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The Effectiveness of Sprint Training and Hollow Sprints in Improving Leg Muscle Power in Players of the Tumbak Raya Mitra Soccer Club

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sprint training; hollow sprint; power limbs

Abstract

This study aims to measure and analyze empirical data on the effectiveness of sprint training and hollow sprint training in improving leg muscle power ability in Tumbak Raya Southeast Minahasa football club players. The method used was the "true experimental method" with a research design referring to the experimental design using "One group pre-test and post-test design" and "randomized control groups group pre-test and post-test design." The population consisted of all Tumbak Raya football club players, with a sample of 24 players selectively sampled based on relatively similar height and leg length. They were divided into 2 groups: the sprint training experimental group (n=12) and the hollow sprint experimental group (n=12). The instrument used was a "standing board jump test." Data analysis technique used was independent statistical test of one sample and two samples with a significance level of α=0.05. The results of the study show: (1) There was an effect of sprint training on the improvement of leg muscle power in players of the Tumbak Raya football club, with the results of the observation t-test (t_ob) = 17,238 > t_tab = 2.101. (2) There was an effect of hollow sprint training on the improvement of leg muscle power, with t_ob = 12,558 > t_tab = 2.101, and (3) There was a difference in the effect between sprint training and hollow sprint training on the improvement of leg muscle power, with t_ob = 4,680 > t_tab = 2.074, with the average score of the two training models indicating sprint training is more effective in increasing leg muscle power.

INTRODUCTION

Football is one of the sports that is very popular and loved by all levels of society both in cities and villages (Arreola et al., 2026; Kerr, 2024; Lapsley, 2024; Rusdi & Helmi, 2025; Simiyu, 2022). This fact can be seen that the development of the game of football has progressed so rapidly, this is evidenced by the number of football clubs both in villages, in cities and government and private agencies. The number of football clubs in the community results in competition among clubs being higher, so each club is clearly required to try to improve achievements as much as possible (Beck et al., 2025; Crossan et al., 2025; Mathebula, 2025; Mead et al., 2023; Rahmati, 2023).

It is very worrying that the talents that have been possessed by children today are not noticed by parents, physical education teachers and even sports coaches (Flynn et al., 2023; Hellison et al., 2025; Kortekaas et al., 2025; Lockyer & Robinson, 2025; Piotrowski et al., 2025; Siedentop & Van der Mars, 2022). The main capital for fostering the achievement of a sport is talent which is then developed through the development of these talents and then carried out with practice so that it can produce a sports skill to achieve achievement. To be able to

excel in sports other than having talent, a player is required to master basic techniques in the game of football, because mastery of basic techniques is the main requirement to become a quality player and have high skills in the game of football. This is as stated by Jef Sneyers (1988) that "In football, the factor that greatly determines the success of a team is the mastery of basic techniques." The basic techniques in the game of football are as follows: 1) Kicking the ball, 2) Receiving the ball, 3) Heading the ball, 4) Dribbling, 5) Deception with the ball, 6) Seizing the ball, 7) Throwing the ball, 8) Goalkeeper technique." (Danny Mielke, 2007).

To be able to carry out these basic techniques properly, exercises are needed that can increase the power or explosiveness of the leg muscles. The training technique must be able to develop the power of the leg muscles, which is seen in the strength and speed of the muscles that play a role. The muscles that need to be developed are the front thigh muscles, namely the sartorius, tensor fasciae latae, adductor longus, rectus femoris, vastus lateralis and vastus medialis, as well as the muscles of the hind thighs, namely semitendinosus, semimembranosus, bicep femoris, adductor magnus and adductor brevis. These thigh muscles are the driving force of the lower limbs.

Leg muscle power can provide strong and fast movement skills when performing movements such as kicking, dribbling, heading or shooting, as well as trick movements without the ball. With the strength and speed of the leg muscles, it can be used to support explosive or the mobility of the muscles that contract and the joints that work when making movements such as when shooting the ball in the goal, dribbling, long pass kicks, heading. If the leg muscles are strong and fast enough, it will support the effectiveness of movements in the game of football.

