Early Student Attrition from Medical Schools: A Scoping Review

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Abstract

Purpose: The number of medical school applicants far exceeds the number of available positions, leading to intense competition. Despite previous academic success and high scores, some students find it difficult to cope with course demands and drop out. This scoping review aims to address potential gaps in the literature on early student attrition from medical schools, including the influence of the admission process and curricula.

Methods: A comprehensive literature search was conducted to identify relevant articles published in English-language, peer-reviewed journals. The search was scanned from inception to January 2021 using online databases PubMed, Scopus, and ERIC. Covidence software was used for article screening and selection. Additional studies were identified via the reference lists of included articles and by scanning titles and abstracts from high-profile medical education journals.

Results: The search resulted in 426 titles, of which 60 articles met our eligibility criteria. Student attrition in the early years of medical school is primarily due to academic failure resulting from cognitive factors such as insufficient basic knowledge or learning capacity. However, potential non-cognitive factors such as personal values and challenges, psychological traits, and the effect of specific curricula have not been sufficiently explored.

Conclusion: Medical educators must understand the reasons for attrition among medical students to enhance the overall learning experience and retain promising students. Results varied among studies due to differences in student populations, admission criteria, assessment methods, and educational approaches across institutions. Cognitive factors are mainly responsible for early dropouts in medical schools. Future research should investigate non-cognitive factors and their impact on student attrition from medical schools.

Keywords: Attrition, Medical education, Medical school, Students, Undergraduate

1. Introduction

Admission to medical school is highly competitive and is based largely on previous academic performance. The number of applicants usually far exceeds the number of available positions. The highest-performing students on academic and college admission tests (s) are eventually admitted [1]. While most applicants are motivated by a desire to care for the ill, some may be motivated by family pressures, financial considerations, and the desire to achieve higher social status and respect [2]. However, following admission to medical school, some students struggle academically and are unable to cope with the physical and mental requirements of this field. These difficulties may include misconceptions about medicine as a career, improper selection by the admissions committee, and learning problems related to the curriculum.

Despite the effort and time spent by admission committees in selecting the best candidates from a large number of talented applicants, some promising students will eventually drop out. It is difficult to identify the factors predicting student attrition due to the marked differences in selection processes, curricula, and student academic backgrounds across

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institutions and nations [3]. Most studies on student attrition focus on the predictive validity of various entry qualifications and related attributes of the students. These studies have been performed in different communities with different admission requirements [3,4]. In a systematic critical literature review of medical education, the attrition rate varied widely, with an average of 9.1% (2.7%−20.1%) [5].

Different terms have been used to describe attrition, including withdrawal, expulsion, dismissal, academic failure, and dropout. However, these terms do not precisely define the causes of attrition. For example, attrition may be caused by the curriculum at a specific medical school which is different from voluntary withdrawal due to social issues or dismissal for improper behavior [6,7]. Moreover, students may reconsider their decision to join medical school and voluntarily withdraw, especially in their early years [8]. Educational interventions by the medical school can help improve the academic performance of students who may leave due to academic difficulties. Therefore, this scoping review aims to identify gaps in the literature regarding the factors influencing early student attrition from medical schools including the potential impacts of the admission process and curriculum design.

2. Methods

2.1. Overview

A comprehensive literature search was conducted in January 2021 for English-language articles published in peer-reviewed journals on early medical school attrition using three online databases (PubMed, Scopus, and ERIC). Table 1 presents the inclusion and exclusion criteria used for selecting the reviewed articles. The literature search focused on identifying factors in the admissions process that influence attrition in the early years of medical school.

2.2. PubMed search

The PubMed search was performed for articles published in English from 1971 to 2021 using the following MeSH key words: "Schools, Medical" [MeSH], "medical school*" [Title/Abstract]) and "Student Dropouts" [MeSH], "College Admission Test" [MeSH], "Student Dropouts" [Title/Abstract], "College Admission Test" [Title/Abstract]) and ("Education, Medical, Undergraduate" [MeSH], or "medical undergraduate*" [Title/Abstract]). The search terms were selected from MeSH terms related to this study. The MeSH term "Student Dropouts" covered attrition and withdrawal terms while "College Admission Test" covered the student selection process. The search was limited to the title and abstract fields (when available) and yielded 189 articles.

2.3. Scopus search

Scopus was searched from inception in 2004−2021 using a filter for English, and all keywords were combined with "title," "abstract," and "keywords." The final search string was as follows: ((TITLE-ABS-KEY ("medical school*") and TITLE-ABS-KEY ("student dropout*") or ("college admission test*") and TITLE-ABS-KEY ("medical undergraduate*")) and (LIMIT-TO (LANGUAGE, "English")). A total of 174 articles were retrieved.

2.4. ERIC search

ERIC was searched from database inception in 1966−2021. Likewise, a filter for English was applied and all keywords were searched in combination with "title", "abstract", and "Thesaurus (DE)" (when available). The search string included (AB "medical school*" or TI "medical school*" or DE "Medical Schools") and (AB "student dropout*" or TI "student dropout*" or DE "Dropouts" or AB "college admission test*" or TI "college admission test*" or DE

Table 1. Inclusion and exclusion criteria used for selecting the reviewed articles.

