



Original Article

Analysis of heart rate and scores in student archery athletes

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ABSTRACT

This research aims to determine the heart rate when aiming at DKI Jakarta student archery athletes which will be carried out in May 2023. The research method used is the cross-sectional survey design method. This research instrument is a polar type H10 as a heart rate monitor used by the samples during the archery process. This research was conducted in the Pulomas field, East Jakarta. Sample selection used purposive sampling technique. The sample in this study were DKI Jakarta student athletes who met the criteria, namely 10 recurve athletes. The stages carried out in the data collection process were, heart rate during aiming was measured when the athlete was in the aiming position until release during the archery process using three arrows with a time of 180 seconds per series and carried out in 5 series with a total of 15 arrows. The results of the study showed that male archers had a lower heart rate with an average of 128.13 bpm, while female athletes had an average of 142.37 bpm. The scores for male athletes were higher with an average of 7.97 compared to female athletes with an average score of 6.47. Based on the results of the independent sample test, it is known that the sig. on the heart rate variable $0.026 < 0.05$. Meanwhile, the sig value. on the score variable $0.042 < 0.05$. Each has a sig value. < 0.05 . Thus, it can be concluded that there are significant differences in the results of measuring heart rate and scores between male and female athletes.

Key words: Heart rate, archery athletes, university students

Received: 2023-11-04; Accepted: 2023-12-22; Published: 2023-12-30

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INTRODUCTION

Exercise is referred to as an activity that nourishes the body including our heart. Heart rate is one of the variables that show how good the performance is in archery. Archery is a sport that uses a bow and arrow, which requires the dominant

arm (pulling arm) to pull the bowstring, while the non-dominant arm holds the bow (Dorshorst et al., 2022). Competitive archery demands specific strength and endurance during training or competition. Archery is a static sport that requires archers to have a *standard posture* when archery and minimize movement when *aiming to be able to improve accuracy* (Baifa et al., 2023). Archery sport is a sport that is carried out by shooting arrows with the help of a bow to reach the target or target, in Indonesia has 3 divisions, namely: *recurve*, *compound* and *standard bow* (Kadek Dian Vanagosi et al., 2015). Archery Skills include 9 basic techniques, namely: (1) *Stance*, (2) *Nocking*, (3) *Set-up*, (4) *Drawing*, (5) *Anchoring*, (6) *Tighten*, (7) *Aiming*, (8) *Release*, (9) *After-hold (follow through)*. (Ramdan Pelana dan Nadya Dwi Oktafiranda, 2017). In archery, like pistol shooting, it is believed that higher heart rate values show a low correlation with scoring points, implying that heart rate-induced vibrations have a negative effect on aiming accuracy. However, during competitions archers show higher heart rates (Tinazci, 2001).

Achieving peak performance in sports is a complex endeavor because it is influenced by many factors. The goal in a sports coaching is to achieve maximum performance (Effendi, 2016). Achievement in archery is determined based on the sum of the scores of arrows shot by an athlete on target (Kolayis et al., 2014). For this reason, the coach's knowledge is very influential on the quality of sports training achievements, if the coach has good knowledge of the sciences that support training methods, it will be very positive and optimal in the training process. Advances in science and technology now offer a means to support a coach to know the physical condition of an athlete, one of which is using polar H10 which has proven its validity to assess heart rate. The technology in polar *heartrate* detects the heart's work activity in every beat and produces real-time data (Weaver, 2019). Heart rate validity is believed to reflect autonomic nervous system activity by noninvasively measuring the time and pattern between successive R signals on the electrocardiogram (Schaffarczyk et al., 2022).

Monitoring the condition of athletes can be done one of them by monitoring the heart rate activity of each athlete during exercise. Heart rate is controlled by the central nervous system that receives feedback from sensory receptors located in the blood vessel wall. An increase in heart rate frequency coincides with an increase in

sympathetic nerve activity and a decrease in parasympathetic nerve activity, conversely a decrease in heart rate frequency coincides with an increase in parasympathetic nerve activity and a decrease in sympathetic nerve activity, in addition to sympathetic and parasympathetic nerves, heart rate frequency is also regulated by *epinephire* and *norepinephrine* (Nengah Sandi, n.d., 2016). *Epinephire* and *norepinephrine* are hormonal systems that regulate heart rate or pulse. *Epinephire* is secreted by the adrenal medulla into the blood on sympathetic stimuli that function to regulate heart rhythm. The same way is also done by the hormone *norepinephrine* (Ganong, 2008).

