

Examining the Physical and Psychology Traits to Three-point Shot Performance in Basketball

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Received May 14, 2023; Revised October 29, 2023; Accepted November 14, 2023

Cite This Paper in the Following Citation Styles

(a): [1] Frizki Amra, Zulbahri, Weny Sasmitha, Fitri Dwi Arini, "Examining the Physical and Psychology Traits to Three-point Shot Performance in Basketball," *International Journal of Human Movement and Sports Sciences*, Vol. 11, No. 6, pp. 1343 - 1348, 2023. DOI: 10.13189/saj.2023.110619.

(b): Frizki Amra, Zulbahri, Weny Sasmitha, Fitri Dwi Arini (2023). *Examining the Physical and Psychology Traits to Three-point Shot Performance in Basketball*. *International Journal of Human Movement and Sports Sciences*, 11(6), 1343 - 1348. DOI: 10.13189/saj.2023.110619.

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Abstract The basketball player considered shooting efficiency as the crucial performance indicator to the strong positive relationship with the winning in the game. This study aims to understand how hand-eye coordination can affect three-point shot skills, with muscle arm strength and self-image being the intervening models. Structural Equation Modeling with Partial Least Square (SEM-PLS) was conducted to examine relationships among variables. The participants were 30 students who were intensively involved in the basketball extracurricular program at a senior high school in Padang City, Indonesia. Results revealed that: 1) hand-eye coordination does not influence three-point shot skills, 2) muscle arm strength does not influence the three-point shot skills, 3) the psychological traits of individual self-image influence the performance of three-point shot skills, and 4) muscle arm strength as moderating variable influences hand-eye coordination to three-point shot skill performance. Hence, the study did not find any direct influence of hand-eye coordination, and muscle arm strength on three-point shot skills, and the influence of hand-eye coordination on the self-image of students. The interrelated components of research findings are essential for coaches and players seeking to enhance their three-point shooting abilities and overall performance on the basketball court.

Keywords Arm Muscle Strength, Basketball, Hand-Eye Coordination, Self-Image, Three-Point Shot

1. Introduction

FIBA, the International Basketball Federation stated that basketball is the second most widely played sport globally [1]. The physical requirements of a basketball game have been readily examined. It is believed that basketball players need a variety of physically developed traits due to the unpredictable and changing positional requirements in basketball games [2]. The physical demand among basketball players requires intensive training. The basketball training is made up of five focus elements, including technical, tactical, physical, and psychological [3].

More precisely, the basketball player considered shooting efficiency as the crucial performance indicator to the strong positive relationship with the winning in the game. A recent study found that the potential to make an effective jump shot is crucial to the player's success [4]. The three-point shot (3S) is the basis of the game, and represents an advantage in the game itself. The factors that affect the three-point shot performance in basketball games among others, are arm muscle strength, eye-hand coordination, confidence, concentration, ball-hand contact, and the technique mastery of the athlete when performing a three-point shot [2], [5], [6].

Among others, the strength of arm muscle greatly affects the results of the shooting performance [7]. If the arm muscle strength is not well enough, it will affect the results of the shooting that will be done. Good arm muscle strength will result in good shooting during the game.

When doing the shooting movement, there will be a push and good strength will also result in good results. Doing shooting with good arm muscle strength will get a push force when shooting. An arm with good strength will have a big impact when shooting in the game, so success will also be good in a game played by the athlete.

Furthermore, eye-hand coordination is also a physical condition aspect that is greatly needed in the results of a three-point shoot in a basketball sports game. It can be interpreted as the eyes serving as a signal catcher (stimulus) and informing the ball that it is in the ideal position, so the hand can perform the shooting movement. If the basketball athletes have good eye-hand coordination, their movement when performing three-point shots will be more effective and efficient. Having good eye-hand coordination will make it easier for basketball athletes to be accurate in making a good shot [6], [8].

Besides the physical traits, sport psychology has attracted wide interest in recent studies. From a psychological standpoint, several traits contribute to an athlete's ability to excel in three-point shooting [9]. Focus and concentration are crucial as they enable players to maintain mental clarity and precision during high-pressure situations. Confidence plays a pivotal role [10], instilling the belief that the shot can be successfully executed, even from long distances. Moreover, mental resilience and a positive mindset are instrumental in rebounding from missed attempts, allowing the player to persistently attempt long-range shots without fear of failure. Sports psychologists encourage basketball players to build positive and strong self-images [11]. It is believed that the higher the self-image of the students associated with success in performing three-point shot skills.

2. Materials and Methods

2.1. Study Design

The current study is based on an exploratory research methodology employing quantitative research tools. The approach was chosen to obtain objective responses to the hypothesis being examined. The study aims to understand the three-point shot skills of basketball athletes by incorporating several variables including, hand-eye coordination, muscle arm strength, and self-image.