Criterion	Inclusion criteria	Exclusion criteria
Language	English	Non-English
Type of Article	Peer-reviewed, including nonelectronic articles	Non-peer-reviewed, webinars, or conference presentations
Type of Study	1. Quantitative 2. Qualitative 3. Reviews (e.g., meta-analyses and systematic reviews)	
Study Focus	Attrition rate and reasons for early attrition in medical school	Articles not related to the study focus
Population	Undergraduate medical students	Other non-medical students, including other professions (e.g., pharmacy, nursing, and veterinary medicine)

"College Entrance Examinations") and (AB "medical undergraduate*" or TI "medical undergraduate*" or DE "Medical Students"). The search yielded 63 articles.

3. Results

A total of 426 titles with accessible abstracts were identified and reviewed. The titles and abstracts were screened for duplicates and irrelevance with Covidence software. A total of 147 duplicate and 192 ineligible abstracts were subsequently excluded, while 87 met the inclusion criteria. Full articles were then retrieved from the Library of the College of Medicine and Health Sciences (CMHS) and online resources from the Dundee Library. Of the 87 articles initially selected, 50 were excluded as unrelated to the aims of this study. However, an additional 23 articles were identified from the reference lists of the selected articles and by manually searching high-profile medical teaching journals. Ultimately, 60 articles were included in the literature review (Fig. 1).

4. Discussion

Student attrition can have substantial negative impacts on the reputation of the medical school, the medical profession, society's well-being, and the students themselves [7]. The admission process is a challenging task because many cognitive and noncognitive factors influence the selection of candidates. A careful review of each component of the admission process and the interrelationships among them is essential for improving the selection process and improving student retention rates [9]. The admission process must be credible, fair, and transparent [10]. To this end, the selection process should consider multiple criteria, including performance in admission examinations, admission committee opinions, and the selected applicants' demographics [9]. Understanding the effects of different admission tools on student selection and that of the curriculum on student attrition is essential to reducing early attrition and conserving medical school resources.
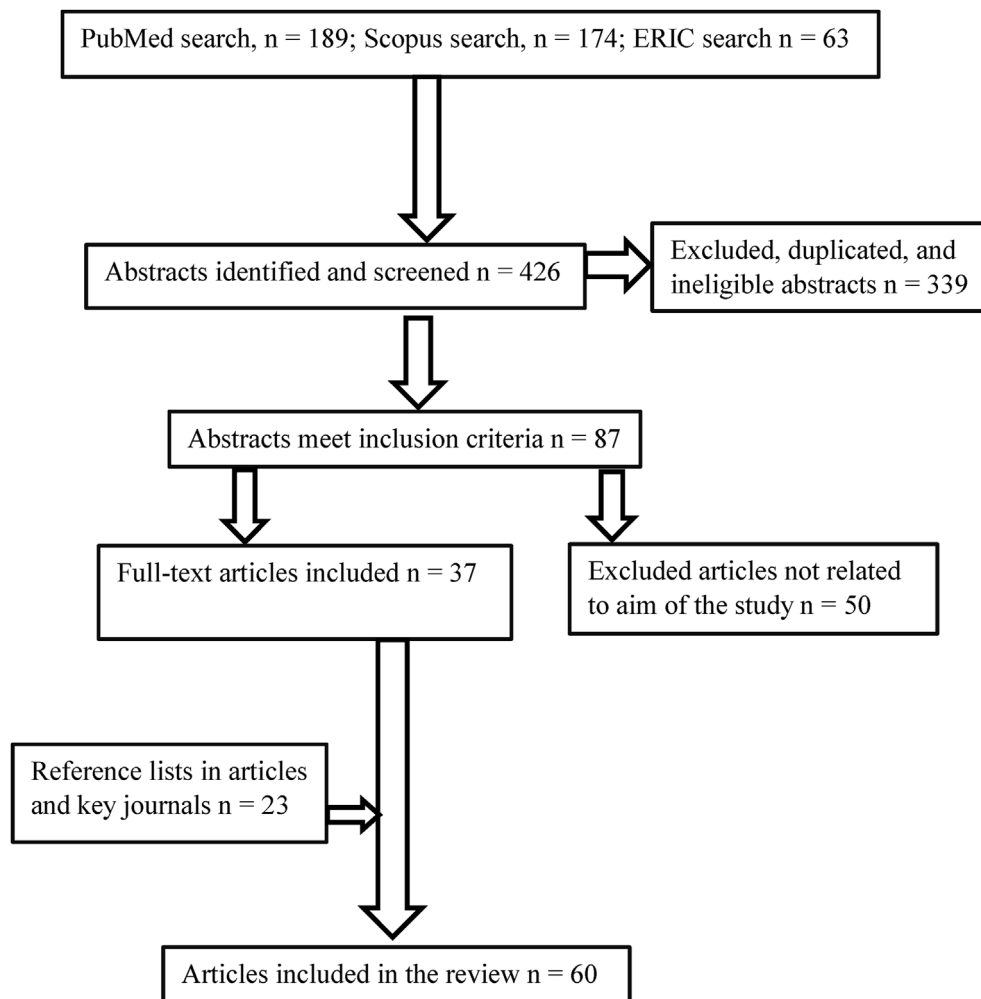
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┌─────────────────────────────────────────────────────────────────┐
│ PubMed search, n = 189; Scopus search, n = 174; ERIC search n = 63 │
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│ Abstracts identified and screened │ ───> │ Excluded, duplicated, and │
│ n = 426                           │      │ ineligible abstracts n = 339 │
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│ Abstracts meet inclusion criteria │
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│ Full-text articles    │   │ Excluded articles not related │
│ included n = 37       │   │ to aim of the study n = 50 │
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│ Reference lists in    │
│ articles and key      │
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│ Articles included in the review n = 60 │
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Fig. 1. Flow chart of search strategy and outcomes.