Heart rate is one of the important parameters used by paramedics to determine the condition of a person's physical health and mental condition (Ikhsani et al., 2022). Exercise has a strong effect on the structure and function of the heart, exercise also plays a role in heart size and mass, depending on the type and duration of the exercise itself (La Gerche et al., 2022). The number of heart beats per minute of an athlete can be used as an indicator to measure their health condition. The heart beats 60-80 times per minute, the beats speed up during activity or emotion, so that the body's need for energy can be met. If the heart rate is 70 times per minute, then in 1 hour the heart beats 4200 times or 100,800 times a day and 11 nights. Each time it beats, it pumps about 70 cc of blood, so in 24 hours the heart pumps about 7000 liters of blood (Prayogo et al., n.d.). The more often an athlete trains, the more the heart rate will increase. This is because the heart muscle is getting bigger so that the heart can drain more blood every minute (Martinelli et al., 2005).

In this research, measurements were carried out in a simulation of an archery competition, where changes in heart rate can be used as an indicator to describe the athlete's performance as in a real archery competition. This can help coaches choose appropriate training methods for each individual athlete. In line with previous research which says that there is a close relationship between archery accuracy and performance and heart rate (Açıkada et al., n.d.). From this statement it can be interpreted that the more consistent the athlete's heart rate, the more consistent the shooting, shooting between heartbeats is not something that can be done consciously.

METHOD

The research design used in this study is descriptive with a cross *sectional survey design* approach, namely conducting surveys, observations and direct data collection at one time. The population in this study were DKI Jakarta Student Athletes. Sampling technique with *purposive sampling* technique. *Purposive Sampling* is a sampling technique whose determination is based on certain considerations (Cholid Narbuko & Abu Achmadi, 2012). The considerations used in determining the sample are criteria;

1. Active as an Archery Athlete in DKI Jakarta
2. Athlete is registered as a student of DKI Jakarta
3. *Recurve* Division Archery Athlete
4. Athletes willing to be sampled

The number of samples in this study were 10 athletes consisting of 6 male athletes and 4 female athletes who met the criteria to be used as research samples.

In this study, data collection used polar H10 as a heart rate monitor. The stages carried out are, resting heart rate is measured before carrying out archery activities, heart rate during *aiming* is measured when the athlete is in the *aiming* position until *release* during the archery process using 3 arrows with a time of 180 seconds per series and carried out as many as 5 series, with a total number of arrows, namely 15 arrows.

The collected data were analyzed using the *Statistical Package for the Social Sciences* (SPSS) version 26. Baseline characteristics were analyzed using descriptive statistics such as number, mean, percentage, and standard deviation. *Shapiro-Wilk* test was used to check the normality of the data. Furthermore, *Independent Samples Test* to determine the difference in mean heart rate and outcome scores.

RESULTS AND DISCUSSION

Research Results

To find out the results of the research data carried out, the next step is for researchers to analyze the data and process the data on the research results. Researchers will discuss the description of the presentation of the results of research

data processing in descriptive form, test the analysis requirements and conduct hypothesis testing. Levene's test is used to test homogeneity

Table 1. Basic Characteristics of DKI Jakarta Student Archery Athletes

Variables	Male (n: 6)	Female (n: 4)
Age (years)	20,8±1,3	20,5±1,0
Height (cm)	173,5±3,7	163,5±4,2
Body Weight (kg)	72,3±14,2	66,3±16,7
BMI (kg/m) ²	24,0±5,3	24,9±6,7
Maximum Heart Rate	199,2±1,3	199,5±1,0
Training Age	6,2±2,14	3,5±2,08

Table 2. Mean ± SD Heart Rate Data when *Aiming* and Score Results of DKI Jakarta Student Archery Athletes

Variables	Gender	n	Average	Std. Deviation
Heart Rate	Male	6	128,13	7,11
	Female	4	142,37	9,55
Score	Male	6	7,97	0,76
	Female	4	6,47	1,21

