Analysis of the Effect of 3 Rounds of Competition on Respiratory Rate and Heart Rate in Pencak Silat Athletes Pekalongan City

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Abstract: Pencak silat, as a traditional Indonesian sport, demands a high level of physical and mental fitness from its athletes. In the context of competition, the test is a crucial moment that tests the ability of athletes to face intense physical challenges. Two important physiological parameters to monitor during the test are respiratory rate and heart rate. Respiratory rate reflects the efficiency of the respiratory system in meeting the body's oxygen needs, while heart rate indicates a cardiovascular response to increased physical activity. This study aims to analyze the effect of 3-round competition on respiratory rate and heart rate in pencak silat athletes in Pekalongan City. The optimal respiratory rate supports strong respiratory capacity, allowing athletes to maintain their peak performance during the game. Meanwhile, the increase in heart rate reflects how the athlete's heart works harder to pump blood and deliver oxygen to the hardworking muscles. Methods This research uses quasy experiments, using quantitative analysis. Primary data sources consist of respiratory rate and heart rate. The sample used in this study amounted to 11 pencak silat athletes. The shapiro-wilk test is used for data normality. The leave test is used for homogeneity. The paired t test was used for the statistical analysis of this study with a significant Nilain P > 0.05 as the standard. SPSS Ins, Chigago, IL USA, used for all analyses. The results showed that an increase in respiratory rate was recorded with a significance value of 0.004 (<0.005), indicating that intensive physical activity during the competition substantially increased the respiratory capacity of athletes. In addition, the increase in heart rate was also significant with a significance value of 0.001 (<0.005), indicating that the cardiovascular response to the test was very high..Conclusion This study showed that the pencak silat test for 3 rounds significantly increased the respiratory rate and heart rate of athletes.

Keywords: Pencak silat, respiratory rate, heart rate

INTRODUCTION

The sport of pencak silat, as one of Indonesia's rich cultural heritage, demands very high physical abilities from its athletes (Sasmita et al., 2023). Pencak silat athletes must have strength, speed, endurance, and precision in each movement to be able to perform optimally in the arena (Warthadi et al., 2022). In this context, effective and measurable physical exercise is very important to develop the physical capacity and performance of athletes (Wahyudi & Herdyanto, 2020). One form of training that is often used is competitive training, which allows athletes to simulate real match conditions. Competitive training not only helps in improving technical and tactical skills, but also has a significant impact on the athlete's cardiovascular and respiratory systems Two important indicators that are often used to measure such impacts are respiratory rate and heart rate (Yanti, 2023).

The respiratory rate is an important indicator because it reflects how well the respiratory system is able to supply oxygen to the body and remove carbon dioxide from the body (Romano et al., 2023). During intense physical exercise, the need for oxygen increases, and the respiratory rate will increase to meet the need (N. Li et al., 2024). By measuring the respiratory rate, we can gain information about how effectively the athlete's respiratory system is at handling the increased oxygen demand during training (Nalbandian et al.,). Meanwhile, heart rate is an important indicator for assessing how the cardiovascular system responds to physical exercise. During intense physical activity, the heart must pump blood faster and harder to deliver oxygen and nutrients to the working muscles (Mongin et al., 2023). The increase in heart rate during competitive training reflects how hard the heart works to meet the body's needs (Reimers et al., 2018). By measuring heart rate, we can assess how well an athlete's heart is functioning under the stress of intense exercise and how quickly the heart can recover after exercise (S. N. Li et al., 2023). These two parameters provide a clear picture of how the body responds to intense physical exercise (Gronwald & Hoos, 2020; Migliaccio et al., 2023).

Previous research has shown that structured physical exercise can improve the efficiency of the cardiovascular and respiratory systems. For example, a study conducted by Tsuji et al., (2023) & Weston et al., (2014) found that high-intensity interval training can improve athletes' aerobic and anaerobic capacity, which directly affects respiratory rate and heart rate. Competitive training, as a form of high-intensity interval training, has the potential to provide similar benefits. However, the specific impact of sparring training on pencak silat athletes still needs to be explored further to provide strong empirical evidence.

Thus, in-depth research on the impact of competitive training on physiological parameters such as respiratory rate and heart rate becomes very relevant. This research will not only provide new insights into the effectiveness of

competitive training in improving athletes' performance, but can also be the basis for the development of more effective and directed training programs. Additionally, a deep understanding of how sparring exercises affect respiratory rate and heart rate can help trainers in designing safer and more efficient training sessions. Given the importance of maintaining heart and lung health for athletes, this information is invaluable in preventing injuries and overtraining, as well as ensuring that athletes can consistently achieve their peak performance.

