Deep Breathing Relaxation Techniques Can Improve Oxygen Saturation Value, a Decrease in Blood Pressure and Pulse Rate in Patients with *Congestive Heart Failure*

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Abstract. Congestive Heart Failure (CHF) is a condition in which an abnormal cardiovascular heart cannot adequately pump blood to meet the metabolic needs of the body's tissues. Complaints that are often felt by CHF sufferers are shortness of breath, easily tired during light activities, increased blood pressure and pulse rate, even to the point of decreased consciousness, when it is severe it will decrease cardiac output which will reduce oxygen supply to the periphery, which will be marked by decreased oxygen saturation. The purpose of this study was to determine the effect of deep breathing relaxation techniques on the value of oxygen saturation, blood pressure, and pulse frequency. The research design used a quasi-experimental without control. The sample is 26 people, using the total sampling technique. The research was conducted at Ciamis Hospital, Indonesia. The results showed that there was a significant difference in the average pulse rate (p-value 0.000), there was a significant difference in the average systolic blood pressure (p-value 0.000), there was a significant difference in the average diastolic blood pressure (p-value 0.000)., there is a significant difference in the mean oxygen saturation (p-value 0.006).

Keywords: CHF · congestive heart failure · blood pressure

1 Introduction

Heart failure or *Congestive Heart Failure* (CHF) is the most common heart function abnormality [1, 2]. *Congestive Heart Failure* (CHF) is an abnormal condition of the cardiovascular system in which the heart cannot pump blood adequately to meet the metabolic needs of the body's tissues [3, 4]. Riskesdas 2018 data reports that the prevalence of heart disease based on doctor's diagnosis in Indonesia reaches 1.5%, with the highest prevalence in North Kalimantan Province at 2.2%, DIY 2%, Gorontalo 2%. Apart from these three provinces, there are also 8 other provinces with a higher prevalence compared to the national prevalence. The eight provinces are Aceh (1.6%), West Sumatra (1.6%), DKI Jakarta (1.9%), West Java (1.6%), Central Java (1.6%), Kalimantan East (1.9%), North Sulawesi (1.8%) and Central Sulawesi (1.9%). When viewed from the

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place of residence, urban residents suffer more from heart disease with a prevalence of 1.6% compared to rural residents which are only 1.3% [5].

Based on data taken from the medical records section of the Ciamis District General Hospital, in 2019 outpatient visits with clients diagnosed with CHF were 1200 people, while clients who were treated with a medical diagnosis of CHF were 737 people in the same year. In January 2019 there were an average of 68 cases of CHF in one Internal Medicine Inpatient Room at RSU dr. Soekardjo, this number increased compared to the number of CHF cases in December 2017 which amounted to 39 cases. The incidence of CHF continues to increase from time to time. CHF reduces the quality of life of sufferers because it causes various kinds of health problems that interfere with activities, rest, and even physiologically disturbed basic human needs, such as complaints of shortness of breath, pain, nausea, and others [6].

Complaints that are often felt in patients with CHF are in the form of shortness of breath, coughing, fatigue during light activities, restlessness and anxiety due to impaired oxygenation, edema in the lower extremities, anorexia accompanied by nausea, frequent urination at night, and weakness, even experiencing nausea. Decreased consciousness, if it is severe, will decrease cardiac output which will reduce oxygen supply to the periphery, which will be marked by decreased oxygen saturation values [7, 8]. CHF patients tend to experience a decrease in quality of life if the initial symptoms are not treated, then heart failure and depression are interrelated diseases and affect the functional status and quality of life of patients [9, 10].

To maintain the quality of life of CHF patients, various medical and non-medical the procedures including nursing play an important role, as well as the patient's adherence to the therapy program he is undergoing. One of the independent nursing the procedures in the care of CHF patients is a complementary therapy. Complementary therapy includes complementary therapy instead of eliminating the main therapy. *The deep breathing relaxation technique* is one of the complementary measures that can cause a feeling of comfort in CHF patients [11, 12].

