

Perception Towards the Impact of the COVID-19 Pandemic on the Future Career Choices of MBBS Students at Manipal University College, Malaysia

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Abstract

The choice of intended specialty of a medical student plays an important role in determining their future career; being a source of motivation and drive to work towards and a goal they strive hard to achieve. There are many factors that could influence the choice of specialty of medical students, both encouraging and discouraging. Currently, in the midst of the COVID-19 pandemic, medical students around the world are continuing their education predominantly via online platforms and distance learning. This alternative approach to medical education has impacted students in numerous ways. This study was designed to determine the student perceptions on the impact of the COVID-19 pandemic on their future specialty choices. A cross-sectional study was conducted among 141 medical students at Manipal University College Malaysia from June to July 2021 using a self-administered questionnaire. Analysis of data was done using Epi Info software, with the use of the Chi-square test and non-parametric statistical tests. All statistical tests included a two-tailed level of significance ($p < 0.05$). Out of the 141 participants, 49 (35%) declared that the COVID-19 pandemic would affect their choice of future specialty, primarily due to the lack of exposure to patients and not having sufficient opportunities to explore specialties of choice. It was noted that students suffering from depression/anxiety ($OR=2.70$) and increased stress during the pandemic ($OR=2.36$) were more likely to alter their choice of specialty. Decreased willingness to specialise was associated with decreased levels of confidence of medical students to approach or examine patients as a result of inadequate exposure to patients and online learning ($r=0.084$). We conclude that the effects of the pandemic on education and lifestyle of medical students have impacted their future career choices making students less confident to approach patients and less willing to specialise in the future.

Keywords

Choice of Specialty, Confidence, COVID-19, Medical Students

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1. Introduction

The choice of specialty after completing Bachelor of Medicine, Bachelor of Surgery (MBBS) among medical students has been well documented by many researchers over the years. The medical specialty chosen by each student has

strong implications on both the doctor themselves as well as the society. Firstly, specialization in a particular field is associated with better outcomes of the patients who are treated. A systematic review conducted to investigate the

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relationship between the volume of surgery and specialization of surgeons, and the outcome of 'Norwood procedures' performed on patients concluded that a surgeon who has completed more than 4 'Norwood Procedures' (more volume) is associated with higher patient survival rate in comparison with a surgeon with less than 4 'Norwood procedures' (less volume). [1] This highlights the importance of increased experience and specialization among medical professionals and portrays that it improves outcomes and quality of care to patients. Another study conducted in 2007 among 169 hospital organizations in England discovered a positive correlation between service specialization and the level of clinical quality provided at the organization, once again indicating the importance of specialization among medical professionals. [2] A similar trend is seen in a study published in 2017, with significantly decreasing mortality and morbidity rates of patients with increased neurosurgeon specialization; especially when compared between the 25th and 75th percentiles of cranial specialization of neurosurgeons. [3]

In Malaysia, specialization of doctors is a subject of immense importance. In a newspaper article published in 2018, the Malaysian government has declared that the country is trying to increase the number of specialists, as a significant shortage of specialised medical professionals is seen throughout the country. [4] Therefore, it is crucial for medical students to delve deeper into the advanced medical fields, not only to explore the frontier of science and knowledge in-depth, but also to enhance the ability to innovate and increase patients' life expectancy. [5] However, choosing a specialty can be confusing or stressful to students. As a start, it becomes important to assess and understand the perceptions of medical students towards specializing in a field beyond MBBS and the factors associated with their choices. In 2011, a cross-sectional survey was done to determine the choice of specialty among medical students in Melaka-Manipal Medical College, Malaysia (MMMC). [6] The results of this survey depicted the overview of medical students' specialty choices at the time, highlighting the increased interest in Medical and Surgical specialties, while Public Health and Radiology were not greatly pursued. The study attributed these choices to the influences of the faculty and consultants on the students as well as the inspiration of students during their clinical postings. [6] Another study conducted in India on the factors influencing specialization of medical students in 2014 also discovered that personal interest in the specialty as well as the focus on community service were the two factors influencing choice of specialty the most. [7]

In the present context, it is important to understand that throughout the world, due to the emergence of the COVID-19 pandemic, the functioning of society and all aspects of life

have been significantly impacted and altered.

Coronavirus disease (COVID-19) is an infectious disease which was formerly referred to as '2019 novel coronavirus' or '2019-nCoV' that has impacted nations across the globe including Malaysia, [8] in terms of economy, society and health. As individual countries struggled to cope with the consequences of the disease, the Malaysian government took the initiative to impose a Movement Control Order (MCO) which has been in effect from March 18, 2020 in order to minimise the spread of the disease within the country. Although an essential measure to curb the disease burden, the MCO has had significant impacts on various aspects of life of all people. Among the affected are medical students, who are required to complete 3 to 4 years of clinical training in hospitals and clinics for their degree.

Many medical schools are adapting to these unprecedented changes by implementing all learning and training sessions on virtual platforms. However, the lack of face-to-face interaction, especially for the hospital postings which involve clinical exposure, may negatively impact the medical students' interest in their current and future education. [9]

A number of studies have been carried out to assess the effects of COVID-19 on the education of medical students, of which one aspect that has been explored is the repercussion of the pandemic on the career choices of the medical students. In a cross sectional study conducted in April 2020, one-fifth of medical students in the United States perceived that the COVID-19 pandemic would influence their choice of future specialty. [10] Another article published in 2021 depicted the negative psychological effects of the pandemic on the choice of future specialty among Chinese medical students. [11] A third study conducted in the United Kingdom concludes that the cancellation of clinical placements of medical students and decreased exposure to their specialty of choice may result in them altering their specialty or career choice. [12] Furthermore, another longitudinal study also conducted in China during the pandemic among Paediatric medical students, highlighted a statistically significant positive impact of COVID-19 on the choice of these students to continue Paediatrics as a specialty, while the students whose career choice was affected by COVID-19 associated this with insufficient knowledge about the hospital environment. [13] Among the existing research exploring the effects of the COVID-19 pandemic on medical education, there is no data available describing how the career choices of medical students may have been altered in Malaysia during this period.

