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From family social support to problematic internet use: a serial mediation model of hostility and depression

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Abstract

Internet usage has become an inevitable part of daily life. Adolescents who are developmentally vulnerable due to family dynamics or who suffer psychological distress are at greater risk of problematic Internet use. This study aims to reveal the intricate psychological pathways linking family social support to problematic Internet use among adolescents and the mediating roles of hostility and depression. The study uses serial mediation analyses and Hayes PROCESS macro to examine a large sample of 2,047 adolescents (1,182 females and 865 males). Results revealed a significant negative association between family social support and problematic Internet use. Both hostility and depression were found to be critical mediators, functioning independently and sequentially in the relationship between family social support and problematic Internet use. The findings highlight the protective role of family social support against problematic Internet use among adolescents by reducing hostility and depressive symptoms. This investigation contributes to the extant literature by elucidating the psychological mechanisms underlying problematic Internet use. It suggests that interventions targeting family support systems, feelings of hostility, and depression may effectively mitigate problematic Internet use among adolescent populations.

Keywords Family social support, Problematic internet use, Hostility, Depression, Adolescent

Introduction

Problematic Internet use (PIU) is a significant psychosocial concern characterized by the inability to control online behaviors, excessive Internet use, and withdrawal symptoms [1, 2]. PIU can lead to negative impacts on academic performance, social relationships, sleep quality, and wellbeing [3, 4]. In recent years, it has become evident that PIU, including its various forms, such as problematic social media use and problematic video game use, has surged among adolescents [5, 6]. Given the increasing prevalence of PIU, it has become important to understand its impact on vulnerable populations, especially adolescents. Studies have demonstrated PIU among adolescents to be associated with a wide range of family-related and psychological variables. For instance, family-related factors such as poor parent-child communication [7], lack of parental monitoring [8] parenting styles [9, 10] and inadequate family social support [11], have been identified as risk factors for the development of PIU. Furthermore, research has shown psychological factors such as depression [12], hostility [4], anxiety [11] to be significantly associated with an increased risk of PIU.

To better understand PIU among adolescents and implement preventive measures, it is crucial to investigate potential mediating mechanisms (e.g., hostility and

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depression) that may mediate the relationship between family social support and PIU. Within this context, family social support can be a starting point for exploring mediation models involving these variables. Furthermore, although earlier studies have suggested a connection between these variables, the intricate interplay among family social support, hostility, depression, and PIU remains unclear. Therefore, the present study aims to expand the field by investigating the serial mediating roles of hostility and depression in the relationship between family social support and PIU among a large sample of Turkish adolescents.

Family social support and problematic internet use

Social support can be described as the support an individual receives from other individuals, groups, and larger communities through social ties [13, 14]. Eker et al. [15] stated that there are three primary sources of social support: family, friends, and significant others. Family social support serves as a crucial protective factor against PIU [16, 17]. Moreover, Fan [18] emphasized the buffering role of family social support in mitigating the risk of PIU. The Buffering Model (BM) posits that social support serves as a vital buffer against stress and negative life experiences [13] When this model is applied to modern contexts, adolescents with a high level of family social support may be less likely to perceive the Internet as a means of escape or relaxation in the face of stressful life experiences. Previous studies indicated that adolescents establishing face-to-face social interactions with family rather than online interactions leads to a decrease in the level of PIU [19], and it can be said that those who receive adequate family social support are less likely to be at risk of PIU [20, 21]. In other words, adolescents who cannot find the expected social support from their real life are at risk of developing PIU as they search for this support from the online arena. Due to the Internet's ability to compensate for the lack of real-life family social support, individuals who often seek such support through online platforms may be more likely to have PIU [22]. Based on this theoretical framework and previous research results, it was hypothesized that family social support would negatively predict adolescents' problematic internet use (H_1).