The purpose of this study was to determine the deep breathing relaxation technique on oxygen saturation values, decrease in blood pressure, and pulse rate in CHF patients.

2 Research Method

This study was quantitative using a research *quasi-experimental design.* The design used is a *pre-test* and *post-test design*, where this design measures the difference between before and after the intervention. The sampling technique is total sampling, with a total of 26 respondents. The study was conducted at Ciamis Hospital, West Java, Indonesia on all CHF patients who were hospitalized. The research instrument used was a standard operating procedure (SOP) for relaxation of breath and a guideline for observing the results of measuring oxygen saturation values. Data analysis used univariate and bivariate analysis.

3 Results and Discussion

3.1 Results

The description of the characteristics of respondents based on the age of the respondents can be seen in the Table 1.

Based on Table 1, the mean age of respondents is 55.04 years (95% CI: 53.65–56.43), with a standard deviation of 3,435 and a minimum age of 50 years, and a maximum of 59 years.

From Table 2 it can be seen that the proportion of respondents based on gender is mostly male, namely 76.9% and 65.4% (Table 3).

The average pulse rate before the procedure was 92.92 (95% CI: 91.08–94.76) with a standard deviation of 4,551 maximum and minimum values are in the range of 86–103 times per minute.

The mean systolic blood pressure before the procedure was 140.77 mmHg (95% CI: 142.93–154.76) with a standard deviation of 14,744 and the minimum-maximum value was in the range of 120–170 mmHg.

The mean diastolic blood pressure before the procedure was 93.58 mmHg (95% CI: 92.02–95.14) with a standard deviation of 3.859 and the maximum-minimum value was in the range of 87–100 mmHg.

Table 1. Distribution of Respondents by Age in Ciamis Hospital

Distribution of respondents	**Mean**	**SD**	**Min–Max**	**95% CI**
Age	55.04	3,435	50–59	53.65–56.43

Table 2. Distribution of Respondents by Gender in Ciamis Hospital

Variable	**N**	**%**
1. Male	6	23.1
2. Female	**26**	**100**

Table 3. Distribution of respondents by Pulse rate, blood pressure and oxygen saturation Before Measures in Ciamis hospitals

Variable	Mean	SD	Min - Max	95% CI
Pulse rate	92.92	4,551	86–103	91.08–94.76
Systolic blood pressure average	140.77	14 744	120–170	134.81–146.72
Diastolic Blood pressure average	93.58	3,859	87–100	92.02–95.14
SpO2 average	94.00	3,200	87–98	92.71–95.29

The average oxygen saturation before the procedure was 94% (95% CI: 92.71–95.29) with a standard deviation of 3.2% and the maximum-minimum value was in the range of 87–98% (Table 4).

The Mean pulse rate after the procedure was 90.81 (95% CI: 89.16–92.46) with a standard deviation of 4.079 and the minimum-maximum value was in the range of 84–100 beats per minute.

The mean systolic blood pressure after the procedure was 135.77 mmHg (95% CI: 129.81–141.72) with a standard deviation of 14,744 and the minimum-maximum value was in the range of 115–165 mmHg.

The mean diastolic blood pressure after the procedure was 91.12 mmHg (95% CI: 89.60–92.63) with a standard deviation of 3,745 and the minimum-maximum value was in the range of 84–97 mmHg.

The average oxygen saturation after the procedure was 95.54% (95% CI: 94.55–96.53) with a standard deviation of 2.453 and the maximum-minimum value was in the range of 91–99%.

From the Table 5 it can be seen that the value of Shapiro-Wilk's pulse, blood pressure, and oxygen saturation before and after the act of showing p values > 0.05, which means that all data is distributed normally.

