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Correlation Analysis between Multiple Mini-Interviews during Medical Student Selection and Their Academic Performance

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ABSTRACT

Multiple mini-interviews (MMI) have been used as a tool in the selection of medical students to evaluate their interpersonal and intrapersonal attributes. It is suggested that rigorous evaluation in MMI may predict academic performance during medical training. Thus, this study aims to determine the relationship between MMI scores and subsequent academic performance at the end of the preclinical phase. MMI scores for the academic session 2019/2020 intake in Universiti Putra Malaysia were gathered. The dependent variables were the students' academic performance at the end of the preclinical phase involving the Professional Examination and Professionalism and Personal Development (PPD) course. No significant positive correlation was observed between MMI and total Professional Examination scores. Total MMI and empathy station scores have a weak positive relationship with objective structured clinical examination (OSCE) marks. There was also a significant positive correlation between resilience station scores and PPD peer assessment marks. In contrast, there was a negative correlation between Malay language station scores and the theory component of Professional Examination marks. This study suggests that MMI has the potential to predict in-programme clinical performance and professionalism characteristics. Studies with larger cohorts are essential to support this evidence.

Keywords: *Multiple mini-interviews, Academic performance, Medical students, Objective structured clinical examination*

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INTRODUCTION

In spite of the high numbers of academically qualified applicants for medical school with limited places to offer, universities now have different strategies for selecting their students, which is very crucial as the accepted candidates must possess the capability to complete

medical training and eventually become competent doctors. Multiple mini-interviews (MMI), a highly structured method resembling the objective structured clinical examination (OSCE), was developed by McMaster University in Canada (1). In MMI, candidates rotate around a series of stations designed to assess cognitive and non-cognitive attributes. The designed scenarios or questions are flexible and can be moulded to assess attributes that best meet the programmes and school's requirements (2), such as critical thinking ability, communication skills and attitudes towards certain ethical or social issues. The MMI, therefore, allows a wide sampling of candidates' competencies to gain a more accurate picture of their overall ability (2).

Most previous studies have shown moderate to high reliability of MMI (3–5). With regard to validity, previous studies by Eva et al. (1, 6, 7) found that MMI is a positive predictor for future examinations as well as clerkship performance. Since 2017, Universiti Putra Malaysia (UPM) has been implementing MMI as a student selection tool for undergraduate medical programme (8). Given that all candidates have undergone screening and shortlisting based on their prior academic achievements, the present MMI evaluates non-cognitive attributes, as they are crucial for the development of future healthcare professionals. From the outset, we have been assessing the identical set of attributes, namely English communication skills, ethics, critical thinking, empathy, Malay language and resilience. These attributes are deemed essential characteristics for medical students and align with the programme's educational objectives. While English is the primary language used for teaching and learning, medical students must possess proficiency in the Malay language for effective communication with patients during clinical training. Nevertheless, some modifications were implemented during the COVID-19 pandemic, as the selection process was carried out remotely (8). Hence, the number of stations was decreased, while the assessment procedure was modified as a result of logistical issues. However, the regular face-to-face selection process has resumed since 2022, incorporating enhancements based on what has been learned during the course of the pandemic.

A longitudinal study by Jerant et al. (9) discovered that higher MMI scores have a stronger association with subsequent academic performance than traditional unstructured interview scores. In contrast, a previous study demonstrated a significant correlation between total MMI scores and academic performance, particularly for stations assessing critical thinking and presentation skills (10). This is corroborated by a recent study, which revealed a similar finding involving several attributes such as student motivation, communication, knowledge of healthcare and current issues, ethics and critical thinking (11). Considering that distinct sets of attributes are assessed at UPM, this study was designed to determine the relationship between the candidate's performance in MMI and subsequent academic performance in the preclinical phase. Their academic performance was determined not only by their knowledge and practical skills in the examination but also by their behaviour, which was evident in the concurrent Professionalism and Personal Development (PPD) course. These findings will provide preliminary data to support the predictive validity of the proposed MMI related to in-programme performance.

