Education in Medicine Journal

**ORIGINAL ARTICLE**

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**Submitted Date**: 18-02-2025

**Accepted Date**: 05-11-2025

**Please cite this article as**: Lokman NFB, Syazril AFA, Raju PS, Mohd Nazan AIN, Omar NS, Abas R. Evaluating clinical medical students' perceptions of preclinical anatomy education at Universiti Putra Malaysia: insights and implications for curriculum enhancement. Education in Medicine Journal. (early view).

# Evaluating Clinical Medical Students' Perceptions of Preclinical Anatomy Education at Universiti Putra Malaysia: Insights and Implications for Curriculum Enhancement

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## ABSTRACT

Mastery of anatomy is crucial for medical students throughout their preclinical and clinical training. In Malaysian universities, anatomy is incorporated into the first two years of preclinical medical education. However, concerns have emerged about the adequacy of anatomical knowledge among clinical students at Universiti Putra Malaysia (UPM). This study examines clinical medical students' perceptions of their anatomy curriculum. A cross-sectional study was conducted with 279 clinical medical students at UPM, employing a universal sampling method. Data were collected through a self-administered online questionnaire, divided into four sections: sociodemographic characteristics, adequacy of anatomy teaching coverage, perceptions of teaching methods, and perceptions of anatomy assessments. The questionnaire's reliability was confirmed with the Cronbach alpha test. Data analysis utilized descriptive

statistics, ANOVA, Chi-square tests, and Multiple Linear Regression. With a response rate of 69.88%, 116 completed questionnaires were analysed. Normality tests indicated non-normal distribution for teaching coverage adequacy and anatomy assessment data. Descriptive analysis revealed that most students perceived adequate teaching coverage in most systems but noted deficiencies in musculoskeletal and clinical correlation classes. Practical sessions were preferred for learning and retaining anatomy knowledge, while early clinical exposure was deemed less beneficial. Multiple regression analyses showed no significant differences in perceptions based on sociodemographic factors. The current anatomy curriculum at UPM is generally well-perceived by clinical medical students, with practical sessions being particularly effective. These findings suggest that strengthening practical-based anatomy sessions and aligning teaching with student preferences could improve learning outcomes and curriculum effectiveness.

**Keywords**: Anatomy education, medical students, teaching, assessment, perception



## INTRODUCTION

Anatomy is a cornerstone of medical education, essential for understanding the human body's structure and functions, as well as for performing physical examinations and clinical procedures (1). Comprehensive understanding of anatomy forms the foundation for medical students' success in preclinical education and their effective application of knowledge in clinical settings (2). Despite its importance, some clinical students have expressed concerns about their level of anatomical knowledge.

In Malaysian universities, medical students usually complete foundational science courses before progressing to the first two preclinical years, during which anatomy is taught alongside other basic medical sciences such as physiology, pharmacology, biochemistry, and pathology (3). At Universiti Putra Malaysia (UPM), the integrated preclinical medical curriculum employs various teaching methods such as problem-based learning (PBL), student-centered learning, blended learning, practical sessions, and digital tools like the Complete Anatomy Application, which has received positive feedback (4).

A significant issue in medical education is how clinical students perceive the anatomy curriculum, which impacts their educational experience and readiness for real-world medical scenarios (5). There is often a gap between classroom-based anatomical knowledge and its application in clinical settings, which can hinder students' ability to perform effectively (6). This issue is compounded by varying learning preferences among students, making it difficult for a one-size-fits-all approach to meet everyone's needs. Additionally, the rapid advancement in medical technology and the increasing importance of interdisciplinary collaboration necessitates regular updates to the curriculum (7). Failure to integrate modern resources and perspectives may leave students underprepared for the evolving challenges in healthcare (8). Understanding these perceptions is critical for enhancing the curriculum and improving the competency of future healthcare professionals.

This study aims to evaluate how clinical medical students at Universiti Putra Malaysia (UPM) perceive the adequacy, delivery methods, and assessments of preclinical anatomy education and whether these perceptions are influenced by sociodemographic factors such as gender, ethnicity, and year of clinical study. By understanding student perceptions, the study seeks to improve both student success in anatomy and the overall learning environment. A solid foundation in anatomy is essential for future physicians, impacting their ability to conduct research, diagnose, and treat patients effectively (9). Therefore, examining these perceptions is crucial for producing competent doctors and enhancing the quality of healthcare education at UPM, ultimately benefiting the broader healthcare system.



Additionally, studying gender and ethnicity is crucial to understanding how diverse backgrounds influence student perceptions of the anatomy curriculum, especially in the context of Malaysia's ethnic diversity (10). These factors can significantly affect how students experience and engage with their education, potentially revealing unique challenges or disparities (11). By analyzing these aspects, the study ensures the curriculum is inclusive and equitable, meeting the needs of all students. This approach helps tailor teaching methods to different learning preferences, thereby enhancing student engagement and success.