We believe that factors such as the change in educational pattern, psychological status of students and the apprehensive attitude of patients towards medical students during the pandemic may influence the choice of specialty among

students following the pandemic. As such, early identification of concerns and potential issues may facilitate the provision of adequate support for medical students during this challenging time. This study aims to determine the MBBS students' perceptions towards the impact of COVID-19 pandemic on

their future career choices.

The conceptual framework inclusive of the independent and dependent variables of the study is given below.

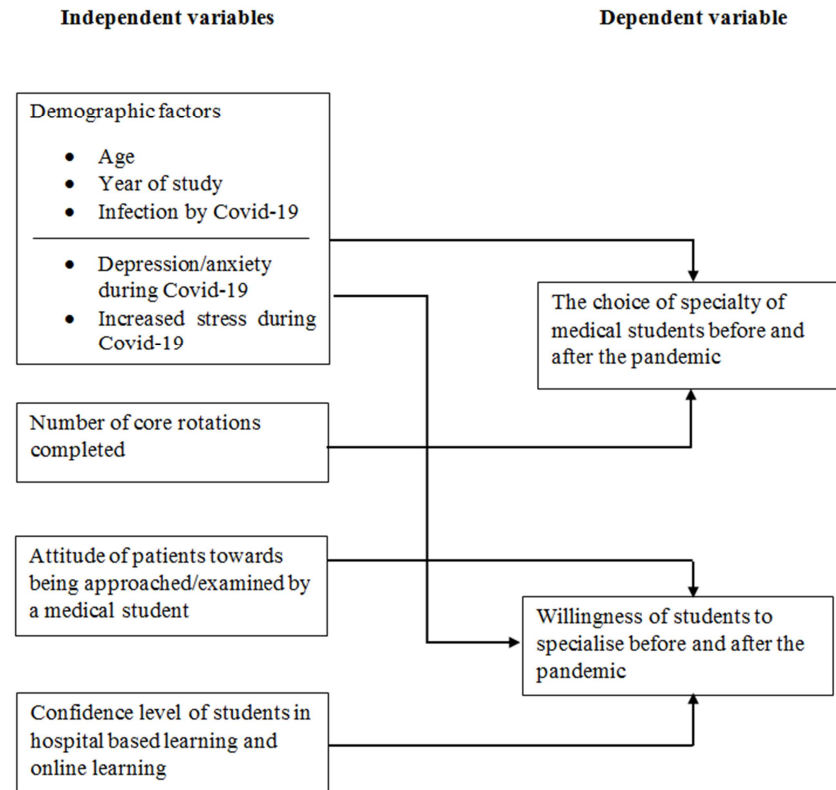


Figure 1. Conceptual framework.

2. Materials and Methods

2.1. Study Design, Time, Setting and Population

This was an analytical cross sectional study carried out among clinical phase MBBS students at Manipal University College Malaysia (MUCM). The MBBS program at MUCM extends over 5 years; out of which the first two are spent studying pre-clinical subjects and the subsequent 3 involve clinical exposure at hospitals. The clinical semesters of this program are conducted predominantly in Malaysia, in the Muar and Melaka facilities, while a single clinical semester is completed in the Manipal Campus, India along with the pre-clinical theory. The target population for this study was all students in the clinical semesters of the MBBS Program and it was conducted between June 2021 and July 2021.

2.2. Sample Size

Out of the 697 students in the clinical phase, a minimum sample size of 111 participants was calculated using the Microsoft Excel Sample Size Calculator. [14] Based on a

similar study done in the US exploring the effect of the COVID-19 pandemic on the career perceptions of medical students, study estimate of 20.2% (percentage of medical students in the study who believed that the pandemic would affect their choice of specialty) was used to calculate the sample size. [10] Taking into account a non-response rate of 10%, the final sample size of 124 was confirmed.

$$N_{final} = \frac{n_{calculated}}{1 - \text{Non response rate}} = \frac{111}{1 - 0.1} = 124$$

2.3. Sampling

The inclusion criteria for this study included medical students of Manipal University College Malaysia studying in Semesters 5 to 10 – the clinical phase of the degree. Students in Semesters 1-4, completing their foundation courses and students completing their Bachelor in Dentistry in the same College were not considered a part of the study. In addition, any responses under the field 'others' in the respective questions were excluded from the study during analysis if irrelevant or inappropriate.

The sample of participants was gathered by purposive

sampling. The study questionnaire was distributed among all the batches of students in the clinical phase of the degree. 141 responses were recorded, and were taken as the sample size of study.

2.4. Data Collection

Data collection was carried out using a self-administered questionnaire shared on Google forms. The study questionnaire consisted of 3 parts, participant information and informed consent, demographics of the study subjects and their perception on career choices before and after the pandemic. Demographic information like the age and semester of study of the participants were included in the second part of the questionnaire. The last segment of questions focussed on the career choices of the students. The progression of the course during the pandemic was assessed by recording the number of clinical postings the students had completed so far. The students were also questioned on their current willingness to specialise in any field following graduation, and if this decision was different from the one they had made before the pandemic. The choice of specialty of the students before the pandemic, and once again during/after the pandemic were also looked into, to identify any changes that might have occurred. The confidence levels of the students during hospital based learning before the pandemic, and during online learning were also included in the questionnaire, using the 5 point Likert scale. Factors like the development of depression or anxiety and being subject to increasing amounts of stress during the pandemic were also questioned. The participants were also asked if they or their family members had been infected by the virus. The dependent variable assessed was whether or not the COVID-19 pandemic would affect the choice of specialty of the medical students studied.

2.5. Data Processing and Data Analysis

The statistical software Epi Info Version 7.2 was used for the analysis of the data.

Initially, a descriptive analysis of the demographic characteristics of the sample was done, including age, academic year, and psychological status during the pandemic, increasing stress during the pandemic and infection by COVID-19. The frequency of each variable along with the

respective percentages were calculated using Epi Info.

A similar descriptive analysis of the career choices of the students was also done, in which the frequency and percentage of students that selected each specialty was observed. For this analysis, the range of specialties in the questionnaire were categorised into broader groups, based on a classification of physicians done by the Organisation for Economic Co-operation and Development. [15] The categories with their included specialties are listed in the table below.

