



The impact of mental toughness on accuracy in archery athletes: a comparative study across distances

El impacto de la fortaleza mental en la precisión de los atletas de tiro con arco: un estudio comparativo a través de distancias

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Abstract

Introduction: Archery athletes experience negative thoughts, uncomfortable feelings, and decreased movement control during competition. These characteristics are indicators of mental toughness. However, to date, there has been no specific research on the influence of mental toughness on archery accuracy results.

Objective: The purpose of the study was to analyze the effect of mental toughness on shot accuracy in archery athletes. Furthermore, this study also compared mental toughness at different distances, namely 40 meters, 50 meters, and 70 meters.

Methodology: This type of research is a cross-sectional observational design in several official archery championships. The sample consisted of 269 athletes who competed between November 2024 and February 2025 in Central Java Province and DIY Province, Indonesia. The characteristics of the sample are 147 athletes in the 40-meter number, 64 athletes in the 50-meter number, and 58 athletes in the 70-meter number. Instrument for data collection using the Sports Mental Toughness Questionnaire (SMTQ) and accuracy results based on archery scores.

Results: Mental toughness has a significant effect on accuracy, as determined by a t-test with a p-value of 0.000, which is less than 0.05. The one-way ANOVA result was $p < 0.05$. Therefore, the Hoc Duncan post hoc test ($\alpha = 0.05$) revealed significant differences in mental toughness among athletes competing at the 40-meter distance compared to those competing at the 50-meter and 70-meter distances sig. 0.170. However, there was no difference in mental toughness among athletes who competed in the 50-meter distance compared to those who competed in the 70-meter sig. 1.000.

Conclusions: Mental toughness has a significant influence on the accuracy of archery athletes. The study's findings showed that the level of mental toughness in athletes in the 40-meter event was higher than in the 50-meter and 70-meter distances. Therefore, the higher the level of mental toughness athletes possess, the more accurate they are. These findings confirm the importance of developing mental aspects in coaching archery athletes.

Keywords

Sports psychology, athletes' mentality, sport performance, archery accuracy.

Resumen

Introducción: Los atletas de tiro con arco experimentan pensamientos negativos, sensaciones incómodas y una disminución del control del movimiento durante la competición. Estas características son indicadores de fortaleza mental. Sin embargo, hasta la fecha, no se han realizado investigaciones específicas sobre la influencia de la fortaleza mental en la precisión del tiro con arco. **Objetivo:** El propósito del estudio fue analizar el efecto de la fortaleza mental en la precisión de tiro en atletas de tiro con arco. Además, este estudio también comparó la fortaleza mental a diferentes distancias: 40, 50 y 70 metros.

Metodología: Este tipo de investigación es un diseño observacional transversal en varios campeonatos oficiales de tiro con arco. La muestra consistió en 269 atletas que compitieron entre noviembre de 2024 y febrero de 2025 en las provincias de Java Central y DIY, Indonesia. La muestra se componía de 147 atletas en la prueba de 40 metros, 64 en la de 50 metros y 58 en la de 70 metros. El instrumento para la recopilación de datos fue el Cuestionario de Fortaleza Mental Deportiva (SMTQ) y los resultados de precisión se basaron en las puntuaciones de tiro con arco.

Resultados: La fortaleza mental tiene un efecto significativo en la precisión, determinado mediante una prueba t con un valor p de 0,000, que es inferior a 0,05. El resultado del ANOVA unidireccional fue $p < 0,05$. Por lo tanto, la prueba post hoc Hoc Duncan ($\alpha = 0,05$) reveló diferencias significativas en la fortaleza mental entre los atletas que compitieron en la distancia de 40 metros en comparación con aquellos que compitieron en las distancias de 50 y 70 metros (sig. 0,170). Sin embargo, no se observaron diferencias en la fortaleza mental entre los atletas que compitieron en la distancia de 50 metros en comparación con aquellos que compitieron en la de 70 metros (sig. 1,000).

Conclusiones: La fortaleza mental influye significativamente en la precisión de los atletas de tiro con arco. Los hallazgos del estudio mostraron que el nivel de fortaleza mental en los atletas de la prueba de 40 metros fue mayor que en las de 50 y 70 metros. Por lo tanto, cuanto mayor sea el nivel de fortaleza mental que poseen los atletas, mayor será su precisión. Estos hallazgos confirman la importancia de desarrollar los aspectos mentales en el entrenamiento de atletas de tiro con arco.

Palabras clave

Psicología deportiva, mentalidad del deportista, rendimiento deportivo, precisión en tiro con arco.



