RETENTION OF CARDIORESPIRATORY ANATOMY KNOWLEDGE AMONG UNIVERSITAS AIRLANGGA MEDICAL STUDENTS WITH HISTORY OF COVID-19

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ABSTRACT

Cardiorespiratory anatomy is fundamental knowledge for doctors. However, knowledge retention in medical students decreases over time. Retention is a reflection of memory ability and is affected by many factors, such as COVID-19 infection. COVID-19 is a disease caused by Sars-CoV-2 and has been declared as a pandemic since March 11th 2020. During the pandemic, cardiorespiratory anatomy tests were held in the 1st semester and 4th semester. The objective of this research was to measure the retention difference between students who had suffered from COVID-19 in that period and the ones without a history of COVID-19. This research was a cross-sectional descriptive analytics observational study involving 59 medical students at Universitas Airlangga, Indonesia. It was known that 19 students had suffered from COVID-19, while the other 40 had not. The average score of overall students experienced a significant decrease from 1st semester to 4th semester (p=0.000), both for students who had (p=0.023) and had not suffered from COVID-19 (p=0.001). However, the 1st semester and 4th semester cardiorespiratory anatomy scores of students with a history of COVID-19 were lower than students without a history of COVID-19. Besides scores, the cardiorespiratory anatomy knowledge retention of students who had suffered from COVID-19 (M=86.72%) was also lower than students who had not (M=86.95%). Nevertheless, the retention difference between those two groups of students was not significant (p=0.703).

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INTRODUCTION

Anatomy is a mandatory course for a doctor because it is the basis of medical science, which includes the structure and function of the human body[1]. Understanding cardiorespiratory anatomy is very important for healthcare professionals considering the high

prevalence of cardiovascular and respiratory diseases in Indonesia, ranging from heart disease at 1.5%, asthma at 2.4%, hypertension at 8.4%, to stroke at 10. 9%[2,3].

Knowledge retention describes an individual's ability to store knowledge in long-term memory, which will eventually be recalled. Long-term memory is consolidated from short-term memory and working memory. Memory abilities are included in cognitive functions along with perception, attention, decision-making, and language comprehension[4,5].

The brain is the main organ for memory processing, especially the hippocampus and thalamus area. Lesions to the brain, whether due to trauma or disease, affect memory abilities[6]. Patients who have suffered from Coronavirus Disease 2019 (COVID-19) experience decreased cognitive function which is based on working memory dysfunction[7]. COVID-19 is caused by infection with the Sars-CoV-2 virus[8]. This virus mainly attacks lung epithelial cells, then causes inflammation and collapse of the lungs[9]. This will disrupt the oxygen diffusion, ventilation, and perfusion processes. Lack of oxygen in circulation will cause the brain to endure hypoxic encephalopathy and lead to tissue death[10].

COVID-19 was newly discovered at the end of 2019 and declared by WHO as a pandemic on March 11th 2020. As of March 2nd 2022, there had been 437 million confirmed cases and 5.9 million deaths due to this disease[11]. This pandemic became the basis for the Ministry of Education, Culture, Research, and Technology, Republic of Indonesia to instruct the change in learning mode to online and then hybrid[12]. The 1st semester and 4th semester cardiorespiratory anatomy tests in the Faculty of Medicine Universitas Airlangga, Indonesia were held during the COVID-19 pandemic. The cardiorespiratory test in 1st semester was held online in January 2021, while in 4th semester the test was held offline in March 2022. Based on that, this research was carried out to determine the frequency of students who had suffered from COVID-19 during this period and the differences in cardiorespiratory anatomy knowledge retention between this group of students and students who had never suffered from COVID-19.

MATERIALS AND METHODS

The ethical clearance number 168/EC/KEPK/FKUA/2023 for this study was obtained from the Faculty of Medicine of Universitas Airlangga's Ethical Committee on June 26th 2023. This research was a descriptive-analytical observational study with a cross-sectional design. The population for this research was medical students of Universitas Airlangga, Surabaya, Indonesia, class of 2020. Questionnaires were used to collect respondents' consent, identity, and history of suffering from COVID-19 before the cardiorespiratory anatomy test in 4th semester. Data were retrieved from the Department of Anatomy, Histology, and Pharmacology to collect 1st semester and 4th semester cardiorespiratory anatomy scores of students who were willing to become research subjects. All students who were willing to be research subjects and had filled out the questionnaire completely were included in this study. However, students who had been assistant lecturers in anatomy courses, won anatomy competitions, and repeated courses were excluded. Data were processed into frequencies, distributions, and percentages using Microsoft Office Excel 2019, while statistical mean

comparison and odds ratio tests between variables were tested using SPSS.