METHODOLOGY

A total of 538 applicants attended the MMI for the Doctor of Medicine (MD) programme at UPM for the academic intake session 2019/2020. Six MMI stations were developed, each lasting for six minutes. Each station was designed to assess one domain: English communication skills, ethics, critical thinking, empathy, Malay language and resilience. All

candidates were required to go through all stations. Candidates were allowed to choose their preferred language (either Malay or English) for each station unless otherwise specified. Each station was assigned to an assessor, with rubrics being provided for scoring. Each station was allotted 30 marks, except for Stations 3 and 4, which have a score of 25 marks. Therefore, the maximum marks for the MMI were 170.

The scores were ranked, and the top 100 candidates were offered to join the medical programme. A total of 97 candidates enrolled in the programme, divided into preclinical (2 years) and clinical (3 years) phases. At the end of the second year, the students sat for their Professional Examination before they were eligible to progress to the clinical years. The examination consisted of theory (75%) and practical examinations (25%). The theory examination consisted of multiple-choice questions and short answer questions, while the practical examination comprised objective structured practical examination and OSCE.

The students also were required to complete the PPD course that ran concurrently throughout the preclinical years. Each semester, the assessment consisted of reflective writing (30%) as well as behavioural assessment by lecturer (30%) and by peers (40%). They needed to submit a 500-word reflective essay on certain topics each semester, and the average marks were calculated. For behavioural assessment, lecturers and their peers assessed the students based on a scoring rubric. The students were assessed on communication skills, appearance, maturity, respect, responsibility, teamwork and punctuality. The peer's rubric had an additional attribute, which was honesty. All scores were summed and averaged at the end of the fourth semester.

Statistical Analysis

The MMI scores, PPD and Professional Examination marks of the 97 students were analysed using IBM SPSS Statistics version 23. Kolmogorov-Smirnov test was utilised to test the normality of the data. Meanwhile, the Pearson correlation coefficient test was used to measure the correlation of normally distributed data, while Spearman's correlation was used for non-normally distributed data. Any p -values < 0.05 were considered significant.

RESULTS

Correlation between MMI and Professional Examination

Table 1 shows the average MMI scores, Professional Examination and PPD course marks of the 97 students. The MMI scores, theory component and OSCE marks are presented as the raw scores, without conversion to percentage. The correlation between MMI scores and Professional Examination marks was analysed (Table 2). No significant correlation was seen between MMI scores and total examination marks. However, significant positive correlations were apparent between total MMI scores and OSCE marks, as well as Station 4 (empathy) scores and OSCE marks. The higher the performance of students in MMI and empathy station, the higher their performance in OSCE during Professional Examination. In contrast, there was a significant negative correlation between scores of Station 5 (Malay language) and the theory component of Professional Examination. The higher the performance of students in the Malay language station, the lower their performance in theory examinations.

Table 1: MMI scores, Professional Examination and PPD course marks (n = 97)

Variables	Mean (SD)
Total MMI scores	140.99 (10.79)
Station 1: Communication skills	25.06 (4.18)
Station 2: Ethics	25.23 (3.87)
Station 3: Critical thinking	19.72 (3.62)
Station 4: Empathy	19.63 (4.03)
Station 5: Malay language	23.79 (4.41)
Station 6: Resilience	26.44 (3.41)
Professional Examination marks (%)	67.95 (8.63)
Theory component	452.22 (59.71)
OSCE	29.48 (3.24)
PPD total marks	92.28 (4.06)
Reflective writing	22.13 (1.61)
Lecturer assessment	31.66 (2.81)
Peer assessment	38.45 (1.39)

Table 2: Correlations between MMI scores and Professional Examination marks (r)

Variables	Professional Examination marks	Theory component	OSCE
Total MMI scores	0.300	0.019	0.210*
Station 1: Communication skills	0.142	0.135	0.193
Station 2: Ethics	0.015	0.059	0.012
Station 3: Critical thinking	0.133	0.113	0.062
Station 4: Empathy	0.016	0.013	0.259*
Station 5: Malay language	-0.195	-0.213*	0.044
Station 6: Resilience	0.050	0.015	0.025

Note: n = 97, *p < 0.05

Correlation between MMI and PPD Course

The correlation between MMI scores and PPD marks is shown in Table 3. There was a significant positive correlation between Station 6 (resilience) scores and peer assessment marks. The higher the performance of students in the resilience station, the higher their marks for peer assessment. Although positive correlations were observed between the MMI scores and PPD marks, they were not significant.

