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Effects of yoga exercise on heart rate in post COVID-19 patients
Efectos del ejercicio de yoga en la frecuencia cardíaca en pacientes post-COVID-19

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Abstract. Objective: The research aimed to study the effect of yoga exercise on heart rate in post-infected patients COVID-19. Methods: The participant group consisted of female post-Covid-19 patients aged 18–22 years at a university. Sukjai (Pseudonym), 20 people, all voluntarily signed a letter of consent. Systematic Random Sampling was performed, with the experimental group (EXG) (n=10) exercising with yoga for eight weeks, three days per day, 90 minutes per session. The control group (CG) (n=10) did not undergo any training. Quantitative data were collected, including heart rate before training and after the fourth and eighth weeks of training. Qualitative data were collected through semi-structured interviews. The data were analysed by checking their stability and trust using a triangular method. Results: It was found that (1) after exercising with yoga after week four and week eight, the experimental group had a mean heart rate that was significantly better than before training and better than the control group . ($p<0.05$). (2) yoga exercises for patients after COVID-19 infection improves heart rate. Conclusions: Yoga exercise improved the heart rate of patients with COVID-19. Therefore, maintaining the health of people of all ages is an alternative activity.
Keywords: Yoga, Exercise, Heart rate, COVID-19,

Resumen. Objetivo: La investigación tuvo como objetivo estudiar el efecto del ejercicio de yoga sobre la frecuencia cardíaca en pacientes post-infectados por COVID-19. Métodos: El grupo de participantes consistió en mujeres post-COVID-19 de 18 a 22 años en una universidad. Sukjai (seudónimo), 20 personas, todas firmaron voluntariamente una carta de consentimiento. Se realizó un muestreo aleatorio sistemático, con el grupo experimental (EXG) (n=10) ejercitándose con yoga durante ocho semanas, tres días por día, 90 minutos por sesión. El grupo de control (CG) (n=10) no realizó ningún entrenamiento. Se recopilaron datos cuantitativos, incluyendo la frecuencia cardíaca antes del entrenamiento y después de la cuarta y octava semana de entrenamiento. Se recopilaron datos cualitativos a través de entrevistas semiestructuradas. Los datos se analizaron mediante la verificación de su estabilidad y confianza utilizando un método triangular. Resultados: Se encontró que (1) después de ejercitarse con yoga después de la cuarta y octava semana, el grupo experimental tuvo una frecuencia cardíaca media que fue significativamente mejor que antes del entrenamiento y mejor que el grupo de control ($p<0.05$). (2) los ejercicios de yoga para pacientes después de la infección por COVID-19 mejoran la frecuencia cardíaca. Conclusiones: El ejercicio de yoga mejoró la frecuencia cardíaca de los pacientes con COVID-19. Por lo tanto, mantener la salud de personas de todas las edades es una actividad alternativa. Nota: La traducción al español se ha realizado con la mayor precisión posible, pero es importante revisar la traducción final con un traductor profesional o nativo para garantizar su exactitud.
Palabras clave: yoga, ejercicio, frecuencia cardiac, COVID-19

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Introduction

Changes in daily life caused by social separation during the COVID-19 pandemic have resulted in lifestyle changes. The most significant lifestyle changes documented during the COVID-19 pandemic were an increase in sedentary behaviour and a decrease in exercise time (Pinton et al., 2020; Xiang et al., 2020), resulting in a decrease in overall body strength. The decrease in type one muscle fibres is associated with the body's energy metabolism and immune system (Jee, 2021; Min et al., 2021).

Exercise is a significant role in improving health (Telama et al., 2004) and a necessary component of a healthy lifestyle that encompasses physical, mental, and social happiness (Bailey, 2006; Strong et al., 2005). To date, exercise training is one of the powerful strategies to delay or prevent the progression of diseases. (Ciolac, 2013; Gronek et al., 2021). Medical researchers all over the world encourage frequent exercise to stay healthy during the COVID-19 pandemic (Chen et al., 2020). Similarly, during the COVID-19 outbreak, 19 exercises of varying intensity should be performed daily for at least 60 minutes (Cheung, 2019; WHO, 2010; Min et al., 2019).

