Demographic and Academic Characteristics of First-Year Medical Students with Low Academic Performance Across Face-to-Face, Online, and HyFlex Learning: A Seven-Year Single-Center Study

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Abstract

Introduction Medical student attrition and poor academic performance have implications for both medical schools and the future healthcare workforce. This study aimed to determine the demographic and academic characteristics of first-year medical students with low academic performance across different instructional modalities—traditional face-to-face, online, and HyFlex learning.

Methods This non-concurrent cohort study included first-year medical students enrolled from School Years (SY) 2018–2019 to 2024–2025. Student characteristics analyzed included sex, pre-medicine degree, pre-medicine general weighted average (GWA), National Medical Admission Test (NMAT) score, and academic performance in annual first-year subjects. Low academic performance was defined as failure in at least one annual subject. Students were grouped according to instructional modality: face-to-face (SY 2018–2020), online (SY 2020–2022), and HyFlex (SY 2022–2025). Demographic and academic characteristics were compared between students with and without low academic performance.

Results A total of 2,936 first-year medical students were included. The proportion of students with low academic performance was 19% during the face-to-face period, 17% during the online period, and 27% during the HyFlex period. Across all instructional modalities, students with low academic performance had significantly poorer pre-medicine GWA than students who passed all annual subjects ($p<0.05$). During the online and HyFlex periods, students with low academic performance also had significantly lower NMAT scores than students who passed all annual subjects ($p<0.05$), whereas no significant difference in NMAT scores was observed during the face-to-face period.

Conclusion Pre-medicine GWA was consistently associated with academic performance across face-to-face, online, and HyFlex instructional modalities. Lower NMAT scores were associated with low academic performance during online and HyFlex learning. Early identification of students with poorer pre-medicine academic performance and lower NMAT scores may facilitate timely academic support.

Key words: Medical students, academic performance, National Medical Admission Test (NMAT), Grade point average (GWA), online learning , HyFlex learning

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The increase in demand for medical education has sparked interest in identifying factors associated with academic success among medical students, particularly during the first year of undergraduate medical education. In this connection, traditional criteria for admission may have to be revisited as teaching and assessment modalities have evolved over time. From traditional classroom-based teaching, it was the global pandemic caused by COVID-19 that forced educators to re-think their teaching-learning activities to ensure continuity of formal learning in educational institutions. Delivering content and performing student assessment online provided a viable alternative to ensure the health and safety of teachers and students alike.[1] While technology supported the rapid adaptation of educational institutions to shift to online methods of teaching and assessment, new challenges arose in undergraduate medical institutions.[2,3]

These newly identified challenges remain to be explored in detail even as the lived in lived experience of teachers and students alike with online teaching and assessment have been described.[4] The improved health situation brought by population-wide anti-COVID-19 vaccinations and developments in technology facilitated the adoption of HyFlex teaching strategies. A hybrid flexible (HyFlex) teaching model refers to an instructional approach that combines face-to-face instruction with online synchronous or asynchronous content delivery.[5-7] In the HyFlex model, teaching-learning activities are conducted either face-to-face or online, thus providing multiple ways to deliver content and interact with students. Consequently, medical students in recent years have experienced three distinct instructional modalities: traditional face-to-face learning, fully online learning, and HyFlex (blended) learning.

There have been several studies on the effectiveness of various instructional modalities, including traditional face-to-face, online, and HyFlex learning.[8] However, findings remain inconsistent regarding the relationship between student characteristics, admission credentials, and academic performance across different learning environments. Some studies have reported no significant differences in learning outcomes between face-to-face and online instruction in undergraduate medical courses such as anatomy and physiology.[3,9-10]

Medical student attrition and poor academic performance have implications not only for individual learners but also for the healthcare workforce. The Philippines continues to face a substantial shortage of physicians, with estimates suggesting a national deficit of approximately 73,687 medical doctors.[11] Consequently, identifying admission and demographic factors associated with academic success and early academic difficulties may help medical schools develop strategies to support at-risk students and contribute to the training of future physicians.

To date, there is a paucity of local studies examining whether traditional admission criteria remain associated with academic performance across changing instructional modalities, including traditional face-to-face, fully online, and HyFlex learning environments. Accordingly, this study aimed to determine the demographic and academic profile of Year 1 medical students with low academic performance across different instructional modalities—traditional face-to-face, online, and HyFlex (blended) learning—during School Years 2018–2019 to 2024–2025. Specifically, it sought to describe students according to sex, pre-medicine course, pre-medicine general weighted average (GWA), and National Medical Admission Test (NMAT) score, and to compare the academic performance of students with low academic performance and those who successfully passed the annual first-year medical subjects within each instructional modality.

