Original Article

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Role of Metacognitive Awareness and Academic Motivation in Medical Undergraduates' Academic Performance: An Observational Study

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Abstract

Introduction: Medical students' performance is influenced by metacognitive awareness and regulation, alongside self-determination or motivation. Understanding these elements is crucial for creating a curriculum that enhances learning outcomes and academic achievement. This study aimed to assess metacognitive awareness and academic motivation among medical undergraduate (UG) students and to determine the association between metacognitive awareness, academic motivation, and academic performance.

Methods: A cross-sectional study was carried out at a medical college on 140 medical undergraduate (UG) students. The data were collected using self-administered questionnaires using Metacognition Awareness Inventory (MAI) and Academic Motivation Scale (AMS). The scores obtained were compared with their academic performance. The data were analyzed using IBM SPSS 20.0. The chi-square test, Mann–Whitney U test, Kruskal–Wallis test, and post-hoc Dunn's test were used for statistical analysis.

Results: The participants included 54.3% males and 45.7% females (age 20.4±0.9 years). High performers scored significantly higher on total (43.14±8.2) and domain-wise MAI scores compared to average and low performers. Female students scored better in all metacognitive domains (40.4±8.0) and had higher motivation scores than males (42.9±10.35). Academic performance was significantly correlated with metacognition regulation subscale scores (r=0.293, p=0.001) and intrinsic motivation scores (r=0.284, p=0.002). Also, metacognition regulation was significantly correlated with intrinsic motivation scores (r=0.376, p=0.00001) as well as extrinsic motivation scores (r=0.223, p=0.01). Intrinsic motivation scores correlated significantly with academic performance, metacognition knowledge subscale scores (r=0.406, p=0.00001), regulation scores, and extrinsic motivation scores (r=0.695, p=0.00001).

Conclusions: High performers demonstrate superior metacognitive awareness and intrinsic motivation, especially females. Significant correlations between metacognition, motivation, and academic performance stress the importance of integrating metacognitive regulation strategies into teaching methods to improve the outcomes and motivation.

Keywords: Motivation; Metacognitive awareness; Academic performance; Knowledge

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Introduction

Academic performance among medical undergraduates is influenced by multiple factors, with metacognitive awareness and self-determination (motivation) emerging as particularly crucial determinants. Metacognition encompasses the individuals' awareness of their knowledge acquisition capabilities and their ability to understand, control, manipulate, and regulate cognitive processes to achieve desired outcomes. This includes self-evaluation of goal achievement and strategy modification when necessary (1).

The implementation of Competency-Based Medical Education (CBME), in a student-centric curriculum, demands that medical students be self-directed learners who must acquire specific skills and achieve defined outcomes during their training period. In this context, metacognition becomes particularly significant as it enables medical undergraduates to manage their cognitive skills effectively and address learning weaknesses through the adoption of new techniques. Research has consistently shown that students with high metacognitive awareness demonstrate greater learning efficiency and accountability for their academic performance (2).

Alongside metacognition, motivational factors significantly affect learning processes and outcomes. Students with strong academic motivation typically display enhanced appreciation for educational activities, demonstrate greater satisfaction in task completion (perceived self-efficacy), and exhibit increased accountability for their academic progress (perception of controllability). These motivated learners are more likely to engage deeply with course material and persist through challenging learning situations (3, 4).

Evidence suggests that students with both strong metacognitive awareness and high motivation tend to achieve superior academic outcomes and demonstrate greater professional success compared to their peers. Importantly, while metacognition has inherent components, it can be developed through targeted training and consistent practice. Students can learn specific techniques to enhance their metacognitive abilities, leading to improved learning outcomes. The medical education landscape has undergone a significant transformation in recent years, incorporating online learning platforms, innovative pedagogical approaches, and novel assessment methods. This evolution necessitates a fresh examination of how metacognition and motivation influence academic performance in contemporary medical education settings. Understanding which specific aspects of metacognition most significantly affects academic outcomes has become crucial for developing effective curricular interventions (5).

While previous research has typically examined metacognition and motivation as separate constructs, this study takes an innovative approach by investigating their combined influence on academic performance. This integrated analysis aimed to determine whether these factors operate independently or synergistically in affecting learning outcomes. The findings will inform the development of targeted training programs that can be seamlessly integrated into medical curricula to enhance the student learning outcomes.

