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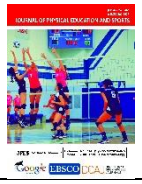

The Influence of Shooting and Weight Training toward Handball Shooting Skills

Rufan Pujianto ✉, Soegiyanto Soegiyanto, Setya Rahayu

Universitas Negeri Semarang, Indonesia

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Abstract

Weak throwing power will cause a lower throw rate so that it would be easy to be anticipated by an opponent's goalkeeper. Therefore, weight and shooting training is essential for handball athletes. This research aims to find out differences in weight and shooting training toward shooting skills and the interaction of shooting and weight training toward handball athletes' shooting skills. This research applied a 2x2 factorial design. The population consisted of 50 handball athletes in Pati municipality while the samples were taken by purposive sampling. The dependent variables were weight training using rubber and medicine balls and shooting practice with bounding takeoff compared to shooting training without bounding takeoff. The dependent variable was handball shooting. The applied data analysis was two-variant analysis (ANOVA) with significant level $\alpha = 0{,}05$.Shooting training with leap-with jump and medicine ball-weight training obtained an average score of 45.95 with a standard deviation of deviation 2.724. Shooting training with leap-without jumping and medicine ball-weight training obtained an average score 44.30 with a standard of deviation 3.262; shooting training without leap-with jump and rubber ball training obtained an average score 42.55 with a standard of deviation 2.762; shooting training with a leap-without jump and rubber ball-weight training obtained an average score 36.65 with a standard of deviation 2.834. There was an interaction between shooting training method and weight training toward shooting skill result with a Sig score = 0.002 < 0.05. The conclusion proves there was an influence between weight training with a medicine ball. It was effective than using a rubber ball to improve shooting skills. The shooting training method without leap-with jump was better than the shooting method with a leap-without jump. There was an interaction of the shooting method without leap-with jump and medicine ball-weight training. It was effective in improving handball shooting.

✉ Correspondence address:
Kampus Pascasarjana UNNES Jl. Kelud Utara 3
Gajahmungkur Semarang
E-mail: rufan.pujianto@yahoo.com

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INTRODUCTION

Handball is a group game by using ball as the media. It is played with one or two hands. The ball is thrown, bounced, or shot. The international organization that manages handball game is *International Handball Federation* (IHF). Meanwhile, in Indonesia, it is organized by Indonesia Handball Association (Asosiasi Bola Tangan Indonesia/ABTI) (Musthofa, 2019; Mahendra, 2000).

Handball will run smoothly when the athletes could master its basic skills. They are such as (1) *Ball handling*, (2) *Dribbling*, (3) *Passing*, (4) *Shooting*, and (5) *Positioning.* (Sridadi et al., 2016). Shooting is the determinant factor of a team victory. There are several influential factors of success. S*hooting* while playing handball such as basic technique, accuracy, power, and so on (Iyakrus & Leo Suginto, 2018). A player's basic techniques are the dominant elements of a team success besides tactics or excellent strategies. Basic techniques of playing handball become the essential skills. Both of them support a player's performance in a match (Sungkono, 2020).

Shooting a handball is an important technique to create an opportunity to score a goal. Several shooting techniques are *flying, rive, jump,* and *straight shots.* Other shooting techniques are such as *center, jump, dive, fall, side, flying,* and *reserve shots* (Sungkono, 2020). Each group attempts to score a goal to win the game (Susanto, 2017).

Handball branch has been growing in Central Java, especially Pati, after the establishment of regional functionaries of Indonesian Handball Association, Pati, December 2014. For male athlete category, they obtained the fourth rank on the first match in 2015, during the province championship in Semarang, the 2016 handball province championship, held by Indonesian Handball Association of Central Java functionary, March 25, until March 26, 2016 in Demak, the male athlete category could win the second rank. In the national handball championship 2017, the qualification match 2018, held in October 31 until November 2017, in Manahan stadium, Surakarta, the male ATHLETE category could win the second rank. In XV province championship, 2018, held in October 20 until 24, 2018, in Giri Mandala Stadium, Wonogiri municipality, the male athlete category could win the second rank.

The most dominant players during the championship were those with excellent techniques or skills. However, based on the observation during XV Province Championship in 2018, the male athletes' *standing throw shots* were still low. From 49 trials, only 21 were shots on target, or with a percentage of 42.8%. During performing jump shot, they were still low. From 52 trials, only 12 were shots on target, with a percentage of 23%.

