

Undergraduate Medical Students Perception of Immunology Learning Process: A Cross-sectional Questionnaire-based Study from a Tertiary Care Teaching Hospital

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Received June 02, 2021; Revised July 05, 2021; Accepted July 18, 2021

Abstract Background: Undergraduate medical education constitutes the preparation of the students towards a broad understanding of human anatomy, physiology, and several other basic, allied, medical, and surgical subjects. Immunology is an integral, and interdisciplinary subject among them, which is generally perceived by the students as a complex one to understand and apply in practice. **Methods:** A cross-sectional questionnaire-based study was undertaken among the II MBBS students to understand their perception regarding learning experiences of immunology as a subject. The study included 157 students, and all had given oral consent to participate in the study. The data collected from the study were entered into a Microsoft Excel sheet and were used to analyze and generate graphs and tables. **Results:** More than 90% (n=157) of the students believed that immunology is an integral part of medicine and medical research, and 85% of the students felt that knowledge of immunology is essential while doing clinical practice. Only 58% of students had enjoyed the immunology learning process, and at least 20% of them were unsure if the knowledge in immunology will be of any help to understand other areas of medicine. **Conclusions:** Students perceive immunology as an important subject that helps them to practice medicine and research. A general perception prevailed among the students regarding the complexity of immunology as a subject, wherein most of them felt that the learning process could be further improved with the use of audio-visual aids and patient/case-oriented/practical teaching.

Keywords: *undergraduate, medical education, immunology, learning process*

Cite This Article: Sabitha Vadakedath, and Venkataramana Kandi, "Undergraduate Medical Students Perception of Immunology Learning Process: A Cross-sectional Questionnaire-based Study from a Tertiary Care Teaching Hospital." *American Journal of Educational Research*, vol. 9, no. 7 (2021): 449-456. doi: 10.12691/education-9-7-9.

1. Introduction

Immunology is a subject that falls under the purview of the branch of science/biology which deals with the study of the immune system. The immune system is a combination of organ, cellular, and molecular mechanism that every living organism is equipped with, to fight against the non-self, recognize the self and protect the living organisms (humans/animals/plants) against any abnormalities [1]. The non-self may be the infection-causing microorganisms, and the abnormalities include allergy, cancers/tumors, and autoimmune conditions.

At present we are noticing that there is an increasing trend in the incidences of emerging and re-emerging infectious diseases, various types of tumors, and the occurrence of different types of immunological disorders like autoimmune diseases, immunodeficiencies, hypersensitivities/allergic

reactions, among several others [2,3,4,5,6]. Therefore, medical doctors need to have a good knowledge of the subject of immunology.

Understanding the type of immune responses both during health and illness is important for the physicians because it helps them to make the correct diagnosis and treatment/management of patients [7].

Immunology is taught to medical undergraduates at various stages of the course/curriculum. It is a part of subjects like clinical microbiology and other basic science subjects like pathology, which are taught in the second year of medicine. Nevertheless, the basics of the immune system, organelles involved in the immunological responses, and other aspects are taught in the first year of MBBS. Teaching immunology to undergraduate medical students is a herculean task since the subject is complex and has deep links with various other subjects in medicine.

Knowledge of immunology is a prerequisite to becoming a successful physician or a clinician. Due to the

complex nature and broad subject linkage of immunology, undergraduates consider the immunology learning process as a burden.

Therefore, the institutions and educators need to assess the student perception regarding the learning methodology and environments, especially of the complex subjects that include immunology. Also, such an analysis could help in the development and delivery of novel and effective teaching/learning methods that garner student satisfaction.

In this study, we have evaluated the perception of the medical students towards the teaching and the learning process of immunology. This study had also attempted to find out the causes of student's concerns, methods and resources used, and potential ways to improve the immunology learning process.

