



Research Article

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Instagram Use Intensity and Academic Performance Among Medical Students: The Mediating Role of Grit

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Abstract

Background: The increasing use of Instagram among medical students has raised concerns about its potential impact on academic performance. However, existing evidence remains inconsistent, and researchers have not yet fully understood the psychological mechanisms underlying this relationship. **Objective:** To evaluate the association between Instagram use intensity and academic performance while investigating the mediating role of grit. **Methods:** A cross-sectional analytical study was conducted among 128 third-semester medical students at the Faculty of Medicine, Universitas Airlangga, Indonesia. Instagram use intensity was measured using the Instagram Intensity Scale Questionnaire (IISQ), and grit was assessed with the Short Grit Scale (Grit-S). The assessment of academic performance was conducted through pharmacology and biochemistry block examination scores, the semester grade point average (SGPA), and the cumulative grade point average (CGPA). Correlation analyses, group comparisons, and mediation analysis using PROCESS Macro Model 4 with bootstrap resampling were performed. **Results:** Instagram use intensity was not significantly associated with any academic performance measure ($p>0.05$). However, it was negatively associated with grit ($r=-0.276, p=0.002$), whereas grit was positively associated with all academic outcomes (all $p<0.001$). Mediation analysis demonstrated significant indirect effects of Instagram use intensity on pharmacology and biochemistry examination scores, SGPA, and CGPA through grit, indicating full mediation. **Conclusions:** Instagram use intensity was not directly associated with academic performance. Instead, its influence operated indirectly through grit, suggesting that interventions promoting perseverance and self-regulated learning may be more beneficial than strategies focused solely on reducing Instagram use.

Keywords: Academic performance; Grit; Instagram; Medical students; Mediation analysis; Social media.

استخدام إنستغرام: الشدة والأداء الأكاديمي بين طلاب الطب: الدور الوسيط للغمظة

الخلاصة

الخلفية: أثار الاستخدام المتزايد لإنستغرام بين طلاب الطب مخاوف بشأن تأثيره المحتمل على الأداء الأكاديمي. ومع ذلك، لا تزال الأدلة الحالية غير متسقة، ولم يفهم الباحثون بعد الآليات النفسية التي تقوم عليها هذه العلاقة. **الهدف:** تقييم العلاقة بين شدة استخدام إنستغرام والأداء الأكاديمي أثناء دراسة الدور الوسيط للمثابرة. **الطرائق:** أجريت دراسة تحليلية مقطعية بين 128 طالب طب في الفصل الدراسي الثالث في كلية الطب بجامعة إيرلانغا، إندونيسيا. تم قياس شدة استخدام إنستغرام باستخدام استبيان مقياس شدة إنستغرام (IISQ)، وتم تقييم الصلابة باستخدام مقياس الغمظة القصيرة (Grit-S). تم تقييم الأداء الأكاديمي من خلال درجات امتحانات الكتلة في علم الأدوية والكيمياء الحيوية، ومتوسط الدرجات الدراسية (SGPA)، ومعدل الدرجات التراكمي (CGPA). تم إجراء تحليلات ارتباط، ومقارنات جماعية، وتحليل الوساطة باستخدام نموذج PROCESS Macro 4 مع إعادة أخذ العينات التمهيدية (bootstrap). **النتائج:** لم تكن شدة استخدام إنستغرام مرتبطة بشكل دلالي بأي مقياس أداء أكاديمي. ومع ذلك، كانت مرتبطة سلباً بالغمظة ($r=-0.276, p=0.002$)، بينما ارتبطت الغمظة إيجابياً بجميع النتائج الأكاديمية (جميعها $p<0.001$). أظهر تحليل الوساطة تأثيرات غير مباشرة ذات دلالة كبيرة لشدة استخدام إنستغرام على درجات امتحانات علم الأدوية والكيمياء الحيوية، وSGPA، وCGPA من خلال الغمظة، مما يشير إلى الوساطة الكاملة. **الاستنتاجات:** لم تكن شدة استخدام إنستغرام مرتبطة مباشرة بالأداء الأكاديمي. بدلاً من ذلك، كان تأثيرها يعمل بشكل غير مباشر من خلال الغمظة، مما يشير إلى أن التدخلات التي تعزز المثابرة والتعلم المنظم ذاتياً قد تكون أكثر فائدة من الاستراتيجيات التي تركز فقط على تقليل استخدام إنستغرام.