Table 3: Correlations between MMI scores and PPD marks (r)

Variables	PPD total marks	Reflective writing	Lecturer assessment	Peer assessment
Total MMI scores	0.135	-0.006	0.120	0.167
Station 1: Communication skills	0.044	-0.132	0.100	0.071
Station 2: Ethics	0.128	0.190	0.100	-0.068
Station 3: Critical thinking	-0.025	0.047	-0.049	-0.048
Station 4: Empathy	0.161	0.040	0.186	0.134
Station 5: Malay language	-0.007	-0.110	-0.042	0.150
Station 6: Resilience	0.064	-0.065	0.027	0.232*

Note: n = 97, *p < 0.05

DISCUSSION

Previous studies have demonstrated a strong association between MMI scores and subsequent academic performance among medical students (9–12). This study, however, only showed a significant correlation with performance-based assessment in OSCE, which is consistent with previous studies involving medical students (13) and other health profession programmes such as dentistry (14), nursing and midwifery (15). Considering that the present MMI primarily evaluated non-cognitive attributes and medical professionalism, it is reasonable to anticipate that its predictive validity in relation to subsequent cognitive performance may be uncertain. There is a justifiable need for future research to evaluate the performance of these students during the clinical years, where clinical performance and professionalism values hold greater weight in the examinations.

Empathy is a significant attribute for healthcare professionals as it enhances communication skills and improves patient care. During the MMI, the empathy station involved an interaction of candidates with an actor to assess the candidate's ability to understand and mirror the actor's emotions adequately. In the preclinical phase, OSCE focuses on assessing history-taking, communication and physical examination skills in the presence of simulated patients. The present study demonstrated an association between their performance in the empathy station and during OSCE, which is in accordance with previous studies revealing the association between empathy and performance in OSCE among medical students (16, 17). This evidence suggests that empathy is a favourable trait for medical students and is beneficial in a clinical performance examination.

On the other hand, resilience refers to one's ability to cope well with adversities. Although it can be learned, we thought that this attribute is important to be assessed during the admission to ensure the selected students were able to survive and address the likely consequences of handling academic pressure in medical school. The role of resilience in the well-being of medical students has been documented in many previous literatures (18–20). Based on the present study, the higher the students performed in the resilience station during MMI, the higher scores they obtained in behavioural assessment by their peers. This assessment was done each semester by three peer assessors who were rotated for each semester. As the students were in the same learning environment, they might understand better and relate to the challenges and expectations faced by their peers. This study indicated that these students may be perceived by their peers as individuals who can effectively manage their time, stay committed to their studies and adhere to principles of integrity even in challenging situations.

The English language serves as the medium of teaching and learning as well as examination, which can pose a hurdle for some students. Consequently, it can influence their performance during the examination. It was discovered in this study that an inverse relationship existed between the performance of students in the Malay language MMI station and their performance in the theory examination. Thus, it was assumed that most Malay candidates had an advantage at this station during MMI. However, the English language limitations may have an impact on their academic performance. Studies conducted by Kaliyadan et al. (21) and Jha et al. (22) demonstrated that English language proficiency is an important determinant of medical students' performance. The language barrier can result in misunderstanding and hinder the student's ability to comprehend and engage with the teaching and learning effectively. Based on observations from this study, it is also common for students from other ethnicities to predominantly secure the top ranks during examinations. While various factors contribute to this scenario, language proficiency may play a role in this outcome. Although

the candidates' English proficiency was assessed in the communication skill station during MMI, no significant correlation was found in this present study. Hence, it was hypothesised that the level of English mastery during entrance may not have a significant impact on the Professional Examination as all students were expected to attend English courses during the preclinical years to improve and enhance their command of English. Furthermore, no significant correlations were detected between stations that encompassed ethics and critical thinking and their subsequent performance. As these findings are only preliminary and pertain to their performance during the preclinical phase, future investigation during the clinical phase may yield different outcomes.