4.1. Admission examinations

Admission examination results can help predict the students likely to struggle and drop out [11]. The cognitive components of admission examinations can influence student learning processes, ranging from low-level memorization to higher-level understanding, application, and analysis [12,13]. Noncognitive components, such as compassion, flexibility, motivation to study medicine, integrity, and responsibility, are associated with the student's personal traits and their susceptibility to psychological issues [14,15]. The presence of psychological issues may lead to students dropping out of school. Some studies have indicated that psychological disorders are more common in later years and may not be easily noticeable during the earlier years [16,17]. Another study suggested that the prevalence of psychological problems is probably higher than what has been officially documented [17]. Generally, cognitive components are considered a better predictor of academic success [12,13]. According to a systematic critical literature review, lower entry examination performance was the only consistent predictor for dropping out [5]. Other cognitive variables that may predict academic success include pre-university grade point average (GPA), and performance on written admission and English language examinations. In contrast, the non-cognitive variables are evaluated through personal interviews (traditional and multiple mini-interviews), emotional intelligence tests, and the applicants' personal profiles.

4.2. Pre-university grade point average

Pre-university GPA measures students' basic academic skills. Admission to medical school has primarily depended on selecting students with the highest pre-university GPAs across the world. In many countries, admission is granted if the student's pre-university GPA was ranked above a certain level or if the student's GPA was among the highest scores in the applicant pool. Several studies have demonstrated a strong association between high school grades and subsequent academic success [18,19]. A study from the Netherlands found that pre-university GPA was related to study success, job development, and scientific performance, however, the GPA alone had no effect on the attrition rate [20]. In contrast, another study reported that the relative risk of attrition was 2.6 times higher for students admitted with lower GPAs compared to those with higher GPAs [21].

4.3. Written medical school admission examinations

Written admission examinations such as the United Kingdom Clinical Aptitude Test in the UK, the Undergraduate Medicine and Health Sciences Admission Test in Australia, and the Medical College Admission Test (MCAT) in the US are used to determine general knowledge and academic ability [22−24]. These examinations include problem-solving, critical reasoning, and knowledge of scientific concepts and principles. Students' scores on these examinations are then used in combination with other tools during the selection process [3]. Studies with very large student populations have revealed a strong association between written examination results, such as the MCAT, and academic success [18,23,25,26].

A prospective cohort study in Denmark revealed that students admitted based on admission examinations were at lower risk of attrition within the first two years, compared with students admitted solely based on a high pre-university GPA [5]. The authors concluded that GPAs are broad measures of basic academic skills, and for students ranked above the fair−good level, pre-university GPAs would not influence academic success. Moreover, Austria used to employ open admission to medical school, with anyone who successfully completed secondary school entitled to admission. However, half the students withdrew before graduation. The introduction of admission examinations to the selection process significantly decreased the probability of attrition [27].

4.4. Language examinations

Language examinations are essential at many international medical schools. Students who are studying medicine in English must have adequate language competency to fulfill study goals and assignments. Students for whom English is a second language may be at a disadvantage when studying and writing examinations in a non-native language. The most accepted tests for English competency assessment are the International English Language Testing System (IELTS) and Test of English as a Foreign Language (TOEFL) [28,29]. Both exams are internationally recognized by many medical colleges. Studies have shown that language proficiency greatly influences academic performance among non-native English-speaking students [30,31]. In Saudi Arabia, for example, TOEFL and MCAT scores are statistically significant predictors of student performance [32].

4.5. Personal interviews

Personal interviews are widely used to assess applicants' interpersonal skills, which are important for future physicians [33]. There are two main types of interviews used for medical school selection: traditional and multiple mini-interviews (MMIs). Traditional interviews generally involve two or more assessors interviewing one applicant. They may be provided with a list of questions but are free to ask other questions. The questions tend to be related to the applicants' social background, experiences, achievements, and motivations [34]. However, traditional interviews lack a clearly defined scoring rubric, which challenges their reliability and validity [35]. In contrast, MMIs can rapidly and repeatedly assess noncognitive variables to provide a precise measurement of the student's skills in specific areas such as communication, critical thinking skills, and ethical reasoning [36]. MMIs can rate multiple qualities relevant to a medical career with acceptable reliability and validity [37]. In a typical structured MMI, applicants alternate through several stations and reply to standardized questions in different scenarios. Each station has an examiner who assesses the candidate's responses according to a standardized scoring descriptor [38,39]. The assessors receive general training about the MMI examination, the rationale for its use, and the logistics for running the stations. Candidates are oriented to the process as well.