Many beginner football players always want to need proper and measurable training, but the results achieved are not optimal. Some beginner players who practice are not able to show their performance optimally. Many players whose physical and technical abilities are still imperfect, such as leg muscle power has not had much impact on mastering techniques in football and the ability to take advantage of opponents' weaknesses to attack back because they do not have adequate leg muscle power. So for players it is necessary to form the strength and speed of contraction of their leg muscles or the power of the leg muscles to the maximum, it is necessary to be given the right exercises that can increase the power of the leg muscles. Various efforts have been made to improve the achievement of football, including the need for more intensive coaching by implementing a training system that is carried out continuously, gradually, and continuously, especially at the regional level.

The power of the leg muscles contains elements of distance and travel time to the stimuli that arise. The factors that affect the power of the leg muscles include strength and speed. Muscle power is closely related to the execution of the technique. This means that the implementation of technical movements in football games is carried out quickly and strongly and suddenly. Muscle explosiveness is the ability of a muscle or group of muscles to perform work explosively. The explosiveness of these muscles is affected by the strength and speed of muscle contraction. In everyday life, this explosive power is needed to move an object from one place to another suddenly. A fast runner when he is in a "ready" state and preparing to start, must need the strength of the leg muscles and explosive power to be able to start.

Efforts to increase the element of power can be done by: a) increasing power without ignoring speed or focusing on power; b) increase speed without neglecting power or putting an

emphasis on speed; c) increasing both at once, strength and speed are trained simultaneously (Jessen, Schultz and Bangertes, in Assri Isak, 2021:5). The combination of strength and speed training is an exercise to improve the quality of physical condition with the main goal of increasing explosive power. These exercises have a better influence on dynamic values when compared to strength training alone. As for developing explosive power, the training load should not be too heavy so that the movements carried out can take place quickly and have many frequencies (Pyke, in Assri Isak, 2021).

However, there remains a research gap in comparing the effectiveness of sprint training and hollow sprint specifically for leg muscle power improvement in Indonesian football club players. While previous studies have examined these training methods separately or in different contexts, limited research has directly compared the effectiveness of both methods in a controlled experimental setting with Indonesian football players. The urgency of this research stems from the need for evidence-based training recommendations for football coaches and players, particularly at the club level, to optimize training programs and improve performance outcomes. The novelty of this research lies in its direct comparison of sprint training and hollow sprint training using a true experimental design with Indonesian football club players, providing practical insights for training program design in Indonesian football contexts.

The selection of the right training method and in accordance with the situation and conditions of the trainee as well as the facilities and infrastructure will greatly determine the success of the training process. The training method is a procedure or planned method regarding the types of exercises and their arrangement to obtain optimal performance. The right and appropriate training method will affect the achievement of the trainees' achievements. For this reason, the training method must be adjusted to the situation and conditions of the match environment. To produce good technical movements, the right training method is needed. The training methods used in increasing leg muscle power are the sprint training and hollow sprint methods.

The training methods Sprint training and hollow sprint are a form of variation of ways to train speed. The estimated energy system used for these two training methods is almost the same, namely: 90% ATP-PC, 6% LA+O2, 4% O2 for sprint training and 85% ATP-PC, 10% LA+O2, 5% O2 for hollow sprint. This means that the predominance of the energy system of the two exercise methods is alatic anaerobic. This is in accordance with the predominance of the energy system in the game of football.

Based on this, sprint training and hollow sprint training methods may have an effect on leg muscle power, but in relation to the priority scale and which training method is more effective of the two training methods, it has not been proven whether the sprint training method is better or hollow sprint Which is better at increasing leg muscle power? Therefore, the researcher wanted to prove whether there was a difference between the two training methods.

We all know that muscle power is one of the components of physical condition that plays a very important role in almost all sports, where muscle power requires strength and speed. It is very reasonable that almost all sports require muscle power, especially leg muscle power, as in football.