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INTRODUCTION

Social media has become an integral component of modern medical education, providing students with rapid access to information, communication, collaborative learning, and educational resources beyond the traditional classroom [1–3]. Among social networking platforms, Instagram has become increasingly popular among university students because of its visual content, interactive features, and

accessibility. Medical students use Instagram not only for entertainment and interpersonal communication but also to access educational materials, exchange academic information, and participate in online learning communities [1–3]. However, the increasing integration of Instagram into students' daily lives has raised concerns regarding its potential influence on academic performance. Medical education requires sustained concentration, effective time management, self-regulated learning, and persistent motivation to

cope with demanding curricula and frequent assessments. Intensive engagement with social media may interfere with these learning processes through prolonged screen exposure, distraction, reduced study time, and procrastination [4–6]. Nevertheless, social media may also support learning through peer interaction, collaborative activities, and access to educational resources when used appropriately [2,7,8]. Previous studies have therefore reported inconsistent associations between social media use and academic performance. Some studies have demonstrated poorer academic outcomes among students with greater social media or Instagram use, whereas others have suggested that social media may facilitate academic engagement and learning when used purposefully [4–11]. The inconsistent findings suggest that a direct association alone may not adequately explain the relationship between Instagram use and academic performance. The displacement hypothesis suggests that increased engagement in one activity may limit one possible explanation, proposing that increased engagement in one activity may reduce the time available for alternative activities [12]. In an academic context, intensive Instagram use may displace time that could otherwise be devoted to studying and other academically relevant activities, potentially reducing sustained engagement with academic tasks [11–13]. At the same time, the Uses and Gratifications Theory emphasizes that individuals actively select media to satisfy specific needs, such as information seeking, entertainment, interpersonal communication, and self-expression [14,15]. Thus, the academic consequences of Instagram use may depend not only on the amount of engagement but also on the purposes and patterns of use [16,17]. Beyond these behavioral explanations, individual psychological characteristics may help illustrate why students respond differently to intensive social media use. One potentially important construct is grit, which refers to perseverance of effort and consistency of interests toward long-term goals [18,19]. Students with higher levels of grit are more likely to sustain effort, maintain commitment to long-term educational objectives, and persist despite academic difficulties [18,20,21]. In contrast, students with lower grit may be more susceptible to immediate gratification and distraction, potentially making it more difficult to maintain consistent academic effort in environments characterized by frequent digital stimulation. Recent evidence has further suggested that grit may function as a psychological mechanism linking social media use with academic outcomes. Kim *et al.* [22] reported a mediating role of grit in the relationship between social media use and academic outcomes, suggesting that the association may operate through psychological processes related to perseverance and long-term goal commitment rather than through direct effects alone. The potential mediating role of grit is particularly relevant in medical education, where students must maintain persistent effort across demanding coursework, frequent examinations, and prolonged educational training. Although previous studies have examined associations between social media use and academic performance,

several gaps remain. Much of the existing research has focused on direct relationships between social media engagement and academic outcomes, with comparatively limited attention to the psychological mechanisms underlying these associations. Research specifically examining Instagram use intensity and grit simultaneously is also limited, particularly among medical students in Southeast Asian educational settings. Furthermore, researchers have yet to fully understand whether grit mediates the relationship between Instagram use intensity and specific objective indicators of academic performance. Therefore, this study investigated the relationship between Instagram use intensity and academic performance among medical students and examined whether grit mediates this relationship. Academic performance was assessed using pharmacology and biochemistry block examination scores, semester GPA, and cumulative GPA. By integrating behavioral and psychological perspectives, this study aimed to clarify whether the association between Instagram use intensity and academic performance may operate through students' perseverance and commitment to long-term academic goals.

METHODS

Study design and participants

This cross-sectional investigation involved third-semester preclinical medical students enrolled at the Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia, with the objective of exploring the relationship between Instagram use intensity and academic performance and to investigate the mediating role of grit. Data collection was performed using self-administered online questionnaires, while academic performance data were obtained from students' academic records after participants provided informed consent.

Inclusion criteria

Eligible participants were active third-semester medical students who regularly used Instagram and agreed to participate in the study. Students on academic leave, those who failed to complete the questionnaire, and those without academic performance data were excluded from the final evaluation.