The general objective is to determine the associations between UPM clinical year medical students' sociodemographic factors and their perceptions of the preclinical anatomy curriculum as shown in the conceptual framework (**Figure 1**). Specific objectives include assessing the distribution of these factors, evaluating students' perceptions of teaching coverage, methods, and assessments, and examining how these perceptions correlate with gender, ethnicity, and year of clinical study.

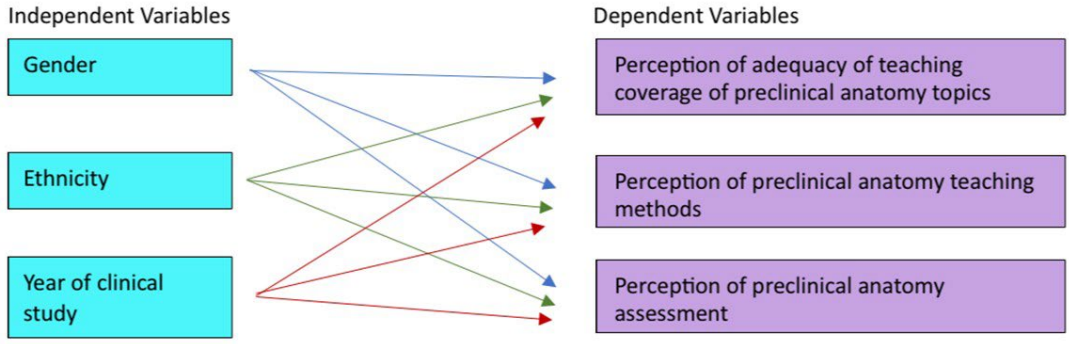


Figure 1



## METHODOLOGY

### Participant and Sampling

The study was conducted at the FMHS, UPM, targeting a total of 279 clinical medical students as potential participants. This research adopted a cross-sectional design, organizing the sampling population according to gender, ethnicity, and years of clinical study. The population included all UPM medical students enrolled in the 2023/2024 academic curriculum during their clinical years of study, specifically those in Year 3, Year 4, and Year 5. Only Year 3 to Year 5 students were selected as they had fully completed the preclinical anatomy curriculum, allowing them to reflect on its relevance during clinical training. Including Year 1 and 2 students would not provide comparable insights. The sampling

frame consisted of a comprehensive list of these students who met the inclusion criteria, with a detailed breakdown provided: Year 3 (113 students), Year 4 (93 students), and Year 5 (73 students).

**Study Design**

Each clinical medical student who met the inclusion criteria represented a sampling unit. A universal sampling method was employed, aiming to include all 279 clinical year medical students at UPM. The sample size was calculated based on previous study, resulting in different required sizes for various objectives (12). The largest sample size needed was 138 students. To accommodate a predicted non-response rate of 20%, at least 166 students were expected to participate. However, given the universal sampling method, the study targeted all 279 students. Exclusion criteria included clinical medical students who declined to participate, those with poor internet connectivity, and those who had completed a different preclinical curriculum.



The dependent variable in this study was the mean score of clinical medical students' perceptions of their anatomy education, while the independent variables included sociodemographic factors such as gender, ethnicity, and year of clinical study. The inclusion criteria required participants to be clinical medical students at UPM in the 2023/2024 academic curriculum. Exclusion criteria included students who refused to participate, those with poor internet connectivity, and those studying a different preclinical curriculum.

**Data Collection**

Data were collected using a self-administered questionnaire in English, which was divided into four parts. Part A addressed sociodemographic characteristics. Part B evaluated the adequacy of anatomy teaching coverage by systems, with adequate coverage considered as 1 mark and both too long and too short considered as 0 marks. Although both categories received the same score, they were recorded separately to distinguish the direction of perceived inadequacy, resulting in a total possible score ranging

from 0 to 12. Part C assessed the perception of teaching methods, with "strongly agree" receiving 4 marks and "strongly disagree" receiving 1 mark, yielding a range of marks between 10 and 40. Part D examined the perception of assessments, using a similar scoring system to Part C, resulting in a range of scores between 7 and 28 (**Appendix**). The validated questionnaire was adapted from previous study with their permission (12), and its reliability was tested using the Cronbach alpha test via SPSS version 29 (13).

Although the data collection relied on voluntary participation, which may introduce response bias, efforts were made to reach diverse student cohorts. The questionnaire, adapted from a validated instrument, was reviewed by an anatomist for contextual relevance. A new pilot test was deemed unnecessary due to the minimal modifications.