Based on the explanation above and the researchers' observations, in football, to produce good technical movements such as shooting to goal techniques, long kick techniques, heading, dribbling the ball, and attacking techniques, leg muscle power is needed. Therefore, in this

study, we will see the difference in the effectiveness of the two training methods, both the sprint training and hollow sprint training methods (as independent or manipulative variables), and then as a benchmark for success is the strength of the leg muscles (as a dependent variable).

METHODS

The method used was a survey method with a descriptive and experimental approach. As stated by Sugiyono (2009), that "based on the types of research included in the quantitative method, it is the survey and experimental research method".

The designs used in experimental research are "*One group pre-test and post-test design"* and "*randomized control groups group pre-test and post-test design"* (Suharsimi Arikunto, 1998), each of which can be described as follows:

Table 1. One Group Sample Plans

Pre-test	Treatment	Post-test
O1	X	O2

Description :

O1 = Initial observation (pre-test)

X = Experiments/treatments (arm speed exercises)

O2 = Post-test

Furthermore, the design of two independent samples, namely;

Table 2. Two Group Sample Design

	Groups	Pre-test	Treatment	Post-test
R	A	O^1	X (1)	O_{1^2}
	B	O^2	X (2)	O_{2^2}

Description:

R = Random

A = Experimental Group I (*Sprint training)*

B = Experimental Group 2 (*Hollow sprint)*

O^1 = Initial test of experimental group 1 before treatment

O^2 = Initial test of experimental group 2 before treatment

O_{1^2} = Final test of experimental group 1 after treatment

O_{2^2} = Final test of experimental group 2 after treatment

X = Treatment or training.

The population intended in this study is all football players who are members of the Southeast Minahasa football club (Mitra) as many as 47 players. The research sample is a portion of the population that is taken as a data source and can represent the entire population. The sampling technique was *selectively sampling* by prioritizing the adolescent age group and relatively the same height, obtained as many as 24 players. Furthermore, the 24 players were

divided into two groups with a double-split technique (odd-even) where each group became; (1) Experimental Group 1 *(Sprint Training)* 12 players, and (2) Experimental Group 2 *(Hollow Sprint)* 12 players.

Figure 1. Standing Board Jump Test Movement.

The research instrument "*Standing broad jump test*" was used to measure the explosive power of the leg muscles with a *reliability level of 0.963 and validity of 0.607* (Nurhasan, 2007:174). The analysis technique used in this study is an analysis technique using descriptive and inferential statistical tests (t-tests) preceded by normality testing and homogeneity tests**.**

RESULTS AND DISCUSSION

First Hypothesis Testing Analysis

The first hypothesis in this study is to test whether there is an effect of *sprint training* on increasing leg muscle power ability in players of the Southeast Minahasa Football Club (Mitra). From the results of the calculation using the t-test statistics of observation pairs, the analysis with the SPSS 26 program obtained an observation t-value of t_{ob} = 17,238. Meanwhile, from the critical value table t with a real level of α = 0.05; n - 1 obtained the value t of the table of ttab = 2.201 *(value of the table attached).* This fact shows that the tob value = 17.238 > the ttab value = 2.201, thus the null (Ho) hypothesis is rejected and an alternative hypothesis (Ha) is accepted, which states that there is an effect of *sprint training* on the improvement of leg muscle power in Partner Football Club players, as shown in the test results in the following table.

Table 3. Sprint Training One-Sample Test

					95% Confidence Interval of the Difference	
		df	Sig. (2 tailed)	Mean Difference	Lower	Upper
Gain Score_ Sprint Training	17.238		0.000	0.42667	0.3722	0.4811

Test Value = 0

*** Very significant tob = 17,238 > ttab = 2,201 or (0.000 < 0.05)*

Subtract Ho if Sig. (2tailet) < α = 0.05, There is an effect of sprint training on the power ability of leg muscles.

