



Resilience and its Effects on Internet Addiction and Academic Performance: The Mediating Role of Life Satisfaction among Medical Students

KARIM SHATERI¹, PhD; MASUME BAGHERI², MD; MOHAMMAD HASAN KESHAVARZI³, PhD; MANA MOGHADAMI⁴, MD; ALI ASGHAR HAYAT^{3*}, PhD

¹Department of Educational Administration, Farhangian University, Tehran, Iran; ²Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran; ³Clinical Education Research Center, Department of Medical Education, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran; ⁴Department of Health Management and Systems Sciences, School of Public Health and Information Sciences, University of Louisville, USA

Abstract

Introduction: Resilience, as an important psychological resource for adaptation, has been associated with lower levels of Internet addiction and better academic outcomes. This research sought to determine how life satisfaction functions as a mediator in the relationship between resilience, academic performance, and Internet addiction among medical students. A deeper understanding of these relationships may contribute to the design of evidence-based interventions to improve academic performance and reduce Internet addiction among medical students.

Methods: This quantitative correlational study with a cross-sectional design was conducted among medical students at Ahvaz University of Medical Sciences during the 2023–2024 academic year. A total of 239 participants were recruited using convenience sampling. Data were collected using the Connor–Davidson Resilience Scale (CD-RISC-10), the Short Form of Young’s Internet Addiction Test (s-IAT), and the Satisfaction with Life Scale (SWLS). Data were analyzed using descriptive statistics and partial least squares structural equation modeling (PLS-SEM) in Smart-PLS 3. Confirmatory factor analysis (CFA) was conducted to assess the measurement model through factor loadings, Cronbach’s alpha, composite reliability, and convergent and discriminant validity. The structural model was evaluated through path coefficient analysis, while bootstrapping with 5,000 resamples was applied to examine the significance of the hypothesized direct and indirect effects.

Results: In the proposed model, resilience was expected to influence Internet addiction and academic performance both directly and indirectly through life satisfaction as a mediating variable. The results showed that resilience had a direct negative effect on Internet addiction ($\beta = -0.24$, $t = 3.35$, $p < 0.001$) and a positive effect on life satisfaction ($\beta = 0.36$, $t = 5.87$, $p < 0.001$), while life satisfaction negatively predicted Internet addiction ($\beta = -0.30$, $t = 4.64$, $p < 0.001$) and positively predicted academic performance ($\beta = 0.16$, $t = 2.36$, $p = 0.018$). However, the direct effect of resilience on academic performance was not significant ($\beta = 0.11$, $t = 1.44$, $p = 0.15$). Indirect effects confirmed that resilience influenced both Internet addiction ($\beta = -0.11$, $t = 3.69$, $p < 0.001$) and academic performance ($\beta = 0.06$, $t = 2.18$, $p = 0.030$) through life satisfaction, supporting the mediating role of life satisfaction in the model. The model also demonstrated acceptable explanatory and predictive power (R^2 , Q^2 , f^2) and good fit (SRMR = 0.074), indicating robustness of the proposed theoretical model.

Conclusion: The findings support the proposed mediation model and highlight that resilience reduces Internet addiction mainly through increasing life satisfaction. In practice, strengthening both resilience and life satisfaction can be an effective approach to lowering problematic Internet use and supporting academic functioning among medical students. These results provide useful guidance for designing targeted mental health interventions in academic settings.

Keywords: Internet addiction, Resilience, Life satisfaction, Academic performance, Medical students

*Corresponding author:

Ali Asghar Hayat, PhD;
Clinical Education Research
Center, Department of
Medical Education, School of
Medicine, Shiraz University of
Medical Sciences,
Shiraz, Iran.

Tel: +98-7132333064

Email: ali.hayat63@gmail.com

Please cite this paper as:

Shateri K, Bagheri
M, Keshavarzi MH,
Moghadami M, Hayat AA.
Resilience and its Effects
on Internet Addiction and
Academic Performance:
The Mediating Role of
Life Satisfaction among
Medical Students. *J Adv Med
Educ Prof.* 2026;14(3):291-
304. DOI: 10.30476/
jamp.2026.108664.2264.

Received: 10 September 2025

Accepted: 3 June 2026

Introduction

Medical education is widely recognized as one of the most academically demanding and psychologically stressful educational pathways (1). Medical students are frequently exposed to intense workloads, competitive learning environments, emotional exhaustion, and persistent performance pressures, all of which may negatively influence both their psychological well-being and academic performance (1-3). Within this context, resilience has emerged as a crucial psychological resource that may protect students against maladaptive behavioral and academic outcomes. Resilience refers to the capacity to adapt successfully to adversity, recover from stressful experiences, and maintain psychological functioning despite challenging circumstances (1, 4, 5). Therefore, for medical students who face ongoing academic and emotional stressors, resilience is increasingly being considered a critical factor in promoting health and academic performance (6-8). Students with higher levels of resilience are generally better equipped to cope with academic challenges, recover from setbacks, and maintain consistent academic functioning even under pressure (9, 10). In contrast, low resilience has been associated with academic burnout, anxiety, poor concentration, and reduced academic achievement (1, 7, 11). However, evidence suggests that the relationship between resilience and academic performance may be influenced by broader psychological and emotional factors, indicating the potential role of indirect mechanisms in explaining academic outcomes (9). These highlight the importance of identifying mediating mechanisms that may explain how resilience contributes to educational outcomes among medical students.