Ethical approval was sought from the Ethical Committee for Research Involving Human Subjects. Ethical protocols were strictly followed, ensuring the confidentiality and protection of participants' privacy. Data collection was conducted through an online survey via Google Forms, with responses automatically saved upon completion. Instructions were provided as necessary to ensure clarity.



**Data Analysis**

Before analysis, the data were cleaned and checked for any errors. Descriptive statistics were used to tabulate the data, reporting results in terms of frequency and percentage. Numerical variables were presented using mean and standard deviation if the data were normally distributed; otherwise, median and interquartile range were used. Subsequently, ANOVA or Chi-square tests were applied, and Multiple Linear Regression (MLR) was used to predict the influence of sociodemographic factors on perceptions of teaching coverage, methods, and assessments. The significance level was set at $p<0.05$. Potential biases were addressed by ensuring a robust data collection and analysis process (14). The use of a self-administered questionnaire minimized interviewer bias (15), and statistical tests were carefully chosen

based on the data distribution to avoid skewed results. Efforts were made to increase the response rate, such as follow-up reminders, to reduce non-response bias (16).

## RESULTS

The study achieved a total of 116 completed questionnaires out of a calculated sample size of 166 respondents, resulting in a response rate of 69.88%. Data collection faced limitations due to the timing, as many target respondents were undergoing assessments and exams. Additionally, some students experienced poor internet connectivity, particularly those without a reliable or strong connection at their college, which contributed to reluctance in participating. Non-response bias was also acknowledged, as approximately 30% of students did not participate, potentially skewing the results if non-respondents had different perceptions. Despite these potential biases, the study provides valuable insights into the perceptions of clinical medical students regarding their anatomy education. The findings reflect areas of strength and those needing improvement in the curriculum, informing future enhancements to better meet students' needs.



The internal consistency of the questionnaire was confirmed through Cronbach's alpha reliability testing. The perception of teaching coverage adequacy had a Cronbach's alpha of 0.831, indicating high reliability. The perception of teaching methods section had a Cronbach's alpha of 0.798, also reflecting good reliability. The perception of anatomy assessment section had a Cronbach's alpha of 0.745, indicating acceptable reliability. These results propose that the questionnaire items were reliably measuring the students' perceptions of the anatomy curriculum.

Normality testing for teaching coverage adequacy, teaching methods, and anatomy assessment was conducted using Skewness & Kurtosis, the Shapiro-Wilk test, the Kolmogorov-Smirnov test, histograms with a normal curve, and Q-Q plots via SPSS version 29.0 (**Table 1**). These observations point to that teaching coverage adequacy and anatomy assessment data were not normally distributed, while the teaching method data appeared to be normally distributed.

Descriptive analysis of sociodemographic characteristics showed that the majority of respondents were male (59.5%) and Malay (43.1%). The respondents were fairly evenly distributed across the clinical years, with the largest group being Year 3 students (48.3%) (**Table 2**).

**Table 1**: Normality Testing of Dependent Variables.

| Variables | Skewness/ SE | Kurtosis/ SE | Kolmogorov-Smirnov | Shapiro-Wilk | Histogram | Q-Q Plot |
|---|---|---|---|---|---|---|
| **Teaching Coverage Adequacy** | -6.782 (Not Normal) | 5.330 (Normal) | <0.001 (Not Normal) | <0.001 (Not normal) | Skewed to Left | Almost Normal |
| **Teaching Method** | 0.249 (Normal) | -0.883 (Normal) | 0.015 (Not Normal) | 0.008 (Not normal) | Normal | Normal |
| **Anatomy Assessment** | -2.674 (Not Normal) | 2.220 (Not Normal) | 0.002 (Not Normal) | 0.004 (Not normal) | Normal | Normal |

**Table 1:** This table summarises the normality tests for dependent variables, including skewness, kurtosis, Kolmogorov-Smirnov, Shapiro-Wilk tests, and visual assessments via histograms and Q-Q plots. Most normally distributed data was observed only in Teaching Method variable.



**Table 2**: Sociodemographic characteristics.

| Independent Variable | | Frequency (n) | Percentage (%) |
|---|---|---|---|
| **Gender** | **Male** | 69 | 59.5 |
| | **Female** | 47 | 40.5 |
| **Ethnicity** | **Malay** | 50 | 43.1 |
| | **Chinese** | 20 | 17.2 |
| | **Indian** | 40 | 34.5 |
| | **Others** | 6 | 5.17 |

| | | | |
|---|---|---|---|
| **Year of Clinical Study** | **Year 3** | 56 | 48.3 |
| | **Year 4** | 32 | 27.6 |
| | **Year 5** | 28 | 24.1 |

| **Dependent Variable** | **Mean (SD)** | **Median (IQR)** |
|---|---|---|
| **Teaching Coverage Adequacy** | | 11 (4) |
| **Teaching Method** | 39.77 (4.646) | |
| **Anatomy Assessment** | | 23 (5) |

**Table 2**: The table presents the sociodemographic characteristics of the respondents, including gender distribution, ethnicity, and year of clinical study. It also provides the mean and median values for teaching coverage adequacy, teaching methods, and anatomy assessment.



