Original Article

Medical students' perceptions of emergency medical care before and during the coronavirus disease 2019 pandemic

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Aim: Understanding how medical students perceive emergency medical care is important in promoting education and recruitment in the field of emergency medicine. This study aimed to clarify the perceptions of undergraduate medical students on emergency medical care with a focus on comparing their perceptions before and during the coronavirus disease 2019 (COVID-19) pandemic.

Methods: Fourth-year undergraduate medical students were invited to complete a self-administered questionnaire in 2017 and 2020. Free comments on emergency medical care were analyzed via text mining. The relationships among categorical words were evaluated via correlation matrix and correspondence analysis.

Results: The number of written words per student were not significantly different between 2017 (4.9 ± 3.4) and 2020 (5.3 ± 4.1). In 2017, the most frequently used word was "busy," and the words "patients," "life," and "care" were not related to each other significantly. In 2020, the frequency of the word "busy" decreased and the word "patients" was related to "life" ($P < 0.01$) and "care" ($P < 0.01$). In the correspondence analysis, seven words including "life" and "care" were associated with "patients," which demonstrates that these words tended to occur together.

Conclusions: Although the responses of the medical students regarding emergency medical care before and during the COVID-19 pandemic included similar words, their expressions tended to be related to patient care or patient life during the pandemic. This change in perception might cultivate a sense of mission and responsibility and an interest in emergency medical care among medical students.

Key words: Correspondence analysis, education, pandemic, students, text mining

INTRODUCTION

DURING THE CORONAVIRUS disease 2019 (COVID-19) pandemic, many countries experienced a shortage of emergency healthcare personnel. It has become essential for every country to cultivate a sense of mission and responsibility in medical students and an interest in emergency medical care. There are reports on the perceptions of students and residents regarding specific skills such as self-perception of ventilation skills[1] or patient groups such as caring for cardiac arrest patients.[2] However, the perception of undergraduate medical students on emergency medical care has not been sufficiently investigated. Undergraduate medical students are potential physicians who will provide emergency medical care in the future, regardless of their field of specialization. This is especially important in situations where there is an increased demand in the healthcare workforce, as required during the ongoing COVID-19 pandemic.

It is essential to clarify and understand the perceptions of medical students toward emergency medical care to develop strategies for better recruitment and for the preservation of the workforce. Therefore, we conducted a survey concerning the perception of medical students toward emergency medical care before (in 2017) and during the COVID-19 pandemic (in 2020), and compared the change in perceptions during these 2 years.

METHODS

Participants

FOURTH-YEAR undergraduate medical students in a 6-year system were enrolled in this study after providing consent to participate. The study was approved by the Research Ethics Committee of the Faculty of Medicine, Kindai University.

The survey was conducted just before a lecture on emergency and critical medicine. In June 2017, the lecture was given in a regular face-to-face class by A.H., and in June 2020, the lecture was provided online by T.U. Although the responses were handwritten in 2017, they were submitted online in 2020.

In this geographical area (Japan), the state of emergency was declared from April 7, 2020 to May 21, 2020.

MEASURES AND ANALYSES

THE STUDENTS were asked to answer the question, "What is your perception about emergency medical care?" The students were asked to provide free comments about emergency medical care in the questionnaire. These free comments were analyzed via text mining using SPSS Text Analytics for Surveys (version 4.0.1; IBM Japan, Tokyo, Japan) and a correspondence analysis using the syntax developed by Leiden SPSS Group (Correspondence version 1.1 Leiden University, The Netherlands) was conducted for the categorical analyses. The syntax is shown below.

```
CORRESPONDENCE
TABLE = ALL(N1 N2)
/DIMENSIONS = 2
/MEASURE = CHISQ
/STANDARDIZE = RCMEAN
/NORMALIZATION = SYMMETRICAL
/PRINT = TABLE RPOINTS CPOINTS RPROFILES
CPROFILES
/PLOT = NDIM(1,MAX)BIPLOT(20)RPOINTS(20)
CPOINTS(20).
```

In this syntax, N1 is number of students and N2 is number of kinds of words.