2. Materials and Methods

The study included 157 medical students, who are pursuing the Bachelor of Medicine and Surgery (MBBS) at Prathima Institute of Medical Sciences (PIMS), Karimnagar, Telangana, India. PIMS is a tertiary care teaching hospital established to cater to the rural population. All the students were in their second year of MBBS during the study. All the participants of the study who volunteered to participate in the study were included. The demographic characteristics of the study participants including age, sex, course pursuing, and year of study are shown in [Table 1](#).

Table 1. Demographic characteristics of the study participants

Gender (n=157)	n (%)
Male	64 (40.76%)
Female	93 (59.23%)
Age	
18-20	95 (60.50%)
21-23	52 (33.12%)
24-26	10 (15.78%)
Couse pursuing	
MBBS	157 (100%)
Year of study	
MBBS II year	157 (100%)

2.1. Ethical Considerations

Informed oral consent was obtained from all the participants of the study. The study was approved by the institutional ethics committee of PIMS (Reference No: IEC/PIMS/2019-1-00272019).

2.2. Methods

A questionnaire was designed indigenously after evaluating the validated questionnaires available online [8,9]. Each study participant is provided with a questionnaire consisting of fourteen elements which should be filled according to the Likert scale as strongly disagree, disagree, neutral, agree, strongly agree.

Three questions were asked to answer on a different scale. "What do you think about immunology as a subject" was asked to be marked on a scale with options-very difficult, difficult, neutral, easy, very easy. "How likely are you going to apply the knowledge of immunology" was asked to be marked on a scale with options-very unlikely, unlikely, neutral, likely, very likely. "How useful is immunology knowledge to a doctor or a healthcare professional" was asked to be marked on a scale with options-very useful, useful, neutral, useless, very useless. **(Please refer to annexure 1)**

Apart from this, students were also asked to give written feedback on five specific points that included the methods and resources used by the students to learn immunology, main concerns while learning, suggestions for improvement in the learning and teaching processes, and any additional feedback that a student may choose to provide. **(Please refer to annexure 2)**

2.3. Statistical Analysis

The data collected from the study were entered into a Microsoft Excel sheet and were used to analyze, interpret, and generate graphs and tables.

3. Results

The student's responses to fourteen- point questionnaire on a Likert scale revealed that more than 90% (n=157) believed that immunology is an integral part of medicine and medical research. More than 85% of the students felt that immunology is essential while doing clinical practice.

The usefulness of immunology as a subject in medical research was endorsed by more than 75% of students. Seventy-three (73%) percent of students felt that the concepts of immunology will help in understanding other areas of medicine.

Only 58% of students had enjoyed the immunology learning process. At least 20% of the study participants were unsure if the knowledge they acquire in immunology will help to understand the other areas of medicine. Almost 25% of the students felt that they were unsure of their appreciation towards immunology and its importance after studying it.

Only 47% of the students felt motivated to learn immunology and about 42% of the students were unaware if they were motivated to study immunology. Less than 50% of the students liked our immunology teaching, and 42% of the students were neither appreciative nor disliked our immunology teaching.

Students were unsure of who should be teaching the immunology classes, the experienced, or the young faculty/professors/lecturers. Almost 44% of the students preferred senior lecturers, and 25% of the students preferred young faculty.

Almost 31% of the students responded in neutral on an average, against all the points asked. More than 60% of the students either agreed or strongly agreed to most of the points asked with regards to the immunology learning process. The detailed responses of all the students are shown in [Table 2](#).

Table 2. Responses of all the students to an eleven-point questionnaire on a Likert scale