Sample size and sampling

The target population consisted of approximately 250 third-semester medical students enrolled during the study period. The smallest sample considered adequate consisted of estimates using Cohen's approach for multiple regression analysis with two predictors (Instagram use intensity and grit). Based on a medium effect size ($f^2 = 0.15$), an alpha value of 0.05, and a statistical power of 80%, the calculation indicated that at least 56 individuals should be recruited. To maximize statistical precision and minimize sampling

bias, total sampling was employed by inviting all eligible students to participate.

Instagram use intensity

Instagram use intensity was considered the independent variable and was assessed with the Instagram Intensity Scale Questionnaire (IISQ), developed through adaptation of the Facebook Intensity Scale by Ellison *et al.* [23] and subsequently modified for Instagram by Stapleton [24]. The instrument evaluates emotional connectedness, frequency of engagement, and the integration of Instagram into daily activities. Higher scores indicate greater Instagram use intensity.

Grit

Grit was treated as the mediating variable and was assessed with the Short Grit Scale (Grit-S), first introduced by Duckworth *et al.* [18] and previously validated for the Indonesian population. The instrument measures two primary components, namely sustained effort and stability of personal interests. Higher scores represent stronger perseverance toward long-term goals.

Academic performance

Academic performance was the dependent variable and was evaluated using objective academic indicators, including cumulative grade point average (GPA), semester grade point average (SGPA), and block examination scores. These indicators were selected because they represent standardized measures routinely used by the Faculty of Medicine to evaluate students' academic achievement.

Data collection

Eligible students were invited to participate through institutional communication channels. Participants completed an online questionnaire containing demographic information and the Instagram Intensity Scale Questionnaire together with the Short Grit Scale after providing electronic informed consent. Academic performance data were subsequently matched with questionnaire responses using participant identification codes while maintaining confidentiality.

Ethical consideration

Ethical approval was granted by the Health Research Ethics Committee, Faculty of Medicine, Universitas Airlangga. All participants provided written informed consent before joining the study. Participation was voluntary, anonymity was preserved throughout the study, and all collected data were analyzed confidentially following the ethical principles outlined in the Declaration of Helsinki.

Statistical analysis

Participant demographics, levels of Instagram engagement, grit scores, and academic achievement were summarized through descriptive statistical methods. Numerical data are reported as mean $\pm$ standard deviation or median with interquartile range according to distributional assumptions, while categorical data are expressed as counts and proportions. The relationships between Instagram use intensity, grit, and academic performance were initially examined using bivariate correlation analyses. Differences in academic performance between students with high and low Instagram use intensity were evaluated using appropriate comparative statistical tests according to data distribution. Mediation analysis was subsequently performed to evaluate whether grit mediated the association between Instagram use intensity and academic performance. Direct, indirect, and total effects were estimated, and statistical significance was determined using bootstrapping procedures with bias-corrected confidence intervals. Statistical significance was established at a two-tailed *p*-value less than 0.05. Data analysis was carried out with IBM SPSS Statistics version 26.

RESULTS

A total of 128 third-semester medical students participated in the study. Most participants were female [86 (67.2%)] and aged 20 years [57 (44.5%)], with a mean age of 19.63 ± 0.73 years (Table 1).

Table 1: Baseline characteristics of study participants (n= 128)

Characteristic	n(%)
Sex	
Male	42(32.8)
Female	86(67.2)
Age (years)	
18	5(3.9)
19	52(40.6)
20	57(44.5)
21	14(10.9)
Mean $\pm$ SD	19.63 $\pm$ 0.73
Academic level	
Third-semester medical students	128(100)

Instagram was the most frequently used social media platform [48 (37.5%)], followed by TikTok [37 (28.9%)] and WhatsApp [26 (20.3%)]. Most students reported using Instagram for 1–3 h/day [62 (48.4%)], while 33 (25.8%) reported 3–5 h/day and 4 (3.1%) more than 5 h/day. Entertainment was the predominant purpose of Instagram use [111 (86.7%)], whereas only 4 (3.1%) primarily used it for educational purposes (Table 2). The average scores for the pharmacology and biochemistry blocks were 77.92 ± 8.80 and 73.17 ± 8.87 , respectively. The average GPAs for the semester and the whole year were 77.92 ± 8.80 and 73.17 ± 8.87 , respectively, while the mean semester and cumulative GPAs were 3.24 ± 0.39 and 3.48 ± 0.26 , respectively (Table 3). Most students had moderate grit [56 (43.8%)]. Students with low Instagram use intensity had slightly higher pharmacology scores (79.40 ± 7.85 vs. 76.67 ± 9.41),