The observation and interview results with the players revealed that they had low power shots. Thus, it made their throw rate low and could be anticipated by the opponent's goalkeepers. Throwing power is correlated to the strength of arms. Various shots had not been done intensively based on the theories of *shooting* training method. The exercise was only limited on using the goalpost. It was done behind the line on every break time with high intensity. The exercise was given during break time and would be stopped with the time was up. Unfortunately, it was not known how many times the athletes performed the *shots. Shooting* training was determined from the break time length. If it lasted in 5 minutes, then they would do it for five minutes. It was done continuously to spend their break time.

Pati Pesantenan The infrastructures and facilities were worthy to use such as the standard yard, goalpost, and sufficient ball numbers. The preliminary observation was done in Pati Pesantenan Stadium by promoting *shooting* test. It consisted of: *The Standing Throw Shoot, The Jump Shoot, The Dive Shoot, The Fall Shoot, The Side Shoot, The Flying Shoot, and The Reverse Shoot*. The total of athletes following the observation consisted of 50 participants. They were grouped into 5 sessions with 10 athletes for each. The test was done three times for each *shooting* with test assessment criteria for all

shooting. Extremely high criterion (ST), the athletes could score 3 balls. High criterion (T), when they could score 2 balls. Low criterion (R), when only one ball could be scored. Very low (SR), when no balls were scored.

The skills to perform shooting were*e standing THROW, DIVE shoot, fall shot, and reserve shoot*. However, unfortunately, the results were not excellent. The physical examination of players, such as the muscle strength, showed under average muscle strength. From fifty athletes, those with moderate muscle strength were 25 athletes, categorized having low muscle strength. The torso, abdomen, arm, and hand are influential factors of *shooting* outcomes.

Shooting technique could be done properly when the players had excellent training method since it supports players to perform *shooting.* Thus, athletes are demanded to have excellent physical conditions.

An individual that performs *shooting* should be able to combine his swing and timing into a harmonious and excellent unit. Athletes should perform quick and accurate movement to decide the ball direction so that it is unreachable for the opponent's goalkeeper. The influential component is such as muscle strength.

Shooting skill require excellent arm muscle. A stronger arm muscle performance will influence the throw strength so it could be an ultimate technique to forward and score a point. As an offensive technique, maximum strength and speed are needed to perform. Excellent arm muscle strength to perform it is needed for an unreachable shot (Yudiana et al., 2007).

The handball athletes of Indonesian Handball Association Pati had not been introduced to *shooting* training to improve their *shooting* skills. Besides the strength, another important method to reach optimal achievement is *shooting* training. Various training are promoted through various exercise to improve and develop an athlete's physics. It has a purpose to lose the boredom. The most frequently used *shooting* technique is *shooting* training with leaping-without jump. In another hand, for the physical training to strengthen the athletes' muscles, rubber-weight training *medicine ball* training could be applied.

According to Adhie et al (2017), training method is a scientific way to provide a programmed treatment to improve talent, skills, and physical condition based on the sports division. Ten physical condition components should be mastered and adjusted to the specific sports divisions. Those components are cardio-respiratory, muscle endurance, muscle strength, flexibility, body composition, speed, agility, balance, reflect, and coordination.

Training is a process to improve. It develops physical quality, body functionality, and psychological quality (Sukadiyanto, 2010).

Shooting training with leaping could help improving the *shooting* performance. It would be useful when the opponent's defense is very hard to breach, the shooter movement is stopped, and the defense players have high body postures. Meanwhile, *shooting* training without leaping facilitates them to be more accurate. They are required to shoot in a limited time, increase the throw rate, to concentrate, to be calm, and to be confident.

Then, rubber-weigh and *medicine ball* training could be used to improve arm muscle strength. By providing this special training, there is expectation to reach the objective. Training is used to improve arm physical strength and *shooting* skill. It should involve developing the muscles based on the applied energy system for a performed activity.

Based on observation results on the male athletes of Indonesian Handball Association Pati, they still had difficulties to keep up with the training especially dealing with leaping without jumping or throwing. Many factors cause this problem such as the athletes' physics (less optimal arm muscle) and inappropriate exercise approach. Handball *shooting* requires excellent arm muscle. Therefore, it is interesting to investigate the influence of shooting and weight training toward *shooting* skills of male handball athletes of IHA Pati.

METHOD

This research is an experimental research with 2x2 factorial plus *pretest-posttest* design. According to Sudjana (2005), experimental research with factorial design is a research combining a factor to all each level of other factors in the experiment.