Table 4. Distribution of respondents based on the value of pulse rate, blood pressure and oxygen saturation after the the procedure in Ciamis hospitals

Variable	**Mean**	**SD**	**Min - Max**	**95% CI**
Pulse rate average	90.81	4079	84–100	89.16–92.46
Systolic blood pressure average	135.77	14 744	115–165	129.81–141.72
Diastolic Blood Pressure average	91.12	3745	84–97	89.60–92.63
SpO_2 average	95.54	2.453	91–99	94.55–96.53

Table 5. Normality test based on the Shapiro-Wilk value in Ciamis Hospital

Variable	**value**
the pulse before the procedure	0.080
the Pulse after the procedure	0.170
the Systolic blood pressure before the procedure	0.125
the Systolic blood pressure after the procedure	0.125
the Diastolic blood pressure before the procedure	0.142
the Diastolic blood pressure after the procedure	0.127
Oxygen saturation before the procedure	0514
oxygen saturation after the procedure	0110

Table 6. Equivalence Test of Variable Pulse Frequency, Blood Pressure and Oxygen Saturation Before The procedure at Ciamis Hospital

Variable	Mean	SD	Min - Max	95% CI	*p-Value*
Frequency Nadi	92.92	4551	86–103	91.08–94.76	0.080
Systolic blood pressure	140.77	14 744	120–170	134.81–146.72	0.125
Diastolic Blood Pressure	93.58	3859	87–100	92.02–95.14	0142
Saturation Oxygen	94.00	3200	87–98	92.71–95.29	0.514

Table 6 shows the equivalence test for the pulse frequency, systolic and diastolic blood pressure variables, and oxygen saturation before the intervention had a p-*value* > 0.05, so it can be concluded that there is no significant difference in the oxygen saturation value before the the procedure which means the second variant. same group.

Bivariate Analysis

Table 7 shows the average value of the average pulse before the procedure is 92.92 while the average pulse frequency after the intervention is 90.81. Statistical test results obtained a *p-value of* 0.000, it can be concluded that there is a significant difference in the average pulse frequency before the procedure.

The average value of systolic blood pressure before the procedure was 140.77 while the average systolic blood pressure after the intervention was 135.77. Statistical test results obtained a *p-value of* 0.000, it can be concluded that there is a significant difference in the mean systolic blood pressure before the procedure.

The average value of diastolic blood pressure before the first procedure was 93.58 while the average diastolic blood pressure after the intervention was 91.12. The results of statistical tests obtained a *p-value of* 0.000, it can be concluded that there is a significant difference in the average diastolic blood pressure before the procedure.

The average value of oxygen saturation before the procedure was 94%, while the average oxygen saturation after the intervention was 95.54%. The results of statistical tests obtained a *p-value of* 0.006, it can be concluded that there is a significant difference in the average oxygen saturation before the procedure.

Table 8 shows the average pulse rate before the procedure was 92.9231. Statistical test results obtained a p-*value of* 0.021, meaning that at 5% alpha there is a significant difference in the average pulse frequency value before exercise on the respondents.

The average value of systolic blood pressure before the procedure was 140.7692. The results of the statistical test obtained a p-*value* of 0.001, meaning that at 5% alpha there was a significant difference in the average value of systolic blood pressure before exercise.

The average value of diastolic blood pressure before was procedure93.5769. Statistical test results obtained a p-*value of* 0.256, meaning that at 5% alpha there was no significant difference in the average diastolic blood pressure value before exercise.

The average value of oxygen saturation before the the procedure was 93.3462. Statistical test results obtained a p-*value of* 0.022, meaning that at 5% alpha there is a significant difference in the average value of oxygen saturation before exercise (Table 9).