The mediating role of hostility

Hostility is characterized as a tendency to feel anger or to want to harm others [23]. Barefoot and Lipkus [24] posit that hostility has three dimensions: emotional, cognitive, and behavioral. Situations such as boredom, anger, disgust, and resentment are expressed as emotional hostility [25]; the cognitive dimension of hostility is the devaluation of others in one's eyes, hoping that they are guilty and at fault (e.g., family members) [24]; the last dimension is behavioral hostility, which is a pattern of aggressive and defiant behaviors such as verbal aggression, rudeness, fighting, slamming doors, or hitting objects [25]. Hostility is influenced by family social support. Studies have shown that behaviors such as inadequate family social support and unaccepting and conflictual behaviors characterized by a negative family environment result in hostility traits in adolescents [26]. An adolescent who has higher family support exhibited lower aggression levels [27]. Another study conducted with Turkish adolescents shows that inadequate family social support contributes to the development of violence, a dimension of behavioral hostility [28]. In addition, findings indicate that there is an association between feelings of hostility and PIU among adolescents [29, 30]. Studies have also found that other types of hostility, such as aggression and anger, are associated with PIU [31, 32]. The relationship between hostility and PIU can be explained through the Compensatory Internet Use Theory (CIUT) [33]. The CIUT suggests that negative life events or experiences (e.g., inadequate family social support) can lead individuals to excessively use the Internet to compensate for hostile feelings (e.g., emotional, cognitive, and behavioral). Internet-based tools or applications can facilitate the expression of hostile feelings through virtual reality headsets, online aggressive games, and chat platforms. In addition, these digital platforms, which provide an anonymous and unrestricted space, can also allow direct expressions of hostility due to the loosening of social norms and the absence of physical contact. Based on this framework, findings from both Lin and Chiao [29] and a study conducted with Turkish adolescents [34] found that feelings of hostility have been an important risk factor for PIU. Therefore, inadequate family social support may increase hostility and lead to increased PIU. Consistent with these theories and findings, it was hypothesized that hostility would have a mediating effect on the relationship between family social support and adolescents' problematic Internet use (H2).

The mediating role of depression

Depression is a prevalent mental health issue that can have significant consequences for individuals, particularly during the critical developmental stage of adolescence [35]. Specifically, numerous studies have shown the role of family social support in mitigating the negative effects of depressive symptoms during this critical developmental period [36, 37]. Pössel et al. [38] demonstrated that family social support is negatively related to depressive symptoms among adolescents in a one-year longitudinal study. Another study indicated that low family social support is related to higher depression [39, 40]. In addition, depression is also strongly related to individuals' levels of PIU [41]. According to the cognitive-behavioral model proposed by Davis [42] regarding pathological Internet

use, individuals' existing psychopathologies (e.g., depression, anxiety, etc.) result in PIU. Based on this theoretical model, having a history of depressive symptoms is considered a risk factor that makes someone more likely to develop PIU. Studies related to PIU show that depressive symptoms are common mental health problems among adolescents [43]. Also, Amini and Hassanzadeh [44] found that depression associated with PIU and depressed adolescents were more likely to use the Internet problematic. Based on these findings, it was hypothesized that depression would have a mediating effect on the relationship between family social support and adolescents' problematic Internet use (H3).

The serial mediating role of hostility and depression

The psychosocial vulnerability model of hostility proposes that hostile individuals are more likely to experience interpersonal conflict, perceive lower social support, and have a higher likelihood of depression [45]. Individuals with high levels of feeling of hostility perceive life as more stressful and, most importantly, exhibit higher levels of depression due to behaviors such as anger, cynicism, and interpersonal aggression [46]. In this context, it can be suggested that there is a strong relationship between feelings of hostility and depression [47–49]. BM posits that social support acts as a protective factor against psychological distress [13]. When this support (e.g., family social support) is inadequate, adolescents may develop hostile feelings, behaviors (verbal aggression, fighting…), and cognitions as a coping mechanism. These negative behaviors can damage relationships and make adolescents maybe feel lonely, which can lead to depression [48]. The CIUT suggests that people with this psychological distress (hostility and depression) may use the Internet to feel better and connect with others when their real-life needs aren't met [33]. Finally, according to the Cognitive-Behavioral Model of PIU, adolescents experiencing depression may engage in problematic Internet use as a coping mechanism [42]. By providing a means of escape and mood regulation, internet use can become a primary strategy for managing negative emotions such as hostility feelings and depression, potentially leading to PIU. Consequently, it can be stated that low levels of family social support will lead to feelings of hostility, and these feelings, which are not accepted by the self, increase feelings of depression in adolescents, which might increase the risk of PIU [50–52]. Therefore, it was hypothesized that hostility and depression would have serial mediation effects between family social support and adolescents' problematic Internet use (H_4).