Furthermore, descriptive analysis of teaching coverage adequacy exhibited majority of students find the teaching coverage for the cardiovascular, respiratory, urinary, reproductive, and endocrine systems to be adequate, as indicated by the predominance of red bars in these categories (**Figure 2**). However, certain areas such as the musculoskeletal system and clinical correlation classes are perceived by many students as being too short, highlighted by the presence of blue bars. Conversely, classes on the central nervous system, developmental anatomy (embryology), and microscopic anatomy (histology) are often viewed as too long, represented by the orange bars.

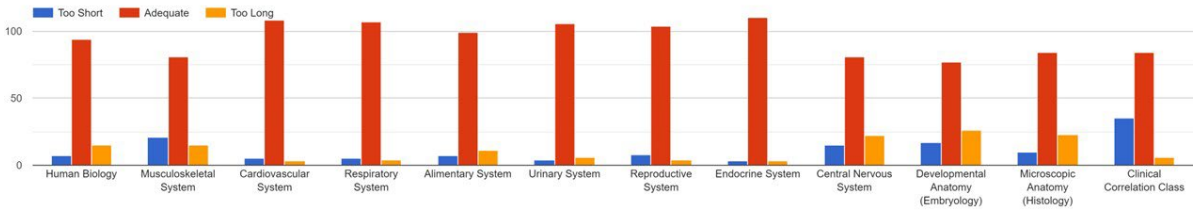


Figure 2

The bar charts in **Figures 3** provide insights into the perceptions of clinical students regarding the effectiveness of various teaching methods in understanding and retaining anatomy knowledge at UPM. The majority of students believe that practical sessions are highly beneficial for understanding anatomy, as indicated by the high "Strongly Agree" and "Agree" responses, while early clinical exposure sessions are not perceived as helpful. Similarly, in retaining anatomy knowledge, practical sessions again received strong positive feedback, whereas student-centered learning (SCL), problem-based learning (PBL), and early clinical experiences (ECE) were not perceived as effective.

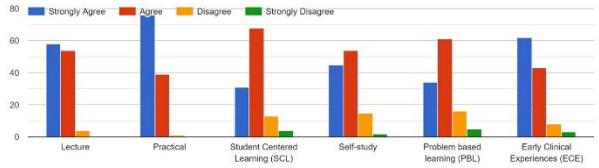


Figure 3a

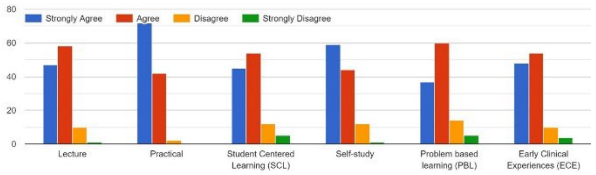


Figure 3b

The bar graph in **Figure 4** illustrates various perception responses to different anatomy assessment methods in retaining anatomy knowledge. The SBAQ and OSPE methods perceived the highest levels of strong agreement. EMI and MEQ also had significant levels of agreement, though they also had notable disagreement. MTF and OSCE had a mixed distribution, with both high agreement and disagreement levels. SAQ was relatively balanced across all response categories. This recommends varying preferences and perceptions of effectiveness across different anatomy assessment methods, with a general trend towards favouring more structured and objective formats.

