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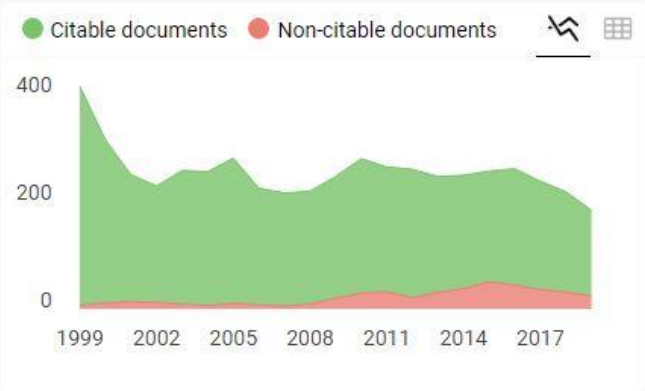

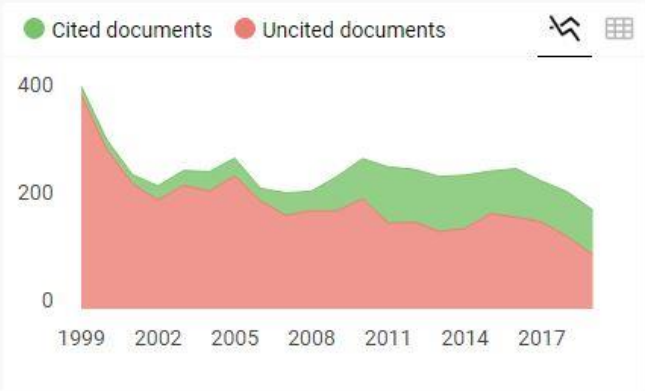

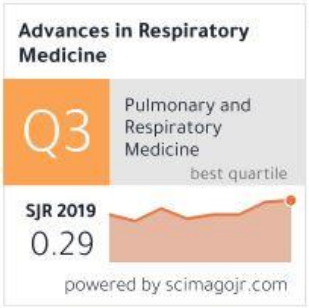

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Effect of yoga on FEV_1, 6-minute walk distance (6-MWD) and quality of life in patients with COPD group B

Abstract

Introduction: Yoga is used in the treatment of various diseases, including chronic obstructive pulmonary disease. However, no studies have assessed the effect of yoga on COPD patients in Indonesia. The difference between this study and similar studies completed in other countries lies in the type of yoga exercises completed, the method in which they were completed, and in certain, unique demographic characteristics. This study aims to analyze the effect of yoga on FEV_1, 6-minute walk distance, and quality of life in patients with COPD group B in Indonesia.

Material and methods: This article reflects research done in the form of an experimental study using a randomized controlled trial with pre and post-test control group design. The samples were divided into 2 groups: the treatment group (yoga practice for 1 hour, 2 times a week for 12 weeks) and the control group (untreated with yoga, given lung rehabilitation brochure). Assessment of the effect of yoga exercises on lung function parameters (FEV_1), 6-minute walk distance and quality of life were used using SGRQ questionnaires in COPD group B.

Results: 33 COPD patients fulfilled the inclusion criteria. 30 patients completed the study. Pre and post yoga results were evaluated in the treatment group versus the control group and then further assessed using statistical tests. There was a significant increase in FEV_1, 6-MWD and quality of life using a SGRQ questionnaire after 12 weeks of yoga ($p < 0.05$) as well as a a significant change in FEV_1, 6-MWD and quality of life in the treatment group ($p < 0.05$) when compared with the control group ($p > 0.05$).

Conclusions: Yoga affects FEV_1, 6-MWD, and quality of life in patients with Group B COPD.

Key words: yoga, COPD, FEV_1, 6-MWD, quality of life, SGRQ

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Introduction

Chronic obstructive pulmonary disease (COPD) is one of the non-communicable diseases that is becoming an important public health issue in Indonesia. The morbidity and mortality of COPD patients is associated with periodic exacerbations or worsening of symptoms [1, 2]. As the frequency of exacerbations increases, damage to the lungs proportionately rises in severity. This is ultimately followed by a decrease in lung function [3]. Problems frequently experienced by COPD patients, especially in stages II and III, include exercise de-conditioning, muscle wasting, weight loss, depression, and isolation. Therefore, comprehensive management of COPD symptoms in patients suffering from the disease is necessary to improve their quality of life [3].