Table 1. Classification of specialties into categories for analysis

Category	Specialties included
General Practitioners	General Medicine
	Family Medicine
General Paediatrics	Paediatrics
	Neonatology
Obstetrics and Gynaecology	Obstetrics and Gynaecology
Psychiatry	Psychiatry
Medical group of Specialties	Cardiology
	Gastroenterology
	Respiratory Medicine
	Neurology
	Radiology
	Dermatology
	ENT (Otorhinolaryngology)
Surgical group of specialties	General Surgery
	Neurosurgery
	Plastic Surgery
	Orthopaedics
	Ophthalmology
	Anaesthesiology
	Emergency Medicine
	Cardiothoracic Surgery
Other specialties	Physical Medicine and Rehabilitation
	Preventive Medicine
Administration	Administration
Undecided	Undecided

Graphs and charts were drawn up to illustrate the psychological status of the students during the pandemic, increasing stress levels and infection by COVID-19. Illustrations of the change in choices of specialty, willingness to specialise and confidence levels of the students before and after the pandemic were done.

Inferential statistical analysis was also carried out on the variables of the study, as presented in the table below.

Table 2. Independent and dependent variables with appropriate statistical tests

Independent variable	Dependent variable	Statistical test
Year of study	Effect of the pandemic on choice of specialty	
Year 3	Yes	Chi-square test
Year 4	No	
Year 5		
Core rotations completed	Effect of the pandemic on choice of specialty	
All	Yes	Chi-square test
Some	No	

Independent variable	Dependent variable	Statistical test
None		
Depression/anxiety during the pandemic	Effect of the pandemic on choice of specialty	
Yes	Yes	Chi-square test
No	No	
Increasing stress levels during pandemic	Effect of the pandemic on choice of specialty	
Yes	Yes	Chi-square test
No	No	
Attitude of patients towards students during the pandemic		
Good	Willingness to specialise after the pandemic	Non-parametric – Kruskal Wallis test
Bad	1 to 10	
Unsure		
Depression/anxiety during the pandemic	Willingness to specialise after the pandemic	Non-parametric – Mann Whitney U test
Yes	1 to 10	
No		
Increasing stress levels during pandemic	Willingness to specialise after the pandemic	Non-parametric – Mann Whitney U test
Yes	1 to 10	
No		
Confidence of student during online learning		
1		
2	Willingness to specialise after the pandemic	Spearman Rank Correlation
3	1 to 10	
4		
5		

Table 3. Non-parametric statistical tests for related ordinal variables.

Variable 1	Variable 2	Statistical test
Confidence of student before the pandemic	Confidence of student after the pandemic	Wilcoxin signed rank test
Willingness of student to specialise before the pandemic	Willingness of student to specialise after the pandemic	Wilcoxin signed rank test

Calculation of the odds ratio as a measure of association was done between the independent variables and whether COVID-19 affected the choice of specialty of these students or not. The level of significance used for analysis was $\alpha=0.05$.

Ethical Considerations

Approval for conduction of the research was obtained from the Research Ethics Committee, Faculty of Medicine, Manipal University College Malaysia (MUCM), Malaysia. Participation in the study was completely voluntary, and participants were informed that they could withdraw from the study at any time, with no consequences. Written explanations were provided to the participants regarding the purpose of the

study and nature of the questions included before the questionnaire was distributed. Responses of the study were recorded anonymously in order to assure confidentiality.

3. Results

A total of 141 responses were collected from the total population size of 697 medical students, resulting in a response rate of 20.2%. The ages of participants ranged from 19.0 to 34.0 years, with a mean of 22.5 years. A significant proportion of students (56.0%) were 4th year MBBS students, while only 23.4% were from 3rd year, and the remaining 20.6% were from final (5th) year.

Table 4. Socio-demographic characteristics of the medical students that participated in the study (n=141).

Variables	Frequency (n)	Percentage (%)
Age	≤22	79
	>22	62
	Mean (SD)	22.5 (1.6)
	Min- max	19.0 – 34.0
Academic Year	Year 3	33
	Year 4	79
	Year 5	29
Depression/ Anxiety	Yes	30
	No	111
Increased stress	Yes	108
	No	33
Infected with COVID-19	Yes	23
	No	118

When inquired about the mental health of these students, it was brought to light that 21.3% of them had been diagnosed

with depression or anxiety during the pandemic, while 76.6% of the students stated that they were increasingly stressed

during this period. Only 16.3% of the students however, mentioned that either they or their family members had been infected with COVID-19. Table 4 contains this socio-demographic information.

As per the objective of our study, the students were questioned whether the COVID-19 pandemic would affect their choice of specialty after MBBS. Figures 2 and 3 depict the effects of the COVID-19 pandemic on the future career choices of these students. 35% of the participants stated that the pandemic would impact their choice of specialty. Among these 35%, a significant proportion (54%) declared that they had not had the opportunity to practice their preferred specialty, while another 52% mentioned that they were frustrated or stressed

about certain specialties due to the change in exposure and training methods.

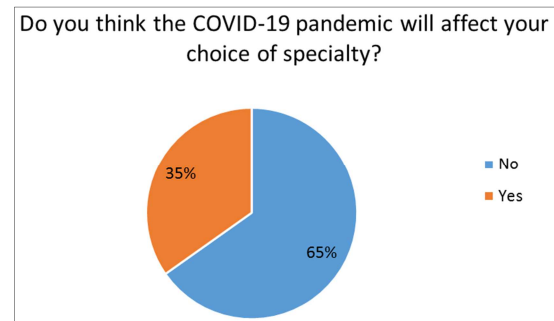


Figure 2. Did the COVID-19 pandemic affect the choice of specialty of students?