Therefore, this study aims to analyze the effect of competition training on respiratory rate and heart rate in pencak silat athletes in Pekalongan City.

METHOD

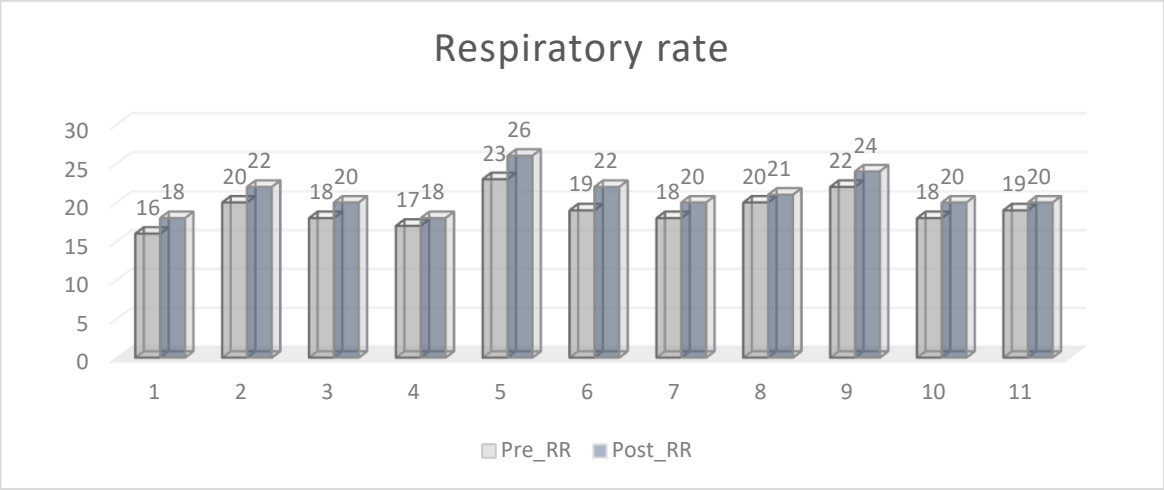
This study uses a quantitative method with a pseudo-experiment design. This design involves a pre-posttest approach in a one-group pretest-posttest design (Isnawan & Nahdlatul, 2020). The samples used in this study were 11 male pencak silat athletes, sample age 14.9 ± 0.8 years, height 162.4 ± 4.8 cm, weight 52.7 ± 4.6 kg, and body mass index 20 ± 1.9. This research was carried out at the UMPP Campus of Pekalongan City in October 2023. The data sources taken were respiratory rate and heart rate before and after conducting the 3-round test.

The procedure in this study is that first, participants are collected and by filling in their biodata and given procedures and series to be carried out. Second, a *pre-test was carried out* to measure respiratory rate using the value of the frequency of depth during inspiration and exfaction for 1 minute and heart rate using *a pluse oxymeter.*

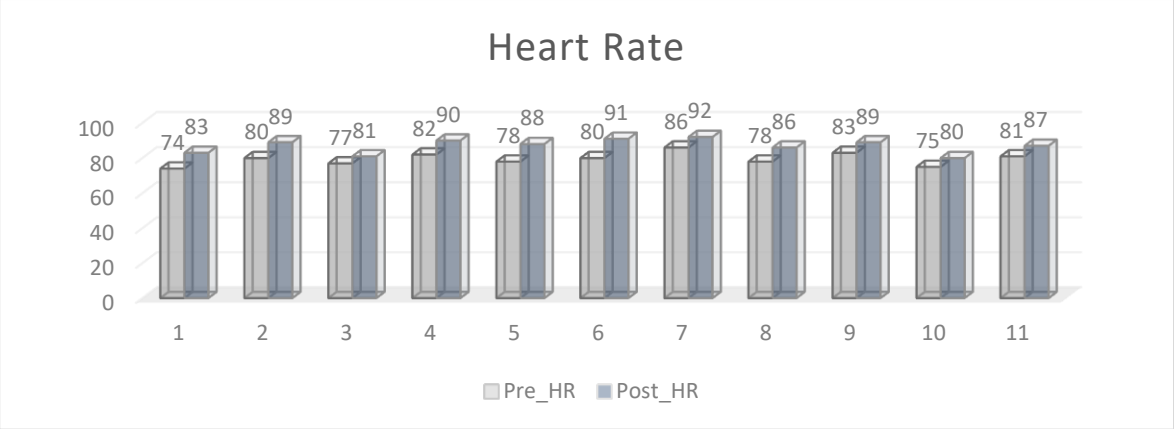
The third stage is to carry out treatment with a 1 x 1 competition system. The last stage is to take post test data on respiratory rate and heart rate and carry out analysis tests.