In addition to its educational implications, resilience also appears to play a protective role against maladaptive behavioral patterns such as Internet addiction (12-14). Internet addiction (IA), commonly conceptualized as excessive and uncontrolled Internet use that interferes with daily functioning, has become an important public health and educational concern among university students (15, 16). Medical students may be particularly vulnerable to problematic Internet use due to high academic stress, extensive engagement with online learning environments, the demanding nature of their education, prolonged screen time, and high academic pressure (15, 17). Previous research has consistently linked Internet addiction with numerous adverse outcomes, including reduced academic performance, reduced concentration, sleep disturbances,

anxiety, depression, procrastination, and social dysfunction (7, 15, 18, 19).

In Iran, Internet addiction among university students has emerged as a significant educational and psychological concern (15). Previous studies have reported relatively high prevalence rates of problematic Internet use among Iranian students, particularly within medical universities (14, 15, 20).

Given the demanding nature of medical education, students may increasingly rely on online environments as a coping mechanism to escape academic stress and emotional difficulties. However, resilient individuals tend to employ more adaptive coping strategies and are, therefore, less likely to engage in problematic Internet use as a maladaptive form of emotional regulation (12-14, 21-24). Evidence supports the existence of a negative relationship between resilience and problematic Internet use (12, 21, 25). Nevertheless, some investigations have reported non-significant or inconsistent findings (12), suggesting that additional psychological mechanisms may influence this relationship. One such mechanism may be life satisfaction (23). Life satisfaction refers to individuals' cognitive and subjective evaluation of the overall quality of their lives and constitutes a central dimension of subjective well-being (26, 27). Students with high life satisfaction typically report greater emotional balance, psychological adjustment, social functioning, and academic adaptation (28). Within the framework of positive psychology, resilience is considered an important antecedent of life satisfaction because resilient individuals are more likely to interpret stressful experiences positively, maintain optimism, and preserve psychological stability under adversity (22, 23, 29). Empirical evidence consistently demonstrates that resilience positively predicts life satisfaction across different student populations and cultural contexts (22, 23).

Life satisfaction may also influence both academic and behavioral outcomes among university students (22, 30, 31). A substantial body of research has demonstrated a negative relationship between life satisfaction and Internet addiction, suggesting that individuals with lower life satisfaction are more likely to engage in problematic Internet use (23, 30, 32). Evidence also indicates that students with higher life satisfaction tend to demonstrate greater academic engagement and improved academic performance (31, 33).

Taken together, these findings suggest that life satisfaction may function as an important mediating mechanism linking resilience to both academic performance and Internet addiction. Although previous studies have examined

associations among resilience, life satisfaction, academic performance, and Internet addiction, limited research has investigated these variables simultaneously within an integrated mediational framework, particularly among medical students. Furthermore, evidence regarding the mechanisms through which resilience influences educational and behavioral outcomes in medical education remains insufficient. Therefore, the present study aims to investigate the relationships between resilience, life satisfaction, Internet addiction, and academic performance among medical students, with particular emphasis on the mediating role of life satisfaction (Figure 1).

Methods

Design and Participants

The study employed a quantitative cross-sectional correlational design to evaluate the hypothesized associations related to the main study variables. The study targeted the entire population of medical students attending Ahvaz University of Medical Sciences during the 2023–2024 academic year. A total of 239 participants voluntarily took part in the study, using a convenience sampling method. Inclusion criteria included being a student at Ahvaz University and expressing consent to participate. Participants who submitted incomplete questionnaires or were unwilling to continue with the study were excluded.

Measures

In this study, the following three questionnaires were used:

- **Connor-Davidson Resilience Scale (CD-RISC-10)**

The CD-RISC-10 is a concise self-assessment tool consisting of 10 items that evaluate resilience as a single, unified construct. The participants' responses to all items were recorded using a 5-point Likert scale (0 = lowest, 4 = highest). The scale's unidimensional factor structure, has demonstrated validity in different populations like Mexican medical and psychology students (34) and adults in Iran (35). Internal consistency reliability was robust, according to Cronbach's alpha values which ranged from 0.85 to 0.89 (11, 24, 36). Moreover, evidence for its convergent and discriminant validity confirms the that CD-RISC-10 serves as a psychometrically sound scale suitable for measuring resilience across diverse groups (34). The study made use of confirmatory factor analysis (CFA) to rigorously evaluate the psychometric properties of the CD-RISC-10.

- **Young's Internet Addiction Test (IAT)**

The study made use of the s-IAT, the short and psychometrically validated version of Young's Internet Addiction Test, to examine Internet addiction (37). Participants responded to 12 items using a 5-point Likert scale, where 1 indicated 'rarely' and 5 indicated 'always' to assess how often Internet-related behaviors occur. With strong psychometric properties, the s-IAT accurately assesses the core diagnostic features of Internet addiction. Total scores range from 12 to 60 and reflect the intensity of addictive use. Previous research in Iran has confirmed the acceptable validity and reliability of the instrument (38). In the present study, the psychometric properties of the s-IAT were rigorously assessed employing confirmatory factor analysis (CFA), with the results shown in the results section (Tables 1, 2, 3, and 4).