Table 1 Demographic characteristics of the sample ($n = 2047$)

Variables		*n*	%
Gender	Female	1182	57.7
	Male	865	42.3
Socioeconomic statuses	Low	149	7.3
	Medium	1204	58.8
	High	694	33.9
Daily usage of the Internet	0–60 min	1008	49.2
	61–180 min	703	34.3
	181–300 min	222	10.8
	301 min or more	114	5.6
Grade	9th grade	547	26.7
	10th grade	559	27.3
	11th grade	522	25.5
	12th grade	419	20.5

The present study

This study investigates the complex association between family social support, hostility, depression, and PIU among adolescents and aims to examine the nature and strength of the association between family social support and PIU. Furthermore, we will determine the serial mediating roles of hostility and depression in this relationship, exploring how family social support may indirectly influence PIU through its impact on these mediating variables.

Methods

Participants

Table 1 presents the demographic characteristics of the participants. The sample was selected from the province of Siirt, located in the Southeastern Anatolia region of Türkiye. A convenience sampling methodology was employed to collect data from two distinct categories of high schools: general high schools and vocational/technical high schools. The inclusion criteria for participants were: (*i*) current enrollment in high school, (*ii*) age under 18 years, and (*iii*) active Internet use. Participants were excluded if they declined voluntary participation in the research ($n = 83$). The final sample comprised 2047 adolescents (1182 females, 865 males). Participants ages ranged from 14 to 18 years ($M = 15.82$, $SD = 1.22$). The grade-level distribution was as follows: ninth grade: $n = 547$ (26.7%), tenth grade: $n = 559$ (27.3%), eleventh grade: $n = 522$ (25.5%), and twelfth grade: $n = 419$ (20.5%). Regarding school type distribution, 1020 participants (49.8%) were enrolled in general high schools, while 1,027 (50.2%) attended vocational/technical high schools. Self-reported socioeconomic status (SES) was distributed as follows: low SES: 7.3% ($n = 149$), medium SES: 58.8% ($n = 1,204$), and high SES: 33.9% ($n = 694$).

Measures

Young's internet addiction test-short form (YIAT-SF)

Twelve items YIAT-SF developed by Pawlikowski et al. [53] and adapted to the Turkish version by Kutlu et al. [54], were used to assess the individual's PIU levels (e.g.,

"*How often do you stay online longer than you planned?*") and rated on a five-point Likert scale from 1 (*never*) to 5 (*always*). The minimum and maximum scores are 12 and 60, respectively. Higher scores indicate higher PIU. The scale's internal consistency was reported as 0.91. In the present study, Cronbach's alpha coefficient was calculated as 0.86, and McDonald's ω was 0.86.

Multidimensional scale of perceived social support (MSPSS)

Twelve items MSPSS, developed by Zimet et al. [55] and adapted to the Turkish version by Eker and Akar [56], is a tool used to measure three dimensions of social support in adolescents. This scale consists of three subscales: (i) family social support, (ii) friend social support, and (iii) significant others social support. MSPSS has 12 items rated on a seven-point Likert scale from 1 (*strongly disagree*) to 7 (*strongly agree*). In this study, we use family social support subscales (e.g., "*I can discuss my problems with my family.*"). This subscale consists of 4 items. Possible scores for the family social support subscale range from 4 (lowest perceived support) to 28 (highest perceived support). The higher the score, the greater the family's social support. An individual's family social support score is obtained by summing all family social support subscale items. The family social support subscale's internal consistency was reported as 0.85. In the present study, the internal reliability for the family social support subscale was α = 0.83, and McDonald's ω was 0.84.

Brief symptom inventory (BSI)

The fifty-three-item BSI developed by Derogatis [57] and adapted to the Turkish version by Sahin et al. [58] were used to assess psychological symptoms. The scale includes nine subscales. In the present study, we used depression (e.g., "*Feelings of worthlessness.")* and hostility (e.g., "*Having urges to beat, injure, or harm someone.*") subscales rated on a five-point Likert scale from 0 (*not at all*) to 4 (*extremely*). Each subscale is scored independently. Higher scores indicate greater levels of depression and hostility. An individual's depression and hostility scores are obtained by summing all related items. The hostility and depression subscale's internal consistency was reported as 0.72 and 0.85 respectively. In the present study, the internal reliability for the depression and hostility subscale was α = 0.88 and α = 0.74, respectively. McDonald's ω was 0.88 for depression and 0.76 for hostility.