Methods

Study design and participants

A cross-sectional study was carried out at a Medical College from April to October 2024. MBBS students of the 2nd phase were chosen as participants as they had appeared for their first University exam. Sampling was convenient sampling, and all the students were invited to participate in the study. Out of 150 students in phase II, 140 students participated in the study.

Data Collection and Measurements

Data collection was done using self-self-administered questionnaire, which consisted of questions exploring their socio-demographic profile, metacognitive awareness, and academic motivation. The students' university results of previous exams were obtained, and students were divided into three groups, namely, high performers (≥65%), average performers (55-65%), and low performers (<55%) for analysis.

1. **Metacognition Awareness Inventory (MAI)** (6): devised by Schraw and Dennison (1994) comprises 52 items and was used for the assessment of the metacognition awareness level of students. The items of MAI represent two components of metacognition: 1) knowledge of cognition, 2) regulation of cognition and their subscales.

Knowledge of cognition: Declarative knowledge, procedural knowledge and conditional knowledge are essential for developing conceptual knowledge (content knowledge).

Regulation of cognition: Planning, information management, comprehension, monitoring, correction, and evaluation are the subscales. Regulation refers to the students' knowledge about the implementation of strategies and the ability to monitor the effectiveness of their strategies. When students regulate, they are continually developing and monitoring their learning strategies. The scale has good internal consistency (α≥0.9). Comparative fit index (0.78), goodness-of-fit index (0.8), and adjusted goodness of fit index (0.77). A Cronbach's alpha value of more than 0.9 indicates that items in a test are closely related and measure the same concept.

2. **Academic motivation Scale (AMS)** (7)**:** It consists of 28 items and is scored using a 5-point Likert scale (1=no match and 5=total match). The scale has seven dimensions and measures Intrinsic Motivation (IM), Extrinsic Motivation (EM), and demotivation. The scale is widely used, valid, and reliable, having indices such as intrinsic motivation (10 items; α=0.84; CR=0.86); extrinsic motivation (8 items; α=0.84; CR=0.90); and demotivation (4 items; α=0.84; CR=0.88).

Data Analysis

The data were collected using Google Forms and downloaded from Google Sheets. Data were analyzed using IBM SPSS 20.0. The scores of Mai and AMS were compared among high performers, average performers, and low performers. Continuous data was represented as the mean and standard deviation. Discrete data was presented as percentages and numbers. The normality was checked based on the Shapiro-Wilk test (α=0.05). The chi-square test, Mann–Whitney U test, and Kruskal–Walli's test were used to evaluate the difference in the dependent variable between different groups, as the assumption of normality could not be applied to the study sample. The post-hoc Dunn's test with Bonferroni correction was also applied. Spearman's rank Correlation coefficient was calculated to assess the correlation between the two variables.

Ethical Considerations

The study was approved by the Institutional Ethics Committee (Letter no. BKLWH/IEC/11/2024), and informed consent was obtained from participants after explaining to them the purpose of the research.

Results

The mean age of 140 students was 20.4±0.97 years. 86 students (61.4%) were 20 and 21 years old. Around 76 (54.3%) were male students and 64 (45.7%) were female. Most male students preferred living outside the campus (51; 67.1%), while most female students preferred staying in hostels (40; 62.5%). A total of 22 (15.71%) students reported that they were not involved in any extra-curricular activities or pursued no hobbies, as seen in Table 1.

Students were divided into three groups, namely high performers (≥65%), average performers (55-65%), and low performers (<55%) based on the university exam marks they obtained in phase I MBBS. Female students were mostly in the high performers group (21.32; 65.6%) as compared to males, and high number of males (22.32; 68.8%) were in the low performers group as compared to females. The difference was statistically significant. (For high performers - $x2$=4.69, df=1, p=0.03: low performers $x2$=7.569, df=1, p=0.006) (Figure 1).