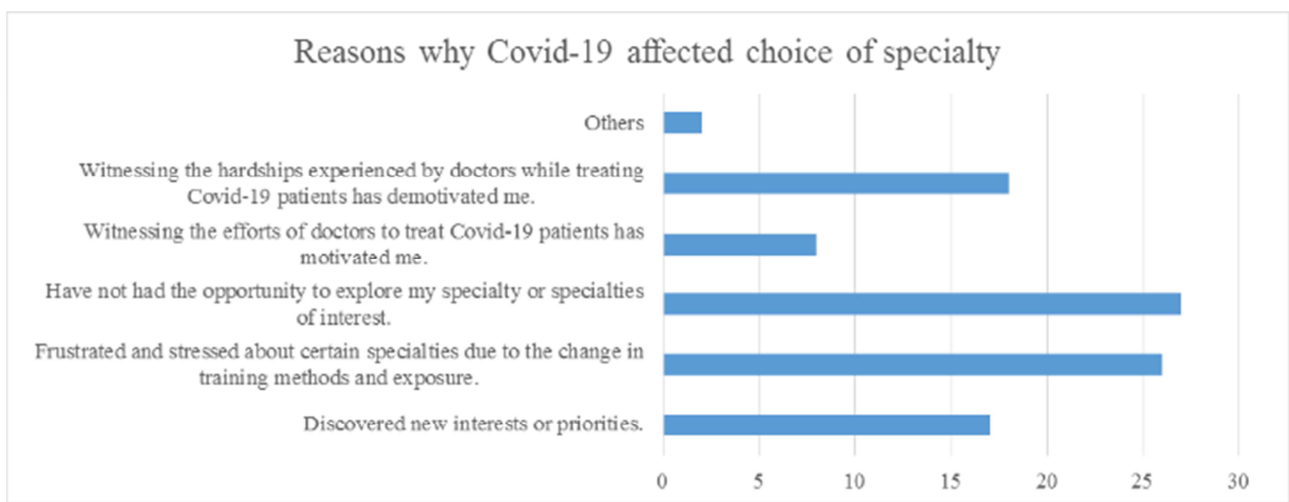


Figure 3. Reasons why COVID-19 affected the choice of specialty

To further understand this change in choice of specialty, the students were asked to choose which specialty/specialties they were considering before the pandemic, and which they were

considering during and after the pandemic. Table 5 illustrates the frequency and percentage of students considering each specialty and how it varied before and after the pandemic.

Table 5. Choices of specialty of students before and after the pandemic.

Choice of specialty	Before the pandemic		After the pandemic	
	Frequency	Percentage (%)	Frequency	Percentage (%)
1. General Practitioners	23	16.3	24	17.0
2. General Paediatrics	31	22.0	25	17.7
3. Obstetrics and Gynaecology	27	19.2	32	22.7
4. Psychiatry	16	11.3	12	8.5
5. Medical group of specialties	27	19.2	23	16.3
6. Surgical group of specialties	96	68.1	86	61.0
7. Other specialties	3	2.1	4	2.8
8. Administration	1	0.7	2	1.4
9. Undecided	16	11.3	23	16.3

The overall trend seen in this table is a decrease in the percentage of students willing to specialise in each specialty after the pandemic compared with before. The most significant decrease is seen in the surgical group of specialties, where the percentage of students willing to follow the specialty is almost 7% less after the pandemic compared to before. The percentage of students willing to specialise in

Paediatrics as well as the medical group of specialties is around 3% less after the pandemic compared with before. However, it must be noted that there is an increased interest (3.5%) to specialise in Obstetrics and Gynaecology after the pandemic compared to before, and a larger proportion of people are also willing to pursue careers in an administrative fields. Another significant finding is that COVID-19 has

resulted in many students (5% more than before the pandemic) being undecided about their future specialty.

The students were also questioned about which specialties they would be less likely to pursue after the pandemic was over. A notable proportion deemed the surgical group of

specialties to be least likely to be chosen as a future specialty (75.0%) while the medical group of specialties was the second least likely to be chosen (46.4%). These findings are portrayed in figure 4, below.

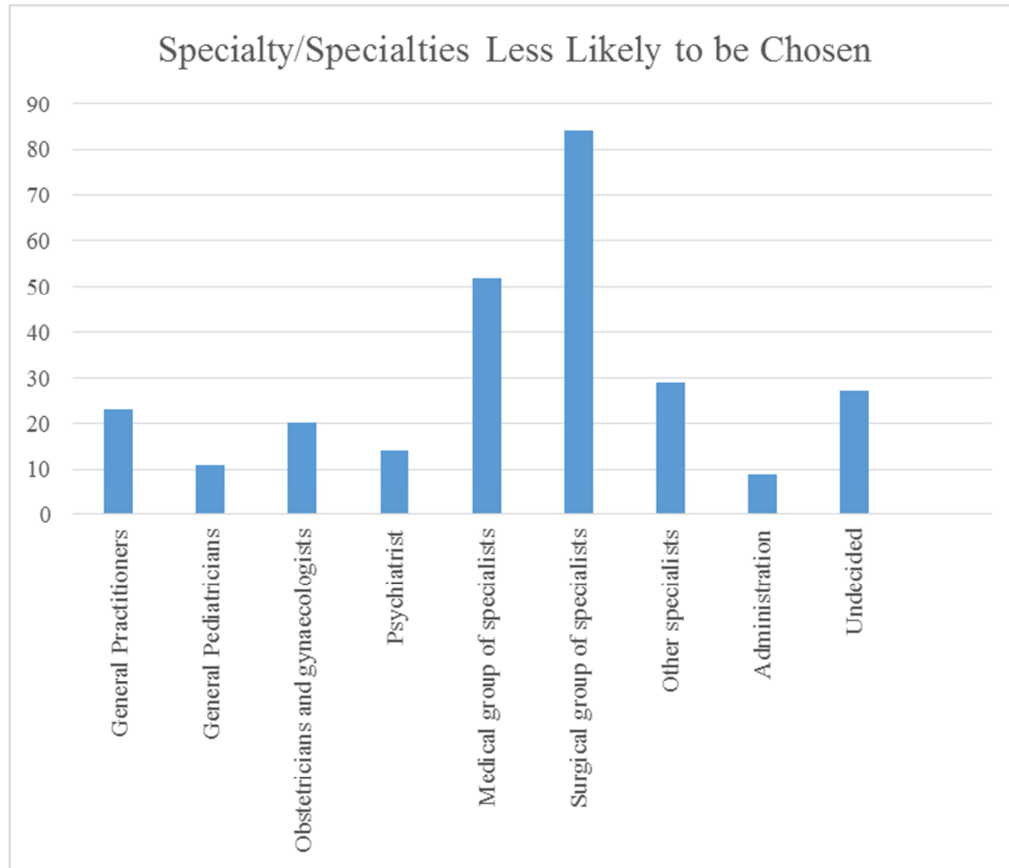


Figure 4. Specialties students are less likely to specialise in after the pandemic.