Heart Rate (HR) is the number of heart beats per minute and represent of the most widely used parameters in the assessment of cardiac activity (Rodas et al., 2008 ; Rochel Vera et al., 2024). In terms of cardiac function, a heart rate of 60 beats per minute and diastolic blood pressure were comparable to those seen in resting bradycardia. Long-term exercise frequently produces this blood response (Lee et al., 2022; Sugiura et al., 2015). Following exercise, the heart rate (HR) returns to normal levels as a result of activity (Pober et al., 2004; Sriton & Ruangthai, 2022), which includes yoga that focuses on mindful breathing control. Breathing gently and deeply may help enhance diaphragmatic mobility. This leads to enhanced ventilation and full movement of the respiratory muscles. Yoga is a discipline that promotes balance in the body, emotions, and mind, as well as relaxation. Asanas are physical postures; pranayama are controlled breathing methods; and dhyana is meditation. Physiologically, yoga activates the nervous system, allowing the autonomic nervous

system to work more effectively; thus, it is utilized to prevent and treat disease. As a result, yoga has recently been recognized as an area of alternative medicine, with added benefits for both mental and physical rehabilitation (Prathikanti et al., 2017; Sullivan et al., 2018). Including yoga exercise enhances muscles strength (Kanjirathingal et al., 2021), cardio and pulmonary function (Balaji et al., 2019)

Yoga has also been shown to help reduce negative emotions like anger, despair, and anxiety. It produces a sense of bodily and mental peace. Enhancing self-control (Kim & Lee, 2022; Klainin-Yobas et al., 2015; Miller et al., 1995; Prathikanti et al., 2017). This study sought to investigate the effect of yoga activity on heart rate. Heart in patients after COVID-19 infection. This is an appropriate alternate exercise activity for patients recovering from COVID-19 infection.

Material and Methods

Participants

The participant were 40 female COVID-19 patients aged 18-22 years from Sukjai University (fictitious names) volunteered for the project. Simple random sample was used by drawing lots to select individuals who had never exercised with yoga previously and completed a pre-exercise readiness assessment (PAR-Q) to examine their overall health. Then, 20 old persons were chosen, their heart rate (HR) was measured, and the scores were sorted using Systematic Random Sampling to ensure that the balance values before training in both groups were comparable (10 people per group).

There were the following sample groups: 1) an experimental group (EG) that exercised with yoga for eight weeks, three days a day, 90 minutes per session, and 2)

a control group (CG) that did not receive any instruction. All of the participants voluntarily signed a letter of consent.

Criteria for selecting research participants included female patients aged 18 to 22 years, those able to move normally and perform light exercises, and those without any congenital disease that has previously hindered their ability to engage in yoga exercise. The criteria for choosing participants in the research involved excluding those who had injuries or illnesses that prevented them from engaging in yoga exercises and those who missed more than three sessions. Additionally, the research also excluded participants who withdrew from the training before completing it for the specified duration.

Study Organization

The researchers recruited a group of volunteers who practiced yoga three days a week for 60 minutes each day for eight weeks. They then assessed their heart rate (HR) before and after training. Qualitative data was collected through interviews and observations of the sample group's yoga exercise abilities. The data were examined inductively by comparing their stability. To summarize the effects of yoga exercise training on heart rate in COVID-19 patients.

Statistical Analysis

The statistical analyses were conducted using SPSS 25 (IBM Corp., IBM SPSS Statistics for Windows, Version 25.0; Armonk, NY: IBM Corp). The data are reported as the mean ± standard deviation (SD). The normality of the data was assessed using the Shapiro-Wilk test. The one-way analysis of variance with repeated measures followed by the Bonferroni post-hoc test was used to evaluate differences in flexibility and muscular strength between groups (comparisons between values obtained before, after 4-week and after 8-week training) and independent t-tests (comparisons of differences

to baseline between groups) were completed. P values < 0.05 was statistically significant.

Results

The research found that following, (1) after exercising with yoga after week four and week eight, the experimental group had a mean heart rate that was significantly better than before training and better than the control group $p<0.05$, and (2) yoga exercises for patients after COVID-19 infection improves heart rate and blood pressure.