Outside of pharmacological therapy, some COPD patients are managed non-pharmacologically (i.e. by smoking cessation and pulmonary rehabilitation) [3, 4]. The main purpose of pulmonary rehabilitation is to reduce complaints, improve physical ability to perform daily activities, improve emotions, and improve quality of life [3, 5].

Research has shown that exercises such as upper body workouts, Tai Chi, and yoga can improve COPD patients' quality of life [6]. Yoga has been included as a recommended exercise component for pulmonary rehabilitation programs. In addition to the treatment of physical therapy

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in industrial rehabilitation programs, it has been proven to improve the coordination of mind and body. Yoga is called a "low impact" exercise that can be adapted to the needs and abilities of practitioners so that it is suitable for anyone. This includes COPD patients through activities such as asana (yoga posture) and pranayama (breathing technique). Short-term studies on yoga practice have reported an increase in pulmonary function parameters, diffusion capacity, improvement in the quality of life, and a reduction in asthma--induced stress. Yoga has also been proven to be an effective tool for coal miners with COPD [6]. This study serves to further research the impact and confirm the beneficial role of yoga in COPD based on the information that has been described above.

Material and methods

Study design

This article reflects research done in the form of an experimental study using a randomized controlled trial with pre and post-test control group design . The initial step was made one week before the start of the intervention by performing CAT score and mMRC score assessments to ensure that COPD group B was included in this study. Then, spirometry assessments were conducted using the Koko Legend Spirometer (606055 9.A), and 6-MWD was performed. Every result was re-calculated according to GLI-2012 and add z-score assessment to the analysis [7]. The follow-up steps were carried out one week after completion of the intervention, which lasted 12 weeks. Yoga classes were undertaken in one setting which was determined by the researcher. Classes were led by a certified yoga instructor.

Statistical analysis

The data normality test was done using the Shapiro-Wilk test. Analysis of variance before and after treatment was carried out using a paired T-test or Wilcoxon Signed Ranks Test. Analysis of variance between yoga groups and control groups was made using the independent sample T-test or Mann-Whitney test.

Participants

Participants were recruited from clinics and pulmonary rehabilitation centers, or by physician referral. Inclusion criteria comprised men over the age of 40, patients with stable COPD category B, patients that were willing to follow the research criteria properly and patients who agreed to informed consent. Exclusion criteria included patients suffering from COPD which was accompanied by other diseases (i.e. neoplasm, congestive heart failure and/or asthma). Dropout criteria included subjects who refused to participate in the research, did not undergo the research protocol, and/or experienced exacerbations more than one time.

Randomization

All participants agreed to be randomized. Stratified randomization was done using baseline measures of spirometry to ensure participant balance in disease severity. They were randomized according to time of attendance. Odd dates were included in the yoga group, and even dates were included in the control group. Participants in both groups continued to receive normal care, and those in the yoga group continued to attend the program. All participants were asked to refrain from learning or practicing anything other than what is taught during yoga interventions. Also, participants in the yoga intervention group signed a confidentiality agreement not to discuss class content with fellow participants in the control group.

Intervention

Yoga interventions consisted of yoga classes that lasted 60 minutes twice a week, every week for 12 weeks. Yoga instructors must have had formal training. Due to the need for supplemental oxygen in order to maximize the effectiveness for persons with COPD, the class time was limited to 60 minutes. The program minimized the traditional focus on breathing during the beginning of yoga exercises to address issues related to persons with COPD. The management of non-threatening symptoms that focused on raising awareness of the dangers of dyspnea was included. *Ujjayi*, *Kaphalabati*, and *Sitkari* breathing were included. Further, a spiritual focus was introduced to augment a feeling of comfort during meditation. *Savasana* was chosen as the meditative movement exercise. This was based on the expertise of the teacher leading the intervention.