2.2. Participants

The study involved a group of extracurricular basketball students from Pembangunan Senior High School in Padang City, Indonesia to participate in the research. The study included a total of 30 high school students aged 16-18 years. Most participants were male (23) and the rest were female (7), representing 77% and 23% of the total participants, respectively.

2.3. Data Collection

The study aims to understand the three-point shot skills of basketball athletes by incorporating hand-eye coordination, self-image, and muscle arm strength as intervening models (see Figure 1). The structure in Figure 1 was formulated based on preceding research and relevant theories. The research employs a nonprobability sampling design, specifically utilizing judgment sampling. This method involves deliberately selecting subjects who are in the most advantageous position to provide the necessary information. Considering the specific nature of the study, it is the most suitable sampling approach for obtaining information from particular students. To collect self-image data, a self-administered questionnaire is utilized. Additionally, data related to arm muscle strength, hand-eye coordination, and three-point shot skills are collected through administered tests.

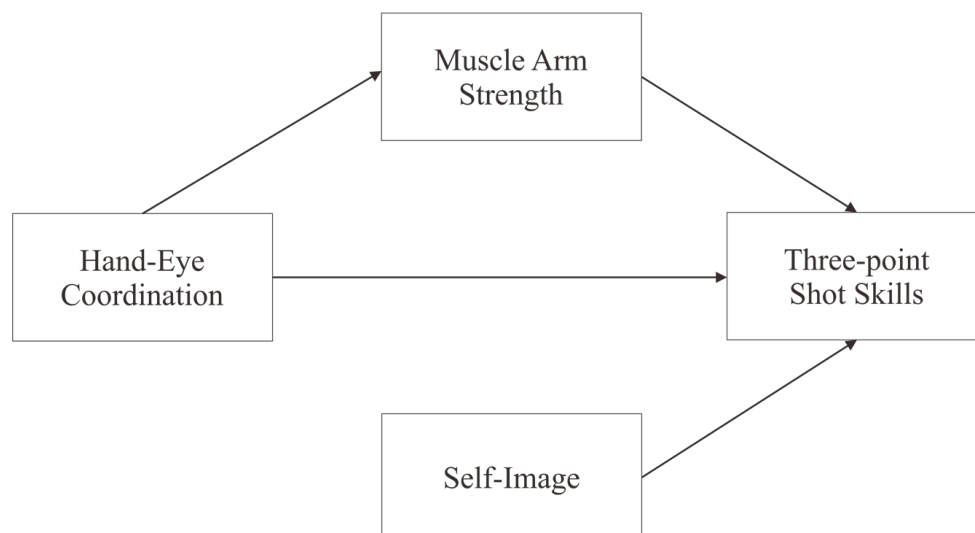


Figure 1. Theoretical Model of Factors Influencing Three-point Shot Skills

2.3.1. Self-image

Self-image was measured using two items, and evaluated students' contentment with their physical appearance and body shape adopted from Kuo et al. [12]. A 5-point Likert scale was used to rate each item. The participants' responses were categorized into five assessment levels, ranging from "strongly disagree" (1) to "strongly agree" (5).

2.3.2. Arm Muscle Strength

A hand-held dynamometer was used to measure the components of arm muscle strength, as suggested by Stuberg & Metcalf [13]. The researcher facilitated and supervised the test while recording the scores. Each participant underwent the test twice for accuracy and consistency. The hand-held dynamometer served as the tool used to perform the pull and push arm muscle strength test. To conduct the test, the participants were instructed to stand upright with their legs stretched and their gaze fixed straight ahead, ensuring a standardized testing environment for all participants. Both hands of the participants hold the hand-held dynamometer tool in front of the chest, with the arms and hands straight with the shoulders.

2.3.3. Hand-eye Coordination

The hand-eye coordination is measured by throwing a tennis ball on the targeted wall. To score one point, the ball must be thrown from below, the ball must hit the target, and the ball must be immediately caught by the hand of the participants. The procedure to conduct the test is that the participants were asked to stand upright behind the foul line, facing the targeted wall at 2 meters while holding the tennis ball. The participants throw the ball when asked, and catch the ball with the other hand.

2.3.4. Three-point Shot Skills

We collected the data on the basketball court in Universitas Negeri Padang compliant with the FIBA Central Board normative [14]. Before participating in the data collection process, every participant received a comprehensive written informed consent detailing the overall purpose and procedure of the current study. This step ensured that each individual was fully aware of the study's objectives and the steps involved before proceeding. Once informed, the participants were given the freedom to conduct their shots at their own pace, choosing to do so when they felt adequately warmed up and ready to perform. The participants' task consisted of performing as many as possible three-point shots within one minute. Each shot was taken at a different starting point.