The analyses were carried out according to the procedures indicated by Uchida *et al.*[3]

For the categorical analyses, we chose "five" as the threshold level in the frequency of appearance of the words, and the relationships of the extracted words were analyzed by a correlation matrix.

In the statistical analyses, the differences in the number of the extracted words between 2017 and 2020 were assessed using the Wilcoxon rank sum test. The frequency of individual words was assessed using the Fisher's exact test. A pair correlation in correlation matrix was assessed by Spearman's rank correlation. All analyses were performed using the SPSS statistical software version 25. Statistical significance was set at $P < 0.05$.

RESULTS

IN 2017, OF the 114 students, 111 agreed to answer the questionnaire (recovery rate: 97.4%). A total of 548 words were counted using a primary extraction procedure for text mining. In 2020, all 128 students participated in this study and 684 words were counted using the aforementioned procedure. The number of words per student was 4.9 ± 3.4 in 2017 and 5.3 ± 4.1 in 2020 (average ± standard deviation). These numbers between 2017 and 2020 showed no statistical difference. The median value was 4 for both years. Quartiles were also the same in both years (upper quartile 7, lower quartile 2).

In 2017, the following words were written in order of frequency: "busy" (29), "decision" (21), "necessary" (14), "life" (12), and "patients" (12); whereas, in 2020, the words were: "necessary" (22), "busy" (14), "care" (14), "decision" (13), "prompt" (13), and "knowledge" (12). For these words, significant differences in frequency were observed only in "busy" ($P < 0.01$) between both years.

The tables made by the text mining and supplied for further analyses that were for correlation and correspondence analyses are shown in Supporting Information Table S1 for data of 2017 and Table S2 for data of 2020, in which extracted words from each student were listed.

In Table 1, "prompt," "necessary," and "decision" were positively correlated, but not with "patients." In Table 2, "patients" was positively correlated to "life," "decision," and "care," which were not observed in 2017.

The summary of these correspondence analyses is shown in Table 3 for the data of 2017 and in Table 4 for the data of 2020. In the analyses, the inertias of dimension 1 were 15.1% and 16.9% in 2017 and 2020, respectively. The inertias of dimension 2 were 14.5% and 15.5% in 2017 and 2020, respectively.

In 2017, "patients" was distant from other words including "life" and "care" (Fig. 1); whereas, "patients" was used together with seven other words including "life" and "care" in 2020 (Fig. 2). This demonstrates that these words tended to occur together.

For example, in 2017, one student wrote "a lot of critically ill patients." In 2020, another student wrote, "I think this is the real frontline where care for the life of patients takes place."

Table 1. Correlation matrix 2017 (correlation coefficients between two words)

	Hard	Challenging	Knowledge	Support	Busy	Decision	Prompt	Necessary	Care	Patients	Life
Hard	1										
Challenging	−0.056	1									
Knowledge	−0.047	−0.056	1								
Support	−0.061	−0.072	−0.061	1							
Busy	0.069	0.099	0.167	−0.166	1						
Decision	−0.105	−0.125	0.117	0.043	−0.025	1					
Prompt	−0.061	−0.072	−0.061	0.192*	−0.166	0.488**	1				
Necessary	−0.083	0.013	0.310**	−0.106	−0.041	0.440**	0.209*	1			
Care	−0.056	0.085	−0.056	0.071	−0.154	0.159	0.071	0.236*	1		
Patients	−0.076	0.029	−0.076	0.015	−0.207*	−0.02	0.015	−0.045	0.148	1	
Life	−0.076	0.029	−0.076	0.127	−0.075	−0.168	−0.097	−0.132	0.029	−0.121	1

*$P < 0.05$.
**$P < 0.01$.