Table 6 displays the willingness of students to specialise before the pandemic, compared with after as well as the change in the confidence level of students to approach and examine a patient before the pandemic – during hospital based learning and after the pandemic – during online learning. According to the respondents, the median willingness to study a specialty after MBBS before the pandemic was 9 out of 10

on the visual analogue scale. This value dropped to 8 out of 10 after the pandemic, with a 2 point increase in the interquartile range as well. The confidence level of students during hospital based learning had a median of 4 on the 5 point Likert scale, while after the pandemic, the median confidence level to approach and examine patients was only 2 out of 5.

Table 6. Willingness of students to specialise after MBBS before and after the pandemic, Confidence level of students after each hospital posting and after online learning.

Variable	Median (Q1, Q3)	Minimum, Maximum
Willingness to specialise after MBBS before pandemic	9 (8.0, 10.0)	0, 10
Willingness to specialise after MBBS since pandemic	8 (6.0, 10.0)	0, 10
Confidence to approach and examine patients after each hospital posting	4 (3.0, 5.0)	0, 5
Confidence to approach and examine patients after each online posting	2 (1.0, 2.3)	0, 5

Table 7 shows the association between completion of core rotations, psychological issues faced by medical students during the pandemic, academic year and their choice of specialty. It is seen that students who have completed some of the core rotations were 3.38 times more likely to change their

choice of specialty due to COVID-19, compared to students who have completed all their core rotations (95% CI for OR 1.20-9.57; P-value: 0.017). This association was statistically significant.

The study also revealed that students who have not completed any core rotations were less likely to change their choice of specialty due to COVID-19 compared to those who have completed all core rotations (95% CI for OR 0.07-6.88; P-value: 0.747). The choice of specialty of students who were diagnosed with depression/anxiety during the pandemic was 2.70 times more likely to change compared to students who were not diagnosed with depression/anxiety (95% CI for OR 1.18-6.16; P-value: 0.160). In addition, students who experienced increased stress during the pandemic were 2.36

times more likely to change their choice of specialty compared to students who did not experience increased stress (95% CI for OR 0.94-5.93; P-value: 0.062). In terms of academic year, students in 4th year were 1.16 times more likely to change their choice of specialty compared to students in 3rd year (95% CI for OR 0.49-2.73); P-value: 0.733). However, students in 5th year were less likely to change their choice of specialty due to the pandemic in contrast to students in 3rd year (95% CI for OR 0.31-2.62; P-value: 0.847). These associations were not statistically significant as they all had a p value over 0.05.

Table 7. Association between completion of core rotations, psychological factors faced by medical students, academic year and their choice of specialty.

Independent Variables	Choice of specialty affected by COVID-19		Odds ratio	Chi-square	P-value
	Yes (%)	No (%)			
Depression/anxiety during the pandemic					
Yes	16	14	2.70 (1.18-6.16)	5.802	0.160
No	33	78			
Increased stress during the pandemic					
Yes	42	66	2.36 (0.94-5.93)	3.483	0.062
No	7	26			
Core rotations completed					
All (reference)	5	24	3.38 (1.20-9.57)	5.713	0.017
Some	43	61			
None	1	7			
Academic year					
3 (reference)	11	22	1.16 (0.49-2.73)	0.116	0.733
4	29	50			
5	9	20			

Statistical analysis was done to compare the number of students who were willing to specialise before and after the pandemic, as well as the confidence levels of the students before and during/after the pandemic in regard to approaching and examining patients.

The median willingness to specialise before the pandemic was higher in the students compared to after the pandemic, and after the pandemic also showed a higher interquartile

range. The confidence of students to approach and examine patients before the pandemic – in hospital based learning was also higher than that during online learning. The comparison between willingness of students to pursue a specialty before and after pandemic is statistically significant ($p < 0.001$), as is the association between confidence after hospital posting and after online postings ($p < 0.001$). This is indicated in Table 8.

Table 8. Comparison of willingness of students to specialise and confidence of students to approach patients before and after the pandemic.

Wilcoxon signed ranks test

Variable		Median (Q1, Q3)	P value
Willingness to specialise	Before pandemic	9 (8.00, 10.00)	<0.001
	After pandemic	8 (6.00, 10.00)	
Confidence to approach / examine patients	After each hospital posting	4 (3.00, 5.00)	<0.001
	After each online posting	2 (1.00, 2.25)	

Table 9 consists of the association between the attitudes of patients towards medical students during the pandemic and psychological issues faced by the students during the pandemic compared with their willingness to specialise after the pandemic, calculated using non-parametric tests.

Of the students who did complete a few days or weeks of training in the hospital during the pandemic, it can be understood that the students who were unsure about patients attitudes towards them, or believe that the patients have a good

attitude towards them as medical students are more willing to specialise after the pandemic than those who perceived bad attitudes from the patients. However, this association is not statistically significant. It is also evident that students who did not suffer from depression or anxiety during the pandemic are more willing to pursue a specialty, although this association is also not statistically significant. Finally, there is no notable difference in the willingness to specialise between students who were increasingly stressed during the pandemic and those who were not. This finding too however, is not statistically

significant.

Table 9. Association between attitudes of patients towards medical students during the pandemic, psychological issues faced by students during the pandemic, and willingness to specialise after COVID-19.