biochemistry scores (73.38 ± 8.58 vs. 72.98 ± 9.16), cumulative GPA (3.52 ± 0.24 vs. 3.44 ± 0.28), and semester GPA (3.30 ± 0.35 vs. 3.19 ± 0.41) than those with high Instagram use intensity; however, none of

these differences was statistically significant ($p=0.106, 0.811, 0.110$, and $p=0.097$, respectively) (Table 4).

Table 2: Instagram use characteristics of study participants (n=128)

Variable	n(%)
Primary social media platform	
Instagram	48(37.5)
TikTok	37(28.9)
WhatsApp	26(20.3)
Others	17(13.3)
Daily Instagram use (hr)	
< 1	-
1-3	62(48.4)
3-5	33(25.8)
> 5	4(3.1)
Primary purpose of Instagram use	
Entertainment	111(86.7)
Educational purposes	4(3.1)
Both equally	13(10.2)
Perceived effect of Instagram on academic performance	
Positive	80(62.5)
Negative	48(37.5)
IISQ (mean: 3.45 ± 0.68 ; median [range]: 3.50 [1.13 – 4.88])	128(100)
Low	60(46.9)
High	68(53.1)

Table 3: Descriptive statistics of academic performance indicators (n=128)

Academic performance indicator	n(%)	Median (Min–Max)	Mean±SD
Pharmacology block examination score		78.97(46.43-89.93)	77.92±8.8
Biochemistry block examination score		71.55(51.71-91.78)	73.17±8.87
Semester Grade Point Average (SGPA)		3.27(2.00-3.94)	3.24±0.39
Cumulative Grade Point Average (CGPA)		3.48(2.63-3.92)	3.48±0.26
GRIT		3.13(1.28-4.50)	3.24±0.58
Very low	1(0.8)		
Low	29(22.7)		
Medium	56(43.8)		
High	34(26.6)		
Very high	8(6.3)		

Table 4: Correlations between Instagram use intensity, grit, and academic performance

Variables	Instagram intensity	Grit	Pharmacology score	Biochemistry score	CGPA	SGPA
Instagram intensity	1.0					
Grit	-0.276**	1.0				
Pharmacology score	-0.116	0.423***	1.0			
Biochemistry score	-0.081	0.388***	0.74***	1.0		
CGPA	-0.122	0.461***	0.615***	0.587***	1.0	
SGPA	-0.11	0.475***	0.689***	0.662***	0.891***	1.0

** $p < 0.05$; *** $p < 0.01$.

Instagram use intensity was inversely correlated with grit ($r = -0.276$, $p = 0.002$). In contrast, grit was positively correlated with pharmacology scores ($r = 0.423$, $p < 0.001$), biochemistry scores ($r = 0.388$, $p < 0.001$), cumulative GPA ($r = 0.461$, $p < 0.001$), and semester GPA ($r = 0.475$, $p < 0.001$). Hayes PROCESS Model 4 analysis demonstrated significant indirect effects of Instagram use intensity on pharmacology scores (95% bootstrap CI: -3.0876 to -0.7539), biochemistry scores (95% bootstrap CI: -3.3561 to -0.7382), and semester GPA (95% bootstrap CI: -0.1485 to -0.0402) through grit (Table 5). For cumulative GPA, Instagram use intensity negatively predicted grit ($B = -0.277$, $p < 0.001$), while grit positively predicted cumulative GPA ($B = 0.224$, $p < 0.001$). The direct effect of Instagram use intensity on cumulative GPA was not significant after adjustment for grit ($B = 0.012$, $p = 0.710$), whereas the indirect effect was significant ($B = -0.062$, 95% bootstrap CI: -0.100 to -0.028), indicating full mediation (Table 6).