Table 7. Distribution of Average pulse rate, Systolic Blood Pressure and Diastolic And Oxygen Saturation Before and After Intervention In Ciamis Hospital

Value		Mean	SD	SE	p-*Value*
Pulse rate	Before After	92.92 90.81	4.551 4.079	0.893 0.800	0.000
Systolic Blood pressure	Before After	140.77 135.77	14.744 14.744	2.892 2.892	0.000
Diastolic Blood pressure	before After	93.58 91.12	3.859 3.745	0.757 0.734	0.000
Saturation Oxygen	before After	94.00 95.54	3.200 2.453	0.628 0.481	0.006

Table 8. Distribution Differences in the average pulse rate, Systolic and Diastolic blood pressure and oxygen saturation before intervention in Ciamis Hospital

Variables	Mean	SD	SE	p-*Value*
Pulse rate	92.9231	4.55125	0.89257	0.021
Pressure Systolic	140.7692	14.74397	2.89153	0,001
Diastolic Pressure	93.5769	3.85925	0.75686	0.256
Oxygen saturation	93.3462	4.08845	0.80181	0.022

Table 9. Distribution Differences in the average pulse rate, Blood Pressure Systolic and Diastolic and oxygen saturation After the procedure in Ciamis hospitals

Variable	**Mean**	**SD**	**SE**	**p-*Value***
Pulse rate	92.9231	4.55125	0.89257	0,021
Pressure Systolic	140.7692	14.74397	2.89153	0,001
Pressure Diastolic	93.5769	3.85925	0.75686	0,256
Oxygen saturation	93.3462	4.08845	0.80181	0,022

Table 10. Comparison of Changes in Average pulse rate, Systolic & Diastolic Blood Pressure Before and After Intervention at Ciamis Hospital

Variables	**Group**	**Mean Before**	**Mean After**	**Changes in**	**Meaning of**
Oxygen Saturation	Control	93.3462	95.5385	Increases 2.19	SpO_2 Values Increase

Table 10 clearly shows that the average oxygen saturation before the intervention was 93.3462 and after the intervention changed to 95.5385, meaning that there was a change in the value of 2.19. It can be concluded that the value of oxygen saturation increased after taking deep breath relaxation.

The average oxygen saturation before the intervention was 95.3846 and after the intervention changed to 97.9615, meaning that there was a change in the value of 2.58. It can be concluded that the oxygen saturation value has increased after deep breathing relaxation were performed.

3.2 Discussion

With age, the susceptibility to coronary atherosclerosis increases. The heart in old age tends not to work properly. The walls of the heart thicken and the arteries can become stiff and hard, making the heart less able to pump blood to the body's muscles. Because of these changes, the risk of developing cardiovascular disease increases with age. The risk of atherosclerosis increases after age 40 in men and after age 60 or after menopause in women. Women aged 60 years or older have the same risk of cardiovascular disease as men of the same age [13, 14]. The male gender suffers the most from CHF [15, 16].

Deep breathing relaxation can reduce pulse rate and blood pressure [17, 18]. At the time of breathing, the oxygen that enters the respiratory tract will undergo a process of ventilation, perfusion, and diffusion. As oxygen continues to diffuse from the air in the alveoli into the bloodstream and carbon dioxide (CO_2) continues to diffuse from the blood into the alveoli. Diffusion is the movement of molecules from an area of high concentration to an area of low concentration. Diffusion of respiratory air occurs between the alveoli and the capillary membrane. The pressure difference in the respiratory membrane area will affect the diffusion process. For example, the partial pressure of pO_2 in the alveoli is about 100 mmHg while the partial pressure in the pulmonary capillaries is 60 mmHg so that oxygen will diffuse into the blood. Unlike the case with CO_2 with PCO_2 in the capillaries 45 mmHg while in the alveoli 40 mmHg, CO_2 will diffuse out of the alveoli. The condition of lack of oxygen to the tissues is called hypoxia. One of the causes of hypoxia is blockage of blood vessels, lack of *cardiac output* due to disturbances in the heart.

