THE DIFFERENCES IN THE EFFECTS OF PLYOMETRIC TRAINING AND COMPLEX TRAINING ON SPRINT ABILITY VIEWED FROM LEG LENGTH

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Abstract

The Study Purpose: This study purpose was determined: (1) the difference in the effect of plyometric training and complex training on sprint ability, (2) the difference in sprint ability between players with long legs and short legs, (3) the effect of the interaction between training method and leg length on sprint ability.

Material and Method: This study used an experimental method with a 2 x 2 factorial design. The 40 players aged 21.80 ± 2.71 years, height 174.53 ± 6.21 cm, weight = 76.10 ± 5.78 kg participated in this study, grouped into groups based on leg length. Each sample underwent a sprint test measured with a 20m sprint test. Data analysing used two-way ANOVA with a significance level of 5%.

Conclusions: The research results shown that: (1) there is a significant difference in the effect of plyometric training and complex training in improving sprint results. The complex training is better than plyometric training in improving sprint results, (2) there is a significant difference in the effect of long legs and short legs on sprint ability. The players with long legs is better than short legs in sprint results, (3) there is a significant interaction between training methods and leg length on sprint ability. Players who have long legs are suited for complex training. Players who have short legs are suited for plyometric training

Keywords: Plyometric training, Complex training, Sprint, leg length

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Introduction

Futsal is increasingly popular, closely related to football, because it is known as "five-a-side indoor soccer" (Spyrou et al., 2020). Barbero-Alvarez et al (2008), explained that the futsal game required anaerobic strength capacity, although it also required aerobics, because it is played at an intensive tempo. Regarding the need for anaerobic capacity, Yildiz (2012) explains that this capacity arises as a result of physical activity using anaerobic energy transfer from skeletal muscles. Activities such as explosive power actions with workloads that can cause fatigue, so this activity is not possible to carry out for a long period time. Regarding explosive power activities, various activities carried out in futsal matches include jogging, jumping, changing direction, and running in different directions (Makaje et al., 2012). Apart from that, short sprint actions within 17 seconds are also generally performed by futsal athletes (Bradley et al., 2009).

In various sports, the most important motor feature is speed, so it needs to be paid attention (Kartal, 2016). Speed is related to the action of moving with maximum velocity. In futsal matches, players generally reach the 90% level for maximum heartbeat density. This shown that sprint action in futsal matches as a motor characteristic of players (Nascimento et al., 2015). Supporting this, it was reported in a study that better sprint performance was displayed by elite futsal players (Spyrou et al., 2020). Therefore, speed development was needed as a focus of training for futsal athletes to reach the highest level in competition. Stimulus training can be carried out with short sprint activities to meet the demands of the competition.

Regarding competition demands, approximately ~26 sprint actions are performed over a distance of 8–20 m for 2–4 seconds (Spyrou et al., 2020). A competition analysis was reported that the characteristic of futsal are distance of 117.3 m, medium-intensity running (28.5%), high-intensity running (13.7%), and sprinting (8.9%) were included. This means that multiple-sprints are a characteristic of futsal (Barbero-Alvarez et al., 2008). During competition, high speed actions are categorized as maximum speed or acceleration actions for players to move as quickly as possible, for one-on-one duels, to maximize forward and defense, to display better performance of techniques and tactics, to cover the distance of forward and defensive conditions (Göral, 2014).

Futsal achievement coaching, Faculty of Sports, Sebelas Maret University, Surakarta, is an activity to channelling students' talents and interests in futsal. The observations on male athletes from the Futsal achievement coaching, Faculty of Sports, Sebelas Maret University, Surakarta, shown that their sprinting ability is still low, because most male athletes do not run efficiently. The problem is "reaching", which occurs when the athlete's foot passes the opposite knee. The result is that athlete's foot reaches and lands past the center of mass, causing a breaking action. When they run, their feet are over their hips and not directly under them. This means that they are "reaching" and running slower than their capability. Additionally, they put a lot of stress on the hamstrings because the muscles are not working as they should

Based on the explanation above, futsal training should generally include exercises to improve sprinting ability, because futsal is a game that requires sprints (Mănescu, 2018). One exercise that can be applied is plyometric training, a strategy for team sports to improve physical performance, as well as being a safe and effective way to improve jumping, sprinting, and change of direction (Yanci et al., 2017). Branquinho et al (2022) have reported that there was a significant average change between before and after plyometric training, where a 6 week plyometric training program in sub-elite futsal players showed the greatest effect on the 20 meter sprint with a large effect, followed by small and moderate effect for agility and 10 meter sprint.

Markovic & Mikulic (2010) explained that plyometric training combined with other training modalities has potential to improve various athletic performances such as jumping, sprinting, agility and endurance. One of the training combination is plyometric training and strength training, which is called complex training. Lesinski et al (2014) explained that complex training is effective in increasing power, strength and speed. Therefore, Talpey, Young, & Saunders (2016) tried to prescribe this complex training program, i.e. a 9 week program of sets of ½ back squats and jump squats (complex training) compared to sets of jump squats and ½ back squats (conventional training). The results that complex and conventional training program are able to increase jump performance and lower body explosive muscle function. Complex training provided a better increasing in vertical jump performance.