Variable	Willingness to specialise after the pandemic Median (Q1, Q3)	Mean	P value
Attitude of patients towards medical students			
Good	7.5 (6.0, 9.50)	7.4	0.838 ^a
Bad	7.0 (7.0, 8.0)	7.2	
Unsure	8.0 (6.0, 9.0)	7.3	
Depression / anxiety during pandemic			
Yes	7.5 (6.0, 9.0)	7.5	0.497 ^b
No	8.0 (6.0, 10.0)	7.7	
Increased stress during pandemic			
Yes	8.0 (6.0, 10.0)	7.6	0.974 ^b
No	8.0 (6.0, 10.0)	7.7	

a – Mann Whitney U Test, b – Kruskal Wallis Test

The association between confidence of the students in online learning and their willingness to practice a specialty after the pandemic was also assessed using the Spearman rank correlation. A little, if any positive correlation was seen between these two variables, which meant that as the

confidence of students increased, their willingness to specialise would also increase. The p value was 0.324, making the association statistically insignificant. Table 10 illustrates this association.

Table 10. Association between confidence in online learning and willingness to specialise.

Spearman rank correlation

	Willingness to specialise after the pandemic (r)	P value
Confidence of students to approach a patient after online learning	0.084	0.324

4. Discussion

This cross-sectional study aims to determine the MBBS students' perceptions towards the impact of COVID-19 pandemic on their future career choices.

Out of our total of 141 respondents, only 35 percent indicated that the COVID-19 pandemic would affect their choice of specialty. A significant proportion of these students stated that they had not had the opportunity to practice their preferred specialty due to the pandemic. A similar study has been done previously which yielded consistent results as our study. This study was about the effect of COVID-19 pandemic on medical students' career perceptions. It was a national survey study which involved students from US allopathic medical schools. In this study, approximately one fifth of their respondents indicated that the COVID-19 pandemic would affect their specialty choice and most of their students had concerns about not having time to explore their areas of interest. [10] It has been reported that several hospitals in the UK suspended medical students from clinical studies which led to students receiving reduced exposure in specific specialties. This too could affect students' choice of specialty in the future, if this factor was to be assessed. [16]

Similarly in our study, the students were asked to choose which specialty/specialties they were considering before the

pandemic, and which they were considering during and after the pandemic. There was a decrease in the percentage of students willing to specialise in each specialty after the pandemic compared to before. Surgical group of specialties had the most significant decrease, where the percentage of students willing to follow the specialty is almost 7% less after the pandemic compared to before. Nonetheless, there was an increase interest towards choosing to specialise in Obstetrics and Gynaecology after the pandemic compared to before, and there was also an increase in the number of students who were undecided on what specialty to pursue after the pandemic. This indecision could most likely be due to the decreased confidence levels of medical students to pursue a field of interest, or loss of interest in a particular field due to the shortcomings of online learning. A cross sectional study conducted among Chinese medical students from medical schools all around China discovered a decreased interest of students to pursue respiratory medicine and infectious diseases after the pandemic, which could be attributed to the immense risk to their lives taken by health care professionals in treating infective COVID-19 patients. [11] Although the specialties preferred by the two groups of students are different in the two studies, it is apparent that the pandemic has affected the choices of their specialties.

According to our study, a positive association was found between depression/anxiety during the pandemic and the choice of specialty of these students being affected. The

previous study done among Chinese medical students also demonstrated that anxiety during the pandemic affects the choice of specialty in medical students, decreasing their willingness to select majors in respiratory medicine or infectious disease after the COVID-19 pandemic. [11]

Our study also showed an association between increased levels of stress during the pandemic and the students' choice of specialty being affected. To reinforce this, we quote a study done in Fujian Medical University in China, which revealed that there were significant positive correlations between the perceived influence on career choice and the mental stress of a student. [17] This may occur because psychological problems could enhance student burnout, affect medical career interest and increase career choice regret and dropout rates among medical students. [18]

There was a significant positive association seen between students who completed some core rotations and their choice of specialty being affected by COVID-19, compared with students who completed all core rotations. It was also evident that students who hadn't completed a single core rotation were less likely to change their choice of specialty compared to students who completed all their core rotations. Meanwhile in the previously cited national survey study done in USA, in students who haven't completed any core rotations there was no significant relationship between completion of an elective of interest and certainty in specialty choice. The same study demonstrated that only 9.7% of students who have completed some core rotations thought the pandemic would affect their specialty choice, which was an unexplainable finding. [10] Students who completed all core rotations may have had equal amounts of exposure in all fields, allowing them to make an informed decision on their specialty, while students who completed only some rotations are likely to be more indecisive when it comes to choosing a specialty of choice.

Our results bring out a positive association between students in their 4th academic year and their choice of specialty being affected by COVID-19 in comparison with students in their 3rd academic year. It also shows a negative association between 5th year students and their choice of specialty being affected by the pandemic compared to students in 3rd year. Meanwhile, a national survey done on final year medical students in the United Kingdom revealed that the impact of COVID-19 on OSCEs, written examinations and student assistantships significantly affected students' confidence in that specialty. [19] This effect on their confidence may result in them altering their specialty of choice in the future.

When the willingness of students to specialise after their MBBS was compared before and after the pandemic, it was evident that more people were willing to specialise before the pandemic than after. This comparison was found to be

statistically significant. The median willingness before the pandemic was also higher on the scale than that after the pandemic. Similarly, in an online cross-sectional study carried out on Chinese medical students from medical schools all around China, it was discovered that 6.9% students showed decreased willingness to be a doctor after the pandemic, while another 9.5% showed decreased willingness to major in fields like respiratory medicine and infectious diseases. [11] This decrease in willingness is likely to be either due to concern for their own health, or hesitancy to undergo the stress and increased workload that comes with the job. The study in reference however, also includes significant percentages of students who showed increased willingness to be a doctor (10.6%) and increased willingness to major in respiratory medicine or infectious diseases (11.7%). This increase is not seen in our population, possibly due to the decreased exposure of students to patients and hospital exposure during the period of the pandemic, as a result of which the students may not have grasped the gravity of the situation and the lifesaving role played by the doctors.