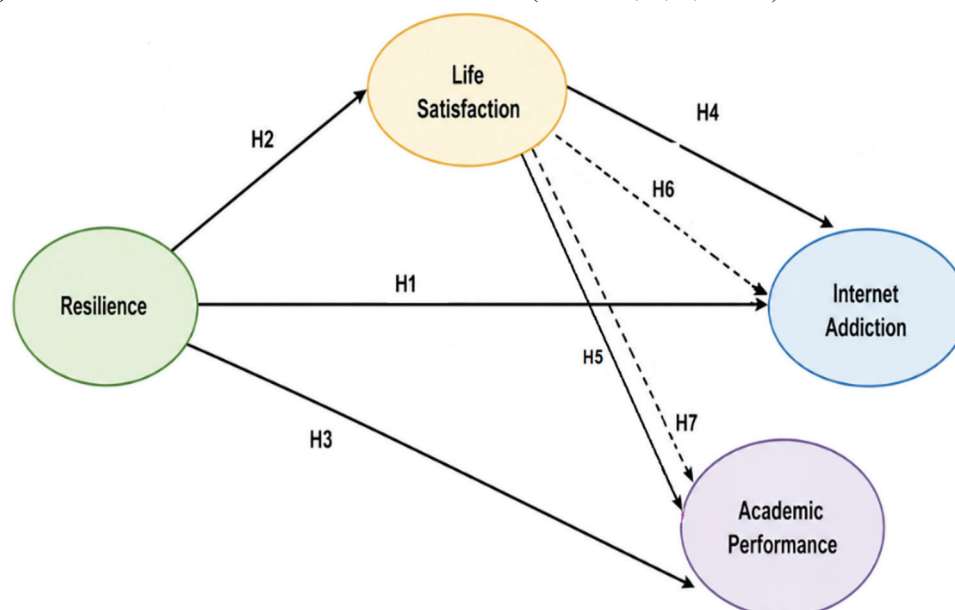


Figure 1: Proposed research model

Table 1: Factor Loadings, Reliability and Convergent Validity Metrics

Constructs	Items	Factor loading (≥ 0.7)	α (≥ 0.7)	CR (≥ 0.7)	AVE (≥ 0.5)
Resilience	R1	0.78	0.93	0.94	0.62
	R2	0.78			
	R3	0.77			
	R4	0.80			
	R5	0.82			
	R6	0.79			
	R7	0.79			
	R8	0.84			
	R9	0.75			
	R10	0.76			
Life Satisfaction	LS1	0.84	0.87	0.90	0.65
	LS2	0.79			
	LS3	0.79			
	LS4	0.78			
	LS5	0.83			
Internet Addiction	IA1	0.78	0.94	0.95	0.60
	IA2	0.80			
	IA3	0.78			
	IA4	0.79			
	IA5	0.75			
	IA6	0.71			
	IA7	0.74			
	IA8	0.79			
	IA9	0.77			
	IA10	0.82			
	IA11	0.75			
	IA12	0.76			

CR= Composite Reliability, AVE= Average Variance Extracted

Table 2: Item-Level Discriminant Validity Assessment via Cross-Loadings

NO.	Internet Addiction	Life Satisfaction	Resilience
IA1	0.78	-0.32	-0.27
IA2	0.80	-0.32	-0.35
IA3	0.78	-0.30	-0.38
IA4	0.79	-0.31	-0.22
IA5	0.75	-0.34	-0.20
IA6	0.71	-0.29	-0.13
IA7	0.74	-0.33	-0.27
IA8	0.79	-0.30	-0.34
IA9	0.77	-0.14	-0.20
IA10	0.82	-0.24	-0.24
IA11	0.75	-0.23	-0.31
IA12	0.76	-0.36	-0.22
LS1	-0.34	0.84	0.37
LS2	-0.31	0.79	0.20
LS3	-0.26	0.79	0.23
LS4	-0.32	0.78	0.21
LS5	-0.31	0.83	0.37
R1	-0.33	0.28	0.78
R2	-0.27	0.21	0.78
R3	-0.16	0.19	0.77
R4	-0.22	0.26	0.80
R5	-0.35	0.29	0.82
R6	-0.29	0.31	0.79
R7	-0.30	0.37	0.79
R8	-0.26	0.42	0.84
R9	-0.33	0.12	0.75
R10	-0.17	0.25	0.76

Table 3: Fornell–Larcker Criterion: Square Roots of AVE and Inter-Construct Correlations

	Mean±SD	Resilience	Life Satisfaction	Internet addiction	Academic Performance
Resilience	27.11±7.45	0.79			
Life Satisfaction	21.90±6.28	0.36**	0.81		
Internet Addiction	29.68±8.93	-0.35**	-0.39**	0.77	
Academic Performance	16.44±1.58	0.16*	0.20*	-0.25**	1

* $p < 0.05$; ** $p < 0.01$; The diagonal values represent the square root of the Average Variance Extracted (AVE), while the off-diagonal values indicate the correlations among the constructs.

Table 4: HTMT list for Assessment of Discriminant Validity at the Construct Level

	Resilience	Life Satisfaction	Internet Addiction	Academic Performance
Resilience				
Life Satisfaction	0.36			
Internet Addiction	0.35	0.41		
Academic Performance	0.17	0.21	0.26	

• Satisfaction with Life Scale (SWLS)

Created by Diener, et al. (1985), the SWLS is a well-established psychological tool intended to assess people's general cognitive evaluations of how satisfied they are with their lives (39). The scale comprises five statements, each evaluated through a 7-point Likert scale, with 1 representing 'completely disagree' and 7 representing 'completely agree,' giving an overall score between 5 and 35. The SWLS has demonstrated strong psychometric properties across various populations and age groups worldwide, with studies reporting a satisfactory level of internal reliability ($\alpha = 0.84$) (40-42). Acceptable levels of internal reliability were obtained for the scale, as indicated by Cronbach's alpha coefficients between 0.85 and 0.88 in different populations, including students, nurses, and clinical samples (43-46).

We also used the students' GPA as an indicator of academic performance, as it provides a standardized, widely accepted measure of overall achievement across subjects. GPA reflects not only students' mastery of the course content but also their consistency and effort over time, making it a useful proxy for academic success in educational research.

Data analysis

Data were analyzed using SPSS version 21 for descriptive statistics and Smart-PLS 3 for Partial Least Squares Structural Equation Modeling (PLS-SEM). Before the analysis, the dataset was screened for missing values. No missing data was identified in the final dataset. The analysis was conducted in two stages: measurement model evaluation and structural model evaluation.