Table 1.
Characteristics of the participant

Given name	Age (year)	Weight (kg)	Height (cm)	BMI (kg/m^2)	Health Problems
MD.1	21	46	155	19.14	Back Pain
MD.2	21	50	157	20.28	Back Pian
MD.3	21	60	160	23.43	Back Pian
MD.4	20	70	155	29.21	-
MD.5	21	60	158	24.03	-
MD.6	20	73	156	30.00	-
MD.7	20	89	160	34.77	-
MD.8	21	50	161	19.29	-
MD.9	20	68	157	26.23	-
MD.10	21	57	159	23.12	-
X	20.60	62.60	158.40	24.99	

Table 1, it was evident that the sample group utilized the fictitious name P.R. 1 (signifying the first sample group) and consisted of individuals between 18 to 22 years of age. The average age was 20.60 years, while the average body weight was 62.60 kilograms. The average height was 158.40 centimetres and the average body mass index (BMI) was 24.99. Interestingly, the group faced similar health issues, particularly back pain.

Table 2.
Summary of findings

Benefits of yoga exercise on heart rate in post-COVID-19 patients
Better heart rate and blood pressure

Summary of findings: Table 2, could be summarized as follow; Better heart rate and blood pressure.

The interview and observation could be described as following.

Better Heart Rate and blood pressure

Yoga practice was the continuous movement of the body in accordance with systematic breathing exercises, making the body flexible, strong, and balanced. Having a better heart rate and blood pressure complies with *MD. 1* said that before practicing, felt tired easily and had a fast heartbeat, but after practicing yoga, their heartbeat became slower. *MD. 2* heart rate and blood pressure improved, and it was not as tired as before.

After contracting COVID-19, individuals may experience difficulty breathing and feel unusually tired, leading to an increased heart rate and blood pressure. However, engaging in yoga practice has demonstrated improvements in physical health, including a healthier heart rate and lower blood pressure according to *MD.5*. Compliance with *MD.6* indicated that after recovering from COVID, individuals needed to adjust their physical fitness and engage in exercise. Practicing yoga has been shown to provide numerous benefits, including relaxation, improved breathing, and increased movement. It has been suggested that yoga can improve breathing and heart rate, similar to *MD.8*, which found that after contracting COVID, individuals experienced difficulty breathing fully. The heart rate and blood pressure increases rapidly and becomes fatigued easily, but after practicing yoga, the body feels more relaxed, the heart beats more normally, and the heart rate improves. *MD.9* concludes that yoga promotes continuous movement, helps individuals breathe better, reduces stress, and improves both breathing and heart rate.

Table 3.
Baseline characteristics in the control and experimental groups.

Parameters	CG (n = 10)	EXG (n = 10)	t	P-value
Age (year)	.2050 ± .053	.2060 ±0.5 2	-0.429	0.673
Weight (kg)	59.40 ± 6.90	62.70 ± 12.34	-0.738	0.470
Height (cm.)	160.44 ± 3.13	158.40 ± 1.90	1.744	0.099
BMI (kg/m^2)	23.83 ± 4.33	24.99 ± 4.84	-0.563	0.580

Table 3, Description: CG; control group and EXG; Experimental group; BMI; body mass index. Values are mean ± SD .$p > 0.05$ No significant difference was found between the two groups for any variable.

Table 4.
Mean changes in hemodynamic parameters in all two groups after a 4-week (MID) and an 8-week (POST) training period.

Parameters	Time	CG (n = 10)	EXG (n = 10)	t	P-value
Hemodynamic parameters					
Heart rate)beat/min(	PRE (week 0)	96.60 ± 13.87	96.50 ± 11.85		
	MID (week 4)	95.80 ± 14.37	88.40 ± 13.37		
	POST (week 8)	97.80 ± 14.63	81.50 ± 12.80		
	%Changes (MID vs. PRE)	0.83- ± 2.55	8.39-± 6.54*)p = 0.00(6	3.429	0.00‡ 3
	%Changes (POST vs. PRE)	1.24 ± 1.59	15.54- ± 6.33#)p = 0.001(	8.186	0.001 Ω
	%Changes (POST vs. MID)	2.09 ±)†2.34p = 0.0(35	7.81- ±)(†5.43p = 0.00(5	5.282	0.001§
Systolic blood pressure (mmHg)	PRE (week 0)	114.50 ± 13.94	115.90 ± 4.56		
	MID (week 4)	113.60 ± 15.03	112.20 ± 3.85		
	POST (week 8)	114.70 ± 14.12	106.0 ±5.03		
	%Changes (MID vs. PRE)	0.79- ± 3.96	3.19- ± 2.03*)p = 0.00(3	1.648	0.117
	%Changes (POST vs. PRE)	0.17 ± 2.88	8.54- ± 2.48#)p = 0.001(	7.268	0.001 Ω
	%Changes (POST vs. MID)	0.97 ± 2.38	5.53- ±)†2.75p = 0.001(	5.777	0.001§
Diastolic blood pressure (mmHg)	PRE (week 0)	83.60 ± 3.60	80.40 ± 4.35		
	MID (week 4)	85.20 ± 5.37	75.60 ±4.50		
	POST (week 8)	86.50 ± 4.50	71.20 ± 5.27		
	%Changes (MID vs. PRE)	1.91 ± 5.33	5.97- ± 3.54*)p = 0.001(	3.894	0.‡ 001
	%Changes (POST vs. PRE)	3.47 ± 5.59	11.44- ± 6.09#)p = 0.00(1	5.709	0.001 Ω
	%Changes (POST vs. MID)	1.53 ± 2.63	5.82- ± 5)(†22.p = 0.0(28	3.999	0.00§ 1