Introduction

In competitive sports, an athlete's mental ability is often judged as necessary as physical fitness. Especially in sports that require high concentration, such as archery, mental aspects can be decisive between victory and defeat (Sybil et al., 2025). Archery is a sport that requires psychological components such as composure, accuracy, and high consistency in every shot (Prasetyo et al., 2023). One of these psychological factors is mental toughness, which has the potential to greatly influence an athlete's performance in maintaining consistent performance even under pressure (Pandian et al., 2023). In reality, many archery athletes struggle to improve their accuracy results due to several factors, including mental aspects (Musa et al., 2019 & Lee & Dobrich, 2023). Reinforced by direct observation, archery athletes experience negative thoughts, uncomfortable feelings, and decreased movement control when entering the 3rd round.

The results of previous studies have shown that mental toughness affects performance in professional athletes (Hasmyati et al., 2022). In student-level athletes aged 13-24 years, it has also been demonstrated that mental toughness is effective in improving athletic achievement (Akbar et al., 2023). Then, mental toughness can increase motivation and decrease competitive anxiety, so there is a reciprocal relationship between mental toughness, motivation, and competitive anxiety (Nugraha et al., 2020 & Sridana et al., 2024). Furthermore, mental toughness can also play a mediating role in weightlifting among individuals aged 17-28 years, increasing motivation and helping athletes overcome fatigue (Shang & Yang, 2021). High mental toughness can help athletes overcome burnout, which has a significant impact on their level of well-being between the ages of 18 and 33 (Ozcan, 2022). In individual and team sports, higher mental toughness is associated with decreased symptoms of depression, anxiety, and stress (Morrison et al., 2024). Therefore, mental toughness is needed for archery.

Mental toughness in archery is the ability of athletes to maintain optimal performance in various circumstances. The goal of mental toughness in archery is stress resistance, sustained concentration, recovery from mistakes, emotional regulation, strong motivation to succeed, and mental flexibility (Yachsie et al., 2023 & Gmamdya et al., 2023). In archery, where every shot requires calmness and precision, the role of mental toughness helps athletes manage stress, stay focused despite distractions, and quickly recover from mistakes (Iwandana et al., 2021). High mentality in archery athletes serves to control emotions, maintain self-confidence, adapt to changing conditions, and maintain high motivation (Wibowo et al., 2024). These factors combine to form a strong foundation for athletes to achieve consistent and successful performance in tight competition. However, to date, there has been no specific research on the influence of mental toughness on archery accuracy results. Although several studies explain that distance competition numbers similar to archery, such as runners and shooting sports, can influence differences in psychological factors and self-efficacy during competition (Moreira da Silva et al., 2021; Seabury et al., 2023; & Ramos et al., 2024).

This study aims to analyze the effect of mental toughness on shot accuracy in archery athletes. Furthermore, this study also compared mental toughness at different distances, namely 40 meters, 50 meters, and 70 meters. This is done to determine if different competition numbers impact the relationship between mental toughness and accuracy. By understanding the role of mental toughness in supporting accuracy at various distances, coaches and athletes can focus more on developing training programs that not only improve the physical aspects but also the psychological aspects of athletes. The results of this study are expected to provide new insights into coaching archery athletes, particularly in enhancing performance by improving mental aspects.

Method

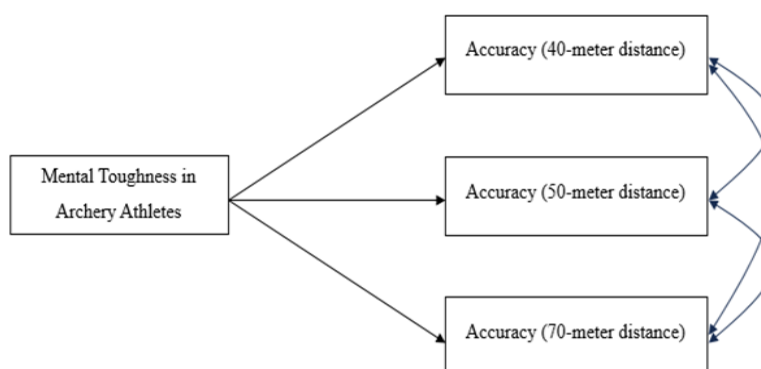
Study Organizations

This type of research is a cross-sectional observational design in several official archery championships. In this study, the independent variable (cause) is the level of mental toughness, and the dependent variable (effect) is archery accuracy at distances of 40 meters, 50 meters, and 70 meters. The outline of this study is shown in Figure 1. This research has four stages to ensure the production of high-quality

scientific research results. This research has obtained a research permit letter which includes ethical approval from the university B/1578/UN34.16/PT.01.04/2024.