Second Hypothesis Testing Analysis

The second hypothesis in this study is to test whether there is an effect of *hollow sprint* training on increasing leg muscle power ability in Mitra Football Club players. From the results of the calculation using the t-test statistics of observation pairs, the analysis with the SPSS 26 program obtained an observation t-value of t_{ob} = 12,558. Meanwhile, from the critical value table t with a real level of α = 0.05; n - 1 obtained the value t of the table of ttab = 2.201 *(value of the table attached).* This fact shows that the tob value = 12.558 > the ttab value = 2.201, thus the null (Ho) hypothesis is rejected and the alternative hypothesis (Ha) is accepted, which states that there is an effect of *hollow sprint* training on the improvement of leg muscle power in Partner Football Club players, as shown in the following table.

Table 4. One-Sample Test Hollow *Sprint Training*

	t	f	Sig. (2 tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Gain Score Hollow Sprint	2.558 **	1	.000	22583	.1863	0.2654

Test Value = 0

*** Very significant tob = 12,558 > ttab = 2,201 or (0.000 < 0.05)*

Subtract Ho if Sig. (2tailet) < α = 0.05, There is an effect of hollow sprint training on the power ability of leg muscles.

Third Hypothesis Testing Analysis

The third hypothesis test in this study was to test whether there was a difference in the effect between *sprint training* and *hollow sprint training* on the increase in the explosive ability of leg muscles in Partner Football Club players. From the results of the calculation using t-test statistics of two independent samples, the analysis with the SPSS 26 program obtained an observation t-value of t_{ob} = 4.680. Meanwhile, from the critical value table t with a real level of α = 0.05; n1 + n2-2, obtained the value t of the table of ttab = 2.074 *(value of the table attached).* This fact shows that the tob value = 4.680 > the ttab value = 2.074, thus the null (Ho) hypothesis is rejected and an alternative hypothesis (Ha) is accepted, which states that there is a difference in the effect between *sprint training* and *hollow sprint* training on the increase of the explosive ability of the leg muscles in Partner Football Club players, as shown in the following table.

Table 5. T-Test Two Sample *Sprint Training & Hollow Sprint*

	t	df	Sig. (2 tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
GainScore_Kedua Group.	4.680 *	22	0.000	0.20084	0.1859	0.2157

Test Value = 0

** Significant tob = 4.680 > ttab = 2.074 or (0.000 < 0.05)*

Subtract Ho if Sig. (2tailet) < α = 0.05, There is a difference between sprint training and hollow sprint training on the power ability of leg muscles.

After meeting the requirements of normality analysis where both experimental and control groups are normally distributed, as well as the homogeneity test where both sample groups show homogeneous or equal variance, this means that the two sample groups before receiving different treatments have the same initial ability so that if there is or a change occurs solely due to the presence of a treatment or training factor which in this case is the treatment with The approach of providing *sprint training* & *hollow sprint training* to increase the explosiveness of the leg muscles.

Discussion of the First Hypothesis Results

The results of descriptive statistical analysis with the distribution of the frequency of the explosive score of the leg muscles with *sprint training* on Partner Football Club players. From the difference or *gain score* data of the frequency distribution of the score of the explosive ability of the leg muscles of the experimental group with *sprint training*, the researcher can group into three categories, namely the low category, the medium category and the high category. As a result, the difference between 0.30 - 0.38 values as many as 3 players (25.00%) have the explosive ability of the leg muscles is in the low category group, while the score of the explosive ability of the leg muscles between the value of 0.40 - 0.44 as many as 5 players (41.67%) are in the medium category group, then for the score of the explosive ability of the leg muscles between the value of 0.49 - 0.56 as many as 4 players (33.33%) have the explosive ability of the leg muscles are in the high category group.