Procedure

All research procedures were performed based on ethical guidelines delineated in the Declaration of Helsinki [59]. Ethical approval from the Institutional Review Board of Siirt University was obtained (Reference number: 0301/36). Also, informed consent was obtained from all willing participants' parents or legal guardians. The sample was drawn from fifteen high schools in Siirt, Türkiye. After initial communications with educational administrators to discuss the study's aims and expected timings, the principal investigator conducted on-site visits to provide information and gather the necessary documentation. Data was collected via in-person, paper-based surveys administered in classroom settings. The data collection process for each participant was designed, requiring approximately 8 to 10 min to complete the survey. Before the survey was administered, participants were informed of the study's purpose and their right to withdraw without giving a reason. Participants were instructed to omit any personally identifiable information from their responses to maintain anonymity and confidentiality.

Data analysis

Statistical analyses were conducted using IBM SPSS Statistics software (Version 27.0). Preliminary analyses included descriptive statistics and correlations among study variables. Subsequently, mediation analyses were performed in two stages: (1) simple mediation analyses (Model 4) to test the singular mediating roles of hostility and depression, and (2) a serial mediation analysis (Model 6) to evaluate the sequential pathway linking family social support to PIU through hostility and depression. The PROCESS macro (Model 4 and Model 6) [60] was employed to test the hypothesized singular and sequential mediation model. This analytical approach facilitated the assessment of the indirect effects of family social support on PIU through the sequential mediator roles of hostility and depression.

Before primary analyses, preliminary data screening was performed to evaluate statistical assumptions underlying regression analysis. The normality assumption for parametric tests was assessed via examination of skewness and kurtosis coefficients. Following George and Mallery's [61] guidelines, values within the ± 2 range indicated normal distribution. As Table 2 shows, all variables were in line with this assumption. Additionally, multicollinearity analyses were conducted to examine the potential relationship among predictor variables (family social support, hostility, and depression). Following Shrestha's [62] recommendations, three indices were evaluated: Bivariate correlation coefficients: Values ranged from − 0.28 to 0.62 (p <.001), indicating the absence of excessive intercorrelations. Variance Inflation Factors (VIF): Values ranged from 1.14 to 1.70. Condition Indices (CI): Values ranged from 3.61 to 11.44.

To assess multicollinearity, established thresholds were utilized: VIF < 10 [63] and CI < 30 [64]. Additionally, bivariate correlations approaching|0.8| indicate potential multicollinearity issues [64]. All variables in the present

Table 2 Descriptive statistics and bivariate correlations among variables ($n = 2047$)

	Correlations coefficients				Descriptive statistics		
	1	2	3	4	*M* (*SD*)	Skewness	Kurtosis
1. Family social support	1				5.23 (1.58)	−0.83	−0.22
2. Hostility	−0.28**	1			1.68 (0.84)	0.25	−0.65
3. Depression	−0.34**	0.62**	1		1.57 (0.92)	0.43	−0.66
4. Problematic Internet Use	−0.22**	0.45**	0.38**	1	2.28 (0.77)	0.49	−0.38

Note: M, mean; *SD*, standard deviation

** $p < .001$

Table 3 Results of simple mediation analyses ($n = 2047$)

Path	Effect	SE	t	*p*	LLCI	ULCI
Model 1: Mediator = Hostility						
FSS → Hostility (a)	−0.152	0.011	−13.348	0.000	−0.174	−0.129
Hostility → PIU (b)	0.382	0.019	20.333	0.000	0.346	0.419
FSS → PIU (c')	−0.051	0.010	−5.033	0.000	−0.070	−0.031
Indirect effect (ab)	−0.058	0.005	-	-	−0.068	−0.048
Model 2: Mediator = Depression						
FSS → Depression (a)	−0.198	0.012	−16.277	0.000	−0.222	−0.174
Depression → PIU (b)	0.291	0.018	16.079	0.000	0.256	0.327
FSS → PIU (c')	−0.051	0.011	−4.800	0.000	−0.072	−0.030
Indirect effect (ab)	−0.058	0.005	-	-	−0.069	−0.048

Note: FSS = Family Social Support; PIU = Problematic Internet Use; LLCI = Lower Level Confidence Interval; ULCI = Upper-Level Confidence Interval. Bootstrap sample size = 5000. All path coefficients are unstandardized

study fell well within these parameters, suggesting no violation of the assumption of independence among predictor variables.