In patients with heart failure/*Congestive Heart Failure* (CHF) patients experience various symptoms. In patients with left heart failure, the most common symptom is shortness of breath, which is characterized by a decrease in oxygen saturation, an increase in pulse rate, which is the heart's response to compensate for the lack of blood supply throughout the body, which is then accompanied by an increase in systolic and diastolic blood pressure. These symptoms are closely related to the autonomic nerves (sympathetic and parasympathetic). The sympathetic response will cause the release of epinephrine, an increase in epinephrine causes a rapid heart rate, rapid and shallow breathing, and increased arterial pressure. Anxiety also hurts the physiology of the human body, including the impact on the cardiovascular, respiratory system, gastrointestinal, neuromuscular, urinary tract, skin, impact on behavior, cognitive and affective [19]. An increase in respiratory rate occurs due to a physical response to compensate for an increase in pulse rate. Giving relaxation techniques such as deep breathing relaxation techniques will automatically stimulate the sympathetic nervous system to reduce levels of catecholamine substances which catecholamines are substances that can cause constriction of blood vessels which can cause increased blood pressure. When the activity of the sympathetic nervous system decreases due to the relaxing effect, the production of catecholamine substances will decrease, causing dilation of blood vessels, and eventually, blood pressure, heart rate, and respiratory rate will decrease. In patients with heart failure/*Congestive Heart Failure* (CHF) patients experience various symptoms. In patients with left heart failure, the most common symptom is shortness of breath, which is characterized by a decrease in oxygen saturation, an increase in pulse rate, which is the heart's response to compensate for the lack of blood supply throughout the body, which is then accompanied by an increase in systolic and diastolic blood pressure. These symptoms are closely related to the autonomic nerves (sympathetic and parasympathetic). The sympathetic response will cause the release of epinephrine, an increase in epinephrine results in a fast heart rate, rapid and shallow breathing, and increased arterial pressure. Anxiety also harms the physiology of the human body, including the impact on the cardiovascular, respiratory system, gastrointestinal, neuromuscular, urinary tract, skin, impact on behavior, cognitive and affective [19]. An increase in respiratory rate occurs due to a physical response to compensate for an increase in pulse rate. Giving relaxation techniques such as deep breathing relaxation techniques will automatically stimulate the sympathetic nervous system to reduce levels of catecholamine substances which catecholamines are substances that can cause constriction of blood vessels which can cause increased blood pressure. When the activity of the sympathetic nervous system decreases due to the relaxing effect, the production of catecholamine substances will decrease, causing dilation of blood vessels, and eventually, blood pressure, heart rate, and respiratory rate will decrease.

4 Conclusion

Deep breathing relaxation techniques effectively increase oxygen saturation, blood pressure, and pulse rate in patients with CHF.

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References

1. W. Niu, H. Yang, and C. Lu, "The relationship between serum uric acid and cognitive function in patients with chronic heart failure," *BMC Cardiovasc. Disord.*, vol. 20, no. 1, pp. 1–11, 2020, doi: https://doi.org/10.1186/s12872-020-01666-z.
2. O. Y. Shiryaev, V. L. Yankovskaya, A. V Budnevsky, and E. S. Ovsyannikov, "Psychosomatic Aspects of Chronic Heart Failure," *Int. J. Biomed.*, vol. 7, no. 3, pp. 248–250, 2017.
3. J. C. De La Torre, "Hemodynamic Instability in Heart Failure Intensifies Age-Dependent Cognitive Decline," *J. Alzheimer's Dis.*, vol. 76, no. 1, pp. 63–84, 2020, doi: https://doi.org/10.3233/JAD-200296.
4. G. J. Crystal, S. I. Assaad, and P. M. Heerdt, "Cardiovascular physiology: Integrative function," in *Pharmacology and Physiology for Anesthesia: Foundations and Clinical Application*, Second Edi., Elsevier Inc., 2018, pp. 473–519.