Results

Characteristics of research subjects

Table 1 shows the characteristics of these research subjects. The number of research subjects was 33 people, all of them being males. Subjects excluded from the research consisted of 3 people: 2 people from the treatment group, and 1 person from the control group. The num-

Table 1. Characteristics of research subjects

Characteristics	Groups		P-value
	Treatment (yoga)	Control	
Age mean (SD)	64.40 (10.453)	65.33 (8.121)	0.787
< 51 years	1 (6.7%)	0 (0.0%)	
51–60 years	4 (26.7%)	5 (33.3%)	
61–70 years	5 (33.3%)	5 (33.3%)	
71–80 years	4 (26.7%)	5 (33.3%)	
≥ 81 years	1 (6.7%)	0 (0.0%)	
IMT mean (SD)	23.59 (5.366)	20.42 (3.770)	0.072
< 18.5 (less)	1 (6.7%)	4 (26.7%)	
18.5–24.9 (normal)	3 (20.0%)	10 (66.7%)	
25–29.9 (excess)	9 (60.0%)	1 (6.7%)	
≥ 30 (obesity)	2 (13.3%)	0 (0.0%)	
Comorbid			
Non comorbid	11 (73.3%)	11 (73.3%)	0.557
Hypertension	1 (6.7%)	1 (6.7%)	
DM	3 (20.0%)	1 (6.7%)	
Coronary heart disease	0 (0.0%)	2 (13.3%)	
Smoking duration mean (SD)	33.21 (8.781)	25.62 (12.984)	0.085
< 20 years	0 (0.0%)	2 (15.4%)	
20–39 years	10 (71.4%)	8 (61.5%)	
≥ 40 years	4 (28.6%)	3 (23.1%)	
Number of cigarettes per day (median/range)	24 (12 until 48)	12 (12 until 30)	0.144
< 20	5 (35.7%)	8 (61.5%)	
20–29	6 (42.9%)	4 (30.8%)	
> 30	3 (21.4%)	1 (7.7%)	
Brinkman Index			
0–199 (light)	0 (0.0%)	2 (15.4%)	0.104
200–599 (medium)	6 (42.9%)	8 (61.51%)	
≥ 600 (high)	8 (57.1%)	3 (23.1%)	
Obstruction degree			
GOLD 1	1 (6.7%)	1 (6.7%)	0.895
GOLD 2	5 (33.3%)	3 (20.0%)	
GOLD 3	4 (26.7%)	5 (33.3%)	
GOLD 4	5 (33.3%)	6 (40.0%)	

ber of subjects that took part in the study until its completion was 30 people. Based on the degree of COPD, in the treatment group there were 5 people in category GOLD 2 and 5 people in category GOLD 4 (33.3%). Meanwhile, in the control group, there were 6 people (40%) in the GOLD 4 obstruction degree.

The results of the normal distribution test using the Shapiro-Wilk test showed that the data on differences in 6-MWD in the yoga and control groups and the impact data of the yoga group were not normally distributed ($p < 0.05$). Therefore, the paired T-test was used to find out differences in observations before and after treatment was given in each group, except for the difference in 6-MWD using the Wilcoxon Signed Rank Test. Meanwhile, the T-test of 2 free samples was used to observe differences in findings between yoga

Table 2. Results of the T-test of FEV_1 (L) and FEV_1 (%) before and after treatment given in each group and T-tests among groups

		Mean (standard deviation)		P-value
		Yoga group	Control group	T-test of 2 free samples
		n = 15	n = 15	
FEV_1 (L)	Before	1.025 (0.507)	0.941 (0.488)	0.647
	After	1.402 (0.629)	1.017 (0.534)	0.082
	Difference	0.377 (0.364)	0.077 (0.273)	0.016
	P-value Paired T-test	0.001	0.295	
FEV_1 (%)	Before	43.53 (20.625)	40.87 (22.309)	0.736
	After	58.93 (22.799)	44.60 (22.344)	0.093
	Difference	15.40 (15.371)	3.733 (10.964)	0.024
	P-value Paired T-test	0.002	0.208	
FEV_1, Z-score	Before	–3.558 ± 1.089	-3.409 ± 0.986	0.697
	After	–2.613 ± 1.302	-3.162 ± 1.191	0.239
	Different	0.945 ± 0.786	0.247 ± 0.617	0.011
	P-value Paired T-test	0.001	0.144	

and control groups except for the difference in the impact after treatment, which was done using the Mann-Whitney test.

FEV_1 change

FEV_1 assessment was carried out in the two groups. Mean FEV_1 in the treatment group before yoga was 1.025 L (0.507), while in the control group was 0.941 L (0.488). FEV_1 re-assessment was carried out after 12 weeks. In the treatment group there was an increase to 1.402 L (0.629) ($p = 0.001$) while in the control group there was an increase to 1.017 L (0.534) ($p = 0.295$).