While the findings of this study suggest that MMI may help to reveal underlying professional attributes and clinical performance, several limitations are worth noting. First, this study's sample was limited to one cohort, which limits the generalisability of results. Measuring the student's performance through a single measure, which is the Professional Examination, is limited since the results can be influenced by many factors. Second, the potential limitations were seen associated with the variability of scores due to the assessor's bias during the MMI and PPD behavioural assessment. This present study provides preliminary findings on the relationship between the MMI exercise and students' academic achievement. Future longitudinal studies involving multiple cohorts to determine the student's progress until clinical years are warranted. The psychometric properties of the MMI stations, such as reliability and predictive validity, should be explored to further inform refinements to the MMI exercise.

CONCLUSION

MMI is indeed a helpful tool for selecting medical students and has the potential to predict future performance in specific areas. As the proposed MMI primarily emphasised non-cognitive attributes, a weak correlation can be observed between these attributes and the subsequent clinical performance and professionalism characteristics. More research on a larger cohort is essential to support this evidence. Further comprehensive psychometric analysis would be necessary to determine the superiority of MMI in relation to the subsequent academic performance among medical students.

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ETHICAL APPROVAL

Ethical approval to conduct this study was obtained from the Ethics Committee for Research Involving Human Subjects Universiti Putra Malaysia (JKEUPM-2022-700).

REFERENCES

1. Eva KW, Reiter HI, Rosenfeld J, Norman GR. The ability of the multiple mini-interview to predict preclerkship performance in medical school. *Acad Med.* 2004;79(10 Suppl):S40–2. <https://doi.org/10.1097/00001888-200410001-00012>
2. Pau A, Jeevaratnam K, Chen YS, Fall AA, Khoo C, Nadarajah VD. The multiple mini-interview (MMI) for student selection in health professions training – a systematic review. *Med Teach.* 2013;35(12):1027–41. <https://doi.org/10.3109/0142159X.2013.829912>
3. Abdul Rahim A, Yusoff M. Validity evidence of a multiple mini-interview for selection of medical students: Universiti Sains Malaysia experience. *Educ Med J.* 2016;8(2):49–63. <https://doi.org/10.5959/eimj.v8i2.437>
4. Dore KL, Kreuger S, Ladhani M, Rolfson D, Kurtz D, Kulasegaram K, et al. The reliability and acceptability of the multiple mini-interview as a selection instrument for postgraduate admissions. *Acad Med.* 2010;85(10):S60–3. <https://doi.org/10.1097/ACM.0b013e3181ed442b>
5. Roberts C, Rothnie I, Zoanetti N, Crossley J. Should candidate scores be adjusted for interviewer stringency or leniency in the multiple mini-interview? *Med Educ.* 2010;44(7):690–8. <https://doi.org/10.1111/j.1365-2923.2010.03689.x>
6. 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(8):767–75. <https://doi.org/10.1111/j.1365-2923.2009.03407.x>
7. Eva KW, Reiter HI, Rosenfeld J, Trinh K, Wood TJ, Norman GR. Association between a medical school admission process using the multiple mini-interview and national licensing examination scores. *JAMA.* 2012;308(21):2233–40. <https://doi.org/10.1001/jama.2012.36914>
8. Adam SK, Mohamad F, Maniam S, Ismail SIF, Hasan MK, Mohtarrudin N, et al. Student selection process for undergraduate medical programme amid the COVID-19 pandemic: lessons learned and future directions for Universiti Putra Malaysia. *Mal J Med Health Sci.* 2022;18(Suppl4):173–6.
9. Jerant A, Henderson MC, Griffin E, Hall TR, Kelly CJ, Peterson EM, et al. Do admissions multiple mini-interview and traditional interview scores predict subsequent academic performance? A study of five California medical schools. *Acad Med.* 2019;94(3):388–95. <https://doi.org/10.1097/ACM.0000000000002440>
10. Lee HJ, Park SB, Park SC, Park WS, Ryu SW, Yang JH, et al. Multiple mini-interviews as a predictor of academic achievements during the first 2 years of medical school. *BMC Res Notes.* 2016;9:93. <https://doi.org/10.1186/s13104-016-1866-0>
11. Alam F, Lim YC, Chaw LL, Idris F, Kok KYY. Multiple mini-interviews is a predictor of students' academic achievements in early undergraduate medical years: a retrospective study. *BMC Med Educ.* 2023;23:187. <https://doi.org/10.1186/s12909-023-04183-7>
12. Oluwasanjo A, Wasser T, Alweis R. Correlation between MMI performance and OSCE performance – a pilot study. *J Community Hosp Intern Med Perspect.* 2015;5(3):27808. <https://doi.org/10.3402/jchimp.v5.27808>
13. Husbands A, Dowell J. Predictive validity of the Dundee multiple mini-interview. *Med Educ.* 2013;47(7):717–25. <https://doi.org/10.1111/medu.12193>
14. Duff RE, Katcher PA, Daniels RM, Ramaswamy V. The multiple mini-interview as a dental school admission tool: can it predict noncognitive traits associated with professional behaviors? *J Dent Educ.* 2020;84(4):478–85. <https://doi.org/10.21815/JDE.019.184>