Compared to traditional interviews, MMIs are more reliable, valid, feasible, and acceptable for both applicants and interviewers [38,40,41]. Studies have found that MMI scores are a significant predictor of success in the early years of medical school [42,43]. However, MMIs may not detect subtle personality traits that could negatively impact academic progress and career as a physician, such as specific cognitive deficits, impulsive actions, and dysfunctional interpersonal relationships [44−46].

4.6. Emotional intelligence tests

Emotional intelligence (EI) includes a critical set of intrapersonal skills that are highly relevant to the medical profession. Physicians with strong EI demonstrate effective communication and empathy to build trust with patients, work collaboratively in healthcare teams, and manage their own emotions to avoid burnout [47]. Evaluating EI in medical school admissions and encouraging its growth in students may help create empathetic, cooperative, and resilient physicians capable of delivering exceptional patient-centered care [48]. Generally, self-report questionnaires are used to assess emotional intelligence in medicine. However, some studies have found that these tests do not reliably predict future academic performance [48,49].

4.7. Personal profile

An applicant's personal profile may include a personal statement and letters of recommendation. However, concerns have been raised about the credibility of personal statements and their value as an indicator of future academic and professional performance [50,51]. Similarly, letters of recommendation may provide important information to guide decisions on interview selection and candidate admission; however, non-standardized letters generally have low predictive validity and there is limited evidence about their value in the selection of medical students [52]. For these reasons, there is growing interest in using a structured format for letters with detailed writing guidance and the use of rating scales for important competencies [44,53].

4.8. Student demographics

In some countries, the selection process takes place immediately after high school (as in the United Kingdom) or after several years of general university studies (as in the United States and Australia) [3]. There is conflicting evidence regarding the effects of age at admission on attrition rate. A retrospective study performed at Nottingham University, UK, found no relationship between age of entry to medical school and attrition rate [7]. However, another study reported that older students aged 21 years and above were less likely to withdraw than younger students [54]. Likewise, while some studies have found no relationship between gender and attrition [5,55], others have found attrition to be more common among females [27,56,57].

4.9. Selection process

A proper selection process for student admission can improve learning efficiency and professional outcomes. The selection process should combine the scores of several selection tools and use weighted formulas to rank applicants [9]. These selection tools usually include high school grades, a written standardized entry exam, assessment of noncognitive variables by personal interviews and other social skills assessments, and, in some cases, demographic characteristics. The decision-making style of the committee and voting patterns among the members are critical for effective selection [3]. The academic progress of admitted students and their attrition rates

should be closely monitored to evaluate admission criteria and refine the selection process [58,59].

The medical profession has been dominated by members of higher social classes, likely because individuals from lower socioeconomic classes have fewer educational opportunities, which results in a lower chance of being admitted to a medical school [60]. Several studies have found lower academic achievements and a higher likelihood of withdrawal among ethnic minorities. For instance, one study from the UK reported that the performance of Caucasian students was superior to that of students of other ethnicities [61].

4.10. Curriculum-in-use

The curriculum is the actual material delivered to the students and taught by each professor. It includes an overt (explicit or written) component and an implicit component of unwritten perspectives and values [62]. One of the most important goals of a medical school is to continually improve the curriculum for enhanced learning and foster academic success and professional competence [63]. Medical schools have a responsibility to establish measures to ensure students' development into competent physicians. However, some level of attrition should be allowed to ensure the quality of future physicians [64,65].

While relatively few studies have been conducted on the effects of different curricula on medical school attrition rates, higher attrition rates have been reported using traditional curricula in which basic and clinical sciences are taught separately compared with curricula using problem-based learning (PBL) [66]. In PBL, students learn about a subject by working in groups to solve a clinical problem, an approach that motivates students to learn [66]. A 10-year retrospective study of eight Dutch medical schools found lower graduation rates among those using traditional curricula compared with those using problem-based curricula [64]. Similar results have been reported in South Africa, where the introduction of a PBL curriculum has resulted in improved academic performance and a significant decrease in attrition rates [67]. A recent study found that changing the curriculum design from the traditional model to an integrated model, where basic and clinical sciences are taught simultaneously, led to a dramatic decrease in attrition from 41.5% to 3.3% [68]. The advantages of an integrated curriculum include earlier clinical involvement, prevention of basic science overload, increased use of active learning methods in teaching and formative assessment, and the integration of a mentorship program to promote learning [68]. These changes may help students manage their stress and responsibilities by allowing more time for extracurricular activities such as community service and sports [68,69]. For these reasons, the influence of curriculum design on attrition rate warrants additional studies.

Table 2 summarizes the factors that affect early medical student attrition and provides evidence-based strategies for improving selection and enhancing student retention.

Table 2. Summary of factors influencing early medical student attrition and strategies for improving selection and enhancing student retention.