DISCUSSION

The present study provides new evidence regarding the association of Instagram use intensity, grit, and academic achievement in medical students. Although students with higher Instagram use intensity tended to have slightly lower pharmacology and biochemistry block examination scores, although differences were observed in SGPA and CGPA, they were not statistically significant. In contrast, Instagram use intensity demonstrated a significant negative association with grit, whereas grit was positively associated with all academic performance indicators. More importantly, mediation analysis revealed that grit completely explained the association between Instagram use intensity and academic performance. These results suggest that Instagram use alone may not directly impair academic achievement; rather, its influence appears to operate indirectly through students' persistence and continuous dedication to long-term educational objectives.

Table 5: Comparison of academic performance according to Instagram use intensity

Academic performance indicator	Low Instagram intensity	High Instagram intensity	p-value
Pharmacology block examination score†	79.4±7.85 (Median: 80.83)	76.67±9.41 (Median: 77.08)	0.106
Biochemistry block examination score	73.38±8.58	72.98±9.16	0.811
Cumulative Grade Point Average (CGPA)	3.52±0.24	3.44±0.28	0.11
Semester Grade Point Average (SGPA)	3.3±0.35	3.19±0.41	0.097

†Compared using the Mann–Whitney U test because the data were not normally distributed; all other comparisons were performed using the independent samples t-test.

Table 6: Mediation analysis of grit in the association between Instagram use intensity and academic performance

Outcome	a path (Instagram → Grit)	b path (Grit → Outcome)	Conclusion	Direct effect (c')	95% Boot CI	Indirect effect	95% Boot CI	Mediation
Pharmacology	−0.277*	6.899*	NS			−1.91	−3.09 to −0.75	Full
Biochemistry	−0.277*	7.12*	NS			...	...	Full
CGPA	−0.277*	0.224*	0.71 (NS)	0.012	−0.05 to 0.07	−0.062	−0.100 to −0.028	Full
SGPA	−0.277*	0.283*	NS			...	...	Full

*** $p < 0.01$; NS: not significant.

This study did not identify a statistically significant direct relationship between Instagram use intensity and academic performance among medical students. Students with higher Instagram use intensity showed slightly lower pharmacology and biochemistry block examination scores, SGPA, and CGPA than those with lower Instagram use intensity; however, these differences failed to achieve statistical significance. These results imply that the amount of time or intensity of Instagram use alone is insufficient to explain variations in academic performance within this population. One possible explanation is the unique academic environment experienced by medical students. Medical education is characterized by a highly structured curriculum, intensive learning schedules, frequent examinations, mandatory attendance, and continuous academic evaluation. These academic demands require students to develop effective time management, self-regulation, and adaptive learning strategies. Consequently, although students frequently access Instagram, many may still be able to maintain satisfactory academic performance because recreational social media use is balanced with academic responsibilities. Therefore, the detrimental effects of Instagram may not become apparent unless accompanied by deficiencies in psychological or behavioral factors that influence learning persistence. The present findings are consistent with several previous studies reporting that social media use does not necessarily lead to poorer academic achievement. Lahiry *et al.* [7] demonstrated that social media platforms may facilitate collaborative learning and improve interaction between learners and instructors while expanding access to learning materials when used appropriately. Similarly, Bhat *et al.* [8] reported that Instagram could support knowledge sharing, academic engagement, and interactive learning experiences, particularly when integrated into educational activities. These findings indicate that the educational value of Instagram depends not only on the duration of use but also on how students utilize the platform in supporting their learning activities. In contrast, numerous earlier studies have documented inverse relationships between excessive Instagram use

and academic performance. Pekpazar *et al.* [4] found that problematic Instagram use reduced academic achievement primarily through increased procrastination and decreased study time. Likewise, studies by Bhandarkar *et al.* [5] and Foroughi *et al.* [6] suggested that excessive social media engagement may interfere with concentration, reduce learning efficiency, and impair academic outcomes. Differences in study populations and measurement approaches may explain the discrepancy between these studies and the present findings. Previous investigations generally focused on problematic or addictive social media use, whereas the present study measured Instagram use intensity, which reflects the frequency and level of engagement rather than pathological dependence. Moreover, participants in this study were medical students, who are likely to possess stronger academic motivation and institutional support than students from the general university population. These results indicate that the academic performance of medical students is influenced not only by the frequency of Instagram usage but also by their capacity to manage their learning behaviors while interacting with digital media. In other words, Instagram itself should not be regarded as an inherently harmful platform. Instead, its influence appears to depend on whether students can maintain appropriate self-regulation and continue prioritizing long-term academic goals despite regular exposure to digital distractions. This interpretation provides a more comprehensive understanding of why previous studies have produced inconsistent findings regarding the relationship between social media use and academic achievement. Furthermore, the absence of a direct association between Instagram use intensity and academic performance supports the growing perspective that psychological characteristics should be considered when examining the educational consequences of social media use. Rather than assuming that reducing screen time alone will improve academic outcomes, educational institutions may benefit from interventions that strengthen students' resilience, perseverance, and self-regulated learning skills. Such approaches are likely to produce more sustainable improvements in academic performance