Methods

This is a non-concurrent cohort study. The University's Research Ethics Committee approved the study.

The demographic profile of students was obtained as to sex, undergraduate course (science/health science vs. non-science/non-health science), general weighted average (GWA) in the pre-medicine course, score in the National Medical Admission Test (NMAT), and the final grades of first-year medical students in the three annual subjects, namely Anatomy, Physiology, and Biochemistry, for seven school years (SY 2018–2019 to SY 2024–2025).

Student characteristics were compared between students with low academic performance and those who passed all three annual subjects across three instructional modalities: traditional face-to-face

instruction, fully online instruction, and HyFlex (blended) instruction.

Continuous variables were summarized using means and standard deviations and compared using one-way analysis of variance (ANOVA). Categorical variables were summarized using frequencies and percentages and compared using the chi-square test. Statistical significance was set at $p < 0.05$.

Low academic performance was operationally defined as failure in at least one annual subject (final grade <75%). Student characteristics were compared between students with low academic performance and those who passed all annual subjects.

The study period encompassed several changes in instructional delivery and assessment methods resulting from the COVID-19 pandemic and the subsequent transition to blended learning. Teaching and assessment modalities for each school year are summarized in Table 1.

Based on these modalities, students were exposed to three major learning environments: traditional face-to-face instruction (SY 2018–2019 and SY 2019–2020), fully online instruction (SY 2020–2021 and SY 2021–2022), and HyFlex/blended instruction (SY 2022–2023 to SY 2024–2025).

During SY 2022–2023, Anatomy, Physiology, and Biochemistry employed a blended approach consisting of face-to-face and online (synchronous and asynchronous) instruction, with both online and face-to-face assessments. In contrast, Preventive Medicine, Humanities, and Patient-Doctor Relationship (PDR) were delivered fully online (synchronous and asynchronous), with assessments conducted online using visual proctoring.

Results

A total of 2,936 first-year medical students were included in the study, comprising 882 students during the face-to-face period, 560 during the online period, and 1,494 during the HyFlex period. The proportion of students who passed all annual subjects was highest during the online period (83%), followed by the face-to-face period (81%) and the HyFlex period (73%). Correspondingly, the proportion of students with low academic performance was lowest during the online period (17%) and highest during the HyFlex period (27%).

Mean NMAT scores decreased across instructional modalities, from 88 ± 7 during the face-to-face period to 85 ± 10 during the online period and 83 ± 8 during the HyFlex period. Mean pre-medicine GWA was 1.88 ± 0.26 during the face-to-face period, 1.93 ± 0.26 during the online period, and 1.63 ± 0.25 during the HyFlex period. Female students constituted the majority of the study population across all instructional modalities, accounting for 63% to 69% of students. Likewise, most students had science-related pre-medicine degrees, comprising 83%, 86%, and 96% of students during the face-to-face, online, and HyFlex periods, respectively (Table 2).

During the face-to-face instructional period, NMAT scores did not differ significantly between students who passed all annual subjects and those with low academic performance (89 ± 7 vs. 88 ± 7, $p > 0.05$). However, students with low academic performance had significantly poorer pre-medicine GWA than students who passed all annual subjects (2.06 ± 0.25 vs. 1.82 ± 0.26, $p < 0.05$).

During the online instructional period, students who passed all annual subjects had significantly higher NMAT scores (87 ± 10 vs. 80 ± 7, $p < 0.05$) and better pre-medicine GWA (1.81 ± 0.26 vs. 2.06 ± 0.23, $p < 0.05$) than students with low academic performance. Similar findings were observed during the HyFlex instructional period, wherein students who passed all annual subjects had significantly higher NMAT scores (84 ± 8 vs. 80 ± 7, $p < 0.05$) and better pre-medicine GWA (1.59 ± 0.24 vs. 1.70 ± 0.23, $p < 0.05$) than students with low academic performance.

Across all instructional modalities, students with low academic performance consistently demonstrated

Table 1. Teaching and assessment modalities by school year.

School Year(s)	Teaching Method	Assessment Method
2018–2019	Face-to-face	Face-to-face
2019–2020	Face-to-face → Online (mid-semester transition)	Face-to-face → Online (without visual proctoring)
2020–2022	Online (synchronous and asynchronous)	Online with visual proctoring
2022–2025	HyFlex/Blended (face-to-face and online)	Face-to-face and online

Table 2. Demographic and academic characteristics of first-year medical students by instructional modality.