Factors	Importance	Evidence-based recommendations	References
Pre-university GPA	Measures students' basic academic skills, general knowledge, and critical reasoning abilities.	Prioritize higher GPA students to reduce the risk of attrition.	[18,19,21]
Written Medical School Admission Examinations	Evaluate a wider range of cognitive abilities and provide a standardized method for evaluating candidates.	Prioritize applicants with higher-scoring examinations.	[5,18,23,25–27]
English Language Examinations	Improving English proficiency is essential for the success of medical students and their future careers as physicians.	Implement English language proficiency assessments for non-native speakers using standardized tests such as IELTS and TOEFL tests.	[28–32]
Personal Interview	Determines personal characteristics and predicts psychological problems. MMIs are reliable, valid, and feasible for both applicants and interviewers.	Use MMI in personal interviews to assess and select applicants; however, it may not detect subtle personality traits.	[38,40–46]
EI Tests	Physicians with high EI scores communicate effectively and empathize with patients while managing their emotions to avoid burnout.	Further investigations are needed to determine the EI test's predictive validity regarding future academic performance.	[47–49]
Applicants' personal profile	Provide vital information to guide decisions on candidate selection.	Utilize structured rating scales in recommendation letters to enhance applicant assessment.	[44, 53]

Table 2. (continued)

Factors	Importance	Evidence-based recommendations	References
Student demographics	The impact of age and gender on the attrition rate at admission is still inconclusive.	Consider students' demographics in line with community needs and admission committee decisions.	[5,7,27,54−57]
Admission Committee Selection Process	An effective selection process involves combining the scores of several selection tools and using weighted formulas to rank applicants.	Ensure the process is reliable, fair, justifiable, and publicly defensible. Monitor the attrition rates to evaluate admission criteria and refine the selection.	[9,10,58,59]
Curriculum-in-Use	Few studies have examined the effects of different curricular approaches on student attrition.	Implement an integrated curriculum that combines basic and clinical sciences with PBL and offers early clinical exposure.	[62,64,66−68]

International English Language Testing System (IELTS); Test of English as a Foreign Language (TOEFL); Multiple Mini Interviews (MMI); Emotional Intelligence (EI), problem-based learning (PBL).

5. Conclusions

The attrition of students in medical schools is influenced by several factors. Recent studies have mainly linked attrition to academic failure caused by cognitive factors. However, personal and psychological factors may also play a role in attrition, but these factors may not be as common in the early years of university study. Although attrition among undergraduate medical students has been studied extensively in the literature, these studies have been conducted in diverse communities with different methods of student admission, assessment, and judgment, resulting in significant differences among the results. Furthermore, the effects of the curricula on attrition in medical schools are not well studied. It is crucial for medical educators to understand the causes of attrition to prevent the adverse impacts of dropouts on students, medical schools, and the broader medical community.

Ethical approval

Ethical approval was not required because the authors used secondary data from research already subjected to ethical review. Moreover, the data are publicly accessible.

Consent for publication

Not applicable.

Availability of data and material

The datasets generated and analyzed for the current study are available from the corresponding author on request.

Conflict of interest

The authors declare no conflicts of interest with respect to the content, authorship, and/or publication of this article.

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References

[1] James D, Chilvers C. Academic and non-academic predictors of success on the Nottingham undergraduate medical course 1970−1995. Med Educ 2001;35:1056−64. https://doi.org/10.1046/j.1365-2923.2001.01042.x.

[2] Shahab F, Hussain H, Inayat A, Shahab A. Attitudes of medical students towards their career—perspective from Khyber-Pukhtunkhwa. Medicine 2011;36:27.

[3] Fayolle AV, Passirani C, Letertre E, Ramond A, Perrotin D, Saint-André JP, et al. Sélection des étudiants en médecine: facteurs prédictifs de réussite; une revue systématique de la littérature [Predictive validity of selection process in medical school, a systematic review of the literature]. Presse Med 2016;45:483−94. https://doi.org/10.1016/j.lpm.2016.03.007. French. Epub 2016 May 2.

[4] O'Neill LD, Wallstedt B, Eika B, Hartvigsen J. Factors associated with dropout in medical education: a literature review. Med Educ 2011;45:440−54. https://doi.org/10.1111/j.1365-2923.2010.03898.x. Epub 2011 Mar 22.

[5] O'Neill L, Hartvigsen J, Wallstedt B, Korsholm L, Eika B. Medical school dropout–testing at admission versus selection by highest grades as predictors. Med Educ 2011;45:1111−20. https://doi.org/10.1111/j.1365-2923.2011.04057.x.

[6] Maher BM, Hynes H, Sweeney C, Khashan AS, O'Rourke M, Doran K, et al. Medical school attrition-beyond the statistics a ten year retrospective study. BMC Med Educ 2013, 31;13:13. https://doi.org/10.1186/1472-6920-13-13.

[7] Yates J. When did they leave, and why? A retrospective case study of attrition on the Nottingham undergraduate medical course. BMC Med Educ 2012, 20;12:43. https://doi.org/10.1186/1472-6920-12-43.

[8] Sinclair HK, Cleland JA. Undergraduate medical students: who seeks formative feedback? Med Educ 2007;41:580−2. https://doi.org/10.1111/j.1365-2923.2007.02768.x. PMID: 17518838.