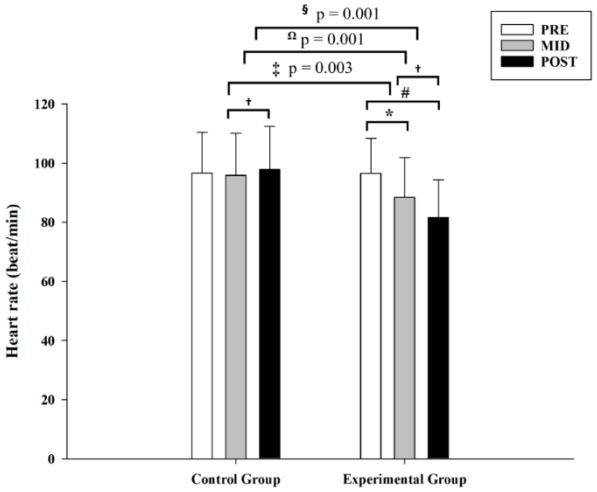

Figure 1. Changes in the heart rate before (PRE), after 4 weeks (MID), and after 8 weeks (POST) of the training period. Values are present as mean ± SD. Figure 1, *Significant p<0.05)MID vs. PRE(, #Significant p<0.05)POS† Significant p<0.05)POST vs. MID(, ‡Significant p<0.05) %Changes MID vs. PRE), ΩSignificant p<0.05) %Changes POST vs. PRE), §Significant p<0.05)%Changes POST vs. MID)

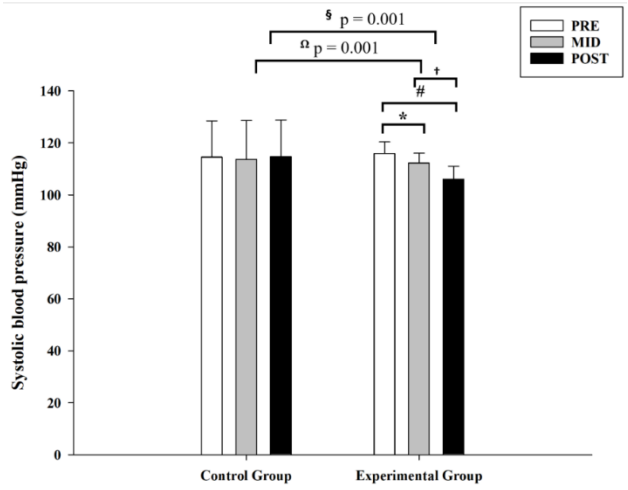

Figure 2. Changes in the systolic blood pressure before (PRE), after 4 weeks (MID), and after 8 weeks (POST) of the training period. Values are present as mean ± SD.Figure 2, *Significant p<0.05)MID vs. PRE(, #Significant p<0.05)POST vs. P† Significant p<0.05)POST vs. MID(, ‡Significant p<0.05) %Changes MID vs. PRE), ΩSignificant p<0.05) %Changes POST vs. PRE), §Significant p<0.05)%Changes POST vs. MID)