The first stage involves observation to collect initial information and identify and formulate problems in the field. The purpose of this study is to determine the purpose of this study. After the problem is found, the second step is to prepare the material for analysis. The preparation in this second stage involves collecting scientific articles, books, and compiling research instruments. The third stage involves collecting research data using instruments prepared in the second stage. Data collection was conducted by searching for archery competitions from November 2024 to February 2025 in Central Java Province and DIY Province, Indonesia. The data collection procedure involves the researcher submitting a purpose statement and an official permit letter to the competition organizer, as well as obtaining approval from the trainer. Once this is done, the sample can participate in the research voluntarily. The distribution of questionnaires is carried out before the competition begins, and the collected questionnaires are returned after the competition is over. The fourth stage is the reporting of research results, which includes the analysis of research data and the preparation of research findings to become original scientific articles.

Figure 1. Research Framework



Study Participants

Inclusion criteria were: 1) athletes participating in the 40-meter, 50-meter, and 70-meter events; 2) registered as official participants in the covered competitions; 3) willing to complete the pre-event questionnaire and give permission for the use of official scores. Exclusion criteria were: 1) incomplete questionnaire data; 2) unavailable event scores; 3) multiple participation in multiple events within the study period without a matchable identity. The recruitment technique was convenience sampling, with a census of all eligible athletes at the observed events. To prevent duplication of responses, each athlete was assigned a unique ID formed from a combination of full name, date of birth, club, and license number; if an athlete was detected participating in more than one event, only the first observation was analyzed. The total analytical sample size was 269 athletes, with a distribution of 147 athletes in the 40-meter, 64 athletes in the 50-meter, and 58 athletes in the 70-meter. There was variation in age and experience across the distance groups; Therefore, the main analysis controlled for the covariates of age, years of training, and highest level of competition.

Instrument

The results of the instrument were compiled in the second stage of this study, which involved the questionnaire format. The Mental Toughness variable adapts the Sports Mental Toughness Questionnaire (SMTQ) from research Sheard et al., (2009) which consists of three aspects of confidence, constancy, and control, while archery accuracy is based on the results of athlete competitions. SMTQ shows a good model fit as evidenced by the goodness-of-fit index (GFI) = .95; adjusted goodness-of-fit index (AGFI) = .93; root-mean-square error of approximation (RMSEA) = .05; root-mean-square residual (RMR) = .05. Then, the three aspects show a positive intercorrelation ($p < 0.01$). Then, the scale used by SMTQ ranged from 1 to 4, with options: 'strongly disagree', 'disagree', 'agree', and 'strongly agree'. In addition to the SMTQ and archery accuracy results, a special column is provided in the questionnaire for

athletes to share their opinions and comments. The aim is to obtain additional data that will be used for discussion in the study.

Statistical Analysis

The statistical method employed in this study utilizes the t-test to analyze the effect of mental toughness on accuracy. This was followed by a one-way ANOVA test to test the difference in mental toughness based on accuracy in distance numbers in this study. If a difference is found, a post hoc test will be applied using the Duncan method. The statistical analysis of this study was conducted using SPSS 26 (George & Mallery, 2019).

Results

The results of the first analysis in this study were descriptive. This analysis aims to explain the minimum, maximum, and average values in the Sports Mental Toughness Questionnaire (SMTQ) and the score results for archery accuracy at distances of 40 meters, 50 meters, and 70 meters. The descriptive results are presented in Table 1 below.

Table 1. Descriptive results

Distance number	Mental Toughness				Accuracy			
	Minimum	Maximum	Mean	Std. Deviation	Minimum	Maximum	Mean	Std. Deviation
40-meter	35	40	37.56	1.282	270	320	291.70	11.887
50-meter	33	40	36.92	1.930	290	345	325.92	8.675
70-meter	32	39	36.57	1.817	291	320	310.71	12.626

Based on the results in Table 1, the 40-meter distance, as indicated by the questionnaire value in Mental Toughness, ranges from a minimum value of 35 to a maximum value of 40, with an average value of 37.56. The results of the accuracy score show a minimum value of 270, a maximum value of 320, and an average value of 291.70. The 50-meter distance number, specifically the questionnaire value in Mental Toughness, ranges from a minimum value of 33 to a maximum value of 40, with an average value of 36.92. The results of the accuracy score show a minimum value of 290, a maximum value of 345, and an average value of 325.92. The 70-meter distance number, specifically the questionnaire value in Mental Toughness, ranges from a minimum value of 32 to a maximum value of 39, with an average value of 36.57. The results of the accuracy score show a minimum value of 291, a maximum value of 320, and an average value of 310.71.