[9] Edwards JC, Elam CL, Wagoner NE. An admission model for medical schools. Acad Med 2001;76:1207−12. https://doi.org/10.1097/00001888-200112000-00010.

[10] Prideaux D, Roberts C, Eva K, Centeno A, McCrorie P, McManus C, et al. Assessment for selection for the health care professions and specialty training: consensus statement and recommendations from the Ottawa 2010 Conference. Med Teach 2011;33:215−23. https://doi.org/10.3109/0142159X.2011.551560.

[11] Li J, Thompson R, Shulruf B. Struggling with strugglers: using data from selection tools for early identification of medical students at risk of failure. BMC Med Educ 2019;19: 415. https://doi.org/10.1186/s12909-019-1860-z.

[12] Ferguson E, James D, Madeley L. Factors associated with success in medical school: systematic review of the literature. BMJ 2002, 20;324(7343):952−7. https://doi.org/10.1136/bmj.324.7343.952.

[13] Kreiter CD, Kreiter Y. A validity generalization perspective on the ability of undergraduate GPA and the medical college admission test to predict important outcomes. Teach Learn Med 2007;19:95−100. https://doi.org/10.1080/10401330701332094. Spring.

[14] Albanese MA, Snow MH, Skochelak SE, Huggett KN, Farrell PM. Assessing personal qualities in medical school admissions. Acad Med 2003;78:313−21. https://doi.org/10.1097/00001888-200303000-00016.

[15] Hurwitz S, Kelly B, Powis D, Smyth R, Lewin T. The desirable qualities of future doctors–a study of medical student perceptions. Med Teach 2013;35:e1332−9. https://doi.org/10.3109/0142159X.2013.770130. Epub 2013 Feb 27.

[16] Simpson KH, Budd K. Medical student attrition: a 10-year survey in one medical school. Med Educ 1996;30:172−8. https://doi.org/10.1111/j.1365-2923.1996.tb00739.x.

[17] Ward AM, Kamien M, Lopez DG. Medical career choice and practice location: early factors predicting course completion, career choice and practice location. Med Educ 2004;38: 239−48. https://doi.org/10.1046/j.1365-2923.2004.01762.x.

[18] Maslov Kruzicevic S, Barisic KJ, Banozic A, Esteban CD, Sapunar D, Puljak L. Predictors of attrition and academic success of medical students: a 30-year retrospective study. PLoS One 2012;7:e39144. https://doi.org/10.1371/journal.pone.0039144. Epub 2012 Jun 18.

[19] Mercer A, Puddey IB. Admission selection criteria as predictors of outcomes in an undergraduate medical course: a prospective study. Med Teach 2011;33:997−1004. https://doi.org/10.3109/0142159X.2011.577123. Epub 2011 May 19.

[20] Cohen-Schotanus J, Muijtjens AM, Reinders JJ, Agsteribbe J, van Rossum HJ, van der Vleuten CP. The predictive validity of grade point average scores in a partial lottery medical school admission system. Med Educ 2006;40:1012−9. https://doi.org/10.1111/j.1365-2929.2006.02561.x.

[21] Urlings-Strop LC, Themmen AP, Stijnen T, Splinter TA. Selected medical students achieve better than lottery-admitted students during clerkships. Med Educ 2011;45:1032−40. https://doi.org/10.1111/j.1365-2923.2011.04031.x. Epub 2011 Aug 30.

[22] Adam J, Dowell J, Greatrix R. Use of UKCAT scores in student selection by U.K. medical schools, 2006-2010. BMC Med Educ 2011, 24;11:98. https://doi.org/10.1186/1472-6920-11-98.

[23] Callahan CA, Hojat M, Veloski J, Erdmann JB, Gonnella JS. The predictive validity of three versions of the MCAT in relation to performance in medical school, residency, and licensing examinations: a longitudinal study of 36 classes of Jefferson Medical College. Acad Med 2010;85:980−7. https://doi.org/10.1097/ACM.0b013e3181cece3d.

[24] Emery JL, Bell JF, Vidal Rodeiro CL. The BioMedical Admissions Test for medical student selection: issues of fairness and bias. Med Teach 2011;33:62−71. https://doi.org/10.3109/0142159X.2010.528811.

[25] Julian ER. Validity of the medical college admission test for predicting medical school performance. Acad Med 2005;80: 910−7. https://doi.org/10.1097/00001888-200510000-00010.

[26] Schwartz S. Fair admissions to higher education: recommendations for good practice. Department for Education and Skills; 2004.

[27] Reibnegger G, Caluba HC, Ithaler D, Manhal S, Neges HM, Smolle J. Dropout rates in medical students at one school before and after the installation of admission tests in Austria. Acad Med 2011;86:1040−8. https://doi.org/10.1097/ACM.0b013e3182223a1b.

[28] Test of English as a Foreign Language - Wikipedia. Retrieved from: https://en.wikipedia.org/wiki/Test_of_English_as_a_Foreign_Language. [Accessed 1 July 2024].

[29] International English Language Testing system, Wikipedia. Retrieved from: https://en.wikipedia.org/wiki/International_English_Language_Testing_System. [Accessed 1 July 2024].