Furthermore, it is seen from the average score in the first hypothesis (the effect of *sprint training* on the power ability of the leg muscles) shows that there is an increase in the score of the explosive ability of the leg muscles from the value (pre-test) or initial condition to the value (post-test) or final condition, where the average pre-test score = 1.9992 while the average post-test score = 2.4258. This shows that the *sprint training* program given for eight weeks of training with a frequency of three times a week can have a significant effect on improving the ability of leg muscle power in players of the Tumbak Raya Mitra football club.

Furthermore, the difference in average values both pre-test and post-test can be illustrated in the form of the following bar chart.

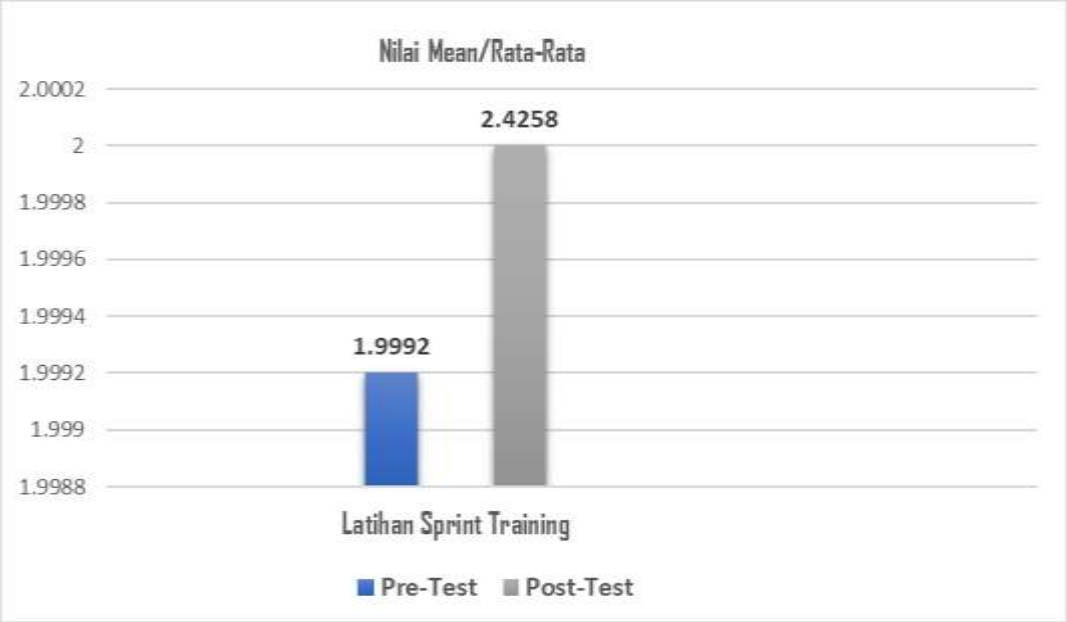

Figure 2. Sprint Training Pre-test–Post-test Explosive Power Diagram

The results are in accordance with the test hypothesis of the first study, where the results of the analysis calculation with the t-test statistics of the observation pair, the result of which is the value of t_{ob} = 17,238 > the value of t_{tab} = 2.201 so that $H_{o\ is}$ rejected and H_a is accepted which states that there is an effect of *sprint training* on the increase of the explosive power of the leg muscles. This means that *the sprint training* program can make a positive contribution to increasing leg muscle explosiveness or leg muscle power in Tumbak Raya Mitra football club players.