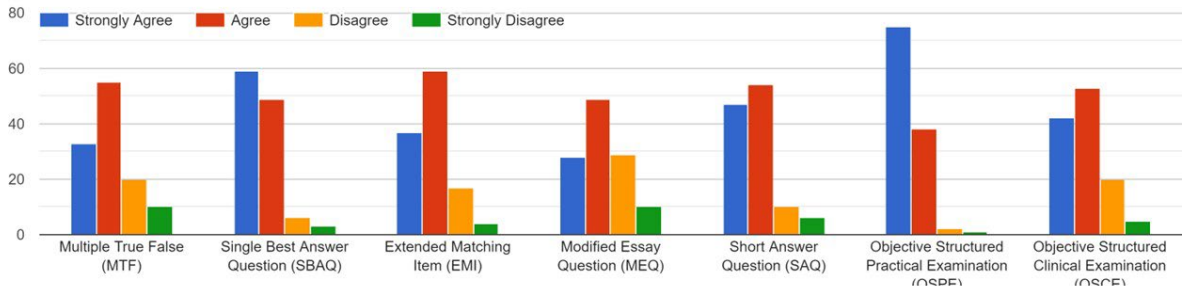


Figure 4

Further analysis revealed no statistically significant differences in teaching coverage adequacy perceptions based on gender, ethnicity, or year of clinical study, as determined by Kruskal-Wallis H tests (**Table 3**). Similarly, one-way ANOVA tests showed no significant differences in teaching method perceptions across these variables (**Table 4**). For anatomy assessment perceptions, Kruskal-Wallis H tests again indicated no significant differences across gender, ethnicity, or year of clinical study (**Table 5**).



**Table 3:** Association between Sociodemographic Factors with Perception of Teaching Coverage Adequacy.

| Dependent Variable | Gender | n | Median (IQR) | Chi-square statistic (df) | p-value |
|---|---|---|---|---|---|
| **Teaching coverage adequacy** | Male | 47 | 11 (4) | 16.292 | 0.162 |
| | Female | 69 | 11 (3) | | |

**Table 3a:** A Kruskal-Wallis H test shows that there was not a statistically significant difference in teaching coverage adequacy between the different gender, $\chi^2(1) = 16.292$, $p = 0.162$.

| Dependent Variable | Ethnicity | n | Median (IQR) | Chi-square statistic (df) | p-value |
|---|---|---|---|---|---|
| **Teaching coverage adequacy** | Malay | 50 | 11 (3) | 31.407 | 0.814 |
| | Chinese | 20 | 11.5 (4.25) | | |

| | | |
|---|---|---|
| Indian | 40 | 11 (3.25) |
| Others | 6 | 10 (1.5) |

**Table 3b:** A Kruskal-Wallis H test shows that there was not a statistically significant difference in teaching coverage adequacy between the different ethnicities, $\chi^2(1) = 31.407$, $p = 0.814$.

| Dependent Variable | Year of Clinical Study | n | Median (IQR) | Chi-square statistic (df) | p-value |
|---|---|---|---|---|---|
| **Teaching coverage adequacy** | Year 3 | 56 | 11 (4) | 26.235 | 0.427 |
| | Year 4 | 32 | 12 (4) | | |
| | Year 5 | 28 | 10.50 (3) | | |

**Table 3c:** A Kruskal-Wallis H test shows that there was not a statistically significant difference in teaching coverage adequacy between the different years of clinical study, $\chi^2(1) = 26.235$, $p = 0.427$.

**Table 4:** Association between Sociodemographic Factors with Perception of Teaching Method.

| Gender | Sum of Squares | df | Mean Square | F | p-value |
|---|---|---|---|---|---|
| **Between Groups** | 17.407 | 1 | 17.407 | 0.805 | 0.372 |
| **Within Groups** | 2465.308 | 114 | 21.626 | | |
| **Total** | 2482.716 | 115 | | | |

**Table 4a:** There was no statistically significant differences between group means as determined by one-way ANOVA $F(1,114) = 0.805$, $p = 0.372$

| Ethnicity | Sum of Squares | df | Mean Square | F | p-value |
|---|---|---|---|---|---|
| **Between Groups** | 64.357 | 3 | 21.452 | 0.994 | 0.399 |
| **Within Groups** | 2418.358 | 112 | 21.592 | | |
| **Total** | 2482.716 | 115 | | | |

**Table 4b:** There was no statistically significant differences between group means as determined by one-way ANOVA $F(3,112) = 0.994$, $p = 0.399$.

| Year of Clinical Study | Sum of Squares | df | Mean Square | F | p-value |
|---|---|---|---|---|---|
| **Between Groups** | 30.104 | 2 | 15.052 | 0.693 | 0.502 |
| **Within Groups** | 2452.612 | 113 | 21.705 | | |

| | | |
|---|---|---|
| **Total** | 2482.716 | 115 |

**Table 4c:** There was no statistically significant differences between group means as determined by one-way ANOVA $F$ (2,113) = 0.693, $p$ = 0.502.