[30] Al-Mously N, Salem R, Al-Hamdan N. The impact of gender and English language on the academic performance of students: an experience from new Saudi medical school. J Contemp Med Educ 2013;1:170−6.

[31] Hayes SC, Farnill D. Medical training and English language proficiency. Med Educ 1993;27:6−14. https://doi.org/10.1111/j.1365-2923.1993.tb00222.x.

[32] Dabaliz AA, Kaadan S, Dabbagh MM, Barakat A, Shareef MA, Al-Tannir M, et al. Predictive validity of pre-admission assessments on medical student performance. Int J Med Educ 2017;24(8):408−13. https://doi.org/10.5116/ijme.5a10.04e1.

[33] Meredith KE, Dunlap MR, Baker HH. Subjective and objective admissions factors as predictors of clinical clerkship performance. J Med Educ 1982;57:743−51. https://doi.org/10.1097/00001888-198210000-00002.

[34] Johnson EK, Edwards JC. Current practices in admission interviews at U.S. medical schools. Acad Med 1991;66: 408−12. https://doi.org/10.1097/00001888-199107000-00008.

[35] Kreiter CD, Yin P, Solow C, Brennan RL. Investigating the reliability of the medical school admissions interview. Adv Health Sci Educ Theory Pract 2004;9:147−59. https://doi.org/10.1023/B:AHSE.0000027464.22411.0f.

[36] Eva KW, Rosenfeld J, Reiter HI, Norman GR. An admissions OSCE: the multiple mini-interview. Med Educ 2004;38: 314−26. https://doi.org/10.1046/j.1365-2923.2004.01776.x.

[37] Ali S, Sadiq Hashmi MS, Umair M, Beg MA, Huda N. Multiple mini-interviews: current perspectives on utility and limitations. Adv Med Educ Pract 2019, 12;10:1031−8. https://doi.org/10.2147/AMEP.S181332.

[38] Lemay JF, Lockyer JM, Collin VT, Brownell AK. Assessment of non-cognitive traits through the admissions multiple mini-interview. Med Educ 2007;41:573−9. https://doi.org/10.1111/j.1365-2923.2007.02767.x.

[39] Dowell J, Lynch B, Till H, Kumwenda B, Husbands A. The multiple mini-interview in the U.K. context: 3 years of experience at Dundee. Med Teach 2012;34:297−304. https://doi.org/10.3109/0142159X.2012.652706.

[40] Eva KW, Reiter HI, Trinh K, Wasi P, Rosenfeld J, Norman GR. Predictive validity of the multiple mini-interview for selecting medical trainees. Med Educ 2009;43: 767−75. https://doi.org/10.1111/j.1365-2923.2009.03407.x.

[41] O'Brien A, Harvey J, Shannon M, Lewis K, Valencia O. A comparison of multiple mini-interviews and structured interviews in a UK setting. Med Teach 2011;33:397−402. https://doi.org/10.3109/0142159X.2010.541532. Epub 2011 Feb 28.

[42] Husbands A, Dowell J. Predictive validity of the Dundee multiple mini-interview. Med Educ 2013;47:717−25. https://doi.org/10.1111/medu.12193.

[43] Basco WT Jr, Lancaster CJ, Gilbert GE, Carey ME, Blue AV. Medical school application interview score has limited predictive validity for performance on a fourth year clinical practice examination. Adv Health Sci Educ Theory Pract 2008;13:151−62. https://doi.org/10.1007/s10459-006-9031-5. Epub 2006 Nov 7.

[44] Kreiter CD, Axelson RD. A perspective on medical school admission research and practice over the last 25 years. Teach Learn Med 2013;25(Suppl 1):S50−6. https://doi.org/10.1080/10401334.2013.842910.

[45] Bagge C, Nickell A, Stepp S, Durrett C, Jackson K, Trull TJ. Borderline personality disorder features predict negative outcomes 2 years later. J Abnorm Psychol 2004;113:279−88. https://doi.org/10.1037/0021-843X.113.2.279.

[46] Wongpakaran N, Wongpakaran T. Personality disorders in medical students: measuring by IPDE-10. J Med Assoc Thai 2005;88:1278−81.

[47] Mayer JD, Salovey P, Caruso DR. Emotional intelligence: new ability or eclectic traits? Am Psychol 2008;63:503−17. https://doi.org/10.1037/0003-066X.63.6.503.

[48] Arora S, Ashrafian H, Davis R, Athanasiou T, Darzi A, Sevdalis N. Emotional intelligence in medicine: a systematic review through the context of the ACGME competencies. Med Educ 2010;44:749–64. https://doi.org/10.1111/j.1365-2923.2010.03709.x.

[49] Humphrey-Murto S, Leddy JJ, Wood TJ, Puddester D, Moineau G. Does emotional intelligence at medical school admission predict future academic performance? Acad Med 2014;89:638–43. https://doi.org/10.1097/ACM.0000000000000165.

[50] Kumwenda B, Dowell J, Husbands A. Is embellishing UCAS personal statements accepted practice in applications to medicine and dentistry? Med Teach 2013;35:599–603. https://doi.org/10.3109/0142159X.2013.798402. Epub 2013 May 23.