In addition, when a comparison was made between the confidence levels of the students before the pandemic – when they could visit hospitals to examine patients and after the pandemic – when all clinical postings were conducted online, there is a significant difference between these results as well. The median confidence level of students to approach or examine a patient by themselves was significantly higher before the pandemic when compared with after. Similar to this, a cohort study conducted among 33 medical schools in the United Kingdom discovered that only 8.7% of the participants 'strongly agreed, that they were confident enough to start work in hospitals earlier than predicted towards the end of the pandemic, while another 39.5% of the students 'agreed'. [19] In addition, this study assessed the level of preparedness of the students for their final year 1 after COVID-19, where 18.6% of the participants 'strongly agreed' that they felt less prepared, while another 40.7% 'agreed' that they were not prepared enough. [19] Once again, this brings out the effects of decreased clinical exposure on medical students - for whom interaction and direct patient interaction is essential in terms of their confidence and preparedness to work in hospitals. The confidence of students to approach patients would only be built if they had the opportunity to do so and familiarize themselves with the situation.

The willingness of the medical students to specialise during/after the pandemic was also assessed against other factors like the attitudes of patients towards the medical students during the pandemic and psychological issues experienced by the students during COVID-19. It was evident that students who believed that patients had a good attitude towards them or were unsure about patient's attitudes towards

them were more willing to specialise than those who had bad experiences with patients. In a cross-sectional study conducted in 2008 among 39 medical schools in France, it was discovered that a significant percentage of students stated 'patient contact' as a motivating factor for them to select their future specialty. [20] This indicates the importance of patient interactions and the influence experiences with patients can have on the willingness of these students to specialise. The positive attitude of the patients may make students feel more comfortable and confident, as compared to demotivated and afraid to approach patients who do not wish to be examined by medical students.

In addition, students who suffered from depression or anxiety during the pandemic were seen to have a lower willingness to specialise compared to those who did not experience these psychological drawbacks. The study conducted among the Chinese medical students also explored this aspect of the pandemic, concluding that students who had fewer depressive symptoms and less severe symptoms of anxiety were more willing to work in specialties like respiratory medicine or infectious diseases, while severe anxiety reduced the willingness to specialise ($OR = 1.099$, $p < 0.001$). [11] The students with fewer depressive and anxious symptoms were also the students who were willing to continue studying as a doctor. The depressive and anxious symptoms experienced by these students may be singly associated by the students with their choice of career, as it is a very demanding one, although other restrictions due to the pandemic may also have played a role. Therefore, it is likely that the students may not be motivated to continue their studies further, dedicating many more years of their life to the same lifestyle.

In the comparison of students who were increasingly stressed during the pandemic with those who were not, there was no change in willingness to specialise noted. The cause for this absence of association is not clearly understood, however it may be attributed to the fact that the students believe that their stress would significantly decrease once the pandemic is over.

The willingness of these medical students to specialise was also influenced by the students' confidence to approach and examine patients after the pandemic. The more confident the students were, the more willing they were to specialise. In a similar cross-sectional study on future specialties conducted in 2002 in South Africa among medical students from the University of Transkei, it was discovered that the students who believed in themselves having a bright future after their MBBS attributed this view to their increased level of confidence about doing their job. [21] This coincides with the positive correlation seen in our study between confidence of the students and willingness to specialise. The more confident the students were, the more likely they would want to further their medical careers, whereas students who were less

confident would simply settle for the minimum result they could obtain to practice as a doctor.

As a whole, the findings of the study were consistent with those of other studies conducted during the same period, assessing the effects of the COVID-19 pandemic on the future specialties of medical students.

This study has several limitations. The sample size in this study was small as compared to the target population of medical students. Therefore, the results obtained may not represent the views of the general population of medical students at this University. The number of responses were influenced by the fact that there was no physical distribution of questionnaire, it was simply distributed online. There was also a paucity of responses from students in the 5th year of study, which may have influenced the findings of the study, as they are the proportion of the population closest to graduating and pursuing their future specialty. This study was a cross-sectional study so the respondents were observed at one point of time only. The results were obtained in a very short period of time. If there is to be any change in students' perception after the pandemic is over, it will not be observed as no follow-up will be done. In addition, this study was carried out in only one medical institution, so the findings may not be applicable to other institutions, as students from other institutions may have disparate perceptions on changes in choice of specialty caused by COVID-19.

It is not plausible to advise the students not to be discouraged to pursue their choice of specialty due to the pandemic, but the factors discouraging the students could be changed to optimize the transition from student to doctor. Medical students should also not compromise their leisure activities because it might have significant impacts on their mental health despite the fact that the pandemic has affected the normal curriculum. Students can also benefit from learning methods like the use of simulated patients, which would increase their confidence in approaching a real patient in the future.

During times of crisis and future pandemics, clear guidelines on continuous educational growth for medical students are required. The health and safety of medical students must not be affected as they will be the future health workforce. The priority for medical students is to continue their studies in order to complete the learning objectives required to graduate as doctors and to meet the medical council's criteria. The use of online platforms for both education and assessment should be optimised across medical schools. Online platforms provide medical schools with a path to provide medical education remotely, in order to maintain the professional development of medical students as set out by the medical council. There must be reliable systems in place to ensure

fairness of online assessments done by the students. This is necessary as part of preparation for future pandemics or other disruptions to medical education, to develop the capacity to seamlessly carry out examinations remotely.

In future studies, the students could be inquired in more detail about the reasons as to why they are less confident to approach patients and why they are discouraged to pursue their current specialty. It is also advisable to further assess the relationship among medical students and their lecturers, as this might potentially have an influence on the interest of the specialties of the students. Future studies could also benefit by using a larger sample size, which our study lacked. We hope this study will inspire more researchers to conduct in-depth studies to understand the impact of the pandemic towards medical students and its consequences.

5. Conclusion

In conclusion, the unprecedented pandemic has had a significant effect on medical students in regard to their choices of specialty. Multiple factors, including the degree of exposure to patients, confidence levels of the students after online teaching as well as psychological issues faced by the students during this time have influenced changes in their choices of future specialty. COVID-19 has also reduced the willingness of medical students to pursue a specialty post-pandemic. Since medical students are vulnerable to the

slightest change in their education system, every university and college administration would benefit from assessing the current situation and attempting to maintain the interest and enthusiasm of medical students towards their preferred specialties regardless of the limitations caused by the pandemic.

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Appendix

Perception towards the impact of the COVID-19 pandemic on the future career choices of MBBS students at Manipal University College Malaysia.