The results of this study are strengthened by Bompa (1990), that "the training process is nothing but to prepare athletes for the maturity of physical abilities, techniques, tactics and mentality". Considering that these factors play a role in achieving maximum achievement, it is absolutely essential to prepare athletes in various sports, both physically, technically, tactically and mentally. Especially in terms of physical training, the training model applied in the experimental group with *sprint training* with the aim of increasing the explosive power component of the leg muscles is running at maximum speed by covering a distance between 30 meters to 50 meters, with 4 to 5 repetitions, using recovery time and complete intervals with a ratio of 1: 4 - 5 (Bowers and Fox, 1992). This means that if the activity (work) lasts for 5 seconds, the *recovery time* and *interval* range from 20 seconds to 25 seconds. The form of exercise, especially in *sprint training*, is running at maximum speed (sprint) covering a distance of 50 meters, jogging 50 meters and jogging back 50 meters, done repeatedly. These results are adjusted to the opinion of Harsono (1998:13), that "power or explosive power is a very important component to improve the overall physical condition, because: *(1) the* explosive power of the leg muscles is the driving force of every physical activity, *(2) the* explosive power of the leg muscles plays an important role in protecting athletes or people from possible injury, *(3)* With leg muscle power or leg muscle explosiveness athletes can run or advance faster, hit faster & stronger, kick farther and more efficiently, hit harder, pierce faster, likewise can help joint stability."

Discussion of the Second Hypothesis Results

The results of descriptive statistical analysis with the distribution of the frequency of the explosive score of the leg muscles with *hollow sprint training* on players of the Tumbak Raya Mitra football club. From the difference or *gain score* distribution of the frequency of the limb muscle explosiveness score score with *hallow sprint training*, the researcher can group it into three categories, namely the low category, the medium category and the high category. As a result, the value of the difference between the value of 0.15 - 0.17 as many as 5 players (41.67%) had the explosive ability of the leg muscles were in the low category group, while the score of the explosive ability of the leg muscles between the value of 0.21 – 0.26 as many as 4 players (33.33%) were in the medium category group, then for the score of the explosive ability of the leg muscles between the value of 0.30 – 0.31 as many as 3 players (25.00%) had the explosive ability of the leg muscles were in the high category group. Furthermore, it is seen from the average score in the second hypothesis (the effect *of hollow sprint* training on the explosive power of the leg muscles) shows that there is an increase in the explosive power score of the leg muscles from the value (pre-test) or initial condition to the value (post-test) or the final condition, where the average score in the pre-test = 1.9992 while the average value in the post-test = 2.1417. This suggests that *a hollow sprint* training program given over eight weeks of training with a frequency of three times a week can have a significant effect on the improvement of leg muscle power in Partner Football Club players, the difference in the following pre-test and post-test average scores.