	SD	D	N	A	SA
Immunology is an integral part of medicine and medical research	2 (1.27%)	0 (0.00%)	12 (7.64%)	69 (43.94%)	74 (47.13%)
There is a relevance of immunology with clinical practice	0 (0.00%)	0 (0.00%)	21 (13.37%)	81 (51.59%)	54 (34.39%)
Immunology study is justified in medical research	0 (0.00%)	2 (1.27%)	33 (21.01%)	95 (60.50%)	26 (16.56%)
I enjoyed/I am enjoying immunology	0 (0.00%)	9 (5.73%)	57 (36.30%)	68 (43.31%)	23 (14.64%)
Concepts of immunology helped/will help understanding other areas of medicine	0 (0.00%)	8 (5.09%)	33 (21.01%)	85 (54.14%)	30 (19.10%)
My appreciation of immune system has increased as a result of studying it	0 (0.00%)	0 (0.00%)	39 (24.84%)	88 (56.05%)	31 (19.74%)
You are motivated to study immunology	3 (1.91%)	13 (8.28%)	67 (42.67%)	58 (36.94%)	16 (10.19%)
You like our immunology teaching	6 (3.82%)	9 (5.73%)	66 (42.03%)	57 (36.30%)	19 (12.10%)
You think that we should improve our immunology teaching	0 (0.00%)	23 (14.64%)	60 (38.21%)	52 (33.12%)	22 (14.01%)
You want immunology to be taught by a senior teacher	2 (1.27%)	22 (14.01%)	63 (40.12%)	45 (28.66%)	24 (15.28%)
You think immunology must be taught by a young teacher	19 (12.10%)	16 (10.19%)	82 (52.22%)	28 (17.83%)	11 (7.06%)

SD: Strongly disagree; D: Disagree; N: Neutral; A: Agree; SA: Strongly agree.

Response of the students about the usefulness of the knowledge of immunology to a doctor or a health professional revealed that 70% of the students felt that the knowledge of immunology is very useful. The detailed response of the students is shown in Figure 1.

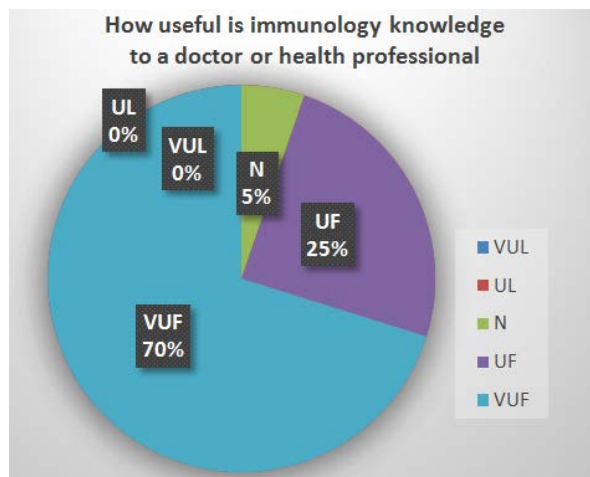


Figure 1. Response of the students about the usefulness of the knowledge of immunology to a doctor or a health professional (VUL: Very useless; UL: Useless; N: Neutral; UF: Useful; VUF: Very useful)

How likely are you going to apply the knowledge of immunology in the future

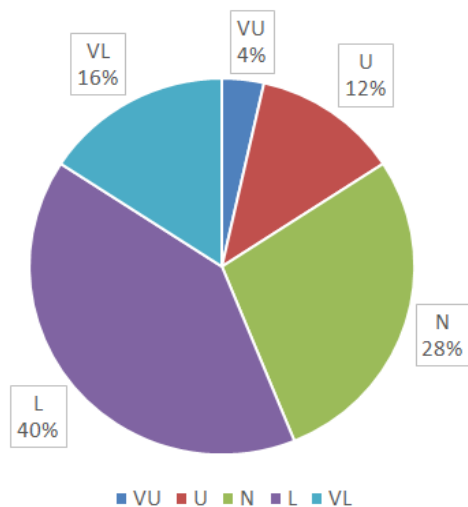


Figure 2. Student’s responses about how likely they are going to apply the knowledge of immunology in the future (VU: Very unlikely; U: Unlikely; N: Neutral; L: Likely; VU: Very unlikely)

Students’ responses about how likely they are going to apply the knowledge of immunology in the future revealed that more than 55% were positive about their application of knowledge of immunology in the future. The details of the student’s response are shown in Figure 2.

Only 39% of the students felt that immunology as a subject is easy or very easy to study. Interestingly, 44% of the students were neutral and could not decide if immunology as a subject is easy or a difficult one to study. The details of the responses of the students are shown in Figure 3.