**Table 5:** Association between Sociodemographic Factors with Perception of Anatomy Assessment.

| Dependent Variable | Gender | n | Median (IQR) | Chi-square statistic (df) | p-value |
|---|---|---|---|---|---|
| **Anatomy Assessment** | Male | 47 | 23 (5) | 14.074 | 0.217 |
| | Female | 69 | 23 (4) | | |

**Table 5a:** A Kruskal-Wallis H test showed that there was not a statistically significant difference in anatomy assessment between the different gender, $\chi^2(1) = 14.074$, $p = 0.217$.

| Dependent Variable | Ethnicity | n | Median (IQR) | Chi-square statistic (df) | p-value |
|---|---|---|---|---|---|
| **Anatomy Assessment** | Malay | 50 | 23 (5) | 40.013 | 0.898 |
| | Chinese | 20 | 22.5 (3.25) | | |
| | Indian | 40 | 21.5 (5.25) | | |
| | Others | 6 | 22.5 (3.25) | | |



**Table 5b:** A Kruskal-Wallis H test showed that there was not a statistically significant difference in anatomy assessment between the different ethnicities, $\chi^2(2) = 40.013$, $p = 0.898$.

| Dependent Variable | Year of Clinical Study | n | Median (IQR) | Chi-square statistic (df) | p-value |
|---|---|---|---|---|---|
| **Anatomy Assessment** | Year 3 | 56 | 23 (5) | 23.119 | 0.964 |
| | Year 4 | 32 | 22.5 (4) | | |
| | Year 5 | 28 | 23 (5.25) | | |

**Table 5c:** A Kruskal-Wallis H test showed that there was not a statistically significant difference in anatomy assessment between the different years of clinical study, $\chi^2(2) = 23.119$, $p = 0.964$.

Multiple regression analyses were performed to predict perceptions of teaching coverage adequacy, teaching methods, and anatomy assessments from gender, ethnicity, and year of study (**Table 6**). None of these sociodemographic factors were statistically significant predictors for any of the dependent variables. The overall models did not significantly predict the perceptions, as indicated by the p-values exceeding the 0.05 threshold.

**Table 6:** Predictors of Sociodemographic Factors on Dependent Variables.

| | **Unstandardized Coefficients** | | **Standardized Coefficients** | | | **95.0% Confidence Interval for B** | |
|---|---|---|---|---|---|---|---|
| **Model** | B | Std. Error | Beta | t | Sig. | Lower Bound | Upper Bound |
| **(Constant)** | 8.407 | 0.972 | | 8.653 | <0.001 | 6.482 | 10.332 |
| **Gender** | 0.715 | 0.506 | 0.133 | 1.413 | 0.160 | -0.288 | 1.717 |
| **Ethnicity** | -0.096 | 0.248 | -0.036 | -0.385 | 0.701 | -0.587 | 0.396 |
| **Year of Study** | 0.210 | 0.304 | 0.065 | 0.690 | 0.491 | -0.393 | 0.813 |

**Table 6a:** A multiple regression test was run to predict teaching coverage from gender, ethnicity & year of study. These independent variables not statistically significantly predicted teaching method, $F$ (3, 112) = 0.993, $p$ =0.399, $R^2$ = 0.026. All three variables added were not statistically significantly to the prediction, $p < 0.05$.



**DISCUSSION**

It can be inferred that this study reflect positively on the current anatomy curriculum at UPM, as perceived by clinical medical students. One strength of this study is the high reliability of the questionnaire, as indicated by Cronbach's alpha values of 0.831 for teaching coverage adequacy, 0.798 for teaching methods, and 0.745 for anatomy assessments. These reliability measures ensure that the questionnaire items consistently captured the students' perceptions, adding robustness to our results (17).

The generally positive feedback on teaching coverage adequacy, teaching methods, and anatomy assessments indicates that the curriculum is meeting students' expectations and needs effectively. This concludes that UPM has successfully implemented teaching strategies that resonate with students from diverse sociodemographic backgrounds, fostering a supportive learning environment conducive to acquiring anatomical knowledge (18). The multiple regression analysis confirmed that none of the sociodemographic factors significantly predicted students' perceptions of teaching coverage, methods, or assessments. These findings imply that students across diverse backgrounds share similar experiences and attitudes toward the anatomy curriculum. The non-significant results may reflect the effectiveness of a standardized and inclusive curriculum design, a goal increasingly emphasized in modern medical education (19). While this is encouraging, it is also possible that structural consistency in curriculum delivery limits variability in student experiences. Additionally, other factors such as prior academic background, language proficiency, or preferred learning styles known to influence educational outcomes were not captured in this study and warrant future exploration (11).



These positive findings are indicative of several strengths within the anatomy curriculum at UPM. Firstly, the integration of various teaching methods, including problem-based learning (PBL), student-centered learning, blended learning, practical sessions, and digital tools such as the Complete Anatomy Application, demonstrates a commitment to innovation and student engagement (20). By employing a diverse range of instructional approaches, UPM has catered to different learning preferences and styles, ensuring that clinical medical students have multiple avenues to acquire and retain anatomical knowledge effectively (21). This approach aligns with best practices in medical education, where active learning methods have been shown to enhance student learning outcomes and satisfaction (22).