Table 2 shows the results of the paired T-test of FEV_1 (L) and FEV_1 (%) before and after treatment was given in each group and before T-test among these groups. There were significant differences in FEV_1 (L) before and after treatment in the yoga group ($p < 0.05$), whereas no significant differences were noted in the control group ($p > 0.05$). The results of the T-test of 2 free samples between the yoga and control groups indicated that there were no significant differences in FEV_1 (L) both before and after treatment ($p > 0.05$), but there were significant differences in the value of FEV_1 (L) ($p < 0.05$).

As can be seen in Table 2, the mean FEV_1 (% prediction) in the treatment group before yoga was 43.53% (20.625). In the control group, it was 40.87% (22.309). FEV_1 re-assessment was carried out after 12 weeks. In the treatment group there was an increase of 58.93% (22.799) ($p = 0.002$), and in the control group there was an increase of 44.60% (22.344) ($p = 0.208$). The results of the paired T-test showed significant differences in FEV_1 (%) before and after treatment in the yoga group ($p < 0.05$), whereas there were no significant differences in the control group ($p > 0.05$). The results of the T-test of 2 free samples between the yoga and control groups indicated that there were no significant differences in FEV_1 (%) both before and after treatment ($p > 0.05$), but there were significant differences in the value of FEV_1 (%) ($p < 0.05$).

6-MWD change

As can be seen in Table 3, there was an increase in mean 6-MWD after yoga in the treatment group. The Wilcoxon Signed Rank Test results in the treatment group showed no significant difference in 6-MWD value before and after yoga with a p-value of 0.001. It can be concluded that patients with COPD treated with yoga have a significantly increased 6-MWD value, whereas in the control group there was a decrease in the mean of 6-MWD after 12 weeks. The Wilcoxon Signed

Table 3. Results of T-test of 6-MWD (m) before and after treatment in each group as well as T-test among groups

6-MWD (m)	Median (IQR)		P-value Mann--Whitney test
	Yoga group n = 15	Control group n = 15	
Difference	19 (28)	0 (85)	0.016
Before	289 (75)	258 (147)	
After	334 (66)	258 (69)	
P-value Wilcoxon Signed Rank Test	0.001	0.328	

6-MWD — 6-minute walk distance

Rank Test results in the control group showed no significant difference in 6-MWD value before and after yoga with a p-value of 0.328 (NS). It can be concluded that COPD patients who did not get yoga treatment have an insignificantly declining 6-MWD value. The 6-MWD change in the yoga group was greater than in the control group. Test results using Mann-Whitney test showed a significant difference in 6-MWD value change between the two groups with a p-value of 0.016. It can be concluded that patients with COPD treated with yoga have a significantly greater 6-MWD value change when compared with patients suffering from COPD not treated with yoga.

The results of the Wilcoxon test showed significant differences in 6-MWD (m) before and after treatment in the yoga group ($p < 0.05$), whereas there was no significant difference ($p > 0.05$) in the control group. The results of the Mann Whitney test on the difference in the 6-MWD between the yoga and control groups showed significant differences ($p < 0.05$).

Change in quality of life

Table 4 shows the results of symptoms, activity, impact, and SGRQ total before and after treatment given in each group. In the treatment group after yoga, there was a decrease in the mean value of the SGRQ questionnaire. The paired T-test results in the treatment group showed a significant difference in the SGRQ questionnaire value between before and after yoga with a p-value of < 0.001. It can be concluded that patients with COPD treated with yoga have a significantly decreased SGRQ questionnaire value, while in the control group there was an insignificantly decreased mean value of the SGRQ questionnaire after 12 weeks. The paired T-test result in the control group showed no significant difference in the SGRQ questionnaire value in terms of symptoms before and after yoga with a p-value of > 0.05. It can be then concluded that patients with COPD not treated with yoga have an insignificantly decreased SGRQ questionnaire value in terms of symptoms.

Discussion

The number of subjects screened was 74 people who are patients with stable outpatient COPD at Asthma-COPD Polyclinics of Dr. Soetomo Hospital Surabaya and Airlangga University Hospital Surabaya. 24 people were excluded, and 17 people refused to participate in the research. 33 people of male sex were randomly divided into two groups. 17 people were placed into the treatment group and 16 people were placed into the control group. Patients who were excluded from this research consisted of 2 people from the treatment group who were unable to regularly exercise according to the schedule, and 1 person from the control group who refused to continue the taking part in the research study. Patients who completed taking part in the research study until it concluded amounted to 30 people.