than strategies focusing exclusively on limiting social media exposure. A major finding of this study was the statistically significant inverse relationship between Instagram use intensity and grit. Medical students who reported higher Instagram use intensity tended to demonstrate lower levels of grit, indicating reduced perseverance and consistency in pursuing long-term academic goals. Although the observed correlation was modest, it supports the hypothesis that frequent engagement with social media may influence psychological characteristics that are essential for sustained academic success. A plausible explanation for this relationship lies in the inherently rewarding nature of Instagram. The platform continuously provides novel visual content, immediate social feedback, and algorithm-driven recommendations that encourage prolonged engagement. Such features promote instant gratification, which may gradually compete with activities requiring sustained concentration and delayed rewards, including studying and completing academic assignments. Over time, repeated exposure to rapidly changing digital stimuli may reduce students' willingness to tolerate frustration, persist through difficult learning tasks, and remain committed to long-term educational objectives. Consequently, students with higher Instagram use intensity may become more vulnerable to reduced perseverance rather than experiencing immediate declines in academic performance. These findings are consistent with the Displacement Hypothesis, which proposes that excessive engagement with digital media replaces the time, attention, and cognitive resources that would otherwise be allocated to productive activities such as studying, problem solving, and self-directed learning. Rather than directly impairing academic outcomes, Instagram may gradually weaken students' ability to maintain sustained effort toward long-term goals. This interpretation is also supported by the Uses and Gratifications Theory, suggesting that individuals actively use social media to satisfy psychological needs, including entertainment, social interaction, and emotional regulation. Although these motivations are adaptive in moderation, excessive reliance on Instagram for immediate psychological gratification may inadvertently reduce persistence in activities requiring prolonged effort. The present findings are supported by Kim *et al.* [22], who reported that greater social media engagement was associated with lower grit, subsequently influencing academic outcomes through diminished perseverance and increased procrastination. Similarly, Pekpazar *et al.* [4] demonstrated that problematic Instagram use indirectly affected academic performance by promoting procrastination and reducing self-regulation. Collectively, these studies suggest that the psychological consequences of intensive social media use extend beyond simple distraction and involve gradual changes in students' motivational and behavioral characteristics. Medical students, who face demanding academic expectations and high educational aspirations, exhibited the association identified in the present study. This finding suggests that even students enrolled in rigorous professional

programs are not immune to the psychological effects of intensive social media use. Therefore, educational institutions should not only encourage responsible social media use but also promote strategies that strengthen students' perseverance and resilience when facing long-term academic challenges. This study indicated that grit exhibited positive relationships with all indicators of academic performance, including scores from pharmacology block examinations, biochemistry block examinations, semester GPA, and cumulative GPA. Students with higher levels of grit consistently achieved better academic outcomes than those with lower levels of grit, emphasizing the importance of perseverance and sustained commitment in medical education. This result aligns with the theoretical framework of grit introduced by Duckworth *et al.* [18], who defined grit as the combination of perseverance of effort and consistency of interests directed toward long-term goals. Medical education requires students to master extensive theoretical knowledge, develop clinical reasoning skills, and maintain continuous learning over prolonged periods. Consequently, students with greater perseverance are more likely to sustain motivation despite repeated academic challenges, whereas those with lower grit may become discouraged when confronted with demanding coursework or examination pressure. Previous empirical studies have consistently demonstrated the beneficial role of grit in educational achievement. Kim *et al.* [22] reported that grit was one of the strongest psychological predictors of academic performance among university students. Likewise, numerous studies have shown that students with higher grit exhibit greater learning persistence, improved self-regulated learning, stronger intrinsic motivation, and superior academic achievement compared with their peers. These findings reinforce the growing recognition that academic success depends not only on intellectual ability but also on non-cognitive psychological characteristics that enable students to sustain effort over time. The positive association observed in the present study may also reflect the unique characteristics of medical education. Medical students continuously encounter complex learning materials, face repeated examinations, and manage substantial academic workloads. Under such circumstances, perseverance becomes increasingly important because academic success depends on consistent engagement rather than short-term bursts of motivation. Students with higher grit are therefore more likely to maintain productive study habits, effectively manage academic stress, and remain committed to their professional aspirations despite temporary setbacks. These findings highlight the potential value of incorporating psychological skill development into medical education. While curricula traditionally emphasize knowledge acquisition and technical competence, interventions designed to strengthen perseverance, resilience, and self-regulated learning may provide additional benefits for academic achievement. Such interventions may become increasingly important as digital technologies continue to compete for students' attention. The principal