As shown in Table 2, the low performers and average performers had a low mean for MAI scores compared to high performers (H=10.912, Df=2, P=0.0043). This difference was also evident in the domain-wise mean scores of the three groups. The difference between domain-wise mean scores was statistically significant between high and low performers though the average performers had lower scores than the high performers and high scores than the low performers. The difference was statistically significant, particularly in the domains of procedural

Table 1: Distribution of students according to their age, gender, place of residence, and engagement in extra-curricular activities

Characteristics	Gender		P
	Males N=76 (%)	Females N=64 (%)	
Age			
19 years (n=27)	14 (18.4)	13 (20.3)	$x2$=1.342, p=0.719
20 years (n=44)	22 (28.9)	22 (34.4)	
21 years (n=44)	24 (31.6)	20 (31.3)	
22 years (n=25)	16 (21.1)	9 (14.1)	
Place of residence			
Living in the hostels in the campus (n=75)	25 (32.9)	40 (62.5)	$x2$=12.243, p=0.000
Living outside the campus (n=75)	51 (67.1)	24 (37.5)	
Engagement in extra-curricular activities			
Sports	40 (52.6)	19 (29.7)	$x2$=0.193, p=0.66
Drawing/painting	19 (25)	25 (39)	
Reading	6 (7.9)	6 (9.4)	
Singing/ Dancing	29 (38.2)	33 (51.6)	
None	11 (14.5)	11 (17.2)	

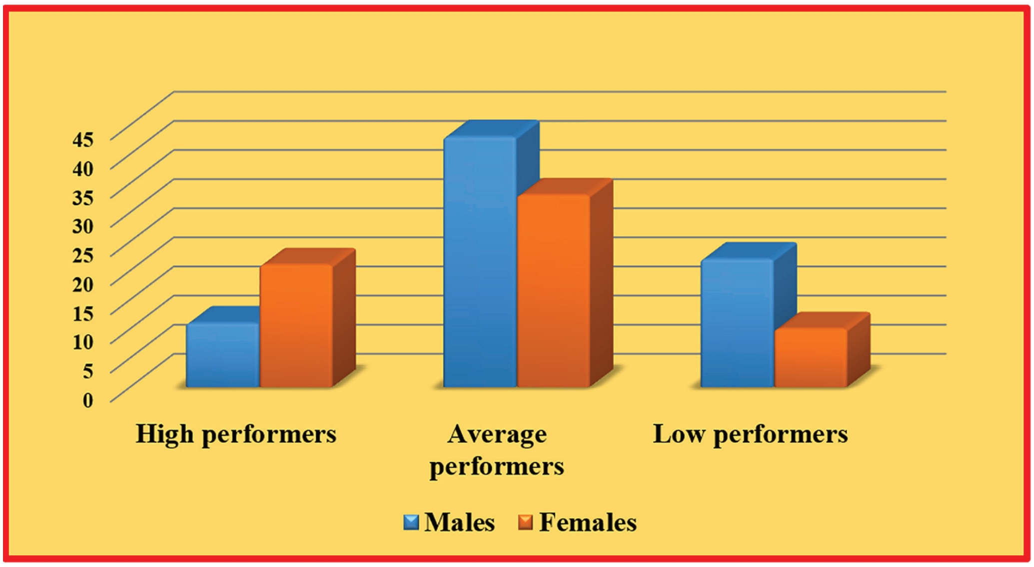

Figure 1: Gender-wise distribution of academic performance of students

Table 2: Domain-wise scores of Metacognitive Awareness Inventory in High, Average, and Low performers

Academic Performance	Domains of Metacognitive awareness								Total MAI score Max-52
	Cognition Max- 8	Procedural Max-4	Conditional Max-5	Planning Max-7	Comprehension Max-7	IMS Max-10	Debugging Max-5	Evaluation Max-6	
High (n=32)	6.26±1.6	2.88±0.12	3.58±1.3	4.92±0.08	5.78±1.22	9.3±0.71	4.76±0.24	5.4±0.6	40.65±8.1
Average (n=72)	5.5±1.9	2.34±0.9	3.67±1.1	3.76±1.5	5.29±1.6	8.03±2.23	4.37±1.21	4.2±1.3	37.7±8.5
Low (n=32)	4.6±1.5	2.1±0.6	2.9±1.5	3±1.4	4.1±1.8	6.8±2.7	4±1.62	3.4±1.8	31.5±8.4
H & p (Kruskal-Wallis test)	4.585 p=0.101	8.705 p=0.013	2.772 p=0.250	9.31 p=0.009	10.75 p=0.004	8.879 p=0.012	4.14 p=0.12	8.88 p=0.011	10.912 p=0.004
Spearman's correlation Coefficient, p-value	0.173 p=0.06	0.218 p=0.016	0.037 p=0.687	0.236 p=0.009	0.219 p=0.015	0.265 p=0.003	0.189 p=0.04	0.292 p=0.036	0.067 p=0.004

(H=8.705, Df=2, p=0.013), planning (H=9.316, df=2, p=0.009), comprehension (H=10.753, df=2, p=0.0046), information management strategies (H=8.879, Df=2, p=0.012), and evaluation domains (H=8.883, df=2, p=0.03). In addition, there was a significant positive correlation between academic performance and mean scores of procedural, planning, comprehension, information management strategies, and evaluation domains, along with the total MAI score.