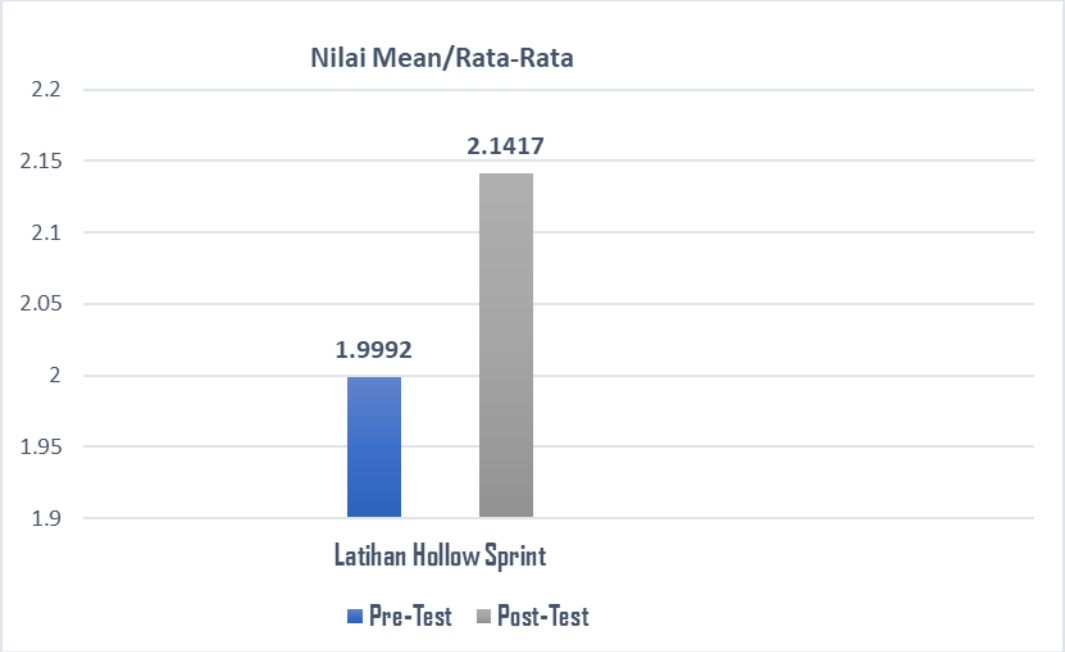

Figure 3. Hollow Sprint Explosive Power Pre-test–Post-test Diagram

The results are in accordance with the testing hypothesis of the second study, where the results of the analysis calculation with the t-test statistics of the observation pair, the result of which is that the value of t_{ob} = 12,558 > value of t_{tab} = 2.201 so that H_o *is* rejected and H_a is accepted which states that there is an effect of *hollow sprint* training on increasing the explosive ability of leg muscles. This means that *a hollow sprint* training program can make a positive contribution to the increase in leg muscle explosiveness or leg muscle explosiveness

in Partner Football Club players. The same results of this study are strengthened by Bompa (1990), that "in the training process is nothing but to prepare athletes for the maturity of physical abilities, techniques, tactics and mentality". Considering that these factors play a role in achieving maximum achievement, it is absolutely essential to prepare athletes in various sports, both physically, technically, tactically and mentally. Especially in terms of physical training, the training model applied in the experimental group with *hollow sprint* training to increase leg power, as explained by Pyke (1980:75) that in developing power or explosive power, the training load should not be too heavy so that the movements performed can be fast and have many frequencies. Based on this opinion, the researcher developed the *hollow sprint* training to be a 50-meter sprint, a 50-meter jog, another 50-meter walk, then walking as a recovery phase. In the recovery phase it is possible to prepare to move on to the next rep. The *hollow sprint* training method is a form of variation of how to train speed. The estimated energy system used for *hollow sprint* training is: 85% ATP-PC, 10% LA+O2, and 5% O2. This means that the predominance of the energy system of *the hollow sprint* training method is alactic anaerobic, which is in accordance with the predominance of the energy system in the sport of football. These results are adjusted to the opinion of Harsono (1998:13), that "power or explosive power is a very important component to improve the overall physical condition, because: *(1) the* explosive power of the leg muscles is the driving force of every physical activity, *(2) the* explosive power of the leg muscles plays an important role in protecting athletes or people from possible injury, *(3)* With the explosiveness of the leg muscles the athlete can run or advance faster, hit/kick further and efficiently, hit harder, pierce faster, as well as help with joint stability."

Discussion of the Results of the Third Research Hypothesis

The results of descriptive statistical analysis with different average values or differences/gain scores of the explosive ability of the leg muscles with *sprint training* and *hollow sprint* training on Mitra football club players. Judging from the average score in this third hypothesis, it shows that there is a difference in the explosive power of the leg muscles with *sprint training* and *hollow sprint training*, where the average value of the difference/gain score of the explosive power of the leg muscles with *sprint training* (X1) = 0.4267 while the average difference/gain score of the explosive score of the leg muscles with *hollow sprint* (X2) = 0.2258 *(see tables 5.2 & 5.5)*. This shows that there is a difference between the two sprint *training* models and *hollow sprint* training in terms of increasing the explosive power of the leg muscles, although both of these training models can increase the explosive power of the leg muscles, judging from the change in the average value in *sprint training* training is more effective in increasing the increase when compared to *hollow sprint training*. Furthermore, the difference in the average value of the difference or gain score of the explosive ability of the leg muscles both in *sprint training* and *hollow sprint* training in Partner Football Club players, the results can be illustrated in the form of the following bar diagram.