Characteristic	F2F (2018–2020)	Online (2020–2022)	Hyflex (2022–2025)
Number of students	N=882	N=560	N=1494
Passed, n (%)	713 (81%)	465 (83%)	1096 (73%)
Failed, n (%)	159 (19%)	95 (17%)	398 (27%)
NMAT score, mean ± SD	88 ±7	85 ± 10	83 ± 8
GWA, mean ± SD	1.88 ± .26	1.93 ± .26	1.63 ± .25
Male, n (%)	321 (36%)	205 (37%)	464 (31%)
Female, n (%)	561 (64%)	355 (63%)	1030 (69%)
Science pre-med degree, n (%)	818 (83%)	484 (86%)	1435 (96%)
Non-science pre-med degree, n (%)	64 (17%)	76 (14%)	59 (4%)

F2F = face-to-face instruction; Online = fully online instruction; Hyflex = blended face-to-face and online instruction

Table 3. Comparison of demographic and academic characteristics between students with and without low academic performance according to instructional modality.

Variable	Face-to-Face (2018–2020)			Online (2020–2022)			Hyflex (2022–2025)		
	Passed	Failed	p-value	Passed	Failed	p-value	Passed	Failed	p-value
NMAT score (mean ± SD)	89 ± 7	88 ± 7	>0.05	87 ± 10	80 ± 7	<0.05	84 ± 8	80 ± 7	<0.05
GWA (mean ± SD)	1.82 ± 0.26	2.06 ± 0.25	<0.05	1.81 ± 0.26	2.06 ± 0.23	<0.05	1.59 ± 0.24	1.70 ± 0.23	<0.05
Male, n (%)	261 (81%)	56 (19%)	<0.05	173 (84%)	32 (16%)	<0.05	356 (77%)	108 (23%)	<0.05
Female, n (%)	452 (81%)	109 (19%)	<0.05	260 (73%)	95 (27%)	<0.05	740 (72%)	290 (28%)	<0.05
Science pre-med degree, n (%)	668 (82%)	150 (18%)	<0.05	399 (82%)	85 (18%)	<0.05	1059 (74%)	376 (26%)	<0.05
Non-science pre-med degree, n (%)	45 (83%)	19 (17%)	<0.05	66 (87%)	10 (13%)	<0.05	37 (63%)	22 (37%)	<0.05

poorer pre-medicine GWA than students who passed all annual subjects. In contrast, lower NMAT scores were associated with low academic performance only during the online and HyFlex instructional periods. Although differences in the distribution of sex and pre-medicine degree background were observed between groups, these findings should be interpreted cautiously because female students and those with science-related pre-medicine degrees constituted the majority of the overall study population (Table 3).

Discussion

This study examined the demographic and academic characteristics of first-year medical students with low academic performance across three instructional modalities: traditional face-to-face, fully online, and HyFlex learning. The findings demonstrated that pre-medicine academic performance, as measured by GWA, was consistently associated with academic performance in Year 1 regardless of instructional modality. In contrast, NMAT scores significantly differentiated students with and without low academic performance during the online and HyFlex periods, suggesting that the predictive value of admission criteria may vary across learning environments.

Medical student attrition and poor academic performance remain important concerns because they affect not only individual students but also the future healthcare workforce. A study among Year 1 Malaysian medical students reported that academic failure contributes substantially to attrition, with an average attrition rate of 11.1% among 40 medical schools worldwide, ranging from 2.4% to 26.2%.[12] In the present study, the proportion of students with low academic performance averaged 21%, ranging from 3% to 36% across the study period. Although the lowest proportion was observed during SY 2019–2020, this finding should be interpreted cautiously because of the unusual educational circumstances brought about by the abrupt transition to online learning during the COVID-19 pandemic.

Previous studies have emphasized the importance of prior academic achievement as a predictor of

success in medical school. An Australian study found that students with lower pre-admission academic performance tended to remain low performers during medical training, although prior academic achievement accounted for only 23% of the variance in undergraduate medical performance.[13] Similarly, present study findings demonstrated that students with low academic performance consistently had poorer pre-medicine GWA than students who successfully passed all annual subjects. This association was observed across face-to-face, online, and HyFlex instructional modalities, suggesting that prior academic achievement remains a robust predictor of early medical school performance despite changes in teaching and assessment strategies.

The predictive value of admission examinations has been widely investigated. A study from Pakistan reported that the University Admission Index (UAI) was the strongest predictor of academic outcomes, whereas the communication dimension of the interview demonstrated modest predictive value for clinically oriented outcomes.[14] Likewise, a study from Chiang Mai University, Thailand found that previous academic performance and female sex were independent predictors of academic success, while interview scores demonstrated predictive value in the later years of training, particularly in clinically-based courses.[16] These findings support the continued use of multiple admission criteria rather than reliance on a single selection tool.