Our results suggested that FEV_1 change (L) in the treatment group is greater than in the control group. It can be concluded that patients with COPD treated with yoga therapy have a significantly greater change in FEV_1 value (L) compared to COPD patients not treated with yoga therapy. FEV_1 change (% prediction) in the treatment group is greater than in the control group. It can be concluded that patients with COPD treated with yoga therapy have a significantly greater change in FEV_1 value (% prediction) compared with COPD patients who did not get yoga treatment.

This research is in line with meta-analysis [8] literature by Katiyar [9] and Donesky [10] which found that there was a significant increase in FEV_1 in patients with COPD treated with yoga therapy for 12 weeks. Madanmohan [11] stated that yoga therapy for a 12 week period would increase the maximum expiratory pressure, maximum inspiratory pressure, length of time holding breath during inspiration, length of time holding breath during expiration, and grip strength. This result is also in line with the research by Joshi *et al.* in 1992 which found that there was an increase in ventilation function in the form of respiratory rate reduction, increase in FVC, FEV_1, MVV and ability to hold breath. during 6 weeks of *Pranayama* exercises.

Table 4. Result of symptoms, activity, impact and SGRQ total before and after treatment given in each group

		Mean (standard deviation)		P-value
		Yoga group	Control group	T-test of 2 free samples
		n = 15	n = 15	
Symptoms	Before	54.26 (16.257)	50.63 (21.031)	0.601
	After	23.26 (14.941)	48.91 (26.145)	0.003
	Difference	-30.99 (21.398)	-1.73 (17.155)	< 0.0001
	P-value Paired T-test	< 0.0001	0.703	
Activity	Before	56.08 (21.860)	56.27 (23.602)	0.981
	After	28.62 (24.037)	54.48 (21.843)	0.005
	Difference	-27.46 (21.481)	-1.80 (12.999)	0.001
	P-value Paired T-test	< 0,0001	0.601	
Impact	Before	37.20 (18.784)	48.29 (23.259)	0.162
	After	13.21 (12.787)	43.85 (22.605)	
	Difference	-23.99 (14.533)	-4.44 (14.851)	0.001
	P-value Paired T-test	< 0.0001	0.266	
Total score	Before	45.76 (16.318)	51.10 (21.135)	0.445
	After	19.55 (14.305)	47.93 (20.405)	< 0.0001
	Difference	-26.20 (14.514)	-3.17 (12.884)	< 0.0001
	P-value Paired T-test	< 0.0001	0.357	
Median (IQR)				**Mann-Whitney test**
Impact	After	8.14 (17.48)	45.63 (38.07)	0.001

The effect of yoga that was demonstrated in this research study relates to the deep breathing technique (*Pranayama*) and meditation, leading to a respiratory rate reduction. This has many beneficial effects: it enables the modulation of airway reactivity, improves breathing sensation through regulating breathing pattern, reduces oxygen consumption, reduces the incidence of hypoxia and hypercapnia, improves blood oxygenation without increasing ventilation, improves respiratory resistance, improves muscle strength and modulates autonomic function by decreasing heart rate at rest and sympathetic activity [3, 10].

The result of this research is in line with the results obtained by Katiyar [9] and Donesky [10] which showed that there was a significant increase in 6-MWD in a COPD group which took part in yoga exercises. Ranjita [12] also obtained a similar result showing a significant increase in COPD patients symptoms after completing yoga exercises over a 12 week period. The increase in 6-MWD is due to the effect of yoga on the musculoskeletal and cardiorespiratory systems, improving cardiovascular efficiency and homeostatic control of the body. The effect on muscle during continuous yoga stretch posture helps to increase oxidative capacity and skeletal muscle strength, flexibility, endurance, coordination, power, static and dynamic balance. It also helps to reduce glycogen utilization which improves physical performance, walking speed, and step length. Relaxation techniques have been found to increase cardiopulmonary resistance through body and breathing control, which manifests clinically as lung capacity increase, oxygen delivery increase and breathing rate reduction. Therefore, overall, it can increase exercise capacity at 6-MWD [12].