It is evident from Table 3 that, again, high performers had higher intrinsic motivation score than average and low performers; the difference was also statistically significant (H=7.664, Df=2, p=0.024), whereas they had lower extrinsic motivation and demotivation scores than the other two groups, but the difference was not statistically significant. It was also observed that intrinsic motivation scores were more (43.14±8.2) than extrinsic motivation scores (39.82±4.4) in high performers, and it was vice versa in average and low performers. There was a positive and statistically significant correlation between the academic scores and intrinsic motivation scores (r=0.2011, p=0.03). Academic performance was not correlated with extrinsic motivation scores (r=0.0954, p=0.308) and demotivation scores (r=0.0976, p=0.327). As shown in Table 4, scores varied across the ages, but there was no fixed pattern seen between the age-groups; also, the mean scores did not differ significantly across the age groups.

Table 5 depicts that females had better (40.4±8.0) total MAI scores than males (36.07±9.2) and even on the metacognition regulation subscale. This difference in scores between males and females was statistically significant (U=1302, p=0.0044). The knowledge subscale, however, did not show any statistical difference between the scores of males and females. Intrinsic and extrinsic motivation scores were higher in females than in males, and the difference was statistically significant (U=1264.5, p=0.0024 and U=1358.5, p=0.011, respectively). Demotivation scores were lower in females than in males, and again the difference was found to be statistically significant (U=246, p=0.002).

Table 3: Domain-wise scores of the academic motivation scale in High, Average and Low performers

Academic grade	Domain-wise scores of Academic Motivation Scale		
	Intrinsic motivation score	Extrinsic motivation score	Demotivation score
High performers (n=32)	43.14±8.2	39.82±4.4	8.46±3.2
Average performers (n=76)	39.84±7.8	40.94±9.4	10.06±4.2
Low Performers (n=32)	30.6±8.4	40.00±9.8	10.6±4.0
H & p (Kruskal-Wallis test)	7.664 p=0.024	0.140 p=0.932	3.641 p=0.161
Spearman correlation coefficient, p-value	0.201 p=0.03	0.095 p=0.308	0.097 p=0.327

Table 4: Distribution of Scores of MAI* and AMS** subscales according to the age of the students

Age	Subscales scores of Metacognitive awareness Inventory			Subscale scores of Academic Motivation Scale		
	Knowledge	Regulation	Total MAI Score	Intrinsic	Extrinsic	Demotivation
19 years	0.68±0.17	0.71±0.20	36.4±9.3	38.93±10.85	40.93±9.97	8.29±3.71
20 years	0.70±0.19	0.79±0.19	39.7±9.4	41.42±10.92	41.29±8.07	9.98±4.96
21 years	0.66±0.20	0.76±0.17	37.9±8.7	40.98±52	41.30±8.56	9.49±3.78
22 years	0.69 ± 0.2	0.74±0.14	37.5±7.6	37.45±10.28	38.5±10.62	9.65±2.72
Kruskal-Wallis test (H)	1.196 p=0.754	4.532 p=0.209	3.181 p=0.365	2.293 p=0.514	0.993 p=0.803	1.662 p=0.645

*Metacognitive awareness Inventory; **Academic Motivation Scale.

Table 5: Distribution of Scores of MAI* and AMS** subscales according to the gender of the students

Gender	Subscales scores of Metacognitive awareness Inventory		Total MAI Score	Subscale scores of Academic Motivation Scale		
	Knowledge	Regulation		Intrinsic	Extrinsic	Demotivation
Male	0.65±0.20	0.71±0.19	36.07±9.2	37.5±10.32	38.84±7.47	10.57±3.35
Female	0.71±0.18	0.81±0.15	40.4±8.0	42.9±10.35	42.56±9.68	8.64±4.51
Mann-whitney U test	U=1539 p=0.103	U=1254 p=0.002	U=1302 p=0.004	U=1264.5 p=0.002	U=1358.5 p=0.011	U=2461 p=0.002

*Metacognitive awareness Inventory; **Academic Motivation Scale.