The hypothesized simple and serial mediation model was tested using the PROCESS macro for SPSS [65]. Statistical evidence for indirect effects was conducted using bootstrapping procedures, generating 5,000 bootstrap samples and constructing bias-corrected 95% confidence intervals. Following existing guidelines [65], indirect effects were considered statistically significant when their confidence intervals did not contain zero.

Results

Descriptive statistics and relationships between variables

The skewness and kurtosis values ranged from 0.49 to −0.83, suggesting that all variables had a normal distribution. Pearson correlation analysis revealed significant correlations between all variables (see Table 2).

As presented in Table 2, family social support was negatively associated with hostility ($r = -.28$, $p < .001$), depression ($r = -.34$, $p < .001$), and PIU ($r = -.22$, $p < .001$). Hostility was positively associated with both depression ($r = .62$, $p < .001$) and PIU ($r = .45$, $p < .001$). Finally, depression has a positive association with PIU ($r = .38$, $p < .001$).

Hypothesis testing

Direct effect of family social support on PIU

To test Hypothesis 1, we first examined the total effect of family social support on PIU. Results revealed that family social support negatively predicted PIU ($c = -0.109$, $p < .001$; see Table 4). This indicates that higher levels of family social support were associated with lower levels of PIU among adolescents. Therefore, H1 was supported.

Simple mediation analyses through hostility

The results of simple mediation analyses, using PROCESS Model 4 and testing Hypotheses 2 revealed that family social support significantly predicted hostility ($a = -.152$, $SE = 0.011$, $p < .001$), and hostility, in turn, significantly predicted PIU ($b = .382$, $SE = 0.019$, $p < .001$). The direct effect of family social support on PIU remained significant ($c' = -0.051$, $SE = 0.010$, $p < .001$). The indirect effect through hostility was significant ($ab = -0.058$, $SE = 0.005$, 95% CI [−0.068, −0.048]), indicating that hostility partially mediated the relationship between family social support and PIU (see Model 1 in Table 3).

Simple mediation analyses through depression

Similarly, testing Hypothesis 3, family social support significantly predicted depression ($a = -.198$, $SE = 0.012$, $p < .001$), and depression, in turn, significantly predicted PIU ($b = .291$, $SE = 0.018$, $p < .001$). The direct effect of family social support on PIU remained significant ($c' = -0.051$, $SE = 0.011$, $p < .001$). The indirect effect through depression was significant ($ab = -0.058$, $SE = 0.005$, 95% CI [−0.069, −0.048]), suggesting that depression partially mediated the relationship between family social support and PIU (see Model 2 in Table 3).

Table 4 Direct, indirect, and total effects of family social support on PIU through hostility and depression

Path	Effect	SE	t	*p*	LLCI	ULCI
Direct Effects						
FSS → Hostility (a_1)	−0.152	0.011	−13.348	0.000	−0.174	−0.129
FSS → Depression (a_2)	−0.104	0.010	−10.050	0.000	−0.124	−0.084
Hostility → Depression (d_{21})	0.621	0.019	32.140	0.000	0.583	0.659
Hostility → PIU (b_1)	0.303	0.023	13.250	0.000	0.258	0.348
Depression → PIU (b_2)	0.128	0.021	5.976	0.000	0.086	0.169
FSS → PIU (c')	−0.037	0.010	−3.658	0.000	−0.057	−0.017
Indirect Effects						
Total indirect effect	−0.071	0.006	-	-	−0.083	−0.060
Ind_1: FSS → Host → PIU	−0.046	0.005	-	-	−0.056	−0.036
Ind_2: FSS → Dep → PIU	−0.013	0.003	-	-	−0.019	−0.008
Ind_3: FSS → Host → Dep → PIU	−0.012	0.002	-	-	−0.017	−0.008
Total Effect						
FSS → PIU (c)	−0.109	0.011	−10.262	0.000	−0.129	−0.088