For the measurement model, indicator reliability was evaluated using factor loadings (≥ 0.70). Internal consistency reliability was

assessed through Cronbach's alpha and composite reliability (CR), with acceptable values ≥ 0.70 . Convergent validity was examined using average variance extracted ($AVE \geq 0.50$). Discriminant validity was assessed using cross-loadings at the item level, as well as the Fornell–Larcker criterion and the Heterotrait–Monotrait ratio (HTMT) at the construct level. In the cross-loadings approach, each indicator was required to load higher on its associated construct than on other constructs. According to the Fornell–Larcker criterion, the square root of the average variance extracted (AVE) for each construct should exceed its correlations with other constructs. HTMT values below 0.85 or 0.90 were considered as adequate discriminant validity (47, 48).

For the structural model, a bootstrapping procedure with 5,000 resamples was applied to assess the significance of the path coefficients using t-values and p-values. Effect sizes (f^2) of 0.02, 0.15, and 0.35 indicated small, medium, and large effects, respectively. The explanatory power of the model was assessed using R^2 values of 0.25, 0.50, and 0.75, representing weak, moderate, and substantial levels. Predictive relevance was examined using Stone–Geisser's $Q^2 (> 0)$, while collinearity was assessed using the variance inflation factor ($VIF < 5$). Model fit was evaluated using the standardized root mean square residual (SRMR < 0.08) (47).

Ethical Considerations

The study obtained ethical approval from the Ethics Committee of Shiraz University of Medical Sciences (IR.SUMS.REC.1401.081). The study ensured that all participants gave their written informed consent before data collection. Respondents were informed that their answers would stay anonymous, and the data would be managed with complete confidentiality.

Results

Among the 239 participating students, 125 (52.3%) were male, 107 (44.8%) were female, and 7 participants (2.9%) chose not to reveal their gender, with an average age of 21.48 years. To investigate the relationships for the variables included in the study, we utilized PLS-SEM, through which the research model was evaluated in two phases: first, the measurement model was evaluated, followed by the assessment of the structural model.

Measurement Model assessment

To ensure the measurement model's robustness, we conducted a comprehensive assessment of key psychometric. This included evaluating indicator reliability, internal reliability, convergent, and discriminant validity. Table 1 provides a summary of the findings. As observed, all factor loadings exceeded the recommended threshold, and Cronbach's Alpha (α), CR, and AVE values met or surpassed acceptable criteria, thus providing robust evidence for the measurement model's reliability and convergent validity.

Discriminant validity was first assessed at the item level using cross-loading analysis. This approach requires that each item loads more heavily on its respective construct than on any alternative constructs. As presented in Table 2, all items exhibited the strongest loadings on their corresponding constructs, thus demonstrating discriminant validity for each item.

Following this, construct-level discriminant validity was examined through the Fornell–Larcker criterion. The findings revealed satisfactory discriminant validity, as the square root of the AVE for each construct was greater than its correlations with all other constructs

(Table 3). Additionally, Table 3 displays the interrelationships among the variables, with all correlations being significant at the 0.05 level.

To further verify discriminant validity at the construct level, the Heterotrait–Monotrait (HTMT) ratio was employed. According to Table 4, all HTMT scores were lower than the suggested cutoff of 0.85, demonstrating acceptable discriminant validity.

Structural Model assessment

Collinearity was evaluated at the indicator and construct levels before the analysis of structural relationships. The variance inflation factor (VIF) scores at the indicator level ranged between 1.91 and 3.19, remaining well under the standard cutoff of 5.0, which suggests an acceptable level of collinearity (47). At the construct level, collinearity among the exogenous constructs in the inner model was assessed. As illustrated in Table 5, all inner VIF scores were equal to or below 1.146, which is far below the threshold of 5.0. These findings confirm the absence of multicollinearity among the latent constructs and support the stability and interpretability of the estimated path coefficients.

After confirming the absence of collinearity issues, the structural relationships among the latent constructs were examined. Path coefficients along with their corresponding t- and p-values were derived through bootstrapping with 5,000 resamples. As shown in Table 6, all hypothesized paths were found to be statistically significant, except for the path from resilience to academic performance. These relationships are also illustrated in Figures 2 and 3, which visually depict the structural model's path coefficients and their statistical significance.

Table 5: Construct -Level VIF Values

Endogenous Variable	Predictor Construct	VIF
Life Satisfaction	Resilience	1
Internet Addiction	Resilience	1.14
Academic Performance	Resilience	1.14
Internet Addiction	Life Satisfaction	1.14
Academic Performance	Life Satisfaction	1.14

Table 6: Path Analysis Results: Direct, Indirect, and Total Effects

Path	β	T statistics	Significance ($p < 0.05$)	Result
Resilience → Internet Addiction	-0.24	3.35	$p < 0.001$	Supported
Resilience → Life Satisfaction	0.36	5.87	$p < 0.001$	Supported
Resilience → Academic Performance	0.11	1.44	$p = 0.15$	Not-Supported
Life Satisfaction → Internet Addiction	-0.30	4.64	$p < 0.001$	Supported
Life Satisfaction → Academic Performance	0.16	2.36	$p = 0.018$	Supported
Resilience → Life Satisfaction- Internet Addiction	-0.11	3.69	$p < 0.001$	Supported
Resilience → Life Satisfaction- Academic Performance	0.06	2.18	$p = 0.030$	Supported