It becomes evident that while core systems like cardiovascular and respiratory are well-covered, there is a need to balance the duration and depth of coverage in areas like the musculoskeletal system and clinical correlation classes. The high agreement levels for SBAQ and OSPE in retaining anatomy knowledge advocate that students favour assessment methods that align with well-covered and adequately taught systems (23). Conversely, the perceived inadequacy in certain teaching areas, such

as the musculoskeletal system, might correlate with the mixed responses for less favoured assessment methods like MTF and OSCE. This alignment highlights the importance of ensuring that teaching coverage and assessment methods are well-coordinated to meet student expectations and educational needs, providing a comprehensive yet efficient learning experience (24). The musculoskeletal system was perceived as inadequately covered, possibly due to its complex, high-volume content and limited integration with clinical scenarios during preclinical years. Students strongly favoured practical sessions, aligning with international literature which shows hands-on approaches enhance anatomical understanding and retention. Although blended and digital tools were incorporated, they were perceived as less effective, underscoring a need to balance innovation with traditional, tactile teaching methods. Thus, these insights can be instrumental in refining both the curriculum and assessment strategies to enhance the overall educational experience for medical students (25).



Collectively, the results demonstrate no significant differences in perceptions of teaching coverage adequacy, teaching methods, and anatomy assessments based on gender and ethnicity. It seems that the anatomy curriculum at UPM is inclusive and effectively meets the needs of a diverse student population. The absence of significant disparities indicates that the current educational strategies are equitable, providing a consistent learning experience across different demographic groups. This is a positive outcome, reflecting that the curriculum does not favor any particular gender or ethnic group, thereby promoting equal learning opportunities. Ensuring that all students, regardless of their background, perceive the curriculum similarly supports the development of a diverse and competent medical workforce (6). This finding underscores the importance of maintaining and enhancing inclusive teaching practices, which are crucial for preparing future medical professionals to work effectively in a multicultural and diverse society (26). Moreover, it highlights the effectiveness of UPM's efforts to create an equitable educational environment, which can serve as a model for other medical institutions aiming to achieve similar goals.

Overall, the positive findings of this study reflect UPM's commitment to providing high-quality anatomy education to its clinical medical students. It may also offer valuable insights for medical

institutions globally, particularly those adopting integrated curricula or facing similar challenges in maintaining long-term anatomical knowledge retention. The strong student preference for practical sessions and structured assessments such as OSPE and SBAQ highlights the enduring importance of hands-on learning, even within digitally enhanced or problem-based programs. Institutions worldwide may benefit from aligning teaching delivery with students' learning preferences and providing balanced coverage across systems. Moreover, the inclusive reception of teaching methods across gender and ethnic groups supports the applicability of this curriculum model in diverse, multicultural settings. As many medical schools move toward competency-based and student-centered education, the integration of equitable, practical-focused strategies as seen at UPM could serve as a model for curriculum development, especially in low- and middle-income countries where similar resource and diversity constraints exist (21). By leveraging innovative teaching methods, fostering student engagement, and ensuring equity and inclusivity, UPM has developed a curriculum that effectively prepares students for clinical practice. Moving forward, UPM can build upon these strengths by continuing to evaluate and update the curriculum based on student feedback and emerging educational trends, ensuring that it remains relevant and responsive to the evolving needs of medical students and the healthcare landscape.



Students' preference for practical sessions may stem from the hands-on, visual, and spatial nature of anatomy learning, which helps reinforce complex three-dimensional relationships. Conversely, less favourable responses toward early clinical exposure could be due to limited prior clinical context during preclinical years, making it challenging for students to link anatomical theory with practice (5). The perceived inadequacy in musculoskeletal and clinical correlation sessions might also reflect the high content volume and limited teaching hours allocated, a challenge frequently reported in anatomy education worldwide (25). These factors collectively highlight that student satisfaction is closely linked to the clarity, contextual relevance, and time allocation of anatomy teaching.

While the study provides valuable insights into the perceptions of clinical medical students regarding their anatomy education, it is essential to recognize and address potential biases. Future research should aim to mitigate these biases through improved sampling methods, mixed data collection approaches,

and robust questionnaire design (27). By doing so, the findings can more accurately inform curriculum enhancements, ultimately leading to better-prepared medical professionals.

## CONCLUSION

The study provides valuable insights into clinical medical students' perceptions of the anatomy curriculum at UPM. Overall, the findings indicate that the curriculum is well-received and supports effective learning across diverse student groups. The results highlight the importance of maintaining practical, student-centred teaching approaches and ensuring balanced system coverage to enhance learning outcomes. Strengthening hands-on anatomy teaching and aligning instructional methods with student preferences may further improve curriculum relevance and effectiveness. Future curriculum reviews should also consider feedback from both preclinical and clinical cohorts to ensure continuity and integration of anatomical knowledge throughout medical training.