Table 6: Spearman's correlation between metacognitive awareness, academic motivation, and academic performance

Variable	Knowledge	Regulation	Total MAI score	Intrinsic Motivation	Extrinsic Motivation	Academic Performance
Knowledge	-	0.740 p=0.000	0.899 p=0.000	0.406 p=0.000	0.271 p=0.002	0.173 p=0.06
Regulation	0.740 p=0.000	-	0.953 p=0.000	0.376 p=0.000	0.223 p=0.01	0.293 p=0.001
Total MAI score	0.899 p=0.000	0.953 p=0.000	-	0.408 p=0.000	0.263 p=0.003	0.26 p=0.004
Intrinsic Motivation	0.406 p=0.000	0.376 p=0.000	0.407 p=0.000	-	0.695 p=0.000	0.284 p=0.002
Extrinsic Motivation	0.270 p=0.002	0.223 p=0.01	0.263 p=0.003	0.695 p=0.000	-	-0.093 p=0.308
Academic performance	0.173 p=0.06	0.293 p=0.001	0.26 p=0.004	0.284 p=0.002	-0.093 p=0.308	-

As displayed in Table 6, academic performance was significantly correlated with metacognition regulation subscale scores (r=0.293, p=0.001) and intrinsic motivation scores (r=0.284, p=0.002). In addition, metacognition regulation was significantly correlated to intrinsic motivation scores (r=0.3764, p=0.00001) as well as extrinsic motivation scores (r=0.223, p=0.01). Intrinsic motivation scores correlated significantly with academic performance, metacognition knowledge subscale scores (r=0.406, p=0.00001), regulation scores, and with extrinsic motivation scores (r=0.695, p=0.00001). Academic performance did not correlate with knowledge subscale scores (r=0.173, p=0.06) and extrinsic motivation scores (r=-0.0930, p=0.308).

Discussions

The transformed curriculum demands students to be critical, creative thinkers and self-directed learners, along with competent doctors. Developing metacognitive skills and using the full potential of one's intelligence will help students attain this goal with ease. However, being a complex phenomenon, it is crucial to explore the role of metacognition in the academic success of the students; hence, this research was planned. In the current study, a statistically significant correlation was observed between three parameters, namely students' metacognition awareness, intrinsic motivation, and their academic performance.

Positive correlation between metacognition awareness and academic performance was also reported by Ullah, et al. (8) at Faisalabad, Pakistan. Another research at St. Vincents and Grenadines by Shah, et al. (1) also showed a significant correlation between metacognitive regulation and final scores of the physiology subject in 70 students. Moreover, they reported that metacognitive regulation strategies like information management, evaluation, debugging and declarative knowledge were significantly correlated with physiology scores. In the present study also, a significant correlation was observed between strategies like information management, planning, procedural strategies, and academic grades, which denotes that students who were poor in managing the cognitive load, planning for their academic goals and understanding the given task lagged behind the high performers who used them. Some other researchers also reported that met cognitively aware learners were better organizers and planners and perform better academically than unaware learners (2-5, 8-11).

A positive correlation between the level of academic performance and regulation of cognition, along with comprehension (part of the knowledge subscale), was reported by Shah, et al. (1) and Ullah, et al. (8). However, conditional knowledge of participants in these studies was not significantly different between high and low achievers. These findings were in coherence with those of the present study. This explains that mere knowledge of conditions that foster learning does not result in achieving good academic scores, but it is their awareness regarding their learning styles, resources, strategies, and planning for learning, evaluating their performance, and skillful use of the knowledge gained that leads to academic success. Also, non-academic reading habits increase comprehension skills of the students who can then better correlate and summarize. Reading books other than academics as a habit was present in only 8.6% of students in the present study.

Contradictory findings were reported by Shah, et al. (1) who observed that average performers had lower scores in the domains of planning and evaluation than low performers, indicating a complacent behavior of average achievers whose planning and evaluation were worse than low achievers. In the current study, a decreasing trend of scores from high to low scorers was evident, indicating that the average performers were better than low performers in planning and evaluation but were still lagging behind the high performers with better scores in planning and evaluation. Therefore, the factors that differentiated high performers from low and average performers were awareness of their abilities, comprehension skills, better planning, monitoring, information management strategies, and evaluation of learning rather than conditional and debugging strategies.