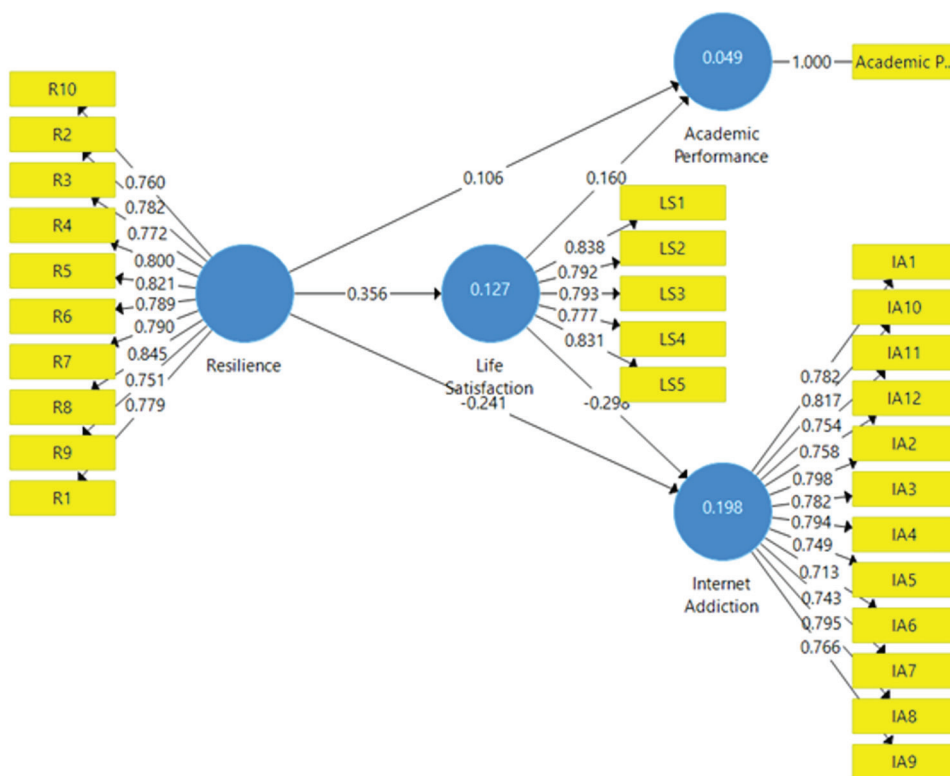


Figure 2. Structural Model with Standardized Path Coefficients

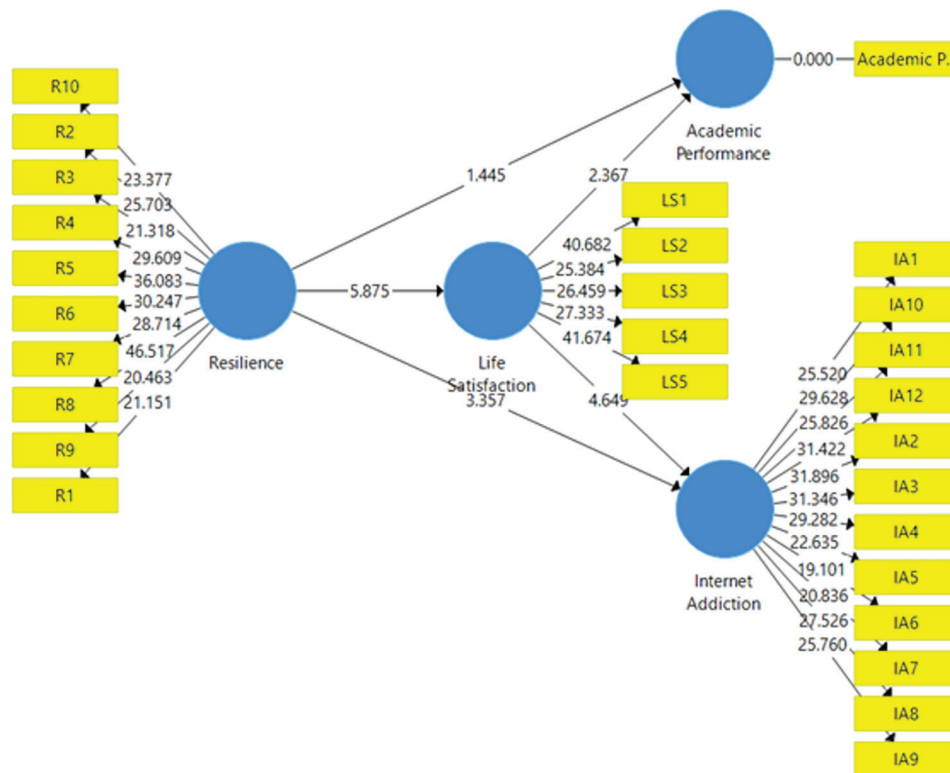


Figure 3: Structural Model with t-Values (Bootstrapping Results)

Specifically, resilience exerted a significant negative effect on Internet addiction ($\beta = -0.24$, $t = 3.35$, $p < 0.001$), thereby supporting Hypothesis 1. In addition, resilience was positively and significantly associated with life satisfaction

($\beta = 0.36$, $t = 5.87$, $p < 0.001$), confirming Hypothesis 2. However, resilience showed a positive but statistically non-significant effect on academic performance ($\beta = 0.11$, $t = 1.44$, $p = 0.15$), leading to the rejection of Hypothesis 3.

Furthermore, life satisfaction had a significant negative effect on Internet addiction ($\beta = -0.30$, $t = 4.64$, $p < 0.001$), supporting Hypothesis 4. In contrast, life satisfaction demonstrated a positive and statistically significant effect on academic performance ($\beta = 0.16$, $t = 2.36$, $p = 0.018$), thereby supporting Hypothesis 5.