[51] Parry J, Mathers J, Stevens A, Parsons A, Lilford R, Spurgeon P, et al. Admissions processes for five year medical courses at English schools: review. BMJ 2006 29;332:1005–9. https://doi.org/10.1136/bmj.38768.590174.55. Epub 2006 Mar 16.

[52] DeZee KJ, Magee CD, Rickards G, Artino Jr AR, Gilliland WR, Dong T, et al. What aspects of letters of recommendation predict performance in medical school? Findings from one institution. Acad Med 2014;89:1408–15. https://doi.org/10.1097/ACM.0000000000000425.

[53] Sarabipour S, Hainer SJ, Furlong E, Jadavji NM, de Winde CM, Bielczyk N, et al. Writing an effective and supportive recommendation letter. FEBS J 2022;289:298–307. https://doi.org/10.1111/febs.15757. Epub 2021 Mar 5.

[54] Arulampalam W, Naylor R, Smith J. Factors affecting the probability of first year medical student dropout in the UK: a logistic analysis for the intake cohorts of 1980-92. Med Educ 2004;38:492–503. https://doi.org/10.1046/j.1365-2929.2004.01815.x.

[55] Glauser W. Why do students quit medical school far less often in Canada than in other countries? CMAJ 2019, 11;191: E174–5. https://doi.org/10.1503/cmaj.109-5704.

[56] Stetto JE, Gackstetter GD, Cruess DF, Hooper TI. Variables associated with attrition from uniformed services university of the health sciences medical school. Mil Med 2004;169: 102–7. https://doi.org/10.7205/milmed.169.2.102.

[57] Huff KL, Fang D. When are students most at risk of encountering academic difficulty? A study of the 1992 matriculants to U.S. medical schools. Acad Med 1999;74:454–60. https://doi.org/10.1097/00001888-199904000-00047.

[58] Green AR, Carney DR, Pallin DJ, Ngo LH, Raymond KL, Iezzoni LI, et al. Implicit bias among physicians and its prediction of thrombolysis decisions for black and white patients. J Gen Intern Med 2007;22:1231–8. https://doi.org/10.1007/s11606-007-0258-5. Epub 2007 Jun 27.

[59] Elam CL, Johnson MM. An analysis of admission committee voting patterns. Acad Med 1997 Oct;72(10 Suppl 1):S72–5.

[60] McManus IC, Richards P, Winder BC, Sproston KA, Styles V. Medical school applicants from ethnic minority groups: identifying if and when they are disadvantaged. BMJ 1995, 25;310:496–500. https://doi.org/10.1136/bmj.310.6978.496. PMID: 7888888; PMCID: PMC2548873.

[61] Kumwenda B, Cleland JA, Walker K, Lee AJ, Greatrix R. The relationship between school type and academic performance at medical school: a national, multi-cohort study. BMJ Open 2017, 31;7:e016291. https://doi.org/10.1136/bmjopen-2017-016291. Erratum in: BMJ Open. 2018 Jan 9; 8(1):e016291corr1.

[62] Fins JJ, Rodríguez del Pozo P. The hidden and implicit curricula in cultural context: new insights from Doha and New York. Acad Med 2011;86:321–5. https://doi.org/10.1097/ACM.0b013e318208761d.

[63] Abdulghani HM, Al-Drees AA, Khalil MS, Ahmad F, Ponnamperuma GG, Amin Z. What factors determine academic achievement in high achieving undergraduate medical students? A qualitative study. Med Teach 2014;36(Suppl 1):S43–8. https://doi.org/10.3109/0142159X.2014.886011.

[64] Schmidt HG, Cohen-Schotanus J, Arends LR. Impact of problem-based, active learning on graduation rates for 10 generations of Dutch medical students. Med Educ 2009;43: 211–8. https://doi.org/10.1111/j.1365-2923.2008.03287.x.

[65] Rajabali H, Dewji R, Dewji F. Medical school dropouts: regrettable or required? Med Educ Online 2018;23:1535739. https://doi.org/10.1080/10872981.2018.1535739. Epub 2018 Nov 8.

[66] Jones RW. Problem-based learning: description, advantages, disadvantages, scenarios and facilitation. Anaesth Intensive Care 2006;34:485–8. https://doi.org/10.1177/0310057X0603400417.

[67] Iputo JE, Kwizera E. Problem-based learning improves the academic performance of medical students in South Africa. Med Educ 2005;39:388–93. https://doi.org/10.1111/j.1365-2929.2005.02106.x.

[68] Vergel J, Quintero GA, Isaza-Restrepo A, Ortiz-Fonseca M, Latorre-Santos C, Pardo-Oviedo JM. The influence of different curriculum designs on students' dropout rate: a case study. Med Educ Online 2018;23:1432963. https://doi.org/10.1080/10872981.2018.1432963.

[69] Schmidt HG, Cohen-Schotanus J, Van Der Molen HT, Splinter TA, Bulte J, Holdrinet R, et al. Learning more by being taught less: a "time-for-self-study" theory explaining curricular effects on graduation rate and study duration. High Educ 2010;60:287–300.