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# Correlating histology examination performance with histopathology examination results in longitudinally followed pre-clinical students: a comparative analysis

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## ABSTRACT

**Background and Objective:** In the undergraduate medical curriculum, various subjects synergize throughout the years, culminating in the completion of the MBBS course. Proficiency in comprehending the normal histological structure of the human body is imperative, enabling a comprehensive understanding of the microscopic foundations and the diagnosis of diseases during one's medical education. This study was therefore designed to compare and contrast the MBBS students' examination performance in Histology with that of Histopathology through a longitudinal follow up in a medical school in the Kingdom of Saudi Arabia (KSA).

**Methods:** The study sample comprised of MBBS students of the College of Medicine, Northern Border University, Arar, KSA, who had completed final examinations for both subjects between the academic year 2016 and 2021, excluding the academic year affected by the Coronavirus disease of 2019. Mean scores for the two subjects were computed, and statistical analysis, including the calculation of *p*-values, was performed using statistical software.

**Results:** The mean scores of Histology and Histopathology, calculated as percentages, of 75.6 and 77.26, respectively, exhibited a striking similarity, indicating a robust correlation ( $p < 0.001$ ) between the averages of the two subjects.

**Conclusion:** The study suggests that under typical circumstances, a solid grasp of Histology enhances the subsequent comprehension of Histopathology. Students with a thorough understanding of normal human tissue in Histology score better in Histopathology thus predicting changes or disruptions in pathological samples with increased accuracy.

**Keywords:** MBBS, curriculum, grades, histology, histopathology, medical students, preclinical, scores.

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## Introduction

Histology is the study of the microscopic details of human tissues and organs<sup>1</sup>. It is crucial to comprehend the intricacy of cell and tissue organization and function because it is a pre-clinical medical subject<sup>2,3</sup>. For individuals entering the medical profession, it is imperative to have a grasp of the typical architecture and operation of organs, as this knowledge forms the basis for understanding Pathology in advanced stages of medical education<sup>4</sup>. A thorough comprehension of the standard microscopic structure of human tissues and organs is essential for comprehending how alterations in the human body's structure, which can be investigated by a Pathologist, relate to disease mechanisms<sup>5</sup>.

Integration of Histology and Pathology into the curriculum in the preclinical years of medical school holds significance in kindling students' fascination with microscopic Anatomy. Furthermore, it calls for the rationale behind developing Histology courses that place a strong emphasis on applying knowledge within a clinical context<sup>6</sup>.

In the undergraduate medical curriculum, several subjects complement each other throughout the duration of the MBBS course. Among these subjects, Anatomy stands out as both fundamental and extensive, encompassing various branches. Microscopic Anatomy, in particular, holds a significant role as a crucial subfield within the realm of Anatomy.

Similarly, Histopathology is a branch of Pathology that can be considered as a clinical extension of Histology. Understanding the normal histological structure of the human body is necessary; as only then can one get a picture of the microscopic basis and diagnoses of diseases during one's medical school years.

Comprehending the microscopic foundations of diseases holds paramount importance and, in numerous instances, can be a critical factor in a patient's life or death. Patients, particularly those undergoing surgery or needing early diagnosis of their tumors, often require swift assessments of their disease's stage from a qualified Pathologist, ideally one that has been trained in Histopathology. This stresses the value of clinicians possessing knowledge in both Histology and Pathology, as Histology serves as a valuable foundation for grasping the intricacies of Pathology.

Since Histopathology involves the microscopic study of diseased tissues, students who possess knowledge of normal tissue structure, i.e., a solid understanding of Histology, are better equipped to anticipate and identify abnormalities in the microscopic structure of tissues<sup>7</sup>.

Acquiring knowledge in Histology and engaging in Histopathology practice form the cornerstone of a thriving medical practice. Recent years have witnessed a significant evolution in medical education, moving toward an integrated curriculum that blends basic scientific principles with clinical content. Simultaneously, there has been a transition from traditional lecture-based teaching to a problem-based learning approach<sup>8</sup>. Both Histology and Pathology can serve as valuable tools to evaluate an individual's understanding and awareness of risk factors and symptoms linked to different tumors<sup>9,10</sup>.