Note. FSS = Family Social Support; Host = Hostility; Dep = Depression; PIU = Problematic Internet Use; LLCI = Lower-Level Confidence Interval; ULCI = Upper-Level Confidence Interval. Bootstrap sample size = 5000. All path coefficients are unstandardized

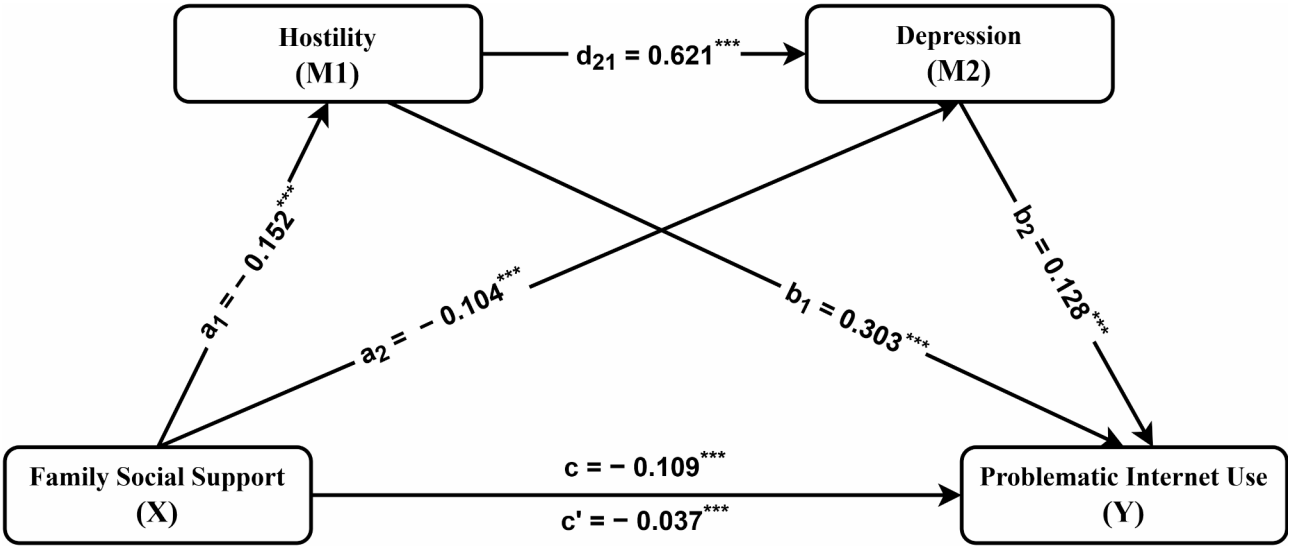

Fig. 1 The serial mediational models, along with unstandardized coefficient values. ***$p < .001$. $n = 2047$

Serial mediation analyses through hostility and depression

Finally, we tested the serial mediation model (Hypothesis 4) using PROCESS Model 6. Results showed that family social support negatively predicted hostility ($a_1 = -0.152$, $SE = 0.011$, $p < .001$), which was positively associated with depression ($d_{21} = 0.621$, $SE = 0.019$, $p < .001$). Depression was subsequently associated with PIU ($b_2 = 0.128$, $SE = 0.021$, $p < .001$). The serial indirect effect through hostility and depression was significant ($a_1 d_{21} b_2 = -0.012$, $SE = 0.002$, 95% CI [−0.017, −0.008]; see Table 4), supporting Hypothesis 4. This indicates that the relationship between family social support and PIU was sequentially mediated by hostility and depression. Figure 1 illustrates the serial mediation model.

Additionally, hostility and depression independently mediated the relationship between family social support and PIU (hostility alone: = −0.046, 95% CI [−0.056, −0.036]; depression alone: = −0.013, 95% CI [−0.019, −0.008], with hostility demonstrating a stronger mediating role. The direct effect of family support on PIU remained significant (c' = −0.037, $SE = 0.010$, $p <$. 001), indicating partial mediation. These findings collectively support the proposed model: reduced family social support increases hostility, which heightens depressive symptoms, ultimately contributing to PIU. All indirect effects were evaluated using bootstrapping procedures with 5,000 bootstrap samples. Confidence intervals that do not include zero suggest significant indirect effects.