The mediating role of life satisfaction in the relationship between resilience and Internet addiction was examined by assessing the indirect effect. The results, as presented in Table 6, revealed a significant negative indirect effect ($\beta = -0.11$, $t = 3.69$, $p < 0.001$), thereby supporting Hypothesis 6. Moreover, life satisfaction was found to indirectly and positively predict academic performance ($\beta = 0.06$, $t = 2.18$, $p = 0.030$), thereby confirming Hypothesis 7. Overall, these findings provide empirical evidence that life satisfaction significantly mediates the relationship between resilience, Internet addiction, and academic performance among medical students, underscoring its key explanatory role in the proposed model.

Moreover, the total effect of resilience on Internet addiction was computed by summing its direct ($\beta = -0.24$) and indirect ($\beta = -0.11$) effects, yielding a total effect of $\beta = -0.35$, which was statistically significant ($t = 5.47$, $p < 0.001$). This finding indicates that resilience reduces Internet addiction both directly and indirectly through enhancing life satisfaction, which in turn contributes to lower levels of Internet addiction among medical students. Overall, these results underscore the dual protective role of resilience in both directly mitigating Internet addiction and indirectly doing so via improved life satisfaction.

In contrast, the total effect of resilience on academic performance, calculated as the sum of its direct ($\beta = 0.11$) and indirect ($\beta = 0.06$) effects through life satisfaction, amounted to $\beta = 0.17$. This total effect was statistically significant ($t = 2.42$, $p = 0.016$), indicating that resilience exerts a modest but statistically significant overall positive effect on academic performance among medical students.

Once the hypothesized paths were examined, the next step was to assess the overall accuracy and fit of the model. In PLS-SEM, various essential metrics are commonly used to evaluate the quality of the structural model, which is explored in depth in the following sections.

The structural model's explanatory power was examined using the coefficient of determination (R^2) of endogenous variables. The model could explain 20% of the variability in Internet addiction ($R^2 = 0.20$), indicating that resilience and life satisfaction collectively accounted

for 20% of the variance in Internet addiction, reflecting a moderate explanatory power. 13% of the variance in life satisfaction was explained by the structural model ($R^2 = 0.13$), attributable solely to Resilience. Although this level of explained variance is relatively low, it remains acceptable within the context of social science research, where psychological and behavioral outcomes are typically influenced by a wide range of factors beyond the scope of a single model. More importantly, the R^2 value depends on the number of predictor constructs; as more predictor constructs are added, the R^2 value rises (47, 48). Additionally, resilience and life satisfaction jointly accounted for 5% of the variance in academic performance ($R^2 = 0.05$). This weak explanatory power indicates that academic performance is a multifactorial construct and is likely determined by other psychological, educational, and contextual variables not included in the current model.

To determine the unique impact of each exogenous construct on the endogenous variables, the effect size (f^2) statistic was calculated. Following Hair, et al. (2022), f^2 values of 0.02, 0.15, and 0.35 can be evaluated as small, medium, and large effects, respectively (47). The f^2 value for the effect of resilience on Internet addiction was 0.06, indicating a small to medium effect size. In addition, resilience exhibited a medium effect size on life satisfaction ($f^2 = 0.15$), while the effect of life satisfaction on Internet addiction was also moderate ($f^2 = 0.10$). Furthermore, the effect of life satisfaction on academic performance was small ($f^2 = 0.03$). Overall, these results indicate that resilience and life satisfaction exert small to moderate effects on Internet addiction and academic performance, suggesting that Internet addiction and academic performance are influenced by multiple determinants beyond the variables included in the present model.

The blindfolding technique was employed to assess predictive relevance, resulting in the cross-validated redundancy statistic (Q^2). The Q^2 value for Internet addiction was 0.11, while for life satisfaction it was 0.07 and 0.03 for academic performance. As noted by Hair, et al. (2021), an endogenous construct exhibits predictive relevance when its Q^2 value exceeds zero (47). Therefore, the findings indicate that the model exhibits adequate predictive power concerning Internet addiction, life satisfaction, and academic performance.

The standardized root mean square residual (SRMR), which is frequently applied to evaluate goodness-of-fit criterion in PLS-SEM, was used to further assess the fitness of the model.

The SRMR value obtained was 0.074, which meets the suggested criterion of being less than 0.08 (49). The findings indicate a satisfactory alignment between the proposed model and the observed data, thereby confirming the adequacy and stability of the structural model.

Overall, the findings demonstrated that both the measurement and structural models met established evaluation criteria. Reliability, validity, and multicollinearity assessments showed no issues, and all hypothesized relationships were statistically supported. Additionally, the model exhibited acceptable explanatory power, predictive relevance, and fit, confirming its robustness and applicability.

Discussion

The present study aimed to examine the effects of resilience on Internet addiction and academic performance among medical students, with life satisfaction investigated as a potential mediating variable. The findings provided empirical support for all hypothesized relationships, highlighting the crucial role of psychological resources in reducing Internet addiction and enhancing academic performance.

Specifically, the findings revealed a negative and significant influence of resilience on Internet addiction, providing empirical support for Hypothesis 1. Supporting prior evidence, these results indicate that resilience enhances adaptive coping capacities, thereby lowering the risk of excessive Internet usage as a maladaptive response to academic pressure or stress (5, 12, 13, 21, 23, 50). However, certain empirical studies have found no statistically significant association between resilience and Internet addiction (14). When confronted with life challenges, those with lower resilience often exhibit diminished emotional regulation and lack the capacity to persevere or sustain a positive perspective in the face of adversity (23). As a result, they frequently resort to negative coping strategies—such as rationalization, fantasy, and self-blame—that may exacerbate their difficulties rather than resolve them. Consequently, exposure to the Internet increases their likelihood of developing Internet addiction.

