

The Importance of Being Calm: The Impact of Heart Rate Towards Performance

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Abstract--The purpose of this study is to analyse the heart rate and accuracy performance of expert and novice archers in mock tournaments. It tries to verify if experience contributes to reduction in heart rate and increases the accuracy of archery performance. Thirty (30) UiTM Pahang archers participated in this study. The heart rate was recorded immediately after the last arrow of the last round was shot. The result shows expert archers have a slightly lower heart rate, 116 bts min, as opposed to novice archers with heart rate of 122 bts min. Expert archers also shoot better with the mean of 107 points compared to novice archers with 103 points. This proves that the experience of archers contributes in lowering the heart rate and gives better accuracy performance in any situation.

Keywords—archery; heart rate; performance

I. INTRODUCTION

Archery is an accuracy sport that requires a relatively low stimulation of the sympathetic nervous system [1]. In archery, a low heart rate is prerequisite to a good performance [2]. A good physical condition is common in sports, but in archery, lowering the heart rate during shooting is very crucial. The purpose of this study is to analyse the heart rate and accuracy performance of expert and novice archers in mock tournaments. It tries to verify if an archer's experience contributes to a reduction in heart rate and increases the accuracy of archery performance.

Heart rate is the speed of the heart beat or heart pulse. It is usually measured in beats per minute (bpm). Heart rate is generally used as the measurement to monitor the body's physiological behaviour and to study arousal [3]. The normal resting heart rate for adults ranges from 60-100 bpm. The resting heart rate is different from one individual to another due to one's age, gender, and physical activity. In general, the resting heart rate of an old person is higher than a younger one. Taking that into consideration, the resting heart rate

incrementally increases year by year. The speed of the heartbeat can also change by the influence of the body needs [4]. Meaning that, all the activities of our body's experiences such as anxiety, illness, stress, arousal, sleep, physical exercise and drugs can affect the speed of the heartbeat.

The heart rate could affect the performance of the archers where the heart rate or nervousness can interrupt with the body coordination and may produce tremor when performing sports, especially shooting and archery [5]. When an archer is aiming, he needs to keep it as steady as possible and he also needs to have a calm state of mind in order to keep the arrow pointing at the specific target. If he is able to be in a calm state of mind but no steady aim, it is just useless as the arrow will not go to the desired target. Hence, the accuracy can be decreased because of the tremor that occurs when shooting. The heart rate can generate tremor depending on how it behaves. If the heart beat is fast, the tremor can be produced more than the slower heart rate.

The archers can control their heart rate based on their own experiences. Hence, theoretically, if the archers are well experienced, their heart rates are slower than the inexperienced ones. The archers are assumed as experienced archers or experts if they have joined at least one major tournament such as open tournaments, where the situation of the big tournaments can be sufficient to make the archers feel burdened with their tasks in the tournaments. This is because they need to perform well in the high competitive events. The burden or what the archers feel is the stimulation of changing in heart rate.

Inexperienced archers or novices are those who never joined major tournaments. The biggest tournaments they have joined are friendly games where there are not enough stimulations to make the heart rate fluctuating. It is found that the heart rate of expert archers decreases while aiming, thus influencing good performance in archery [6]. This is because

the expert archers have adapted with many situations in the tournaments and practices that may stimulate the heart rate to change. Novice archers have not adapted with the instability of the heart rate yet. Thus, they may easily become unstable in performances in either mock tournaments or the real tournaments. However, expert archers can easily stay calm and be able to keep the heart rate low while focusing on aiming at the target [4].

Usually, most archers obtain different scores in practices and in tournaments. This variation is believed to be due to high adrenalin that creates stimulation to cardiac acceleration, whether an increase or decrease of archer's heart rate [7]. This study is to explore how heart rate is associated with the scores. Therefore these hypotheses are developed.

- H₁: Expert archer has lower heart rate during shooting.*
- H₂: There is significant difference in score between expert and novice archer.*
- H₃: There is a positive relationship between heart rate and score.*

II. RESEARCH METHODOLOGY

Thirty (30) UiTM Pahang archers were selected. They consisted of both male and female (n=30). Fifteen archers were considered as experts while the other fifteen were novices. All expert archers had been involved in at least five major tournaments while the novices had no experience in such tournaments.

In this research two instruments were used to measure the heart rate, which are Fitbit Charge HR and OMRON Blood Pressure Monitor. For experimental procedures, all archers used one type and the basic archery equipment such as wooden recurve bow and basic arrow (Jazz type).

At the beginning of experimental procedures, participants were informed of the aim of the study and relevant information such as timing and how many arrows to be shot. The procedure began with 3 sighters rounds (practice round) and proceeded with the 2 scoring rounds. For each round, they had to shoot 6 arrows within 4 minutes. The total score for 12 arrows was 120 pts. After they completed their rounds, the heart rate readings were recorded immediately using Fitbit Charge HR and OMRON to ensure the accuracy of both heart rate readings.