In the land of medicine, across all specialties, the interpretation of visual cues is paramount. This skill enables healthcare professionals to identify patterns, formulate diagnoses, and effectively synthesize intricate data, ultimately facilitating the delivery of comprehensive and meaningful care to patients.<sup>2</sup>

Numerous innovative techniques are continually emerging to render these subjects more engaging, attractive, and digestible for students. It is worth noting that both Histology and Histopathology extend beyond disease interpretation and can also be applied to the study of inheritance patterns<sup>5</sup>. Their wide-ranging applications underscore the importance of medical students possessing a robust comprehension of both subjects.<sup>8</sup>

The use of histopathological examples in early-year practical Histology lessons has been found to increase students' interest in the material. It not only enhances students' engagement with the material but also improves

their ability to remember and understand microscopic morphology<sup>7</sup>.

Previous literature was found to be deficient in comparing the two sisterly subjects; hence, the current study was designed with the primary objective of conducting a comparative analysis of the examination scores for both Histopathology and Histology and correlating them with the students' performance and complimenting comprehension for both the subjects at a medical school in Kingdom of Saudi Arabia (KSA).

## Methods

This longitudinal follow-up study was conducted at the College of Medicine, Northern Border University (NBU), Arar, KSA, for the students enrolled for Histology and Histopathology final examinations from the academic year 2016-2021.

The project was approved by the Deanship of Post Graduate Studies and Scientific Research's Local Committee of Bioethics at NBU, KSA.

The sample population consisted of MBBS students appearing in the examinations of Histology and subsequently taking Histopathology in the next semester. Students of the Coronavirus disease of 2019 year were excluded from the study so that the results form a good representation pool for the study.

A total number of 718 students for Histology and 685 students for Histopathology, of both genders comprised the study group. Student data were obtained from the examination department for the specified years as Excel sheets and their mean scores were fed into Statistical Package for Social Sciences (SPSS) software for final analysis. A simplified comparison was first done between the means of the individual groups for the same year longitudinally and then the complete mean scores obtained for the two subjects were fed into SPSS to get the  $p$ -value.

The SPSS software segregated the students into male and female genders for the same subjects and subsequent separate calculations for the two. Data were fed in such a way that the identity of the students was kept confidential.

Students with GPAs less than 2.0 or who were barred from the final examinations for any reason were excluded from the study so that they would not influence the mean scores.

## Statistical analysis

The data were analyzed using I SPSS software version 24.0. The mean and average percentage of scores were calculated for quantitative variables and compared by using a  $t$ -test.

A  $p$ -value of less than or equal to 0.05 was considered significant.

## Results

The study group comprised a total number of 1,403 students (718 for Histology and 685 for Histopathology). Out of this, 49.3% ( $n = 693$ ) of the students were males while 50.7% ( $n = 710$ ) were females (Table-1).

Notably, the majority of students in the Histology group were males ( $n = 360$ ), whereas the inverse was observed in the Histopathology group ( $n = 352$ ). Furthermore, a decrease in the total number of students was evident in the Histopathology ( $n = 685$ ) as compared to Histology ( $n = 718$ ).

Interestingly, despite the decrease in the overall number of students in the Pathology group, the mean scores for both Histology ( $75.60 \pm 0.94$ ) and Histopathology score ( $77.26 \pm 0.98$ ) were closely aligned, suggesting a positive trend toward Pathology. This trend was reinforced by an increase in the mean score for Histopathology, even with a smaller student population.

It was seen that the mean score for the students of Histopathology increased in the upcoming years when compared to their mean scores in the previous years of Histology.

Upon calculating the  $p$ -value using a  $t$ -test, a significant difference emerged between the two groups, underscoring the noteworthy distinctions in performance between Histology and Pathology Histopathology among the study participants ( $p < 0.0001$ ) (Table 2).

## Discussion

Histology, being integral to comprehending the normal structure and function of tissues and organs, forms the bedrock for several medical disciplines, including Anatomy, Physiology, Embryology, and Cell biology.<sup>11</sup> In contrast, Pathology assumes a more direct role in diagnosing diseases, characterizing their nature and extent, and determining appropriate treatment modalities and hence is considered as a preferred discipline to medical students in comparison to purely basic science subjects<sup>12</sup>. Notably, the present study reports a robust correlation in mean scores between genders for both subjects, suggesting a consistent and complementary acquisition of knowledge irrespective of gender. However, a notable longitudinal increase in the mean scores of Histopathology when compared to Histology is observed. This intriguing trend persisted even in the face of a decrease in the overall number of students enrolled in the Histopathology course. It was speculated that this reduction in student numbers could be attributed to factors such as dropouts or academic relegation over the course of their medical school tenure, a plausible outcome as students' progress through their academic journey.