Discussion

The present paper explored the association between family social support and PIU as well as the potential mediating effects of hostility and depression that may underlie this relationship in 2046 Turkish adolescents. Initial findings support the hypothesis that family social support negatively predicts PIU among adolescents (confirming H_1). Consistent with our findings, previous research has demonstrated that when adolescents perceive adequate social support from their families, it acts as a buffer against stressful life events, allowing them to use the Internet less [66–68]. Adequate family social support can provide adolescents with a sense of belonging and emotional security, reducing their PIU [69, 70] When families do not show adequate social support to their children, adolescents experience higher levels of psychological distress [39, 52, 71] and a sense of social disconnection, such as emotional isolation [72, 73] and use the Internet problematic. According to CIUT [33], adolescents can prefer compensating for these feelings through the easiest and most accessible online platforms as a coping mechanism, gradually developing PIU. This situation is important in terms of showing us the underlying mechanism of internet use in adolescents and understanding the effect of family social support on PIU.

One of the main findings of our study is that hostility plays a mediating role in the relationship between family social support and PIU among adolescents (confirming H_2). This finding suggests and verifies previous research that adolescents who perceive inadequate family social support are more likely to experience higher levels of hostility [74, 75], which in turn increases their vulnerability to PIU [76]. This association can be interpreted through the framework of emotion regulation theory (Groos, 71), which argues that family social support aids adolescents in developing better emotional regulation skills. Conversely, adolescents who perceive inadequate family support are more likely to experience negative affect and show increased tendencies towards frustration, anger, and resentment, which are components of hostility [27, 28]. These feelings of hostility may turn adolescents away from real-world interactions and towards virtual environments. Internet-based tools or applications can facilitate the expression of hostile feelings through virtual reality headsets, online aggressive games, and chat platforms, which in turn increases their vulnerability to PIU [77–79]. Taken together, these findings highlight evidence that family social support can protect against PIU and help mitigate feelings of hostility, which in turn can decrease the risk of developing PIU.

Another main finding of this study is that depression plays a mediating role in the relationship between family social support and PIU among adolescents (confirming H_3). Specifically, family social support was negatively related to depressive symptoms, which in turn were positively associated with PIU. This finding suggests that adolescents experiencing inadequate family support may be more susceptible to elevated levels of depression, subsequently increasing their vulnerability to more severe PIU. Previous research has verified that adolescents experiencing inadequate family social support are vulnerable to psychological distress, including depression [80]. Adolescents with inadequate family social support are susceptible to internalizing negative self-schemas characterized by feelings of worthlessness and unpleasantness [81]. Such negative beliefs, often expressed as thoughts such as "My parents wish I didn't exist," can lead to an increase in depressive symptoms [82]. This situation can be interpreted through the framework of the cognitive behavioral model, which argues that adolescents experiencing depression may use the Internet as a means of alleviating negative and maladaptive cognitions [42, 83]. These findings suggest that inadequate family social support may increase vulnerability to depression, which in turn can increase the risk of developing PIU in adolescents. In response to these depressive symptoms, adolescents may use the Internet as a coping mechanism, which can potentially increase PIU.

Lastly, and as the unique finding of our research, hostility, and depression serially mediate the relationship between family social support and PIU, and family social support exerted its indirect effect on PIU through hostility, which in turn was related to depression and linked sequentially to PIU (confirming H_4). This striking finding highlights the complex nature of PIU among adolescents and the crucial protective role of family social support on hostility, depression, and PIU. Our finding is consistent with previous research, which has shown that inadequate family social support is linked to increased levels of hostility and depression [39, 52, 84], thereby predisposing them to PIU [85, 86]. When adolescents perceive inadequate social support from their families, they may feel neglected, unloved, and insecure [87–89]. This emotional deprivation can lead to feelings of anger, resentment, and frustration, which can be revealed as hostility toward family members, themselves, or others [78]. Increased feelings of hostility can damage adolescents' social relationships and create a sense of isolation. These feelings, which adolescents may find difficult to accept, can lead to the emergence of depressive symptoms [49, 90]. According to CIUT [33] adolescents may turn to prolonged Internet use as emotional compensation for their negative emotions, such as hostility and depression feelings, which, in turn, is related to higher PIU [29, 86].