RESULTS

The research subjects were 59 students from a total population of 281 students. The students' age range was 20-23 years old. The number of female students (69.5%) was greater than male students (30.5%). Based on the history of COVID-19, it was discovered that 19 of them (32.2%) had suffered from COVID-19 while the other 40 (67.8%) had no history of suffering from COVID-19.

Table 1. General Characteristic

Variables	Total (%)
Populations	281
Sample Size	59 (100%)
Age Distribution	20-23 years old
Sex	
Female	41 (69.5%)
Male	18 (30.5%)
History of COVID-19	
Had been suffered from COVID-19	19 (32.2%)
Had not suffered from COVID-19	40 (67.8%)

The cardiorespiratory anatomy scores summary for 1st semester showed that the overall average score was 44.07. Students with a history of COVID-19 had lower 1st semester average scores (43.16) than overall students or those who had not suffered from COVID-19 (44.5). In 4th semester, the average score decreased from 1st semester score. This score decrease happened to overall students, both with or without a history of COVID-19. In the 4th semester, the average scores for overall students, students with COVID-19 history, and students without COVID-19 history were 30.95, 29.88, and 31.45 respectively. After being processed using paired t-test, it was known that the difference between 1st and 4th semester scores was a significant decrease in all three groups: overall students (p=0.000), students who had suffered from COVID-19 (p=0.023), and students without a history of COVID-19 (p=0.001). The percentage of students who had a score decrease was greater in the group of students with COVID-19 history (73.68%) compared to students without it (67.5%). Based on the odds ratio, students who had suffered COVID-19 were 1.34 times more at risk of score decrease compared to students without a history of COVID-19 (p=0.630).

Because there was a decreased score from 1st to 4th semester, the percentage comparison between the 4th and 1st semester average scores was calculated to determine the retention of the cardiorespiratory anatomy knowledge. From the retention percentage, it was discovered that the average retention of cardiorespiratory anatomy for students with COVID-19 history (86.72%) was slightly lower than overall students (86.88%) and those who had not suffered from Covid-19 (86.95%).

Table 2. Cardiorespiratory Anatomy Score Distribution

	Overall N=59 (100%)	**Students with COVID-19 History** N=19 (32.3%)	**Students without COVID-19 History** N=40 (67.8%)
1st Semester Cardiorespiratory Anatomy Score (value=x/100)			
Highest	90	90	90
Lowest	0	0	0
Average (M)	44.07	43.16	44.5
4th Semester Cardiorespiratory Anatomy Score (value=x/100)			
Highest	61.29	61.29	61.29
Lowest	3.23	3.23	3.23
Average (M)	30.95	29.88	31.45
Retention of Cardiorespiratory Anatomy Knowledge			
Highest	151.29%	151.29%	128.71%
Lowest	35.81%	62.26%	35.81%
Average (M)	86.88%	86.72%	86.95%

Table 3. Difference between 1st Semester and 4th Semester Score

Cardiorespiratory Anatomy Score	**Overall**		**Students with COVID-19 History**		**Students without COVID-19 History**	
	M ±SD	***p-value****	**M ±SD**	***p-value****	**M ±SD**	***p-value****
1st Semester	44.07±24.71	0.000	43.16±21.36	0.023	44.5±26.40	0.001
4th Semester	30.95±14.81		29.88±15.69		31.45±14.55	
Difference	13.12		13.28		13.05	

*paired t-test

Table 4. Odds Ratio for Score Decrease

History of COVID-19	**Total** N (%)	**Score Decrease** N (%)	**No Score Decrease** N (%)	**Odds Ratio**	**95% CI**	***p-value***
Had been suffered from COVID-19	19 (100%)	14 (73.68%)	5 (26.32%)	1.34	0.399, 4.552	0.630
Had not been suffered from COVID-19	40 (100%)	27 (67.5%)	13 (32.5%)			

Table 5. Retention Difference between Students with and without a History of COVID-19