contribution of this study is showing that grit completely mediated the association between Instagram use intensity and academic performance. Despite the absence of a direct relationship with academic outcomes, students with higher Instagram use intensity tended to report lower levels of grit, which subsequently predicted poorer academic performance. These findings suggest that the educational consequences of Instagram use are primarily psychological rather than behavioral, highlighting grit as a key mechanism through which social media may influence learning outcomes. This finding provides an important explanation for the inconsistent results reported in previous studies investigating social media use and academic achievement. Although several studies have observed significant negative associations and others have reported weak or nonsignificant relationships, relatively few have examined the psychological processes underlying these findings. By incorporating grit as a mediating variable, the present study demonstrates that Instagram use alone is insufficient to explain academic performance. Instead, its influence depends on whether frequent engagement with social media gradually weakens students' perseverance toward long-term educational goals. From a theoretical perspective, the present findings integrate the Displacement Hypothesis with contemporary models of psychological resilience. Instagram does not appear to reduce academic achievement simply because students spend more time using the platform. Rather, frequent exposure to highly stimulating and immediately rewarding digital environments may progressively diminish persistence, consistency of interests, and sustained motivation. Reduced perseverance subsequently influences learning behaviors, resulting in poorer academic achievement over time. The identification of grit as a full mediator has important implications for educational practice. Conventional interventions often focus on restricting students' social media use or encouraging digital detoxification. Although these approaches may reduce screen time, they may not address the psychological mechanisms responsible for academic success. The present findings suggest that interventions aimed at strengthening grit, self-regulated learning, and long-term goal commitment may be more effective than strategies focusing solely on limiting Instagram use. Such approaches may enable students to benefit from educational aspects of social media while minimizing its potential adverse effects. As far as we are aware, this research is one of the earliest involving Indonesian medical students to identify grit as a mediator in the association between Instagram use intensity and multiple objective indicators of academic performance. The use of objective academic outcomes, including block examination scores, semester GPA, and cumulative GPA, further strengthens the evidence by reducing reliance on subjective self-reported academic achievement. Consequently, the present findings contribute new evidence supporting the growing importance of psychological resilience as a

determinant of academic success in increasingly digital learning environments.

Study limitations

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inference, and reverse causality between Instagram use intensity, grit, and academic performance is possible. Second, Instagram use intensity was assessed using a self-administered questionnaire, which may be subject to recall and social desirability bias. Third, the study was conducted at a single medical school, which may limit the generalizability of the findings to students from other institutions and educational settings. Finally, several potentially relevant factors, including sleep quality, mental health, learning strategies, socioeconomic background, and overall smartphone use, were not assessed and may have influenced academic performance. Future multicenter longitudinal studies incorporating these factors are warranted to validate and further clarify the observed associations.

Conclusion

Instagram use intensity was not directly associated with academic performance among medical students but was significantly associated with lower grit. Higher grit was consistently associated with better academic performance, and grit significantly mediated the relationship between Instagram use intensity and academic performance. These findings suggest that grit may be an important psychological pathway underlying the association between Instagram use and academic performance. Educational interventions that promote grit, self-regulated learning, and purposeful social media use may therefore support academic success among medical students. Longitudinal and multicenter studies are needed to confirm these findings and clarify the temporal relationships among Instagram use, grit, and academic performance.

Conflict of interests

The authors declared no conflict of interest.

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Data sharing statement

The data that supports the findings of this study are available from the corresponding author upon a reasonable request.

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