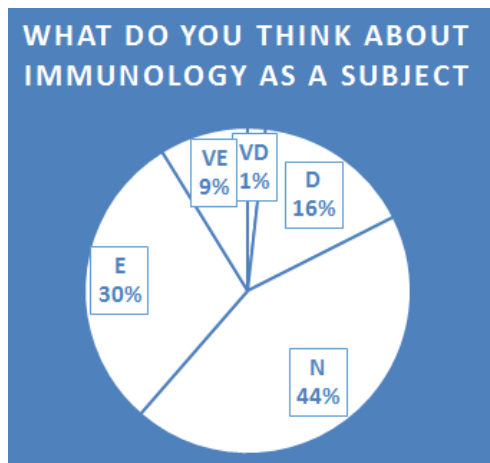


Figure 3. The responses of the students on Immunology as subject (VD: Very difficult; D: Difficult; N: Neutral; E: Easy; VE: Very easy)

The students were asked to provide the details of the resources they utilize while learning immunology. The students were asked to tick their responses against various options that included in the table like the books, internet, professors/lecturers teaching, social media sites like Instagram, the videos, audio, images and other audio-visual methods, study applications (APPS), classroom notes, self-preparation of the notes, group discussions.

The response of the students revealed that many of the students depend on the standard and reference books to learn immunology. The other preferred methods of learning by the students were the internet sources, and the videos, audio, images, and other audio-visual resources.

Few students preferred to learn the subject of immunology through practical’s, which include the demonstration of the clinical cases. Some other students preferred to learn immunology through classroom teaching by the lecturers and by group discussions.

The details of the student responses are shown in Figure 4.

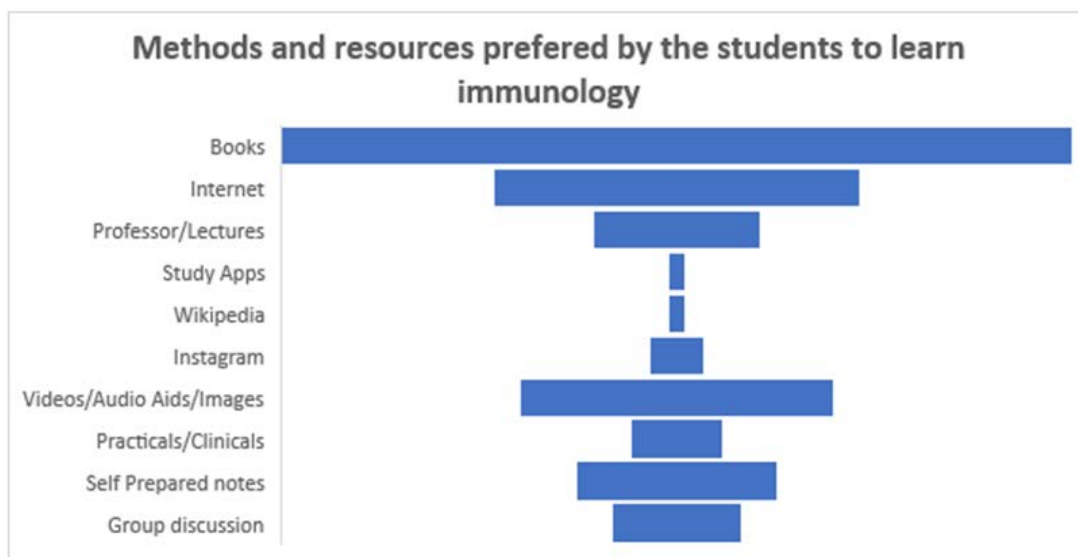


Figure 4. Response of the students about which methods or resources were used to learn immunology

When the students were asked to list out the concerns that they have during the immunology learning process, most of the students felt that they found it difficult in understanding the basic concepts of immunology. They were just trying to mug up the subject for the sake of examinations. Several other concerns which were listed by the students are elaborated in Table 3.