RESULTS

The data of this study is displayed in the form of mean $\pm$ SD. The primary data in this study were Respiratory rate with a pre-test value of 19.1 $\pm$ 2.1 and post test of 21.0 $\pm$ 2.4, as well as heart rate with a pre-test value of 79.5 $\pm$ 3.5 and post test of 86.9 $\pm$ 4. Figure 1 explains the results of pre test and post test respiratory rate data and figure 2 explains the value of pre test and post test heart rate data.



Picture 1. The results of the pre-test and post-test respiratory rate data



Picture 2. The results of the pre-test and post-test Heart rate data

Tabel 1. Statistical analysis of the research data

Statistic	Respiratory rate		Heart Rate	
	Pre	Post	Pre	Post
Mean	19,1	21,0	79,5	86,9
SD	2,1	2,4	3,5	4,0
Max	23	26	86	92
Min	16	18	74	80

Tabel 2. Uji normalitas Kolmogorov-Smirnov

o.	Variabel	N	Normality Statistic	Sig	Kesimpulan
Pre Test:					
	Respiratory rate	11	.934	0.457	Normal
	Heart Rate	11	.983	0.980	Normal
Post Tes:					

	Respiratory rate	11	.952	0.669	Normal
	Heart Rate	11	.923	0.344	Normal

Table 2 of the normality test results for respiratory rate and heart rate variables in pre-test and post-test with a sample number (N) of 11. In the pre-test, the respiratory rate variable had a normality statistic of 0.934 with a significance value of 0.457, while the heart rate variable showed a normality statistic of 0.983 with a significance value of 0.980. Both of these significance values are greater than 0.05, which indicates that the data on the pre-test are normally distributed. In the post-test, the respiratory rate variable had a normality statistic of 0.952 with a significance value of 0.669, and the heart rate variable had a normality statistic of 0.923 with a significance value of 0.344. These two values are also greater than 0.05, which indicates that the data on the post-test is normally distributed. Thus, it can be concluded that the data for both variables in the pre-test and post-test are normally distributed.

Tabel 3. Uji homogenitas

No.	Variabel	Leave statistic	Sig	Kesimpulan
1	Respiratory rate	.083	0.336	Homogen
2	Heart Rate	.232	0.636	Homogen

Table 3 shows the results of the two variables, namely respiratory rate and heart rate, showing homogeneous results. For the respiratory rate variable, the leave statistic was recorded at 0.083 with a significance value of 0.336. A significance value greater than 0.05 indicates that this variable is homogeneous. Similarly, for the heart rate variable, the leave statistic is 0.232 with a significance value of 0.636, which also indicates homogeneity because the significance value is greater than 0.05. Thus, it can be concluded that there is no significant difference in the data variability of these two variables, suggesting that the data are homogeneous.

Tabel 4. Uji T-Paired test

No.	Variabel	Mean	SD	T	Sig	Kesimpulan
1	Respiratory rate	-1.000	.632	-5.244	.004	Ada perbedaan
2	Heart Rate	-7.455	2.207	-11.200	.001	Ada perbedaan

Table 4 shows that the results of the respiratory rate variable have an average difference of -1,000 with a standard deviation of 0.632. The T-value is -5.244 and the significance value (Sig) is 0.004, which indicates that this difference is statistically significant. Thus, it can be concluded that there is a significant difference in respiratory rates. The heart rate variable showed an average difference of -7,455 with a standard deviation of 2,207. The T-value is -11,200 and the significance value (Sig) is 0.001, which indicates that this difference is also statistically significant. Therefore, it can be concluded that there is a significant difference in heart rate. Overall, both variables, respiratory rate and heart rate, showed significant differences with significance values smaller than 0.05.

DISCUSSION

This study aims to determine the effect of 3-round competition on the respiratory rate and heart rate of pencak silat athletes. Respiratory rate is a vital indicator that reflects the effectiveness of the respiratory system in supplying oxygen and removing carbon dioxide from the body (Nicolò et al., 2018). In pencak silat, which demands high physical intensity and fast movements, respiratory efficiency plays a crucial role (Nohan & Wahyudi, 2021). An optimal respiratory rate indicates that athletes have a strong respiratory capacity, allowing them to maintain peak performance during the game (Migliaccio et al., 2023). Adequate oxygen in the blood is key for muscles to work efficiently, supporting endurance and strength in athletes (Jurić et al., 2019). Additionally, effective carbon dioxide removal prevents lactic acid buildup, which can lead to muscle fatigue and reduce dexterity (Sukadiono et al., 2022).