The interesting findings of the present study suggested that female students had better metacognitive awareness and regulation than the male students. However, no such difference was reported in the studies carried out by Misbah, et al. (5), Nguyen, et al. (2), Abdelrahman (10), and Özçakmak, et al. (12). However, Ullah, et al. (8) and Panchu, et al. (13) also found that the female students had higher mean metacognitive scores than male students. Research indicates that metacognitive awareness and regulation skills can be learnt and improved by consistent training (9, 14). Thus, making room for such training in the curriculum and teaching itself can improve learning and overall achievement of the students.

Regarding academic motivation, in the current study, it was observed that there was a significant positive correlation between intrinsic motivation, regulation of metacognition, and academic performance. Also, strikingly, high performers had high intrinsic motivation and low extrinsic motivation, whereas average performers and low performers had higher extrinsic than intrinsic motivation. Female students had significantly higher intrinsic and extrinsic motivation as compared to male students. Similar findings were quoted by Cadête Filho, et al. (3) who conducted a study on 147 medical students from two private institutes located in Belo Horizonte-MG. The predominance of intrinsic motivation in high performers is in coherence with the theory of Self-self-determination, which states that human beings are naturally inclined towards personal development, innovations, creativity, and challenges (11, 15, 16). Having intrinsic motivation fosters learning and healthy learning habits, which differentiates high achievers from low achievers even later on in life.

The predominance of extrinsic motivation observed in average and low performers is not harmful per se, but it indicates that they derive pleasure or satisfaction from extrinsic rewards and don't enjoy the process of learning itself. They also lack planning and other metacognition regulation strategies, which again diminishes the intrinsic motivation to learn. It becomes a vicious cycle for them. Lack of metacognition awareness and regulation reduces their interest in the curriculum as they are not able to cope with and understand the subject matter. This, in turn, reduces intrinsic motivation, and they then depend on extrinsic motivating factors for performing better academically. Therefore, low performance in academics can be attributed to lower metacognitive awareness and regulation and lower intrinsic motivation of the students. Similar findings were reported in many other studies (11). The study by Ramirez-Arellano (2024) explores the relationships between personality traits, motivation, academic engagement, and metacognitive-cognitive strategies using a model based on five core educational theories in 374 Mexican students in Biology and Industrial Management programs. They found that motivation influences emotional engagement and cognitive strategies (α=0.98, Composite Reliability=0.98, and Average Variance Extracted=0.93) for both (17). The students who lack metacognitive skills also lack the habit of deriving pleasure or satisfaction from the learning that happens in the classroom, and if they are trained in this regard, an effort can be made to increase their liking towards learning which can then have a compounding effect on their learning outcomes and enhance their academic performance in the medical field. The study integrates two crucial cognitive aspects—metacognitive awareness and academic motivation—offering a more holistic understanding of the factors influencing academic performance among medical undergraduates, but in a cross-sectional study, the causal relationships between these cognitive factors and academic performance cannot be established. Secondly, the study used a convenience sampling method, and even though we used validated tools, the responses may be context-specific, subjective, and influenced by institutional and cultural factors. This limits the generalizability of the results to different medical education settings. Future research should consider longitudinal designs, multi-institutional samples, and additional cognitive and environmental factors to provide a more comprehensive understanding of the relationship between metacognition, motivation, and academic success in medical students.

Conclusions

This research acknowledges that metacognitive awareness is influenced by multiple factors. There is a difference between high and low performers as to how they process, apply, and regulate the information. Low-performing students lack knowledge of strategies to improve their metacognition and, hence, lag behind in academics. The difference was prominent in the areas of planning, comprehension, implementation or information management, evaluation of achievements, and resetting of goals and procedures. High performers had high intrinsic motivation, but low performers had high extrinsic motivation. Female students had better metacognition awareness and regulation; also, they had high intrinsic as well as extrinsic motivation as compared to male students. Age did not affect metacognition and motivation in any way. Positive, statistically significant correlation between higher metacognition awareness, academic motivation, and better academic performance of students indicate that if metacognitive awareness increases, academic performance can be improved and students can also experience heightened motivation; this also suggests that if teachers focus on teaching metacognitive regulation strategies along with subject matter, academic performance of students can be improved along with their motivation to study. The findings from this study will contribute to the development of evidence-based interventions designed to improve learning strategies and positively affect medical education outcomes.

