 32, 1921–1925.

- Levenson, J.C., Shensa, A., Sidani, J.E., Colditz, J.B., Primack, B.A., 2016. The association between social media use and sleep disturbance among young adults. *Prev. Med.* 85, 36–41. <https://doi.org/10.1016/j.ypmed.2016.01.001>.
- Li, S., Zhu, S., Jin, X., Yan, C., Wu, S., Jiang, F., Shen, X., 2010. Risk factors associated with short sleep duration among Chinese school-aged children. *Sleep Med.* 11 (9), 907–916. <https://doi.org/10.1016/j.sleep.2010.03.018>.
- Lin, C.-Y., Imani, V., Griffiths, M.D., Broström, A., Nygårdh, A., Demetrovics, Z., Pakpour, A.H., 2020. Temporal associations between morningness/eveningness, problematic social media use, psychological distress and daytime sleepiness: Mediated roles of sleep quality and insomnia among young adults. *J. Sleep Res.* 30 (1) <https://doi.org/10.1111/jsr.13076>.
- Lin, L.-Y., Sidani, J.E., Shensa, A., Radovic, A., Miller, E., Colditz, J.B., Hoffman, B.L., Giles, L.M., Primack, B.A., 2016. Association between social media use and depression among u.s. young adults: research article: social media and depression. *Depress Anxiety* 33 (4), 323–331. <https://doi.org/10.1002/da.22466>.
- Lin, M.-P., Ko, H.-C., Wu, J.-W., 2011. Prevalence and Psychosocial Risk Factors Associated with Internet Addiction in a Nationally Representative Sample of College Students in Taiwan. *Cyberpsychology, Behavior, and Social Networking* 14 (12), 741–746. <https://doi.org/10.1089/cyber.2010.0574>.
- Liu, L., Gou, Z., Zuo, J., 2016. Social support mediates loneliness and depression in elderly people. *J Health Psychol* 21 (5), 750–758. <https://doi.org/10.1177/1359105314536941>.
- Liu, R.-Q., Bloom, M.S., Wu, Q.-Z., He, Z.-Z., Qian, Z., Stamatakis, K.A., Dong, G.-H., 2019. Association between depressive symptoms and poor sleep quality among Han and Manchu ethnicities in a large, rural, Chinese population. *PLoS ONE* 14 (12) e0226562.
- Malik, S., Khan, M., 2015. Impact of facebook addiction on narcissistic behavior and Self-Esteem among students. *J. Pak. Med. Assoc.* 65 (3), 1–5.
- Mamun, M.A.A., Griffiths, M.D., 2019. The association between Facebook addiction and depression: A pilot survey study among Bangladeshi students. *Psychiatry Res.* 271, 628–633. <https://doi.org/10.1016/j.psychres.2018.12.039>.
- Matthews, T., Danese, A., Wertz, J., Odgers, C.L., Ambler, A., Moffitt, T.E., Arseneault, L., 2016. Social isolation, loneliness and depression in young adulthood: a behavioural genetic analysis. *Soc. Psychiatry Psychiatr. Epidemiol.* 51 (3), 339–348. <https://doi.org/10.1007/s00127-016-1178-7>.
- Moeller, R.W., Seehuus, M., 2019. Loneliness as a mediator for college students' social skills and experiences of depression and anxiety. *J. Adolesc.* 73, 1–13. <https://doi.org/10.1016/j.adolescence.2019.03.006>.
- Nida Tabassum Khan, Sohail Ahmed, 2018. Impact of Facebook Addiction on Students Academic Performance. *Res. Med. Eng. Sci.* 5 (2).
- O'Leary, K., Bylsma, L.M., Rottenberg, J., 2017. Why might poor sleep quality lead to depression? A role for emotion regulation. *Cogn. Emot.* 31 (8), 1698–1706. <https://doi.org/10.1080/02699931.2016.1247035>.
- Rahman, M., Ahmed, O., 2018. Facebook Use, Facebook Addiction, and Mental Health of Chittagong University Students. *Bulgarian Journal of Science and Education Policy* 12 (2), 345–358.
- Rajesh, T., Rangaiah, D.B., 2020. Facebook addiction and personality. *Heliyon* 6 (1), e03184. <https://doi.org/10.1016/j.heliyon.2020.e03184>.
- Russell, D., 1996. UCLA Loneliness Scale Version 3 (description of Measure). *J. Pers. Soc. Psychol.*
- Ryan, T., Chester, A., Reece, J., Xenos, S., 2016a. A Qualitative Exploration of Facebook Addiction: Working toward Construct Validity. *Addicta: The Turkish Journal on Addictions* 3 (1).
- Ryan, T., Reece, J., Chester, A., Xenos, S., 2016b. Who gets hooked on Facebook? An exploratory typology of problematic Facebook users. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace* 10 (3).
- Saleem, M., Irshad, R., Zafar, M., Tahir, M.A., 2016. Facebook addiction causing loneliness among higher learning students of Pakistan: a linear relationship. *Journal of Applied and Emerging Sciences* 5 (1), 26–31.
- Sarokhani, D., Delpisheh, A., Veisani, Y., Sarokhani, M.T., Manesh, R.E., Sayemiri, K., 2013. Prevalence of Depression among University Students: A Systematic Review and Meta-Analysis Study. *Depression Research and Treatment* 2013, 1–7. <https://doi.org/10.1155/2013/373857>.