After conducting descriptive analysis, a normality test was performed to assess the normality of the data on mental toughness and accuracy results, based on each distance number in the normally distributed competition. Normality test using Kolmogorov-Smirnov ($p > 0.05$) in Table 2 below.

Table 2. Normality test results

Variable	Distance number	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Mental Toughness	40-meter	0.198	147	0.057	0.932	147	0.062
	50-meter	0.165	64	0.062	0.944	64	0.066
	70-meter	0.250	58	0.065	0.903	58	0.072
Accuracy	40-meter	0.094	147	0.069	0.973	147	0.065
	50-meter	0.140	64	0.073	0.952	64	0.055
	70-meter	0.157	58	0.071	0.941	58	0.067

Based on the results of Table 2, the significance value of the Kolmogorov-Smirnov test for mental toughness and accuracy variables, based on each distance in the competition, was greater than 0.05, indicating that the data in this study were normally distributed. To continue the following analysis using a t-test to measure the effect of mental toughness on accuracy ($p < 0.05$). The results of the t-test are presented in Table 3 below.

Table 3. The result of the influence of mental toughness on archery accuracy

	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Mental Toughness - Accuracy 40-meter	-254.136	12.048	0.994	-255.742	146	0.000
Mental Toughness - Accuracy 50-meter	-267.000	8.641	1.080	-247.194	63	0.000
Mental Toughness - Accuracy 70-meter	-274.138	12.893	1.693	-161.932	57	0.000

Based on the results in Table 3, mental toughness affects the accuracy of archery athletes at distances of 40 meters, 50 meters, and 70 meters, with a significance value of $0.000 < 0.05$. Then, the t-table value shows a negative value, indicating that if mental toughness decreases, accuracy ability also decreases. The following analysis was conducted using a one-way ANOVA to examine the difference in mental toughness in accuracy based on the distance numbers in the competition. Below are the results of Table 4 for one-way ANOVA.

Table 3. The results of differences in mental toughness on accuracy at distance numbers

Mental Toughness					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	47.588	2	23.794	9.547	.000
Within Groups	662.970	266	2.492		
Total	710.558	268			

Based on the results of Table 4, the one-way ANOVA results show a sig value. $p < 0.05$ indicates a statistically significant difference between mental toughness and archery accuracy, as measured by distance. Thus, a post hoc test is needed for further analysis. This study used post hoc Duncan's test ($\alpha = 0.05$), as the data from different sample sizes were not as significant. In addition, the post hoc Duncan test was more sensitive in detecting differences between groups. The following is Table 5 of the post hoc Duncan test.

Table 4. Post hoc Duncan results

Mental Toughness					
		Distance Number	N	Subset for alpha = 0.05	
				1	2
Duncan		70-meter	58	36.57	
		50-meter	64	36.92	
		40-meter	147		37.56
		Sig.		0.170	1.000

Based on the results in Table 5, there are differences in mental toughness among athletes competing at the 40-meter distance compared to those competing at the 50-meter and 70-meter distances sig. 0.170. However, there was no difference in mental toughness among athletes who competed in the 50-meter distance with a 70-meter sig. 1.000.

Discussion

The results of this study indicate a significant effect of mental toughness on archery accuracy among athletes competing in the 40-meter, 50-meter, and 70-meter distances. This finding indicates that mental toughness is one of the primary psychological factors influencing athlete performance (Akbar et al., 2023 & Morrison et al., 2024), particularly in sports that require high concentration and consistency, such as archery. As in the results of previous studies, increasing mental toughness in archery athletes can improve archery accuracy at distances of 50 meters, 40 meters, and 30 meters (Yudho et al., 2022). Then, imagery training had a positive effect on controlling panic targets, which were reviewed based on mental toughness in archery athletes (Priambudi & Mashud, 2023). Therefore, the findings of this study reinforce the theory that mental toughness has a positive effect on accuracy in archery athletes.