The majority of medical schools now provide integrated curricula instead of discipline-based ones. For fields such

as gross anatomy and histology, stand-alone practical tests are frequently kept in place, even though the adoption of integrated examinations typically goes hand in hand with this shift.<sup>13</sup>

The increasing use of integrated curriculum and interdisciplinary evaluations in medical education necessitates ongoing educational study on the benefits, drawbacks, and difficulties associated with integration methods. The number of items required to accurately evaluate anatomical knowledge in the context of gross Anatomy and Histology was examined in a retrospective analysis done at the University of Alabama School of Medicine and Rush University Medical College. It was deduced that 30 and 25 items would be needed on each written and practical examination to reach a reliability of 80%. The final examination used in the present study used 60 MCQs for both examinations and hence the results are validated for our study.<sup>14</sup> Significantly, both Histology and Histopathology adhered to identical assessment methods and grading standards. This strategic choice allowed that the mean scores derived from these courses would be more faithfully representative of each other, providing a foundation for an accurate comparison.<sup>15</sup> Similar studies have been found in the previous literature for students of clinical years also, and one study was found to be done at two separate medical schools for students of Surgery thus concluding that higher and lower performing students within a class perform in a similar fashion on subsequent examinations within the intensely structured environment, whether the course is graded or not.<sup>16</sup>

**Table 1.** This table shows the gender distribution for the study groups.

Subject	Gender	Number(%) of students
Histology	Male	360 (50.13)
	Female	358 (49.86)
Total		718
Histopathology	Male	333 (48.61)
	Female	352 (51.38)
Total		685

**Table 2.** The table shows the mean percentage scores of the students subject wise.

Subject	Gender	Mean % score	SEM	$p$ -value
Histology	Male	72.84	1.07	$p < 0.001$
	Female	78.36	0.83	
Total		75.60	0.94	
Histopathology	Male	74.95	1.08	
	Female	79.57	0.88	
Total/Avg		77.26	0.98	

Although done around two decades ago, a similar study showed that students showed a great deal of initiative in investigating the histological characteristics of tissues, detecting the alterations in different pathological states, and understanding how these changes relate to clinical symptoms. The approach could help in ensuring that learning remains both meaningful and interesting.<sup>17</sup> As the two courses are run at two separate and different years of the time, and in regular order, i.e., Histology is taught in the first two years and Pathology in the third year of the MBBS, so this order addresses the potential sources of bias for our study. Both Histology and Pathology adopted similar pedagogical approaches, incorporating lectures and practical teachings in laboratories through microscopes. Similar findings with emphasis on curricular integration between Histology and Histopathology have been proposed by Al Khader et al.<sup>18</sup> stating that the prior knowledge of Histology correlates well with the successful understanding of Histopathology in the subsequent years. This uniformity in teaching methods was considered instrumental in supporting the assertion that the study results are genuinely representative of the actual educational landscape. Furthermore, the study emphasized that the sample size was adequately robust, instilling confidence in the reliability of the conclusions drawn.

### Conclusion

It is concluded that a significant correlation exists between the Histology and Histopathology performance of medical students as depicted through their mean scores in both subjects longitudinally. Students with a thorough understanding of the normal human tissue in Histology score better in Histopathology, thus, predicting changes or disruptions in pathological samples with increased accuracy.

### Limitations of the study

This study did not investigate the students' behavior, potential impact of study habits, motivation, and engagement on their academic performance. It was acknowledged that variations in individual interest and passion for a particular subject could significantly influence scores, with those students more ardently invested in a given subject likely to dedicate additional time and effort, thereby yielding higher scores. Therefore, the authors suggest a multicenter study with an increased number of students and academic years to further authenticate the results of this study.

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### List of Abbreviations

AVG	Average
COVID-19	Coronavirus disease of 2019
KSA	Kingdom of Saudi Arabia.
NBU	Northern Border University
SEM	Standard Error of Mean.
SPSS	Statistical Package for Social Sciences

### Conflicts of interest

None to declare.

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### Ethical approval

NBU Vice-President Office for Post Graduate Studies and Scientific Research's Local Committee of Bioethics [HAP-09-A-043] at NBU approved the study vide its decision no. [46/44/H] dated 11/06/2023 during its 5th meeting for the academic year 2023 held on 16/05/2023.

### Authors' contributions

**WA:** Conception and design of the study, data collection, drafting of the manuscript, analysis, and interpretation of data.

**SS:** Conception and design of the study, drafting of the manuscript, analysis, and interpretation of data.

**ALL AUTHORS:** Approval of the final version of the manuscript to be published.

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