You are invited to participate in a research project which aims to understand the perception towards the impact of the COVID-19 pandemic on future career choices of MBBS students of MUCM. This survey form includes demographic information followed by a series of questions to assess the perception of students towards choosing a specialty before and during/after the pandemic. This survey will take approximately 5-10 minutes to complete. Participation in this study is voluntary. You have the right to deny and/or withdraw from the study at any time without a reason, and this will not have a negative impact on you in any way. Your responses will be kept confidential and anonymous. Results of the study will be reported as a total picture and not individually. If you have any inquiry, kindly contact the investigators below:

1. Mohd Fareez Zulfiqar Shah Bin Jumansa: fareezzulfiqar99@gmail.com
2. Yashwini Rajasekharan: yashwiniraja@gmail.com
3. Kavindu Gayantha Ariyaratne Kolumunnage Don: kariyaratne123@gmail.com
4. Duneesha Malinithi Jayaweera Andra Hennadige: duneesha2000@gmail.com

We would like to thank you for your time and participation.

Consent of participant:

I have read and understood the above information. I am 18 years of age or older. I consent to participate in the study titled above of my own free will. I further understand that I have the freedom to choose not to participate in the study. No reward or inducement has been offered to me to participate as a volunteer in this study.

I agree

Questionnaire:

1. How old are you?

2. Which batch are you in?

a) Batch 39

b) Batch 40

c) Batch 41

d) Batch 42

e) Batch 43

f) Batch 44

3. Which of the following statements is most correct?

a) I have completed all of my core rotations.

b) I have completed some of my core rotations but not all of them.

c) I have not started my core rotations.

If the participants chose b) in Question 3, they may proceed to Question 4.

If the participants chose a) or c), they can proceed to question 5.

4. Which core rotations have you completed?

(You may select more than one.)

a) Surgery

b) Paediatrics

c) Medicine

d) Obstetrics and Gynaecology

e) Orthopaedics

f) Community Medicine

g) Psychiatry

h) Ophthalmology

i) ENT

j) Other: please specify _____

5. Before the pandemic, how willing were you to specialise in a particular field after MBBS?

(1 being not willing to specialise and 10 being extremely willing to specialise)

If willingness is between 0-1, proceed to question 12.

1 2 3 4 5 6 7 8 9 10

6. Since the pandemic, how willing will you be to specialise in a particular field after MBBS?

(1 being not willing to specialise and 10 being extremely willing to specialise)

If willingness is between 0-1, proceed to question 12.

1 2 3 4 5 6 7 8 9 10

7. Do you think the COVID-19 pandemic will affect your choice of specialty?

a) Yes

b) No

If the participants chose a) in Question 7, they may be directed to Question 8

If they chose b), they may be directed to Question 12

8. If you answered yes to the above question, why?

(You may select more than one.)

a) I may not have the opportunity to explore my specialty or specialties of interest

b) I have discovered new interests or priorities

c) I am frustrated and stressed about certain specialties due to the change in training methods and exposure

d) Witnessing the efforts of doctors to treat COVID-19 patients has motivated me

e) Witnessing the hardships experienced by doctors while treating COVID-19 patients has demotivated me

f) Other: please specify _____

9. What specialty or specialties were you considering before the COVID-19 pandemic?

(You may choose up to 3 answers.)

a) Anaesthesiology

b) Dermatology

c) General Surgery

d) General Medicine

e) Paediatrics

f) Neurosurgery

g) Neurology

h) Obstetrics & Gynaecology

i) Ophthalmology

j) Orthopaedic Surgery

k) Physical Medicine & Rehabilitation

l) Plastic Surgery (Integrated)

m) Preventive Medicine

n) Psychiatry

o) ENT

p) Administration

q) Undecided

r) Other – please specify _____

10. What specialty or specialties are you currently seriously considering during/after the COVID-19 pandemic?

(You may choose up to 3 answers.)

a) Anaesthesiology

b) Dermatology

c) General Surgery

d) General Medicine

e) Paediatrics

- f) Neurosurgery
- g) Neurology
- h) Obstetrics & Gynaecology
- i) Ophthalmology
- j) Orthopaedic Surgery
- k) Physical Medicine & Rehabilitation
- l) Plastic Surgery (Integrated)
- m) Preventive Medicine
- n) Psychiatry
- o) ENT
- p) Administration
- q) Undecided
- r) Other – please specify _____

11. Which specialty are you less likely to apply into after the COVID-19 pandemic?

(You may choose up to 3 answers.)

- a) Anaesthesiology
- b) Dermatology
- c) General Surgery
- d) General Medicine
- e) Paediatrics
- f) Neurosurgery
- g) Neurology
- h) Obstetrics & Gynaecology
- i) Ophthalmology
- j) Orthopaedic Surgery
- k) Physical Medicine & Rehabilitation
- l) Plastic Surgery (Integrated)
- m) Preventive Medicine
- n) Psychiatry
- o) ENT
- p) Administration
- q) Undecided
- r) Other – please specify _____

12. Are you concerned about fulfilling your graduation requirements in time?

- a) Yes
- b) No

13. If you have participated in face to face/ hospital based learning, how would you rate your level of confidence to approach/examine a patient after each posting?

(1 being not confident at all and 5 being very confident)

If you have not experienced hospital based learning, please proceed to question 14.

1
2
3
4
5

14. After completing a posting online, how would you rate your level of confidence to approach/examine a patient?

(1 being not confident at all and 5 being very confident)

1	2	3	4	5
1	2	3	4	5

15.If you have participated in hospital based learning during the pandemic, what did you feel about the attitude of patients towards medical students examining them?

- a) Patients were friendly and cooperative.
- b) Patients were not happy to be examined by a student and were uncooperative.
- c) I can't say.
- d) I have not participated in hospital based learning during the pandemic.

16. Have you been diagnosed with depression or anxiety during the pandemic?

- a) Yes
- b) No

17. Would you say you have been increasingly stressed during the period of the pandemic?

- a) Yes
b) No

18. Have you or your family members suffered from COVID-19?

- a) Yes
- b) No

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