Retention of Cardiorespiratory Anatomy Knowledge	**N (%)**	**Mean**	***α****	***p-value*** **
Students with a History of COVID-19	19 (32.2%)	86.72%	0.022	0.703
Students without a History of COVID-19	40 (67.8%)	86.95%	0.352	
		Difference	0.23%	

*Shapiro-Wilk normality test

**Mann-Whitney comparison test

DISCUSSION

This study was in line with Chakkarapani and Sheng's research, which showed that medical students' anatomy knowledge decreased significantly after 2 years ($p<0.05$). However, the decrease in knowledge among Universitas Airlangga medical students (-13.12%) was not as large as medical students at private universities where previous research was conducted (-32.56%)[13]. Specifically related to cardiorespiratory knowledge, Saad et al. also found that there was a decrease in knowledge after 18 months ($p<0.001$) of 26% in medical students of the University of Sao Paulo, Brazil[14]. The result of this research was also in line with Sufiyah et

al.'s research on the population of Universitas Airlangga medical students. This research stated that only 26.92% of subjects completed the steps of basic life support (BLS) even though all subjects were students who had passed the BLS exam in the previous year[15]. This significant decrease in knowledge illustrates that retention of medical students was low. The perception that anatomy is a difficult subject may support this finding. However, as students progress, medical students become more critical about clinical relevance. Therefore, learning strategies linking basic knowledge of anatomy and clinical relevance may overcome this low retention problem[13].

A score decrease means that there was a difference between the knowledge gained in 1st semester and the knowledge remembered in 4th semester. The percentage of knowledge remembered compared to the knowledge obtained at the beginning showed the individual's retention value. With this description, no research has been found regarding differences in knowledge retention value between individuals who have and have never suffered from COVID-19. In this study, it can be seen that the average knowledge retention for students with a history of COVID-19 (86.72%) was slightly lower than for students who have never suffered from the disease (86.95%). However, this difference was not significant (p=0.703). With the statement that retention reflects memory ability[4], the results of this study were both in line and in conflict with Delgado-Alonso et al.'s research. In the research, various types of specific tests were used to measure specific memory abilities. The results showed that there were insignificant differences between subjects with a history of COVID-19 and normal subjects in recall ability (p=0.726), figural short-term and long-term memory (p=0.103), and spatial working memory (p=0.242), while there was a significant difference between subjects with a history of COVID-19 and normal subjects in verbal working memory (p=0.004)[16].

As the theory explains, infection by Sars-CoV-2 damages brain tissue thereby inhibiting memory abilities[9,10]. Case reports state that damage to the hippocampus, bilateral thalamus, and medial temporal lobe was identified in COVID-19 patients[17,18].

Retention of memory is not only affected by the disease, especially COVID-19, but by many other factors, starting from attention, rehearsal, learning methods, sleep quality, and nutrition, to physical activity[19]. Others state that even hydration and depression degrees can affect memory retention as well[20,21]. Therefore, further research is needed regarding those factors. On the other hand, the results of this research can be used as an evaluation base for medical education stakeholders and medical students regarding low scores and retention for cardiorespiratory anatomy, as well as a reference for future research. What has not yet been implemented in this research was the use of specific tests to measure specific memory ability so it is not yet known whether retention value is statistically proportional to memory abilities.

CONCLUSION

There was a significant decrease in cardiorespiratory anatomy knowledge in students with a history of COVID-19. The retention of cardiorespiratory anatomy knowledge in students who had suffered from COVID-19 was also lower than in

students who had not. However, there was no significant retention difference between those two groups.

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CONFLICT OF INTEREST

There is no conflict of interest between authors in this research.

ETHICS CONSIDERATION

The research received ethical clearance from the Faculty of Medicine of Universitas Airlangga. The approval date is June 26th, 2023, with number 168/EC/KEPK/FKUA/2023.

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AUTHOR CONTRIBUTION

All authors have contributed to processes in this study with details as stated next. Initial conceptualization and designed research: AWAA and S. Constructed literature review: AWAA. Supervised literature review: S and F. Made and collected data from questionnaires: AWAA; collected cardiorespiratory anatomy scores: S. Performed statistical tests and analyses: AWAA. Supervised research results and discussion: S, F, and LH. With this, all authors have reviewed and approved this final manuscript of the research.

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