Conversely, resilient individuals tend to rely on internal coping mechanisms and maintain positive attitudes during stressful situations, thereby reducing the likelihood of using the Internet for emotional regulation (25). In the demanding context of medical education, characterized by intense workloads and academic stress, this protective function becomes particularly important. Medical

students with greater resilience tend to employ more constructive coping strategies—like physical activity, social interaction, or problem-focused approaches—rather than seeking escape through excessive Internet use. Given the intense academic and clinical pressures they face, medical students are particularly vulnerable to Internet addiction. However, resilience serves as a crucial protective factor by strengthening their coping abilities, helping them manage stress effectively and reduce dependence on the Internet as an escape. Therefore, greater resilience in this population is associated with a reduced likelihood of developing Internet addiction.

The second hypothesis of this study proposed that medical students' resilience would positively predict life satisfaction. The findings confirmed this hypothesis, showing that greater resilience among students was associated with increased life satisfaction. This finding aligns with extensive empirical evidence highlighting resilience as a key psychological resource that promotes subjective well-being (51, 52). Consistent with Liu, et al. (2013), the current results suggest that resilience enables medical students to implement adaptive coping mechanisms and alleviate negative emotional reactions, thereby enhancing their overall satisfaction with life (53). These findings are particularly relevant given the well-documented psychological challenges faced by medical students, including elevated stress, anxiety, and depressive symptoms (54-56).

Resilience, as a dynamic and malleable psychological capacity (57), holds considerable promise as a focus for interventions aiming at improving life satisfaction and psychological health, particularly within the medical student population. Those with greater resilience typically preserve a sense of happiness during adversity, actively pursue meaningful personal goals, and construct a life imbued with purpose and fulfillment (6). Such a combination of emotional flexibility and forward-looking coping strategies highlights the essential role of resilience in sustaining well-being under pressure.

Moreover, resilience appears to be especially important for fostering life satisfaction during adolescence and early adulthood, given the profound impact of academic achievement, social competence, and avoidance of risky behaviors on individuals' life trajectories (58, 59). A resilient person tends not to be easily overwhelmed by adversity and is typically motivated to confront challenges with optimism and persistence. This adaptive capacity allows for effective emotional regulation in the face of difficulties. Resilient individuals also tend to interpret stressful

situations as growth opportunities rather than as threats, enabling them to adopt proactive strategies and recover from adverse events more quickly and effectively (21).

The third hypothesis, which proposed a positive relationship between resilience and academic performance, was not supported. Although the relationship was positive, it was not statistically significant in this study. This finding contrasts with previous literature, suggesting that students with higher resilience are generally better equipped to cope with academic challenges, recover from setbacks, and maintain consistent academic functioning under pressure (9, 60). Similarly, earlier studies have shown that low resilience is associated with academic burnout, anxiety, poor concentration, and reduced academic achievement (1, 9, 11). One possible explanation for this discrepancy is that resilience may not directly translate into academic outcomes in all contexts, and its effect may be largely indirect, operating through psychological factors such as life satisfaction that more immediately influence the students' academic functioning.

The results obtained in this study confirm the fourth hypothesis, suggesting that higher life satisfaction is inversely associated with Internet addiction among medical students. This result is consistent with a significant body of prior studies that consistently demonstrates an inverse relationship between these two variables (20, 30, 32, 61). Individuals with lower life satisfaction tend to experience emotional distress or dissatisfaction with their real-life circumstances, which may cause them to seek psychological compensation through excessive Internet use (22). In this context, the Internet becomes a coping mechanism, offering immediate relief or distraction from stressors such as academic pressure, social isolation, or emotional challenges.

The protective role of life satisfaction is particularly salient during the university years—a critical developmental stage marked by identity exploration, academic stress, and future uncertainty. As prior research has demonstrated, students with higher life satisfaction tend to experience better emotional adjustment and academic performance (62). This psychological well-being helps to reduce their reliance on maladaptive coping behaviors like overusing the Internet. Specifically, students with greater life satisfaction—who are more likely to find fulfillment in real-life relationships and activities—tend to be less inclined to use virtual environments as a means of emotional regulation. This pattern aligns with Huebner's

(2004) conceptualization of life satisfaction as the fulfillment of psychological needs in the real world, thereby functioning as a protective buffer against behavioral addictions (28). Taken together, the evidence suggests that life satisfaction serves as a psychological safeguard, reducing students' vulnerability to Internet addiction by minimizing the appeal of online escapism in the face of life stressors.

The fifth hypothesis, which proposed that life satisfaction positively predicts academic performance, was supported. The findings revealed a significant positive association between life satisfaction and academic performance. This result is consistent with prior evidence indicating that students with higher life satisfaction tend to show greater academic engagement and better academic outcomes (31, 33). From a theoretical perspective, life satisfaction can be understood as a key component of subjective well-being that enhances cognitive and motivational resources. Students who perceive their lives positively are more likely to experience higher motivation, better emotional regulation, and stronger persistence in academic tasks, which collectively contribute to improved academic performance. Accordingly, life satisfaction may serve as a psychological resource that facilitates sustained academic engagement and effective learning behaviors in university settings.