The first finding in this study was that the pencak silat match test for 3 rounds had a significant influence on increasing respiratory rate, both at the pre-test and post-test stages, with a significance value of 0.004. This shows that there is a significant increase in respiratory rate in pencak silat athletes after undergoing the competition. The results of this study are in line with research conducted by McKenzie, (2012) which shows that intensive physical exercise can improve respiratory capacity and respiratory system efficiency. McKenzie, (2012) noted that endurance training can significantly improve ventilation efficiency and inspiration capacity, which in turn improves athletic performance overall. The results of this study are also supported by research conducted by Chlif et al., (2017) increasing the intensity of physical exercise significantly increases respiratory rate and lung capacity in athletes. The study shows that increased respiratory rate is an important physiological adaptation to meet higher oxygen needs during intensive training and competition. This study confirms that the ability to regulate and increase respiratory rate is key for athletes in improving their endurance and physical performance.

With an efficient breathing system, pencak silat athletes can attack and defend more effectively, maintain stamina, and minimize the risk of injury. Scientifically, a good respiratory rate is related to optimal lung capacity and cardiovascular function (Duong et al., 2022). A regular and optimal respiratory rate not only improves respiratory capacity, but also plays an important role in maintaining the acid-base balance in the body, which is essential for efficient muscle performance during intensive physical activity (Kondamudi et al., 2021). Athletes who are able to regulate their respiratory rate well will be better able to adjust to high physical demands during training and matches (Duong et al., 2022). Therefore, respiratory rate is not just a number, but an important indicator of an athlete's physical fitness and capacity to compete at the highest level.

Heart rate is an important indicator for assessing how the cardiovascular system responds to physical exercise. During intense physical activity, such as pencak silat, the heart must work harder and pump blood faster to deliver oxygen and nutrients to active muscles (Hadjarati & Massa, 2023). Heart rate reflects many important aspects of a person's cardiovascular performance and physical fitness. When athletes train or compete, an increase in heart rate is the body's response to increased energy needs. The heart pumps more blood per minute (cardiac output) to meet the higher oxygen demand of the hardworking muscles (Mairbäurl, 2013). This process not only provides the oxygen necessary for energy production through cellular respiration, but also helps to excrete metabolic byproducts such as carbon dioxide and lactic acid, which if not eliminated, can lead to fatigue and decreased muscle performance (Schindler et al., 2008). Heart rate can also be used to measure exercise effectiveness and recovery (Schneider et al., 2018).

During physical exercise, an increased heart rate indicates how intensely the body works. After exercise, the heart rate returns to normal levels can be an indicator of cardiorespiratory fitness; The sooner the heart rate returns to normal, the better a person's cardiovascular fitness condition will be (Carroll et al., 2012). In addition, a heart rate that is too high or irregular during exercise can be a sign of a cardiovascular problem that requires medical attention (Mratbaevna & Farrux, 2023).

The second finding in this study was that the pencak silat match test for 3 rounds had a significant influence on increasing heart rate both at the pre-test and post-test stages, with a significance value of 0.004. This shows that there is a significant increase in heart rate in pencak silat athletes after undergoing the competition. The results of this study are in line with research conducted by Coyne et al., (2020) which found that high-intensity training in martial arts athletes also led to a significant increase in heart rate. (Batacan et al., 2017) noted that physical activities involving high intensity, such as sparring in martial arts, substantially increase heart rate in response to the body's higher oxygen needs and increased metabolism. In addition, research by (Mohammadalizadeh et al., 2024) also supports these findings, where they observed that intensive training sessions in contact sports triggered a significant increase in heart rate, both during exercise and in the recovery phase. They underlined that the observed increase in heart rate may serve as an indicator of the body's physiological response to intense physical stress, which contributes to better cardiovascular adaptation in athletes.

In the context of pencak silat athletes, a controlled and efficient heart rate means that the heart can quickly adjust to the changing physical demands during the game, providing an advantage in endurance and endurance (Subekti et al., 2023). Heart rate monitoring can help athletes and coaches design training programs accordingly, ensuring that training is performed at the right intensity to

improve performance without overburdening the body (Sutopo et al., 2001). Overall, heart rate is a very useful tool in understanding how the body responds and adapts to physical exercise, as well as in maximizing athlete performance through proper monitoring and adjustment. This study adds to existing evidence regarding the impact of high-intensity exercise on athletes' cardiovascular responses. These findings have important implications for sports coaches and practitioners in designing effective exercise programs to improve cardiovascular fitness and athlete performance. Furthermore, these results also underscore the importance of heart rate monitoring during exercise to identify potential health risks and ensure exercise is carried out within safe limits

CONCLUSION

This study showed that the pencak silat test for 3 rounds significantly increased the respiratory rate and heart rate of athletes. These findings emphasize the importance of monitoring these two parameters to optimize the training program and performance of pencak silat athletes.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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