The population consisted of the whole handball athletes of Indonesian Handball Association Pati, 50 participants. The samples were male handball athletes of IHA Pati, 40 participants taken by *purposive sampling.*

The measurement of *shooting* skill was done for all population. It had a purpose to find out athletes that had *shooting* skills with leaping-without jumping, those having *shooting* skills with leaping-with high jumping, those having *shooting* skills with leaping-without jumping, and those having *shooting* skills without leaping--with lower jumping. All of the measurement results were summarized.

The applied specification for the training method was *ordinal pairing.* The samples were grouped with these following conditions. The first 20 top rank had *shooting* with leaping-without jumping group and *shoring* without leaping-with high jumping; the first until the twentieth rank athletes who had *shooting* skills with leaping-without jumping and *shooting* without leaping-with low jumping.

Population within twenty first rank were those who had *shooting* skills with leaping-without jumping and *shooting* skills without leaping-with jumping started from the twenty first rank athletes. They were categorized to have *shooting* skills with leaping-without jumping and to shoot skills without leaping-with low jumping. These athlete categories were excluded. Therefore, two training groups with relatively equal skills were formed. After that, the groups were randomly chosen to be trained with rubber-weight or *medicine ball* training. Then, four training groups, consisting of 10 participants, were established.

The *shooting* and weight training programs were promoted within 16 meetings for male athletes of IHA Pati.

The applied data analysis was analysis of two-way variance $\alpha = 0{,}05$. Then, to compare the average of the given treatment, *Newman-Keuls* interval test was used (Sudjana, 2005). It had a purpose to find out which treatment had greater influence toward *shooting* skill outcomes. The Requirement analysis test was done with *Kolmogorov-Smirnov*. In another hand, the homogeneity test applied *Levene* test (Sukestiyarno, 2013).

RESULTS AND DISCUSSION

The *shooting* skill test data analysis results of each group were as follow:

Table 1. The Shooting Test Result of Weight and Shooting Training Group

Weight Training	Shooting Training Method	Statistics	Pre-test	Post-test	Results
Rubber weight	With-without jumping	∑	20	20	-
		Average	25.00	36.65	11.65
		SD	3.671	2.834	0.837
	Without-with jumping	∑	20	20	-
		Average	25.40	42.55	17.15
		SD	4.160	2.762	1.398
Medicine Ball Weight	With-without jumping	∑	20	20	-
		Average	25.60	44.30	18.70
		SD	4.122	3.262	0.860
	Without-with jumping	∑	20	20	-
		Average	26.75	45.95	19.20
		SD	4.944	2.724	2.220

Each cell (the experimental group) had different improvements. The average gain of their *shooting* skills for each experimental group is presented below. The complete descriptions of the obtained *shooting* skill average score could be put into this histogram as comparative values.

Figure 1 The Histogram of Shooting Skill Pre-test and Post-test Average Scores.

Notes:

LBDT: Rubber-weight training with leaping without a jumping group, LBTD: Weight training without leaping-with jumping, LMDT: Medicine ball training with a leaping-without jumping group, LMTD: Medicine ball training without leaping with a jumping group.

The Correlation between Rubber-Weight Training and *Medicine Ball* toward *shooting* Skill Results

Based on the data analysis of each experimental group, there were different improvements in *shooting* skill scores. The improvements in each group could be seen in Table 2.

Table 2. Shooting Skill Improvement of Each Experimental Group

Number	Experimental Group (Cell)	*Shooting* Improvement Results
1	A_1B_1	11.65
2	A_1B_2	17.15
3	A_2B_1	18.70
4	A_2B_2	19.20

Notes:

$\mathbf{A_1B_1}$: Shooting Training Group with Leaping-without jumping and rubber-weight training

$\mathbf{A_1B_2}$: Shooting Training Group with Leaping-with jumping and rubber-weight training.

$\mathbf{A_2B_1}$: Shooting Training Group with Leaping-without jumping and medicine ball-weight training

$\mathbf{A_2B_2}$: Shooting Training Group with Leaping-with jumping and medicine ball-weight training.

The descriptions about *shooting* skills for each group based on *shooting* training and weight-training could be seen in this following histogram.