2.4. Data Analysis

In this study, we used multivariate data analysis to analyze the completed data. This study followed two main calculations, including outer and inner model estimation covers convergent validity, discriminant validity and

composite reliability assessment to achieve the criteria of Structural Equation Modeling with Partial Least Square (SEM-PLS). According to Hair et al. [15], the SEM-PLS is usually employed to analyse the complex and multiple relations between the observed and latent variables. According to the studies, the SEM-PLS technique is most appropriate for testing theories, outcome prediction and formulation of models [16]. The measurement and structural model test were using SmartPLS 3.2.9 software.

The analysis of this measurement model involves two primary criteria, which are validity and reliability. The initial step in the evaluation of the outer model within the context of PLS analysis is to conduct tests to ensure the validity and reliability of the instrument used. Construct reliability is further supported by Cronbach's Alpha [17], where a score exceeding 0.6 indicates a high level of construct reliability. To establish validity, two types of tests were employed: convergent validity and discriminant validity tests.

Our proposed model considers three antecedent conditions and their effect on the outcome of the three-point shot skills. Thus, the hypothesis presented is as follows:

H1. Hand-eye coordination positively affects three-point shot skills

H2. Muscle arm strength positively affects three-point shot skills

H3. Self-image positively affects three-point shot skills

H4. Muscle arm strength moderates the effect of hand-eye coordination positively on three-point shot skills

3. Results

The theoretical model was assessed using PLS-SEM analysis in a two-step process. Initially, we conducted an assessment of the measurement model, followed by an evaluation of the structural model. During the assessment of the measurement model, we focused on examining the validity and reliability of the connections between the latent variables and their corresponding observed variables. This step ensured the accuracy and consistency of the measurement process. Subsequently, in the assessment of the structural model, we took into account the interrelationships between the theoretical constructs.

In order to assess convergent validity, several measures were examined including factor loading, composite reliability (CR) and Cronbach's alpha (α), and average variance extracted (AVE). Every item loading is larger than 0.600, suggesting that the measurement items of this survey have appropriate internal reliability. Additionally, as the recommended lower thresholds for α , CR, and AVE are 0.7, 0.7, and 0.5 respectively [18].

Table 1 shows that the convergent validity and reliability are adequate because the loading factor is >0.7 . In addition, the data are reliable as seen from the Cronbach's alpha is >0.7 , the composite reliability is >0.7 ,

and the average extracted variance (AVE) is >0.5. All items were found to have a factor loading greater than 0.600, indicating that the survey's measurement items possess adequate internal reliability.

The PLS-SEM bootstrapping technique provides the assessment value of the structural path model based on study hypotheses as shown in Table 2 and Figure 2. The model shows that hand-eye coordination could not directly affect the three-point shot skills ($t=0.974$;

$p>0.01$). H1 is therefore rejected. In addition, muscle arm strength of students ($t=0.467$; $p>0.01$) also did not affect the three-point shot skills. H2 is rejected. Moreover, the self-image has significantly affected the three-point shot skills of students ($t=3.392$; $p<0.01$), hence H3 is accepted. Additionally, the muscle arm has a moderating effect on the hand-eye coordination in the three-point shot skills ($t=2.988$; $p<0.01$), thus H4 is accepted.

Table 1. Results of the measurement model

Variable	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Hand-Eye Coordination	1.000	1.000	1.000	1.000
Muscle Arm Strength	1.000	1.000	1.000	1.000
Self-Image	1.000	1.000	1.000	1.000
Three-Point Shot Skill	1.000	1.000	1.000	1.000

Table 2. Asymptotic P and T-Test Significance Values for the six hypotheses from the structural model

Hypothesis	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics	P Values	Outcome
Hand-Eye Coordination → Three-Point Shot Skill	0.213	0.190	0.218	0.974	0.165	Rejected
Muscle Arm Strength → Three-Point Shot Skill	0.081	0.114	0.173	0.467	0.321	Rejected
Self-Image → Three-Point Shot Skill	0.467	0.486	0.138	3.392	0.000	Accepted
Hand-Eye Coordination → Muscle Arm Strength → Three-Point Shot Skill	-0.456	-0.454	0.153	2.988	0.002	Accepted