The sixth hypothesis, which proposed that life satisfaction mediates the relationship between resilience and Internet addiction, was supported. The findings indicate that life satisfaction plays a significant mediating role in this relationship, meaning that resilience contributes to lower Internet addiction primarily by enhancing the students' life satisfaction. Resilience enhances psychological well-being by promoting adaptive coping strategies, emotional regulation, and positive cognitive appraisals, all of which lead to greater satisfaction with life (52, 53). Students with greater life satisfaction have an increased chance of experiencing fulfillment from real-life interactions, maintain healthier routines, and rely less on digital environments to manage stress. As such, life satisfaction operates as a psychological buffer that absorbs the negative impact of stressors and lowers the probability that individuals will resort to unhealthy behaviors such as overuse of the Internet. In this way, life satisfaction not only reflects the positive outcomes of resilience but also functions as a crucial pathway through which resilience indirectly mitigates the danger of becoming addicted to the Internet. The results underscore the crucial role of developing resilience-enhancing and life-satisfaction-

boosting programs in academic institutions, particularly medical schools, to reduce the students' vulnerability to Internet addiction.

The final hypothesis, which proposed that life satisfaction mediates the relationship between resilience and academic performance, was confirmed. Although the direct effect of resilience on academic performance was positive but not statistically significant, the indirect effect through life satisfaction was significant, and the total effect was also significant. This pattern suggests that resilience does not directly translate into better academic performance among medical students; rather, its impact is largely channeled through enhanced life satisfaction.

This finding is consistent with previous evidence indicating that life satisfaction may influence both academic and behavioral outcomes in university students (22, 30, 31). Students with higher life satisfaction tend to demonstrate greater academic engagement and improved academic performance (31). From a theoretical standpoint, resilience may function as a foundational psychological resource that helps students adapt to stress and academic pressure, but its effectiveness becomes more pronounced when it contributes to a positive evaluation of one's life circumstances. In this sense, life satisfaction acts as a motivational and emotional mechanism that strengthens persistence, focus, and engagement in academic tasks, thereby converting personal resilience into tangible academic success.

Limitations

Although this study provides meaningful insights, several limitations should be acknowledged. First, the cross-sectional design limits the ability to draw causal conclusions among Internet addiction, resilience, life satisfaction, and academic performance. Longitudinal studies are needed to better understand the direction and stability of these relationships over time. Second, the use of self-reported questionnaires may have introduced response bias, including social desirability and recall inaccuracies, particularly in reporting sensitive behaviors such as Internet use. Third, the study was conducted among medical students from a single university, which may limit the generalizability of the findings to other student populations or educational contexts. In addition, cultural factors influencing Internet use and perceptions of life satisfaction were not directly examined, which may affect the applicability of the results in different cultural settings.

Conclusion

The present study provides important

insights for medical education by highlighting the protective role of psychological resources in both reducing Internet addiction and enhancing academic performance among medical students. The findings show that resilience reduces Internet addiction both directly and indirectly through life satisfaction. However, its influence on academic performance is mainly indirect, operating through life satisfaction rather than a direct pathway. This pattern underscores the central role of life satisfaction as a key psychological mechanism linking personal resources to both behavioral and academic outcomes in a high-pressure medical training environment.

From a medical education perspective, these results emphasize the need to integrate psychological skill development into medical curricula. Strengthening resilience can help students manage academic stress and reduce maladaptive Internet use, while enhancing life satisfaction through supportive learning environments, mentorship, peer support, and well-being programs can further improve academic performance.

Therefore, medical schools should move beyond a purely knowledge-based curriculum and incorporate structured interventions which aimed at building resilience and promoting life satisfaction. Such initiatives—such as stress management training, mindfulness programs, counseling services, and activities that enhance social connection and meaning in life—may simultaneously reduce Internet addiction and improve academic outcomes. Ultimately, fostering these psychological strengths can contribute to healthier, more adaptive, and academically successful future physicians.

Implications

This study offers important implications for educators, mental health professionals, and university administrators by highlighting the dual role of psychological resources in reducing Internet addiction and improving academic performance among medical students. First, the significant negative association between resilience and Internet addiction suggests that resilience-building interventions—such as cognitive-behavioral training, stress management workshops, and mindfulness-based programs—can help students develop more adaptive coping strategies and reduce reliance on the Internet as an avoidance mechanism.

Second, the mediating role of life satisfaction indicates that enhancing the students' overall well-being is crucial not only for reducing problematic Internet use but also for improving

their academic performance. Universities should, therefore, integrate positive psychology approaches, including well-being enhancement programs, peer support systems, mentorship, and counseling services, to strengthen the students' satisfaction with life and academic engagement simultaneously.

Finally, given that life satisfaction was positively associated with academic performance and served as the main pathway linking resilience to academic outcomes, targeted support should be provided to students with low resilience or low life satisfaction. Identifying and supporting these at-risk students may help prevent both behavioral problems such as Internet addiction and academic difficulties. Overall, fostering resilience alongside life satisfaction appears to be a key strategy for promoting healthier behavior and better academic functioning in medical education settings.

Suggestions for Future Research

Future studies should extend this line of research to more diverse student populations across different academic disciplines, cultural contexts, and educational institutions to improve the generalizability of the findings. For better establishment of causal relationships and examine changes over time among resilience, life satisfaction, Internet addiction, and academic performance, longitudinal and experimental research designs are recommended.

In addition, the use of multi-method approaches, such as qualitative interviews and behavioral observations, may help reduce the limitations of self-report data and provide a more comprehensive understanding of students' experiences. Future research should also explore the role of broader social and cultural factors that may shape Internet use behaviors and perceptions of life satisfaction.

Furthermore, it would be valuable to evaluate the effectiveness of targeted interventions designed to enhance resilience and life satisfaction in reducing Internet addiction and improving academic performance. Finally, examining potential moderating variables such as gender, social support, and individual differences in academic functioning could provide deeper insights into variability in students' vulnerability and protective factors.

Authors' contributions

All authors contributed to the study design, data collection, and drafting of the study. All authors read and approved the final version of the manuscript.

Conflicts of Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Declaration of AI use

The authors declare that no AI tools were used in the preparation of this manuscript.

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