5. Rokom, "Penyakit Jantung Koroner Didominasi Masyarakat Kota," 2021. https://sehatnegeriku.kemkes.go.id/baca/umum/20210927/5638626/penyakit-jantung-koroner-didominasi-masyarakat-kota/.
6. Rekam Medis RSUD Ciamis, "Data Penyakit," Ciamis, 2019.
7. B.Kurmanbekova, A.Noruizbaeva, G.Osmankulova, and A.Rustambekova, "Evaluation of the beneficial effect of metformin on clinical indicators of heart failure patients with coronary artery disease and impaired glucose tolerance within a 12-month follow-up," *Am. Heart J.*, vol. 242, p. 164, 2021.
8. S. K. Yarmukhamedova and M. S. Bekmuradova, "No TitleLEVEL OF SODIUMURETIC PEPTIDE IN EARLY DIAGNOSIS OF CHRONIC HEART FAILURE IN PATIENTS WITH ARTERIAL HYPERTENSION," *Int. Sci. Res. J.*, vol. 32, pp. 21–24, 2021.
9. O. M. Uryasev, A. V. Solovieva, S. I. Glotov, A. Zhukova, V. A. Lunyakov, and E. A. Alekseeva, "Relationship of Pain, Dyspnea and Quality of Life in Chronic Heart Failure of Ischemic Genesis," *PJMHS*, vol. 14, no. 4, pp. 2042–2045, 2020.
10. P. van Kessel, D. de Boer, M. Hendriks, and A. M. Plass, "Measuring patient outcomes in chronic heart failure: psychometric properties of the Care-Related Quality of Life survey for Chronic Heart Failure (CaReQoL CHF)," *BMC Health Serv. Res.*, vol. 17, 2017.
11. W. Suksatan and T. Tankumpuan, "Mind–Body Interventions in Patients With Heart Failure: State of the Science," *J. Appl. Gerontol.*, 2021.
12. J. Viveiros, B. Chamberlain, A. O. Hare, and K. A. Sethares, "Meditation interventions among heart failure patients : An integrative review," *Eur. J. Cardiovasc. Nurs. 2019,* vol. 18, no. 8, pp. 720–728, 2019, doi: https://doi.org/10.1177/1474515119863181.
13. S. Sciomer *et al.*, "Role of gender, age and BMI in prognosis of heart failure," *Eur. J. Prev. Cardiol.*, vol. 27, no. 2S, pp. 46–51, 2020, doi: https://doi.org/10.1177/2047487320961980.
14. I. R. Mordi *et al.*, "Heart failure treatment up-titration and outcome and age: an analysis of BIOSTAT-CHF," *Eur. J. Heart Fail.*, vol. 23, no. 3, pp. 436–444, 2021.
15. P. Steca, D. Monzani, A. Pierobon, G. Avvenuti, A. Greco, and A. Giardini, "Measuring dispositional optimism in patients with chronic heart failure and their healthcare providers: the validity of the Life Orientation Test-Revised," *Patient Prefer. Adherence*, vol. 11, pp. 1497–1503, 2017.
16. V. Stubnova *et al.*, "Gender differences in association between uric acid and all-cause mortality in patients with chronic heart failure," *BMC Cardiovasc. Disord.*, vol. 19, no. 4, 2019.
17. R. Asano *et al.*, "Rationale for targeted self-management strategies for breathlessness in heart failure," *Heart Fail. Rev.*, vol. 26, pp. 71–79, 2021.
18. Y. Herdiana and M. Djamil, "The Effectiveness of Recitation Al-Qur ' an Intervention and Deep Breathing Exercise on Improving Vital Sign and anxiety Level among Congestive Heart Failure (CHF) Patients," *Int. J. Nurs. Heal. Serv.*, vol. 4, no. 1, pp. 9–16, 2020.
19. R. C. Austin, L. Schoonhoven, M. Clancy, A. Richardson, P. R. Kalra, and C. R. May, "Do chronic heart failure symptoms interact with burden of treatment ? Qualitative literature systematic review," *BMJ Open*, vol. 11, 2021, doi: https://doi.org/10.1136/bmjopen-2020-047060.