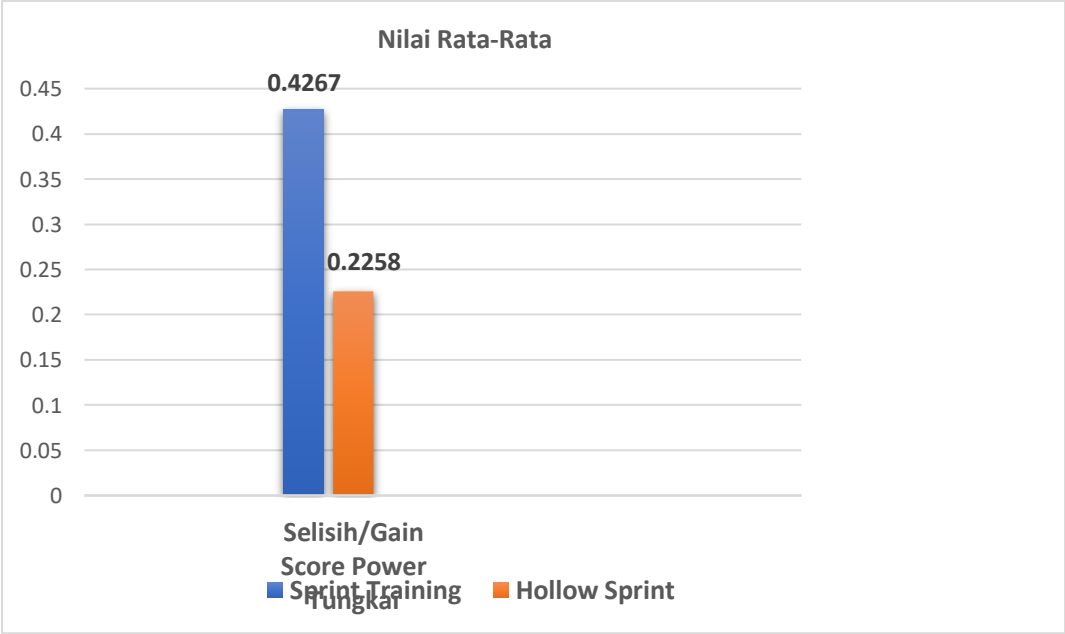

Figure 4. Difference Chart/Gain Score of the Two Training Models

Furthermore, from the results of the calculation for the third hypothesis test using t-test statistics of two independent samples, a t_observasi value of tob = 4,680 was obtained. Meanwhile, from the critical value table t with a real level of α = 0.05; N1+N2-2 obtained a t_tabel value of ttab = 2.074 *(table list attached).* This fact shows that the value of tob = 4,680 > ttab = 2,074 is very significant, thus the null (Ho) hypothesis is rejected and an alternative hypothesis (Ha) is accepted which states that there is a difference in the effect of *sprint training* and *hollow sprint* training on the increase in limb muscle explosiveness in Partner Football Club players, where the improvement is more effective with *sprint training*. The effectiveness of *sprint training* mainly lies in its structure, where *sprint training* is a run at maximum high intensity in a short period of time, while *hollow sprint* is a repetitive running pattern that includes intervals of sprinting, walking, and jogging in a set of exercises. Sprint training focuses on explosive speed and controlled recovery, while hollow sprint uses a pattern of alternating speed to train running speed and longer durations and with varied breaks. Thus, the goal of sprint training is to increase speed and explosiveness (power), while the goal of hollow sprint training focuses on increasing speed and endurance, by maintaining fatigue.

CONCLUSION

Based on the results of the research and discussion, several conclusions can be drawn as follows. 1) There is an effect of *sprint training* on increasing the explosiveness of leg muscles in Mitra football club players. 2) There is an effect of *hollow sprint training* on increasing the explosiveness of leg muscles in players of the Mitra football club. 3) There is a difference in the effect between *sprint training* and *hollow sprint* training on increasing the explosiveness of leg muscles in Mitra football club players. With the difference in the average score of *the sprint training* group, the increase was better (effective) when compared to *the hollow sprint* training.

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