Table 2 above shows that the average and standard deviation of heart rate of male athletes is lower than female athletes. On average and standard deviation of the score results male athletes are higher than female athletes. To facilitate interpretation, the following is presented in the form of the diagram;

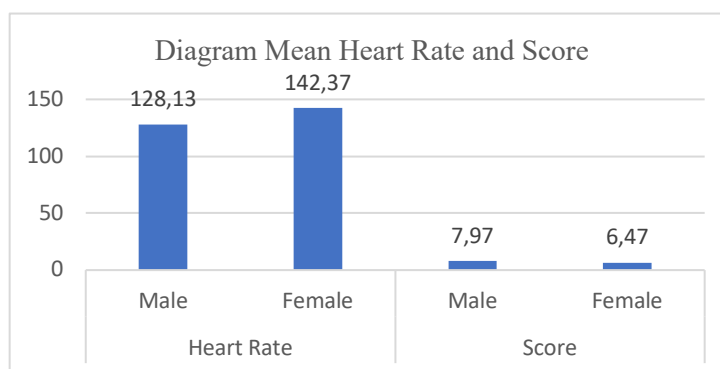


Figure 1. Diagram Mean Heart Rate and Score Male and Female Archer
 Sumber: Research Result

Table 3 Significant Values of Heart Rate and Score between Male and Female Athletes

Variables	<i>t</i>	Independent Sample Test	
		Sig.	Mean Difference
Heart Rate	-2.719	0,026	-14,24
Score	2,412	0,042	1,49

Based on table 3, the results of the *independent sample test*, it is known that the sig. value on the heart rate variable is $0.026 < 0.05$. Meanwhile, the sig. value on the score variable is $0.042 < 0.05$. Each has a sig value < 0.05 . Thus it can be concluded that, there are significant differences in the results of heart rate and score measurements between male and female athletes.

Discussion

The results in this study show that there is a significant difference between heart rate during *aiming* and score results in male and female athletes. Heart rate is the speed of the heart per minute which increases when a person is under pressure (Lu & Zhong, 2023). This study was conducted under individual fighting conditions with *alternate shoot* (archery alternates every one arrow) in mock competition conditions, athletes shoot 3 arrows for 5 series with a time of 20 seconds per arrow. Each athlete must be able to release his arrow to the target within the specified time.

The heart rate of male and female archers was taken when *aiming* in a mock tournament, the results showed that male archers had a lower heart rate with an average of 128.13 bpm, in contrast to the results of a higher heart rate in female archers with an average of 142.37 bpm. Previous research conducted on soccer athletes, stated that the heart rate in amateur athlete subjects was higher than the professional athlete group (Rafi et al., 2018). Male archers also scored better with an average of 7.97 points compared to female archers with an average of 6.47 points. Previous research has shown that the respiratory cycle and cardiac cycle have the potential to affect *aiming* stability in archery. (Eswaramoorthi et al., 2018)

It is known that male athletes have an average age of practicing 6.2 years, while female athletes have an average age of practicing 3.5 years. Based on the results of the study, it can be concluded that male archers have a lower heart rate and higher points than female archers. This could be influenced by gender factors, where men are more likely to consume higher oxygen compared to women, besides physical exercise in the sense of physically trained people, age of practice, where

the average age of practicing male athletes is longer when compared to female athletes in this study. Previous research states that experienced archers have a lower heart rate compared to inexperienced archers, besides that experienced archers display higher accuracy, higher scores compared to inexperienced archers (Clemente & Mendes, 2011).

CONCLUSION

Based on the problems raised which are supported by the description of the theory and framework and data analysis, the results showed that the average heart rate of male athletes is lower than female athletes, and the average score of male athletes is higher than female athletes. The results of the *independent sample test*, it is known that the sig. value on the heart rate variable is $0.026 < 0.05$. Meanwhile, the sig. value on the score variable is $0.042 < 0.05$ by taking score data from 15 arrows with an *alternate shoot* system (alternating archery per one arrow) within 20 seconds per arrow. Each has a sig. value < 0.05 . Thus, it can be concluded that, there are significant differences in the results of heart rate measurements and scores between male and female athletes.

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