- Satici, S.A., 2019. Facebook Addiction and Subjective Well-Being: a Study of the Mediating Role of Shyness and Loneliness. *Int J Ment Health Addiction* 17 (1), 41–55. <https://doi.org/10.1007/s11469-017-9862-8>.
- Shettar, M., Karkal, R., Kakunje, A., Mendonsa, R.D., Chandran, V.V.M., 2017. Facebook addiction and loneliness in the post-graduate students of a university in southern India. *Int J Soc Psychiatry* 63 (4), 325–329. <https://doi.org/10.1177/0020764017705895>.
- Siddiqi, S.A., Islam, M.Z., Siddiqi, K.A., Haider, M.R., 2018. Is Facebook Addiction Leading Adolescents to Depression? Evidence from Dhaka City, Bangladesh. *Value in Health* 21, S191. <https://doi.org/10.1016/j.jval.2018.04.1284>.
- Supartini, A., Honda, T., Basri, N.A., Haeuchi, Y., Chen, S., Ichimiya, A., Kumagai, S., 2016. The Impact of Sleep Timing, Sleep Duration, and Sleep Quality on Depressive Symptoms and Suicidal Ideation amongst Japanese Freshmen: The EQUISITE Study. *Sleep Disorders* 2016, 1–10. <https://doi.org/10.1155/2016/8737654>.
- Swami, V., Chamorro-Premuzic, T., Sinniah, D., Maniam, T., Kannan, K., Stanistreet, D., Furnham, A., 2007. General health mediates the relationship between loneliness, life satisfaction and depression: A study with Malaysian medical students. *Soc Psychiatr Epidemiol* 42 (2), 161–166. <https://doi.org/10.1007/s00127-006-0140-5>.
- Tan, Y., Chen, Y., Lu, Y., & Li, L. (2016). Exploring Associations between Problematic Internet Use, Depressive Symptoms and Sleep Disturbance among Southern Chinese Adolescents. *International Journal of Environmental Research and Public Health*, 13(3), 313.
- To, N., Nguyen, N., 2015. Validity of the Vietnamese version of the Pittsburgh sleep quality index. *Sleep Med.* 16, S52. <https://doi.org/10.1016/j.sleep.2015.02.128>.
- Trần Thị Minh Đức, Cao Quốc Thái, 2018. Cảm nhận cô đơn của sinh viên và mối liên hệ giữa cảm nhận cô đơn với tự đánh giá bản thân, tiêu điểm kiểm soát bên ngoài. *Tạp Chí Tâm Lý Học* 233 (8), 16–30.
- Turgut Karakose, Ramazan Yirci, H. U. & T. Y. O. (2016). Relationship between High School Students' Facebook Addiction and Loneliness Status. *Eurasia Journal of Mathematics, Science & Technology Education*, 12(9), 2419–2429.
- Van den Bulck, J., 2004. Television Viewing, Computer Game Playing, and Internet Use and Self-Reported Time to Bed and Time out of Bed in Secondary-School Children. *Sleep* 27 (1), 101–104.
- Wei, M., Russell, D.W., Zakalik, R.A., 2005. Adult Attachment, Social Self-Efficacy, Self-Disclosure, Loneliness, and Subsequent Depression for Freshman College Students: A Longitudinal Study. *Journal of Counseling Psychology* 52 (4), 602–614.
- Wolniczak, I., Cáceres-DelAguila, J. A., Palma-Ardiles, G., Arroyo, K. J., Solís-Visscher, R., Paredes-Yauri, S., ... Bernabe-Ortiz, A. (2013). Association between Facebook Dependence and Poor Sleep Quality: A Study in a Sample of Undergraduate Students in Peru. *PLoS ONE*, 8(3), e59087.
- Wong, H. Y., Mo, H. Y., Potenza, M. N., Chan, M. N. M., Lau, W. M., Chui, T. K., ... Lin, C.-Y. (2020). Relationships between Severity of Internet Gaming Disorder, Severity of Problematic Social Media Use, Sleep Quality and Psychological Distress. *International Journal of Environmental Research and Public Health*, 17(6), 1879.
- Wright, K.B., Rosenberg, J., Egbert, N., Ploeger, N.A., Bernard, D.R., King, S., 2013. Communication Competence, Social Support, and Depression Among College Students: A Model of Facebook and Face-to-Face Support Network Influence. *Journal of Health Communication* 18 (1), 41–57. <https://doi.org/10.1080/10810730.2012.688250>.
- Younes, F., Halawi, G., Jabbour, H., El Osta, N., Karam, L., Hajj, A., & Rabbah Khabbaz, L. (2016). Internet Addiction and Relationships with Insomnia, Anxiety, Depression, Stress and Self-Esteem in University Students: A Cross-Sectional Designed Study. *PLOS ONE*, 11(9), e0161126.
- Zaffar, M., Mahmood, S., Saleem, M., Zakaria, E., 2015. Facebook addiction: relation with depression, anxiety, loneliness and academic performance of Pakistani students. *Sci. Int. (Lahore)* 27 (3), 2469–2475.
- Zhang, L.i., Li, D., Yin, H., 2020. How is psychological stress linked to sleep quality? The mediating role of functional connectivity between the sensory/somatomotor network and the cingulo-opercular control network. *Brain Cogn.* 146, 105641. <https://doi.org/10.1016/j.bandc.2020.105641>.
- Zhang, Y., Peters, A., Chen, G., 2018. Perceived Stress Mediates the Associations between Sleep Quality and Symptoms of Anxiety and Depression among College Nursing Students. *International Journal of Nursing Education Scholarship* 15 (1).