## LIMITATION AND RECOMMENDATION

Although the study employed a universal sampling method targeting all 279 clinical students, only 116 responses were obtained, with fewer participants from Year 4 and Year 5. This uneven representation may limit the generalizability of the findings. Additionally, non-response bias could have occurred, as students who did not participate may hold different perceptions of anatomy teaching and assessment compared to those who responded. To minimize this limitation, follow-up reminders were sent to encourage participation, and responses were collected over an extended period to accommodate students' schedules. Nevertheless, the findings should be interpreted with caution, as they may not fully represent the perceptions of the entire clinical student population. Future studies should employ stratified or mixed sampling strategies to ensure more balanced representation across academic years and to further reduce potential response bias.

Additionally, future curriculum enhancement should focus on strengthening the integration between anatomy and clinical practice through case-based and cadaveric correlation sessions. Increasing the duration and depth of musculoskeletal and clinical correlation topics could address current gaps. The inclusion of more interactive, multimodal approaches such as 3D visualization tools, small-group dissections, and simulation-based anatomy sessions may improve engagement and retention. Additionally, routine feedback collection from students after each system block could guide continuous improvement in teaching effectiveness and curriculum alignment.

**ACKNOWLEDGEMENT**

We would like to extend our deep appreciation to the batch representatives from different clinical years for their invaluable contributions to our study. We are grateful to the one hundred and sixteen undergraduate clinical medical students from the FMHS, UPM in the 2023/2024 session, who willingly participated in our study, dedicating their valuable time and providing insightful responses. We extend our heartfelt appreciation to the Ethics Committee for Research Involving Human Subjects (JKEUPM-2024-133) for granting ethical approval for our study.



**AUTHORS CONTRIBUTION**

RA performed the conceptualization. NFBL, AFAS and PSR conducted the investigation, while AINMN validated the findings. All authors contributed to the writing, review, and editing process.

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**APPENDIX**

**QUESTIONNAIRE**

**PERCEPTION OF ANATOMY CURRICULUM AMONG**

**CLINICAL MEDICAL STUDENTS IN UPM**



**Part A: Participants Information**

Instructions: Please put a tick (√) in the box of the answer of your choice.

1. **Gender**

- Male
- Female

2. **Ethnicity**

- Malay
- Chinese
- Indian
- Others

3. **Year of Study**

- Year 3
- Year 4
- Year 5

**Part B: Adequacy on teaching coverage of preclinical anatomy for clinical training.**

Instructions: Mark only one answer per row

4. **Do you think the preclinical anatomy teaching coverage is adequate for your clinical training?**

| | Too short | Adequate | Too long |
|---|---|---|---|
| Human Biology | | | |
| Musculoskeletal | | | |
| Cardiovascular System | | | |
| Respiratory System | | | |
| Alimentary System | | | |
| Urinary System | | | |
| Reproductive System | | | |
| Endocrine System | | | |
| Central Nervous System | | | |
| Developmental Anatomy (Embryology) | | | |
| Microscopic Anatomy (Histology) | | | |
| Clinical Correlation Class | | | |



**Part C: Perception on teaching methods**

Instructions: Mark only one answer per row

5. **Do you think the following teaching methods help in understanding anatomy?**

| | Strongly agree | Agree | Disagree | Strongly Disagree |
|---|---|---|---|---|
| Lecture | | | | |
| Practical | | | | |
| Student Centred Learning (SCL) | | | | |
| Self-study | | | | |
| Problem based learning (PBL) | | | | |

**6. Do you think the following teaching methods help in retaining anatomy knowledge?**

| | Strongly agree | Agree | Disagree | Strongly Disagree |
|---|---|---|---|---|
| Lecture | | | | |
| Practical | | | | |
| Student Centred Learning (SCL) | | | | |
| Self-study | | | | |
| Problem based learning (PBL) | | | | |

**Part D: Perception on Assessment**

Instruction: Mark only one answer per row.

**7. Which of the following examination format helps you to retain anatomy knowledge?**

| | Strongly Agree | Agree | Disagree | Strongly Disagree |
|---|---|---|---|---|
| Multiple True False (MTF) | | | | |
| Single Best Answer Question (SBAQ) | | | | |
| Extended Matching Item (EMI) | | | | |
| Modified Essay Question (MEQ) | | | | |
| Short Answer Question (SAQ) | | | | |
| Objective Structured Practical Examination (OSPE) | | | | |
| Objective Structured Clinical Examination (OSCE) | | | | |