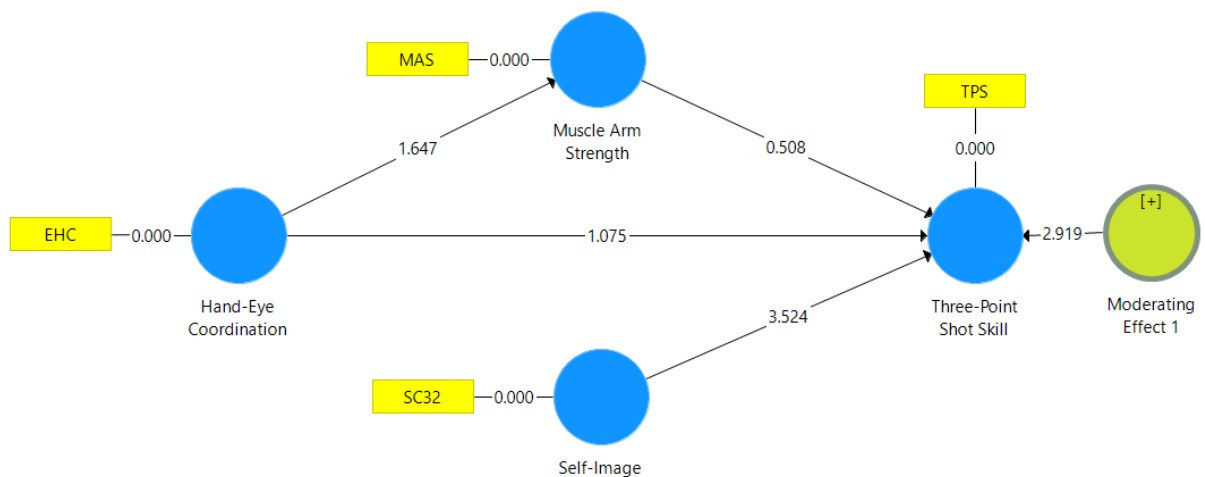


Figure 2. Structural Model of Factors Influencing Three-Point Shots

4. Discussion

The study suggests that hand-eye coordination is a crucial factor in enhancing the arm-muscle strength of athletes, especially basketball players. Coordination can also be said as the ability to combine several movements under control into a unified working of muscles. Hand-eye coordination is the integration between the eyes and the hand as a unified function. Arm muscle strength is the ability of one's arm muscles to make maximum movements. In basketball, hand-eye coordination is needed so that all movement is controlled under the player's sight and mind. This study is in line with Putra [19], that the hand-eye coordination of high-school basketball players is an important factor of arm muscle strength.

The result derived from this study indicates that hand-eye coordination does not influence the three-point shot skill performance. This finding is inconsistent with the prior literature that mentions a positive direct contact of eye-hand coordination with the shooting performance in basketball games [20]. In contrast, the present study's findings raise intriguing questions about the multifaceted nature of shooting skills. It is possible that other factors, such as the manipulations implemented during the test were not powerful enough to determine a relevant detrimental effect on hand-eye coordination characteristics. Alternatively, it could be possible to speculate that the high level of experience of the participants could have cushioned the detrimental effect of time and performance pressure on hand-eye coordination skills [21].

Moreover, this study revealed that muscle arm strength did not significantly impact three-point shot skills. Experienced players, owing to their extensive practice in three-point shooting, exhibited enhanced arm muscle activation, leading to greater efficiency. In contrast, novice players, who had not yet attained this level of proficiency, might have struggled due to their early stages of motor skill development during teaching activities. [7].

In the path analysis, the result indicates that the self-image of high-school basketball players affects directly the three-point shot skills. Many sports psychologists study recognizing the significance of sports and exercise psychology is essential for improving performance in all sports[9],[18]. Basketball players showed stronger self-identity, more self-confidence, and better self-image when participating in a competition [23]. This reason may explain why there was a direct impact of the self-image on the three-point shot skills of basketball players in high school.

Furthermore, this study finds that muscle arm strength plays a vital role in moderating the influence of hand-eye coordination on the three-point shoot skill performance. Furthermore, self-image was found a consistent attribute that is significant as a psychological trait in influencing the three-point shot skills in basketball. It seems that

nothing can stop the students from their desire for achievement. The study's findings can be useful in developing training programs for athletes and designing rehabilitation programs for patients recovering from injuries or surgeries that affect their arm muscle strength. By incorporating exercises that enhance hand-eye coordination, trainers and healthcare professionals can help individuals improve their motor skills and recover faster from physical injuries. A holistic understanding of these interrelated components is essential for coaches and players seeking to enhance their three-point shooting abilities and overall performance in basketball.

5. Conclusions

The result of this study provides further evidence of the structural relationship between the physical demands of basketball players, including hand-eye coordination and muscle arm strength, the psychological traits of the individual namely self-image to the three-point shot performance of the high-school students who join the basketball as an extracurricular program. Based on the research findings, we conclude that (1) the hand-eye coordination does not positively influence the three-point shot skills performance, (2) the muscle arm strength does not influence the three-point shot skills performance, (3) self-image positively influence the three-point shot skills, and (4) muscle arm strength moderates the influences the hand-eye coordination to three-point shot skill performance. Our study contributes to the emerging literature on the effort to improve the three-point shot training program. Further longitudinal research is required to establish if factor discriminant of senior high school students change as athletes progress through certain stages.

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