15. Callwood A, Groothuizen JE, Lemanska A, Allan H. The predictive validity of multiple mini-interviews (MMIs) in nursing and midwifery programmes: year three findings from a cross-discipline cohort study. *Nurse Educ Today*. 2020;88:104320. <https://doi.org/10.1016/j.nedt.2019.104320>
16. Wimmers PF, Stuber ML. Assessing medical students' empathy and attitudes towards patient-centered care with an existing clinical performance exam (OSCE). *Procedia Soc Behav Sci*. 2010;2(2):1911–3. <https://doi.org/10.1016/j.sbspro.2010.03.1008>
17. O'Connor K, King R, Malone KM, Guerandel A. Clinical examiners, simulated patients, and student self-assessed empathy in medical students during a psychiatry objective structured clinical examination. *Acad Psychiatry*. 2014;38(4):451–7. <https://doi.org/10.1007/s40596-014-0133-8>
18. Burgis-Kasthala S, Elmitt N, Smyth L, Moore M. Predicting future performance in medical students. A longitudinal study examining the effects of resilience on low and higher performing students. *Med Teach*. 2019;41(10):1184–91. <https://doi.org/10.1080/0142159X.2019.1626978>
19. Shi M, Liu L, Wang ZY, Wang L. The mediating role of resilience in the relationship between big five personality and anxiety among Chinese medical students: a cross-sectional study. *PLoS One*. 2015;10(3):e0119916. <https://doi.org/10.1371/journal.pone.0119916>
20. Helou MA, Keiser V, Feldman M, Santen S, Cyrus JW, Ryan MS. Student well-being and the learning environment. *Clin Teach*. 2019;16(4):362–6. <https://doi.org/10.1111/tct.13070>
21. Kaliyadan F, Thalamkandathil N, Parupalli SR, Amin TT, Balaha MH, Al Bu Ali WH. English language proficiency and academic performance: a study of a medical preparatory year program in Saudi Arabia. *Avicenna J Med*. 2015;5(4):140–4. <https://doi.org/10.4103/2231-0770.165126>
22. Jha K, Kumar Y, Kumar T, Singh R, Dubey P. Role of language proficiency and personality traits upon the academic performance of undergraduate medical students. *J Educ Health Promot*. 2019;8:260. https://doi.org/10.4103/jehp.jehp_258_19