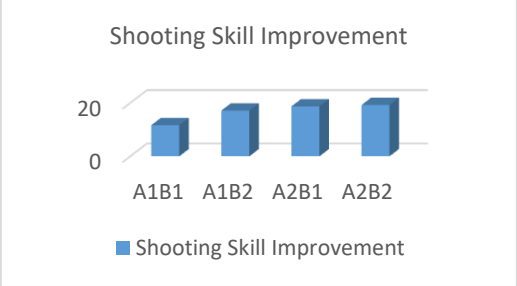

Figure 2. the Histogram of *Shooting* Skill Average Improvement Results of Each Group

Groups intervened by *shooting*. and arm muscle strength training had different *shooting* outcomes. When they were compared. it could be known that athletes obtaining *medicine ball* training had higher *shooting* skill improvement than those trained by rubber weight. with a percentage of 18.95%.

Therefore. different *shooting* training methods influenced *shooting* skill outcomes. When the athletes trained by leaping-without jumping and leaping-with jumping were compared. those trained without leaping-with jumping had higher *shooting* skill outcomes. with a percentage of 18.175%.

Before applying the analysis of two-way variants. normality and homogeneity tests were carried out to see the *shooting* skills. The tests were assisted by SPSS 16.0 software. Here are the normality and homogeneity test results of *shooting* skill outcomes.

Table 3. Normality Test

Data	Sig.	Decision
Shooting Results	0.672	H_0 accepted

Ho is accepted. Thus. the data were normally distributed.

Table 4 Homogeneity Test

Data	Sig.	Decision
Shooting Results	0.540	H_0 accepted

Ho is accepted. It meant the data were homogeneous.

The hypothesis test applied *to Two-Way Anova*. It had a purpose to find out the differences between rubber-weight training and *medicine ball* training toward the *athletes' shooting* skill outcomes. Descriptively. the athletes trained by rubber-weight obtained an average score 0f 39.600 while those trained by *medicine ball* had an average score of 45.125. Here are the calculation based on *Two Way Anova* assisted by SPSS 16.

Table 5. The Differences between Rubber-Weight Training and *Medicine Ball* toward *shooting* Skill Results

Sig.	F_{tabel}	F_{hitung}	Decision
0.000	3.97	74.425	H_0 denied

Rubber-weight training had different improvement compared to *medicine ball* training. Their scores were 14.4 and 18.95. showing that *medicine ball* training had a higher score. Thus. it could be concluded there was an influence between rubber-weight and *medicine ball* training toward *shooting* skills of the male handball athletes.

According to Candra & Rumini (2016). a coach has essential roles in training and accompanying the athletes in each session. He has a job to design programs for athletes based on the exercising stages. The aspects of training should also be following formal education when the coach took a coaching training. A coach is an important factor in reaching achievement. In every implementation. an athlete should be accompanied by a coach. It means a coach should frequently accompany his athletes. A coach's disciplinary factors also became hindrances for athletes to improve their achievements (Rumini. 2015).

Training with a *medicine ball* for 14 meetings. adhering to the coaching principles. training system. training intensity. and training frequency could improve arm muscle strength maximally. In this research. the *medicine ball* training focused on strength exercise because strength is the whole muscular system contraction to overcome burden without using speed. By exercising with *a medicine ball*. the athletes were trained to continuously throw the ball with different positions and directions. They were asked to use their arm. abdomen. and leg muscle strengths. Therefore. *medicine ball* training could improve those muscle strengths and the body's strength.

Medicine ball exercise is training with external weight to stimulate ar muscles to move. This training involves *biceps brachia. triceps. deltoid. anconeus. brachia. extensor carpi radials longus. brachioradialis.* nerve system. and several joints (Syam. 2011). The occurring movements during the exercise stress the upper muscular components so that the muscles experience muscle hypertrophy. It is caused by the increasing numbers of cellular sizes and muscular fibres. Due to the increase. the arm muscle strength will be improved. In other words. the arm muscles will adapt to the obtained load during *medicine ball* training. It could enhance the strength so that the shooting skill would be maximum.

This finding is supported by Hidayat et al. (2018). They found that muscle strength factors individually significantly influenced handball *shooting* accuracy with a percentage of 41.47%. Ignjatovic et al. (2012) found that training with *a medicine ball* for 12 weeks significantly influenced female handball junior players' muscle strength and power.