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Conflict of interest

The authors declare that they have no conflicts of interest.

Authors' Contribution

ND, AB, HMA and ShJ participated as research concept, article editing and final approval; ND, AB and HMA participated as research design; ND, AB participated as supervision, materials, data collection; ND, AB participated as materials; ND, AB, HMA and ShJ participated as data analysis and Interpretation; ND, AB, HMA participated as literature search; ND, AB and ShJ participated as writing article; HMA and ShJ participated as critical review.

References

1. Shah DK, Modna Y. The Impact of Medical Students' Metacognitive Awareness Level on Their Academic Performance. International Journal of Research in Medical Sciences. 2022;10(11):2363–70.
2. Nguyen KX, Tran TV, Nghiem TD, Tran TN, Ta TB, Nguyen BV, et al. Relationship Between Metacognitive Awareness of Undergraduate Students and Students' Academic Performance at Vietnam Military Medical University. Adv Med Educ Pract. 2023;14:791–801.
3. Cadête Filho AdA, Peixoto JM, Moura EP. Medical students' academic motivation: An analysis from the perspective of the Theory of Self-Determination. Rev Bras Educ Med. 2021;45(2):e086.
4. Lozano-Lozano M, Fernández-Lao C, Cantarero-Villanueva I, Noguerol I, Álvarez-Salvago F, Cruz-Fernández M, et al. A Blended Learning System to Improve Motivation, Mood State, and Satisfaction in Undergraduate Students: Randomized Controlled Trial. J Med Internet Res. 2020;22(5):e17101.
5. Misbah S, Mashhadi SF, Urooj M, Parveen M, Aslam MS, Bilal MH, et al. Metacognitive Skills and Academic Performance among Medical Students--An Analytical Cross Sectional Survey. Pak Armed Forces Med J. 2022;72(Suppl-4):S713-8.
6. Omprakash A, Kumar AP, Kuppusamy M, Sathiyasekaran BWC, Ravinder T, Ramaswamy P. Validation of Metacognitive Awareness Inventory from a Private Medical University in India. J Educ Health Promot. 2021;10:324.
7. Souza GC, Meireles E, Mira VL, Leite MMJ. Academic motivation scale - reliability and validity evidence among undergraduate nursing students. Rev Lat Am Enfermagem. 2021;29:e3420.
8. Ullah S, Ullah S, Parvez K, Sheikh GA. Assessment of medical students' metacognitive awareness of reading strategies and its relation with academic performance: a cross sectional study at Aziz Fatima Medical and Dental college, Faisalabad. J Univ Med Dent Coll. 2020;11(3):1-8.
9. Medina MS, Castleberry AN, Persky AM. Strategies for Improving Learner Metacognition in Health Professional Education. Am J Pharm Educ. 2017;81(4):78.
10. Abdelrahman RM. Metacognitive awareness and academic motivation and their impact on academic achievement of Ajman University students. Heliyon.2020;6(9):e4192.
11. Deci EL, Ryan RM. The general causality orientations scale: self-determination in personality. J Res Pers. 1985;19(2):109-34.
12. Özçakmak H, Köroğlu M, Korkmaz C, Bolat Y. The effect of metacognitive awareness on academic success. African Educational Research Journal. 2021;9(2):434-48.
13. Panchu P, Bahuleyan B, Seethalakshmi K, Thomas T. Metacognitive awareness- evaluation and implications in medical students. Int J Res Med Sci. 2016;4(8):3570-5.
14. Akbarilakeh M, Sharifi-Fard T. The relationship between metacognitive awareness and academic success of medical students at Shahid Beheshti University of Medical Sciences. Journal of Medical Education and Development. 2021;16(3):199-206.
15. Wu H, Li S, Zheng J, Guo J. Medical students' motivation and academic performance: the mediating roles of self-efficacy and learning engagement. Med Educ Online. 2020;25(1):1742964.
16. Kunanitthaworn N, Wongpakaran T, Wongpakaran N, Paiboonsithiwong S, Songtrijuck N, Kuntawong P, et al. Factors associated with motivation in medical education: a path analysis. BMC Med Educ. 2018;18:140.
17. Ramirez-Arellano A. Effects of personality and motivation on students' academic engagement and metacognitive-cognitive strategies. Sage Open. 2024;14(4):1-15.