Conclusion and practical implication

As our findings demonstrated, there are multiple links among family social support, hostility, depression, and

PIU. Based on our findings, it can be speculated that individuals with lower family social support, higher hostility, and depression are more prone and vulnerable to PIU. In this context, we can suggest that creating a supportive and positive family environment may aid in reducing the risk of PIU, hostility, and depression in adolescents. By considering the serial mediating effect of hostility and depression, researchers, mental health professionals, and school counselors can develop interventions and prevention strategies aimed at enhancing family support and decreasing the risk of PIU in adolescents.

Research indicates that family-based interventions are efficient in implementation in adolescents [91]. It was also found that therapeutic approaches that include techniques and skills to strengthen family support systems have an impact on reducing the level of PIU in adolescents [92]. The integration of family-based interventions that emphasize the strengthening of family social support may create a buffering effect against psychological distress (e.g., hostility and depression), which may reduce the severity of PIU in adolescents.

Hostility and depression may be an important component in treating PIU in the cognitive-behavioral Internet use model [42]. Therefore, it may be effective for counselors to use cognitive-behavioral techniques to reduce hostility and depression feelings when planning the treatment process for PIU. Consequently, identifying characteristics that may elucidate the risk of PIU might provide valuable knowledge for preventative and treatment approaches. As a result, intervention programs for increasing family social support have the potential to directly and indirectly mitigate the levels of PIU in adolescents.

Limitations and future directions

As with all empirical research, the present study has several limitations that should be considered. Firstly, the data collection methodology relied only on self-report measures, which may be susceptible to various response biases and potential inaccuracies. Participants may have been reluctant to provide complete or accurate information, particularly regarding family social support and Internet usage patterns. Secondly, the sample demographics limit the generalizability of our findings. As data were collected only from adolescents in Türkiye, a culture characterized by strong familial bonds, the results may not be generalizable to other developmental age groups (e.g., children and adults) or populations from cultures with different family dynamics. Thirdly, the cross-sectional design of this study may limit the changes in the association between PIU and other variables (family support, the feeling of hostility, etc.) over time, considering the multifaced and complex nature of the interrelationships among family social support, hostility, depression, and PIU. The correlational nature of this investigation also does not allow causal inferences to be definitively obtained, and the findings should be interpreted with appropriate caution. Future studies would investigate a longitudinal research design that facilitates a more comprehensive understanding of how these relationships evolve over time and would enable the examination of potential developmental trajectories. Finally, the participants were restricted to high school students, potentially limiting the generalizability of findings to other educational cohorts, such as primary school or university. Subsequent investigations could employ diverse methodological approaches, including qualitative methodologies to further elucidate this complex interrelationship across different demographic cohorts.

Furthermore, whereas the present study focused specifically on family social support, future research would take into account the multiple dimensions of social support, such as friends, teachers, and wider social ecosystems. Additionally, the investigation of alternative psychological constructs such as potential mediating variables (e.g., anxiety, obsessive-compulsive, somatization) would provide a more comprehensive understanding of the mechanisms underlying PIU.

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Author contributions
Study conception/design; CD, MB. Data collection; CD. Analysis; CD, MB. Drafting of the manuscript; CD, MB. Statistical expertise; CD, MB. Supervisor and Editing; MB. Administrative/technical/material support; CD, MB.

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Data availability
To protect personal data, the datasets utilized in this study are not publicly available. To access these datasets, please contact the author directly at caner.dogrusever@siirt.edu.tr.

Declarations

Ethics approval and consent to participate
The research was approved by the Institutional Review Board of Siirt University (Reference number: 0301/36). Since the students participating in the study were under the age of 16, informed consent forms were obtained from the parents or legal guardians. We also followed the ethical principles outlined in the Declaration of Helsinki (World Medical Association, 2013).

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Note
Data for the current study was taken from the first author's PhD thesis.

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