Table 2. Correlation matrix 2020 (correlation coefficients between two words)

	Hard	Challenging	Knowledge	Support	Busy	Decision	Prompt	Necessary	Care	Patients	Life
Hard	1										
Challenging	−0.048	1									
Knowledge	−0.077	−0.065	1								
Support	−0.066	−0.055	−0.088	1							
Busy	−0.084	0.059	−0.113	0.099	1						
Decision	−0.081	0.066	0.158	0.009	−0.035	1					
Prompt	−0.081	−0.068	0.069	0.211*	−0.035	0.572**	1				
Necessary	−0.11	−0.092	0.209*	−0.044	−0.16	0.258**	0.327**	1			
Care	−0.084	−0.071	0.145	−0.096	−0.123	0.131	0.214*	0.106	1		
Patients	−0.066	−0.055	−0.088	−0.076	−0.096	0.211*	0.11	0.037	0.295**	1	
Life	−0.058	−0.048	−0.077	−0.066	−0.084	0.033	0.033	−0.018	0.246**	0.337**	1

*$P < 0.05$.
**$P < 0.01$.

Regarding the effects of COVID-19 pandemic on students' perception, the results summarized that before COVID-19 pandemic many students wrote a word "busy" from the point of view of physicians. Although after the state of emergency the frequency of word "busy" decreased and the words concerning with patient life and patient care tended to occur together.

DISCUSSION

BECAUSE UNDERGRADUATE MEDICAL students suffered intense experiences during the COVID-19 pandemic, surveys to assess the perception of these students on COVID-19 or pandemic situations are necessary.[4]

However, their perceptions of emergency medical care and the influence of the COVID-19 pandemic have not been sufficiently investigated.

Our results showed that the word count per student and the initially extracted categorical words were similar between 2017 and 2020, although the circumstances and the answering methods were different (regular face-to-face class; handwritten answers versus. online class; online answers, respectively). As individual members of the two student groups were different, we can consider that the word pattern was rather similar in the undergraduate preclinical stage because the students do not have experience in emergency medical care yet. As such, their perceptions of emergency medical care may

Table 3. Summary of correspondence analysis 2017

Dimension	Singular value	Inertia	χ²	Significance	Proportion of inertia		Confidence singular value	
					Accounted for	Cumulative	Standard deviation	Correlation
								2
1	0.926	0.86			0.151	0.151	0.017	0.114
2	0.907	0.82			0.145	0.296	0.026	
3	0.879	0.77			0.136	0.432		
4	0.841	0.71			0.125	0.557		
5	0.758	0.57			0.101	0.658		
6	0.749	0.56			0.099	0.757		
7	0.677	0.46			0.081	0.837		
8	0.662	0.44			0.077	0.915		
9	0.512	0.26			0.046	0.961		
10	0.472	0.22			0.039	1		
Total		5.68	726.502	1.000[a]	1	1		

[a]1,100 degree of freedom.

Table 4. Summary of correspondence analysis 2020

| Dimension	Singular value	Inertia	χ²	Significance	Proportion of inertia		Confidence singular value	
					Accounted for	Cumulative	Standard deviation	Correlation
								2
1	1	1			0.169	0.169	0	0
2	0.956	0.91			0.155	0.324	0.015	
3	0.887	0.79			0.133	0.457		
4	0.854	0.73			0.123	0.58		
5	0.829	0.69			0.116	0.696		
6	0.696	0.49			0.082	0.778		
7	0.678	0.46			0.078	0.856		
8	0.605	0.37			0.062	0.918		
9	0.577	0.33			0.056	0.974		
10	0.394	0.16			0.026	1		
Total		5.91	739.208	1.000[a]	1	1		

[a]1,270 degree of freedom.

have been stereotypical (i.e., emergency medical care is busy and difficult).

The correlation matrix between words showed us the positive relationships between some pairs of words. If the correlation coefficient between two words is positive, the pair of words are closely related with much co-occurrence. If the correlation coefficient is negative, the pair of words are less related considering co-occurrence and occurrences of the two words. However, this analysis enabled us to show the relationships between pairs of words only. The correspondence analysis demonstrated the overall picture of relationships among the words along with the frequency of appearances of these words (Figs. 1 and 2).