This rubber-weight training is adopted from external restraining exercise. The rubber is snatched on athletes' wrists. According to Hadisasmita in Mylsidayu (2015). restraining practice is a training that requires the athlete to lift. push. or pull something heavy with his weight or other external weights. It is used to improve muscle strength. especially arm muscle strength while performing *shooting.*

According to Sumarsodjono (in Giatarma. 2017). when this training has been applied for 4-8 weeks regularly and sufficiently. it will impact (training effects). This rubber-weight training had been done within 14 meetings. Therefore. the data results showed improvements in *shooting* skill outcomes and receiving the correct training.

This research had either strong and weak points. The device is easy to carry. simple. and applicable for any muscles. It also has an affordable price. various variants. sizes. and weights. The use of rubber-weight training was to train *pectorals major. front deltoid. stratus major. triceps. the short head of bicep. forearm extensor* muscles to support arm muscle strength.

However. there were also weaknesses in this training. The researcher found hindrances concerning rubber-weight uses to train arm muscle strength. In this case. the weight-increase was limited. If the repeating rates had been surpassing or not appropriate to the training objectives. the coach would have difficulties to increase the weight. The alternative was to shorten the rubber so that its stretch would be more decisive. The other way was to replace the rubber with other rubber that had more excellent resistance.

The finding is supported by Yasuda (2014). Receiving *elastic hand* training could improve muscle activation. and it became an effective method to establish muscle hypertrophy of adult people with low activities. Awad (2015) found that elastic rubber or resistant band could influence upper muscle part endurance.

There were significant differences between athletes receiving rubber-weight training and *medicine ball* training toward the shooting skill outcomes. From systematic and programmed rubber-weight exercise. the results showed better *shooting* skill outcomes. The applied exercise with rubber-weight could be done to improve throwing rate speed and accuracy. Performing hand *shooting* requires speed to avoid weak or slow throw rate. Besides that. the position of the opponent's goalkeeper should be considered while shooting. Therefore. the throw rate should be quick and powerful to make the goalkeeper's position unstable. Training to improve *shooting* skills was performing rubber-weight training. It was done by pulling the arranged weight.

A systematic and programmed exercise could influence positively. It means the training provided could influence the *shooting* skill outcomes of handball players. *Medicine ball* exercise is training with external weight to stimulate arm muscles to move. The movement during training with *medicine ball* influenced the shooting direction. It was influenced by the effectiveness of systematic and programmed training. Handball *shooting* should be done quickly and powerfully. The athletes should take the benefits of the distance and the throwing time to create a compelling and directed throw rate.

Medicine ball training was more efficient than rubber-weight training. When the shooting direction was seen. this training had a significant outcome. During *medicine ball* training. it caused various movements to be performed for anticipating the ball. Both training methods were done to improve the muscle strength. so handball *shooting* could be done correctly. accurately. powerfully. and maximally.

The Outcome Differences in *shooting* between athletes with leaping-without jumping and without leaping-with jumping.

Based on the results. the male handball athletes of IHA Pati. that had *shooting* skills with leaping-without jumping. obtained an average score of 40.475. On the other hand. male handball athletes with *shooting* skills without leaping-with jumping got an average score of 44.250. Here are the calculation based on *Two Way Anova* assisted by SPSS 16.0..

Table 6 The hypothesis test results in summary with *Two Way Anova*

Sig.	F_{tabel}	F_{hitung}	Decision
0.000	3.97	33.811	H_0 denied

Shooting training with leaping-without jumping had different improvements to *shooting*

practice without leaping-with jumping. The obtained average scores were 15.175 and 18.175. It meant *shooting* training without leaping-with jumping was better. Thus. it could be concluded that there were differences in handball *shooting* skill outcomes among the athletes with leaping-without jumping and without leaping-with jumping.

The most critical skill in playing handball is a skill to perform *shooting* on the goalpost. It is the core of a handball game strategy. This skill is a real skill that has a tangible result. A coach and players could optimize this basic technique through a careful investigation and could apply the effective strategy to score goals maximally.

The position while executing the shot was done without jumping. It meant the athletes' feet were still on the ground. so their body balances were still stable. Their front arms 90^0 and upper arms and their waists. were rotated backward simultaneously with the throwing arm. Their hands were behind the balls while their fingers were unfolded. At this moment. their feet were directed toward the goalpost. All of their hands. arms. shoulders. and waists should powerfully move forward. Their hands that were behind the ball grabbed the balls and smashed the ball. Those were the stages to perform shots. and they had better successful levels than by jumping. It was due to the body position in the mid air that lost stability. Therefore. while performing the shot. it would have a lower successful chance.