Table 3. Main concerns faced by the students during the immunology learning process

Main concerns faced by the students during the immunology learning process
1. Understanding the concepts and basics instead of mugging up
2. Lack of interest and curiosity in the subjects
3. Unable to concentrate and remember
4. Confusing if the concepts are not understood
5. Availability of clinical cases to improve understanding
6. Classroom teaching is monotonous (not interesting)
7. Unable to revise the subject

When the students were asked to suggest some points to improve the immunology learning process, most students suggested that there is a need for increased use of audio-visual aids while teaching immunology. Several other students felt that the teaching must be case-oriented and practical based to improve the understanding. The details of the student’s suggestions to improve immunology teaching are shown in Table 4.

Table 4. Suggestions from the students to improve immunology teaching

Student’s suggestions to improve the immunology learning process
1. Increase the use of audio-visual aids
2. Group discussions and tutorial sessions
3. Case-oriented teaching
4. Practical applications for patient diagnosis
5. Teachers should be more interactive

4. Discussion

Immunology is a subject which the MBBS students start learning from their first year of study. They learn the

organs of the immunity, and their location in the body in the subject of Anatomy. The functions of the organs, the different types of cells of the immune system, and their potential influence on the functioning of the human body are learned in the subject of Physiology. The biochemistry as a subject will allow them to understand the influence of the cells, the type of the response, and other details of the immune function both during the healthy and the diseased state of an individual.

In the second year of the MBBS course, the curriculum concentrates on the effects of the immune functions during the diseases, immune dysfunction owing to genetic abnormalities, immune dysfunction during various infectious diseases, the prevalence of various immunological diseases like complement deficiency disorders, hypersensitivity/allergic diseases, neutropenia, granulocytopenia, autoimmune disorders like the systemic lupus erythematosus (SLE), rheumatoid arthritis, and others.

The immune responses against infections and tumors are used to diagnose various diseases and most commonly in the diagnosis of infectious diseases. A medical graduate/researcher needs to understand the intricacies of immunology because of its application in patient diagnosis and treatment/management.

Because of the complex nature of immunology as a subject, the learning process must be moderated for different types of learners (slow, medium, fast). Immunology teaching throws several challenges that include the kind of resources used to generate interest in the students.

From the results of the current study, it is evident that the students found it difficult to understand the concepts of immunology with the current teaching methodology. Most students depend on the regular textbooks of immunology for learning and are not much interested in classroom teaching. Students felt that the teaching was monotonous, and the teachers must use audio-visual aids and other resources to improve the learning process.

Students also opined that the immunology learning process can be made easier if the subject was taught using the practical sessions, clinical and by using case studies.

In previous studies that had investigated the applications/usefulness of microbiology integration to

teach immunology through a pre-, and post-test revealed that there was a significant improvement in the knowledge of immunology in the students. The students' performance was analyzed using the Student Assessment of Learning Gains (SALG) instrument. The study results showed that the students were more than satisfied with the classroom teaching which was a contrast to the results of the present study [10,11].

The relevance of the basic sciences, including immunology in clinical practice, was recently analyzed. This study was performed among the first-year MBBS students and has used a course named "Host Defence". The main aim of the study was to signify the relevance of immunology to many other medical branches. The study included topics like innate and adaptive immunity, vaccines, inflammation, allergy, tumor immunology, transplantation, and autoimmunity, which were integrated into clinical microbiology, and infectious diseases to improve the understanding of immunology. The outcome of such a process was to ensure that the students learn to integrate the knowledge of immunology into the clinical practice and to understand the pathology, molecular mechanisms, the laboratory diagnosis, and the potential therapeutic interventions [12].

A study that assessed the perspectives of rheumatology residents concerning immunology teaching found that only 31% of the trainees believed that the learning process was effective. This study had observed a need for the development of an improved curriculum for immunology [13].

Given the increase in the incidences of neurological disorders, and the infectious diseases that affect the central nervous system, a recent study had proposed the inclusion of neuroimmune pharmacology as a sub-subject in the curriculum for students pursuing MBBS in their first year of study [14].