In 2017, expressions such as "busy and cannot sleep" or "a lot of critically ill patients" were frequently seen. These expressions were consistent with our results that the most frequently used word was "busy" in 2017. These
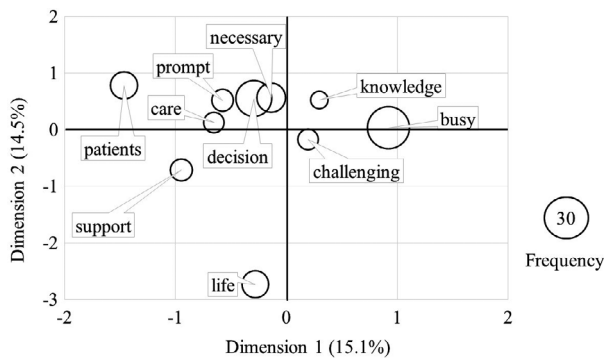
Fig. 1. The biplot of the data obtained by correspondence analysis in 2017. The frequency of the appearance of words is indicated by the size of the bubble. Words that appeared more than five times are shown in the figure. The relationship between the words is shown by the distance among the word bubbles. The most frequently appeared word was "busy," showing the largest bubble in 2017. The word of "patients" was distant from other words including "life" and "care."
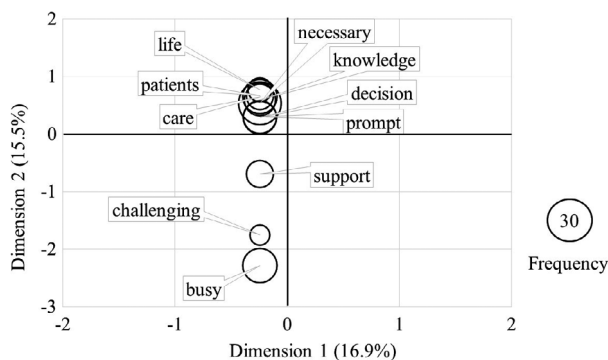
Fig. 2. The biplot of the data obtained by correspondence analysis in 2020. The frequency of the appearance of words is indicated by the size of the bubble. Words that appeared more than five times are shown in the figure. The relationship between the words is shown by the distance among the word bubbles. In this figure, from 2020, the bubble size of the word "busy" got smaller. The word of "patients" was used together with seven other words including "life" and "care" in 2020. This demonstrates that these words tended to occur together.

expressions were demonstrated as typically heard physicians' general perceptions. In contrast, concentrated groups of words such as "patients," "life," and "care" with five other words in the correspondence analysis in 2020 demonstrated that the perception of the students was oriented to patient life or patient care.

In any country, it is essential to cultivate a sense of mission, responsibility, and an interest in emergency medical care in medical students. There are limitations that

visualized co-occurrence of words of students can describe only a part of interpretation of the perception of students. However, the results of our study might give a clue to cultivate this attitude in medical students as well as attract them to this field.

CONCLUSION

ALTHOUGH THE MEDICAL students provided their responses regarding emergency medical care before and during the COVID-19 pandemic using similar words, their expressions tended to be related to patient care or patient life during the pandemic. This change in perception might cultivate a sense of mission and responsibility and an interest in emergency medical care in medical students.

DISCLOSURE

THE STUDY WAS approved by the Research Ethics Committee of the Faculty of Medicine, Kindai University.

Conflict of Interest: None declared

ACKNOWLEDGEMENTS

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table S1 Correspondence analysis 2017. The table is the result of text mining from the 2017 data. The data were used for correspondence analysis. The first column shows the ID number of each student. From the second column, extracted words from students are shown.

Table S2 Correspondence analysis 2020. The table is the result of text mining from the 2020 data. The data were used for correspondence analysis. The first column shows the ID number of each student. From the second column, extracted words from the students are shown.