Prior to conducting any formal statistical analyses, preliminary steps to ensure the quality of data were conducted to determine whether it was worthy of further analyses [8]. There was no missing data and it was not substantial enough to warrant any action.

Secondly, a reliability test using Cronbach's Alpha was conducted using SPSS version 20. The purpose of this test was to assess the internal consistency reliability of the instrument used. The Cronbach's Coefficient Alpha values for the 2 variables were above 0.7 which were considered as

acceptable; hence the instrument was appropriate for use in this study [9,10,11,8,12]

Thirdly, the test of normality was performed. Although Kolmogorov-Smirnov statistics indicated that all variables were significant, hence non-normal, test of normality was sensitive and "often signal departures from normality that do not really matter (p.46)" [13]. To make sure, that the data was approximately normal, the study identified outliers using boxplot. Skewness and kurtosis statistics showed that the z-scores of the variables were within +/-1.96 suggesting approximate normal distribution. This was later confirmed through visual indicator of normal Q-Q plot.

III. RESULTS

In this study, Shapiro-Wilk test was more appropriate because the sample was small and it was used in conjunction with graphical methods. The Shapiro-Wilk test statistic, in Table I for score, HR and RHR is .982, .903 and .912 respectively. With all P value above 0.05, it is evident that the normality assumption is not violated and it suggests that the data is approximate normal.

TABLE I. TEST FOR NORMALITY

	Kolmogorov-Smirnov*			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Score	.088	30	.200*	.982	30	.870
HR	.200	30	.003	.903	30	.010
RHR	.221	30	.001	.912	30	.016

*This is a lower bound of the true significance.

^a Lilliefors Significance Correction

Table II shows that expert archers have a slightly lower heart rate, 116 bts min, in contrast with novice archers with heart rate of 122 bts min. Expert archers also shoot better with the mean of 107 points compared to novice archers with 103 points. Therefore, H₁ was supported.

TABLE II. MEAN OF HEART RATE AND SCORE OF EXPERIENCE AND INEXPERIENCE ARCHERS

	Experience	N	Mean	Std.Deviation	Std. Error Mean
Score	Expert.	15	106.93	7.516	1.941
	Novice	15	103.47	4.912	1.268
HR	Expert.	15	116.40	7.726	1.995
	Novice	15	122.40	6.434	1.661

Furthermore, in Table III, the Levene's Test for Equality of Variance is not significant (F=1.860, Sig >.05) for both scores and (F=3.589, Sig >.05) for HR. Therefore, the assumptions of homogeneity of variance have not been violated, hence the interpretation and report of the t-test for equal variances are assumed.

TABLE III. LEVENE'S TEST FOR EQUALITY OF VARIANCES

	F	Sig
Score	1.860	.184
HR	3.589	0.069

Table II shows that expert archers have lower heart rate and better score compared to novice archers, the *t*-independent test as in Table IV has shown insignificant differences for both scores ($t=1.495$, Sig $>.05$) and HR ($t=-2.311$, Sig $>.05$). Hence it cannot support H_2 , because there is no significant difference in scores between expert and novice archers.

TABLE IV. SIGNIFICANT DIFFERENCE IN SCORE BETWEEN EXPERT AND NOVICE ARCHER

	<i>t</i>	Sig
Score	1.495	.146
HR	-2.311	.028

Next, a bivariate Person's (Table V) correlation coefficient (*r*) between heart rate and score is negative $r(28) = -.212$, and is statistically non-significant ($p = .261$). This implies that the variables, HR and scores have direct relationship thus supporting H_3 .

TABLE V. CORRELATION VALUES BETWEEN HR AND SCORE

	Sig
Pearson Correlation	-.212
p-value	.261
HR N	30

IV. CONCLUSION

In conclusion, from this study, the experienced archers have lower heart rate during shooting, whether in the mock tournaments or practices. Based on the result of this study, it is proven that there is no significant difference in scores between expert and novice archers, but still there is a positive relationship between experience and heart rate, whereby the expert archers contribute in lower heart rate compared to novice archers. Therefore, in an attempt to lower the heart rate during shooting and enhance archery performance, an archer should learn to stay calm and gain experience by involving in many competitive tournaments. This finding verifies that there is a positive relationship between heart rate and score.

The main contribution for this study is the empirical evidence about how experienced archers manage to have lower heart rate during shooting. This finding is consistent with [6], where it is found that lower heart rate while aiming contributes to good performance in archery. The experienced archers are normally able to stay calm and keep the heart rate low while focusing on aiming at the target.

To add value to the findings, an observation was made to determine whether the timing of the shooting affects the archery accuracy. From the observation, senior archers took time to take their shots. This helped to reduce their stress. This finding is consistent with [14] where it is stated that the psychological readiness among expert veteran athletes can affect the 'timing' of the muscle activity in sports.

There is another contribution towards the study. This study found that there is no significant difference in scores between expert and novice archers. There are other variables that are not under study that may contribute in lowering the heart rate and enhancing performance, such as physical fitness, the technique itself, stress level, target distances, weather condition and many more. This may open opportunities for future researches.

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