Quality of life is assessed by the SGRQ questionnaire which consists of symptoms, activity, impact, and total score of each group. The assessment of the quality of life increases when the SGRQ value is decreased. The British Thoracic Society (BTS) recommends using SGRQ as it is more sensitive in assessing clinical change. The SGRQ questionnaire can also be used to detect the response to medical treatment or non-medical treatment, as is the case in a lung rehabilitation program. Clinical change is considered to be significant if the SGRQ value decreases by 4% [4].

The SGRQ change in the yoga group is greater than in the control group in each component of the SGRQ questionnaire. The test result showed a significant difference in the change of SGRQ questionnaire value (symptom, activity, impact, total score) with a p-value of < 0.05. It can be concluded that patients with COPD treated with yoga have a significantly bigger decrease in SGRQ questionnaire values in some components (symptom, activity, impact and total score) compared to patients with COPD untreated with yoga.

This research is in line with previous completed studies. In the investigation completed by Fulambarker [13] and Katiyar [9], there was a significant change in the quality of life through the assessment of the SGRQ questionnaire in the group given yoga treatment for 12 weeks (24 meetings). There was a decrease in the mean value of SGRQ in the treatment group for 12 weeks in terms of symptoms, activity, impact, and total score. It means that there is an improvement in the quality of life in the treatment group. Lacasse *et al.*, as part of their research via a meta-analysis, concluded that pulmonary rehabilitation will reduce shortness of breath symptoms and improve COPD patient's ability to be active, which will improve functional capacity and quality of life [14]. Berry *et al.* explained that pulmonary rehabilitation would increase the maximum oxygen consumption and maximum working capacity, thereby increasing the functional capacity and quality of life [15].

This study also consistent with Kulpati et al. Patients who received yoga training were seen to have the best maintenance of function, reduction in the respiratory rate ($p < 0.001$) and heart rate ($p < 0.01$) compared with a group who received conventional therapy, while a group who received breathing exercise that only intermediate in their response, probably indicated the efficacy of yogasanas [16].

Yoga exercise will improve the functioning of bodily systems, namely in the nervous system and in all organs of the body. It also affects the psychological and spiritual aspects. Yoga exercise is a process of integrating aspects of oneself, including physical, psychological, and spiritual aspects. The optimal integration process enables a person to achieve the quality of life that they expect. A healthy body condition is indicated by the enhancement of psychological well-being (positive psychological conditions such as mood and happiness improve, whilst at the same time decreasing negative psychological symptoms including stress, anxiety, and depression). Practicing yoga also affects spiritual aspects. It allows for greater self-respect, respect of others and the surrounding environment, allows one to be closer to God and to have a meaningful life [17].

This study is consistent with Villien F's research [18], which concluded that changes in breathing patterns could be used as a measure of participating in meditational interventions. However, it is possible that emotions can mediate the relationship between respiratory rate and level of mindfulness. Respiratory patterns have been demonstrated to be stable over time and fluctuate in a consistent manner during changes in respiratory demand, such as exercise. Despite this stability, respiration patterns have been shown to change at rest in response to meditational practices in persons without pulmonary disease. After attending a meditational intervention which focused on *Ujjayi* breathing, it was found that healthy persons demonstrated a decrease in respiratory rate and an increase in expiratory time [18].

Conclusions

Yoga has beneficial effects in COPD Group B. FEV_1, 6-MWD, and the quality of life increase after yoga exercise. Therefore, yoga can be used as an option for pulmonary rehabilitation in patients with COPD category B. The pulmonary rehabilitation program should be given continuously in patients with COPD. However, pulmonary rehabilitation needs to be performed together with the instructor within a set exercise schedule in order to achieve the proper movements that correspond to the set procedures.

Ethical clearance

This study follows the principles of the Declaration of Helsinki. This study has received ethical clearance from Dr. Soetomo General Hospital before the study began (Ethical Clearance Number

300/Panke.KKE/IV/2017). All subjects gave their informed consent prior to their inclusion in the study. Before signing the informed consent, information for informed consent was given. Details that might disclose the identity of the subjects who took part in the study were omitted.

Authors' contributions

MA and RY designed the study. MA and RY collected samples. MA and RY gathered data. MA and RY analyzed the data. MA and RY made Tables and Figures. MA and RY wrote the manuscript, and all authors contributed to review and revision and have been approved the final version.

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Conflict of interest

All authors declare no conflict of interest.

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