The significance of the knowledge of immunology, application of the knowledge of immunology to treat various diseases, and the impact that improved immunology knowledge can bring on public health is highlighted in a recent research study. This study had proposed that the discoveries of immunological therapeutics must be taught to the students to increase their enthusiasm for studying the subject [15].

Use of mnemonics, application of visuals and conceptual clues, and linking them with the difficult terminologies of immunology to improve the memory and subject retention, incorporating interactive video game, ImmuneQuest, in the curriculum, and various other methods were suggested to increase the ease of immunology learning process [16].

The case-based approach to teach immunology was found to improve the student's attendance to the classroom teaching (95%) but was not found enough to improve student's critical thinking capabilities and the performance of the students in the examinations. It was also found that the case-oriented teaching/learning improved student-teacher interactions and was instrumental in lessening the misconceptions of the students regarding the complexity of the subject [17].

The effectiveness of team-based learning (TBL) on immunology courses was previously assessed. This study had suggested that the TBL, which included a three-step

process could improve the student's knowledge of immunology and its applications. This active learning exercise allows students to form small groups of 6-7 members and undergo pre-class preparation, in-class readiness assurance testing (RAT), and application-focused exercises under the guidance of an instructor [18].

Recently, inquiry-based immunology learning was suggested wherein the students develop and perform relevant immunological experiments against a potential real-life problem under the guidance of teachers [19].

A teacher's perspective of the immunology classroom was recently reported. This study had emphasized the role of educators to identify key aspects/core topics of immunology that could act as a foundation upon which further understanding of the subject will depend. These core topics suggested were the adaptive immune system, innate immune system, host-pathogen interactions, and molecular mechanisms of immunological responses. The study had noted that although the number of years of immunology teaching experience had significantly influenced the topics stressed by the young and experienced teachers, the core concepts remained the same [20,21].

The knowledge of immunology is very essential to improve the understanding of the pathology of the diseases, develop and discover vaccines for various infectious diseases that include already existing infections caused by the Human Immunodeficiency Virus (HIV) and the novel infectious diseases like the SARS-CoV-2 [2,22,23,24,25].

Limitations of the Study

The present could not gather qualitative feedback from the students. Also, the study involved only students who were pursuing the second MBBS, and therefore the study results may not be suitable for generalization.

5. Conclusion

Immunology as a subject is overly complex and is considered an interdisciplinary subject. Understanding the basics, and concepts of immunology will improve the ability of a clinician towards patient management/treatment and medical research. Immunology teaching in a classroom appears to be not satisfactory as perceived by the students of the current study. Most students depend on the books, internet, and various other sources to self-learn the subject. The immunology learning process can be improved with the increased use of audio-visual aids and patient/case-oriented/practical teaching.

Acknowledgements

I acknowledge the contribution of my MBBS students who had participated in the study gracefully and with a lot of enthusiasm.

Funding

None.

Conflicts of Interest/Competing interests

None.

Ethics Approval

The study is approved by the Institutional ethics committee of Prathima Institute of Medical Sciences (Reference No: IEC/PIMS/2019-1-00272019).

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ANNEXURE-1

	SD	D	N	A	SA
	VUL	UL	N	UF	VUF
1. How useful is immunology knowledge to a doctor or health professional					
2. Immunology is an important part of medicine and medical research					
3. There is relevance of immunology with clinical practice					
4. Immunology study is justified in medical education					
5. I enjoyed/I am enjoying immunology					
6. Concepts of Immunology helped/will help understanding other areas of medicine					
7. My appreciation for immune system has increased as a result of studying it					
8. What do you think about immunology as a subject	VD	D	N	E	VE
9. How likely are you going to apply the knowledge of immunology in future	VU	U	N	L	VL
10. You are motivated to study immunology					
11. You like our immunology teaching					
12. You think we should improve our immunology teaching					
13. You want immunology to be taught by a senior teacher					
14. You think immunology is to be taught by a young teacher					