Research that supports the current finding is Rahim (2015). He found that *One Hand Set Shots* (without leaping) in the basketball game of SMAN 1 Pengasih Kulon Progro was categorized fair and excellent. On the other hand. the players' *jump shots* were categorized under average and average. Kurniawan (2019) compared medium shots' effectiveness with leaping and without leaping toward *shooting* outcomes while playing basketball. Both of them were effective to use to score a goal.

The Interaction between *Shooting* and Weight Training Methods toward *Shooting* Outcomes

The data process results assisted by SPSS 16 and *Two Way A*NOVA is presented in Table 7.

Table 7. The Interaction between *Shooting* and Weight Training Methods toward *Shooting* Outcomes

Sig.	F_{tabel}	F_{hitung}	Decision
0.002			H_0 denied
	3.97	10.714	

Based on the table. it could be concluded that there was an interaction between shooting training method and strength training toward shooting skill outcomes of male handball athletes of IHA Pati.

Table 7 shows the analysis results of two factors. The main factors of this research showed significant interaction. Table 8 shows the interaction between A and B.

Table 8. Simple and Main Influences and Factor Interaction between A and B toward Shooting Skill Outcomes

Factors		Other *Shooting* Method (B)			
Weight Training (A)	Level	(B_1)	(B_2)	Average	B1-B2
	(A_1)	11.65	17.15	14.40	5.5
	(A_2)	18.70	19.20	18.95	0.5
Average		15.18	18.18	16.68	3
$A_1 - A_2$		7.05	2.05		

Interaction between the two factors could be seen in the figure.

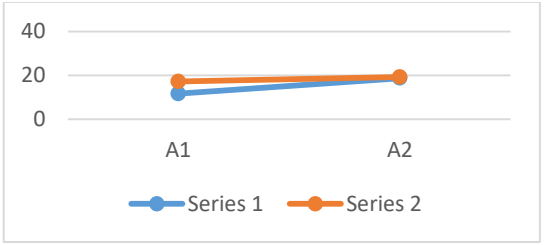

Figure 3. Interaction Realization of Improving *Shooting* Skill Outcomes

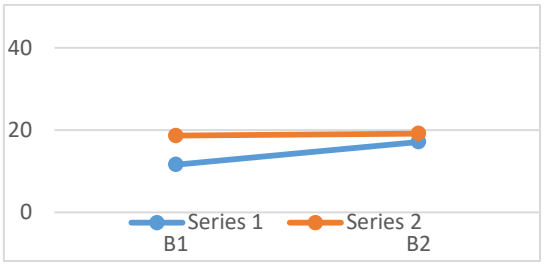

Figure 4. Interaction Realizations of *Shooting* Skill Outcome Improvement

Table 9. The Average Score of Each Group's Shooting Outcome

Weight Training	Shooting Training	Mean	SD	N
Medicine Ball	Without leaping-with jumping	45.95	2.724	20
	With leaping-without jumping	44.30	3.262	20
	Total	45.12	3.082	40
Rubber weight	Without leaping-with jumping	42.55	2.762	20
	With leaping-without jumping	36.65	2.834	20
	Total	39.60	4.069	40
Total	Without leaping-with jumping	44.25	3.209	40
	With leaping-without jumping	40.48	4.909	40

Figures 3 and 4 show the lines of the shooting skill value results are not parallel. The lines indicating shooting skill improvements among groups have a crossing point. There is a midpoint between *shooting* training method and arm muscle strength training to improve shooting skill outcomes. It meant there was a significant interaction among them.

Based on the findings. there were differences between athletes with leaping-without jumping when they were trained by *medicine ball* to those without leaping-with jumping trained by *medicine ball.* There were also differences between athletes with leaping-without jumping trained by rubber-weight and those without leaping-with jumping trained by rubber-weight training.

From figure 3 ad 4. it could be concluded that the applied method. leaping-without jumping. and without leaping-with jumping trained by *medicine ball*. had significant influence compared to the used method with leaping-without jumping. and without leaping-with jumping trained by rubber-weight.

CONCLUSION

The influence of *medicine ball* weight training was more efficient than rubber-weight training to improve *shooting* skill outcomes. The *shooting* training method without leaping-with jumping had a higher result than the *shooting* training method with leaping-without jumping. The interaction of *shooting* training methods without leaping-with jumping and *medicine ball* weight training effectively improved handball shooting skill outcomes. The *shooting* method's interaction with leaping-without jumping would be more appropriate when it was trained by rubber-weight practice.

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