Mental toughness can help athletes stay focused, manage emotions, and recover from pressures or mistakes that occur during matches (Hasmyati et al., 2022; Imtihansyah et al., 2024; Saniah et al., 2024; & Prabowo et al., 2024). The results of previous scientific studies suggest that low mental toughness in

athletes, such as those in golf, volleyball, and basketball, can lead to increased distractibility by pressure, stress, and reduced concentration during the competition (Schaefer et al., 2016; Şenel & Cevahircioğlu, 2022; & Abdurachman & Wahyudi, 2023). The study's results also indicated that athletes tend to lose confidence more easily, struggle with emotional control, and take longer to recover from mistakes or failures. Meanwhile, in closed, futsal and pencak silat sports, it was also found that low mental toughness can lead to inaccurate decision-making, inconsistent techniques, and decreased shooting accuracy (Jun et al., 2023; Supriadi, 2023; & Djaba et al., 2024). In addition, a decrease in mental toughness can also reduce motivation, self-efficacy, self-confidence and enthusiasm for training, thereby hindering the development of athletic abilities (Ozcan, 2022; Pandian et al., 2023; Widyastuti et al., 2024; Mandan et al., 2024, Abdhi et al., 2024; & Latief et al., 2024). Thus, this decrease in mental toughness will have a direct impact on reducing the ability to achieve accurate shots, as seen in the findings of this study.

In addition, this study also found differences in mental toughness among athletes competing in the 40-meter, 50-meter, and 70-meter events. The difference shows that the level of mental toughness among athletes can vary depending on the distance followed such as in swimming and athletics (Meggs & Chen, 2018; Brace et al., 2020 & Gameiro et al., 2023). Based on Duncan's post hoc test, a significant difference was found between athletes competing at a 40-meter distance and those competing at 50-meter and 70-meter distances. In contrast, no significant difference was observed between the 50-meter and 70-meter distances. The analysis in this study suggests that athletes feel more confident or accustomed to the 40-meter distance, resulting in better mental toughness, as statistically described compared to other distances. As in the scientific study of archery athletes in South Korea, to become more confident and familiar with each number, athletes must dedicate themselves to long hours of training and commit to various training methods (Gameiro et al., 2023). In a study of archery athletes in Indonesia, it was found that the 40-meter distance was the most commonly followed distance and the number of choice for athletes pursuing a career in competitive sports (Suhasto et al., 2023 & Arisman et al., 2024). Thus, athletes are more focused on training at the 40-meter distance, compared to other distances. Meanwhile, the absence of differences between the 50-meter and 70-meter distances may suggest that these two distances present relatively similar psychological demands for athletes in this context (Priambudi & Mashud, 2023).

Overall, the results of this study confirm the importance of developing mental toughness in archery athlete training, particularly in improving shot accuracy at various distances. Sports coaches need to pay special attention to the psychological aspects of athletes, for example, through mental training, such as imagery training, goal-setting, and self-talk (Isar et al., 2022; Fachrezi et al., 2023; & Wijayanti et al., 2024). Another method recommended is measurable sports counseling, which enables athletes to maintain their mental toughness throughout progressive training programs and various competitive situations (Iwandana et al., 2021 & Walsh et al., 2023). These findings also provide the basis for further research to explore other factors that can influence mental toughness as well as the most effective intervention strategies to improve archery athlete performance across all distances.

This study has several limitations that need to be considered, including the mental toughness and archery accuracy data obtained during the competition, which may have strongly influenced the results due to the pressure and psychological conditions of the match. Additionally, mental toughness measurements rely on subjective questionnaire instruments that have the potential to introduce response bias. Therefore, it is expected that future research can use more comprehensive and objective measurement methods, such as direct observation, interviews, or a combination of several psychological instruments. In addition to implementing a longitudinal design to monitor the development of mental toughness and accuracy in athletes over time, both in training and competition situations. In addition, further research is expected to explore other factors that affect the relationship between mental toughness and accuracy performance, such as match experience, social support, and coping strategies, to provide a more comprehensive understanding of the role of mental toughness in enhancing the performance of archery athletes.

Conclusions

Based on the research results, it can be concluded that mental toughness has a significant impact on the accuracy of archery athletes. Therefore, the higher the level of mental toughness athletes possess, the



more accurate they are. In addition, this study also found a difference in the level of mental toughness among athletes at different distance levels, with a significant difference observed between 40-meter athletes and those in the 50-meter and 70-meter categories. Still, no difference was found between the 50-meter and 70-meter categories. This finding confirms the importance of developing mental aspects in coaching archery athletes, so that coaches and sports coaches are expected to pay special attention to mental toughness training to support improving the accuracy performance of athletes at various distances. This conclusion also serves as the basis for further research to examine more deeply other factors that may affect the relationship between mental toughness and archery athlete performance.

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Conflict of interest

The author has no conflict of interest regarding the author or results of other studies.

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