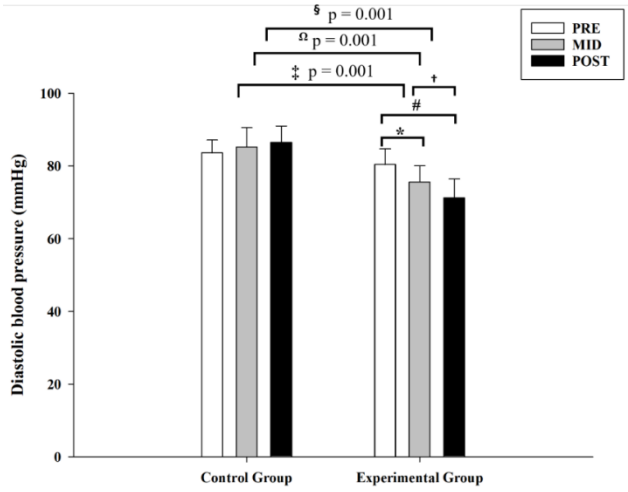

Figure 3. Changes in the diastolic blood pressure before (PRE), after 4 weeks (MID), and after 8 weeks (POST) of the training period. Values are present as mean ± SD. Figure, 3*Significant p<0.05)MID vs. PRE(, #Significant p<0.05)POST† Significant p<0.05)POST vs. MID(, ‡Significant p<0.05) %Changes MID vs. PRE), ΩSignificant p<0.05) %Changes POST vs. PRE), §Significant p<0.05)%Changes POST vs. MID)

Discussion

The trial demonstrated that following eight weeks of yoga exercise, the experimental cohort displayed a higher mean heart rate compared to their pre-training readings, and this difference was statistically significant when contrasted against the control group. Yoga has been proven to enhance the heart rate of COVID-19 patients. According to the American College of Sports Medicine (ACSM), for health benefits, adults should engage in 500-1,000 MET minutes of moderate-intensity aerobic exercise per week for 150 minutes (Garber et al., 2011). Regular physical activity is crucial for fortifying the immune system by combating external antigens (Jee, 2020), and maintaining heart and lung functionality through aerobic exercise (Chen et al., 2020). Exercise during the COVID-19 pandemic has been shown to improve immune function and mental health (Cheung, 2019), the cardiovascular response to exercise is important descries the progressive changer (increases) in HR response (Alvarez et al., 2023), and it enhance breathing capacity and physical fitness (Park et al., 2023). In our present study, Thai yoga improves blood glucose, oxidative stress, antioxidants, pulmonary function, respiratory muscle strength and improve body posture (Agudo Villarejo et al., 2024; Promsrisuk et al., 2023). The respiratory muscles were strengthened using diaphragmatic and abdominal breathing associated with yoga. Yoga allow the joints to move at different angles, enhancing muscle strength, and Flexibility (Srinivasan, 2016), as well as promoting chest and abdominal expansion (Gonzalez-Alvarez et al., 2016), and increasing blood flow to the respiratory muscles (Posadzki & Parekh, 2009). In fact, Thaiprasert (2019) found that these activities can reduce fear and improve balance. Additionally, Pilates and yoga have been shown to offer direct benefits for physical and mental

health by improving posture, flexibility, muscle tone, cardiovascular function, weight management, and stress reduction includes benefits for physical fitness have balance in the body strength and endurance mental health improves and more socialization (Nontakhod et al., 2022; Siqueira et al., 2010). Moreover, training in Chi Gong, Taiji, yoga and pilates has been linked to improved overall physical, mental, and social health, as well as increased balance, strength, and flexibility, leading to a sense of relaxation and mental well-being. This involves enhancing physical fitness and overall health to promote a higher quality of life (Borah et al., 2024; Nontakhod et al., 2022; Park & Lim, 2019; Saetae et al., 2018). Consequently, practicing yoga can aid in improving the heart rate of patients who have recovered from COVID-19. Hence, it serves as a valuable alternative exercise for maintaining the well-being of individuals of all ages.

Conclusion

Yoga exercises help improve the functioning of the heart and lungs. respiratory muscles heart muscle strength It improved the heart rate and blood pressure of patients after being infected with COVID-19. Therefore, it is an alternative activity for maintaining the health of people of all ages and may reduce the risk of COVID-19 disease.

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Human research ethics

This research was approved by the Human Research Ethics Committee of Buriram Rajabhat University (BRU: 005/2023).

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