The role of admission test scores in predicting academic performance remains controversial. A study conducted in Karachi, Pakistan reported that higher admission test scores predicted undergraduate medical school achievement.[17] Similarly, a study from Saudi Arabia found that national achievement examination scores significantly predicted preclinical academic performance, although they were less effective in predicting functional knowledge and progress test outcomes.[18] In the present study, students with low academic performance generally had lower NMAT scores than students who passed all annual subjects, particularly during the online and HyFlex instructional periods. Interestingly, significant differences in NMAT scores were not consistently observed during the face-to-face years. These findings suggest that NMAT performance may be more strongly associated with academic outcomes in learning environments that require greater self-directed learning, adaptability, and independent study skills.

Several studies have also examined the combined predictive value of prior academic performance and admission test scores. Two studies from the University of Western Australia demonstrated that both undergraduate GPA and Graduate Medical School Admissions Test (GAMSAT) scores predicted academic performance throughout medical training.[19,20] Similarly, a separate Australian study reported that combining prior academic achievement with structured interviews assessing communication skills improved the selection of students likely to succeed in medical school.[21] In the authors' institution, admission decisions likewise consider pre-medicine GWA, NMAT scores, and interview performance. The present findings support the continued importance of prior academic achievement in the admissions process while suggesting that NMAT scores may provide additional information regarding academic risk under certain instructional conditions.

The interpretation of sex and pre-medicine degree as predictors of academic performance warrants caution. Although a greater number of students with low academic performance were female and had science-related pre-medicine degrees, females and science-degree graduates also constituted the majority of the overall student population throughout the study period. Consequently, these characteristics cannot be considered independent predictors of low academic performance based on the present analyses alone. Additional studies using multivariable analyses are needed to determine whether these factors remain significant after adjustment for academic and demographic variables.

The findings of this study have important implications for student support. Early identification of students at risk for academic difficulty may allow timely intervention before academic problems become severe. One promising strategy is peer-assisted learning (PAL), a widely used educational approach in which students learn from and teach one another. According to Topping, PAL involves individuals from similar social groups helping each other learn while simultaneously reinforcing their own learning.[23] Studies have demonstrated benefits for both academically challenged students and peer tutors, including improvements in academic performance, confidence, communication skills, teaching abilities, and professional development.[24,25] Given the increasing diversity of instructional

modalities in medical education, PAL may represent a practical and sustainable intervention for supporting students who experience academic difficulties.

The present study contributes local evidence regarding the relationship between admission characteristics and academic performance across face-to-face, online, and HyFlex learning environments. As medical education continues to evolve, further studies are needed to examine additional predictors of success, including resilience, learning strategies, motivation, communication skills, and other non-cognitive factors, as well as their influence on academic and clinical performance in the later years of medical training.

Conclusion and Recommendation

Students with low academic performance in Year 1 consistently demonstrated poorer pre-medicine academic performance than students who successfully passed all annual subjects. Lower NMAT scores were likewise observed among students with low academic performance, particularly during the online and HyFlex instructional periods. These findings suggest that pre-medicine GWA remains a stable predictor of academic performance across different instructional modalities, while NMAT scores may provide additional information regarding academic risk in online and blended learning environments.

While NMAT scores and pre-medicine GWA may be useful in identifying students at risk for academic difficulty, admission decisions should continue to consider multiple cognitive and non-cognitive factors. The interview component of the admissions process may be revisited to further evaluate communication, metacognitive, and meta-affective skills, which are important attributes for patient-centered care and success during the clinical years.[26]

Early identification of students with lower NMAT scores and poorer pre-medicine academic performance may facilitate timely academic support. Based on evidence from previous studies, peer-assisted learning (PAL) may be considered as a potential intervention strategy for students identified to be at risk for poor academic performance. Future studies should evaluate the effectiveness of PAL and other academic support programs in improving academic outcomes among medical students.

Limitations

This study has several limitations. First, it was conducted in a single medical school, which may limit the generalizability of the findings to other institutions with different admission policies, student populations, and curricular structures. Second, the retrospective and observational nature of the study limits the ability to establish causal relationships between admission characteristics and academic performance. Third, the study focused primarily on selected demographic and academic variables and did not evaluate other factors that may influence student performance, such as socioeconomic status, learning strategies, motivation, resilience, mental health, study habits, and other non-cognitive characteristics. Finally, the analyses did not control for potential confounding variables; therefore, the observed associations should not be interpreted as independent predictors of academic performance. Future studies involving multiple institutions and multivariable analyses are recommended to further clarify the factors associated with academic success in medical education across different instructional modalities.

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Conflict of Interest

Jennifer M. Nailes serves as Editor-in-Chief of the UERMMMCI Health Sciences Journal and is a co-author of this manuscript. She had no involvement in the editorial handling, peer review, or publication decision for this article. Editorial responsibility for this manuscript was delegated to an independent editor.

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