This research shows that complex training is useful for improving lower body explosive muscle function. However, research on complex training for futsal players is still lacking, so we cannot know whether training for 8 weeks also provides the same benefits as previous research. Apart from that, there are also not found studies that compare complex training that combines strength training and plyometric training with plyometric training only. Therefore, it is necessary to conduct research to help futsal coaches optimize sprint training strategies.

Beside considering training methods, leg length is also taken into consideration in improving a futsal player's sprint. Handika, Fikri, & Firlando (2022) reported a significant correlation between leg length and 30 meter sprint speed in futsal players. Toyoshima & Sakurai (2016), explained that the combination of stride length and frequency is a factor that affected maximum sprinting speed kinematics. Based on the research background, it was known that training and leg length have an effect on sprint increasing. The difference between plyometric training and complex training for futsal players' sprints has not been implemented. Therefore, this research was carried out to finding out the differences in the effect of plyometric training and complex training on sprint ability, differences in sprint ability between athletes with long legs and short legs, as well as the interaction between training methods and leg length on sprint ability.

Materials and Method

The 40 male athletes from Futsal achievement coaching, Faculty of Sports, Sebelas Maret University, Surakarta (age = 21.80 ± 2.71 years, height = 174.53 ± 6.21 cm, weight = 76.10 ± 5.78 kg) participated in this research. An experimental method used a 2x2 factorial design. In this study, a 2x2 factor design was used where 2 training method factors and 2 leg length factors. Each training method factor was crossed with the leg length factor. So that there were 4 groups (Group a1b1, namely the plyometric training group with long leg samples, n = 10; Group a2b1 is the complex training group with long leg samples, n = 10; Group a1b2 is the plyometric training group with short leg samples, n = 10; and group a2b2 is complex training with short leg samples, n = 10).

Each sample underwent an exercise program 3 times every week for 8 weeks. The training program was carried out with a circuit concept containing 6-15 posts. Maximum training load 50-75%, 4-6 sets, rest between sets 3-5 minutes, work duration 15-30 seconds, and rest duration for alternating posts 15-60 seconds. The plyometric training consists of:

(1) skipping;

(2) side skipping with big arm swing;

(3) power skipping;

(4) backward skipping;

(5) moving split squats with cycles;

(6) alternate bounding with single-arm action;

(7) alternate bounding with double-arm action;

(8) combination of bounding with single-arm action;

(9) Combination of bounding with double-arm action; and

(10) single-leg bounding.

The complex training consists of:

(1) strength training includes:

(a) front lunge;

(b) walking lunge;

(c) walking lunge unilaterally weighted;

(d) walking lunge with weight crossover; and

(e) walking lunge with unilateral shoulder press.

(2) plyometric training includes:

(a) depth jump: drop and feeze;

(b) single-leg hop;

(c) double-leg hop;

(d) standing triple jump; and

(e) standing triple jump with barrier jump.

The research data is leg length and sprint data. Leg length data was carried out by measuring leg length used a meter. The subject stands upright on a flat floor. The testor feels the outermost bone on the lateral side of the thigh (the greater trochanter), and if the thigh is swung anteriorly or posteriorly it appears prominent (the greater trochanter moves). The testor places the meter directly on the greater trochanter point then pulls the meter to the bottom of the foot (sole of the foot) to an accuracy of 0.1 meter. Leg length is measured from the lower spine or can also be from the trochanter to the floor (sole of the foot) (Gripp, Slavotinek, Hall, & Allanson, 2013). To sprint testing used a 20m sprint test. The test was carried out with a 20 meter sprint with a standing start and 60 seconds of active recovery. Two trials were given and the fastest time was taken for analysis (Abd Rahman & Shaharudin, 2018).

Data analysis used a two-way analysis of variance (ANOVA) at α = 0.05. The assumptions of normally and homogeneous data have been fulfilled. Data analysis was carried out using SPSS 17.

Results

The research results showed that there was an increase in the average sprint speed of futsal players in the plyometric training group with long leg samples, namely 0.898 ± 0.287 seconds. The average increase in sprint speed also occurred in the plyometric training group with short leg, namely 1.014 ± 0.315 seconds. The complex training group also showed an increase in average sprint speed, namely 1.449 ± 0.313 seconds for the complex training group with long leg and 0.916 ± 0.265 for the complex training group with short leg (Table 1). The two-way ANOVA test results shown that there is a difference in the effect of plyometric training and complex training on sprint ability with F value = 5.861, α = 0.021; there is a difference in sprinting ability between athletes who have long and short legs with F value = 4.966, α = 0.032; and there was an interaction between training method and leg length on sprint ability with F value = 12.030, α = 0.001 (Table 2).

Table 1. Sprint Data Description.

Training Program	Group	N	Mean±SD
Plyometric Training	Long legs	10	0.898±0.287
	Short legs	10	1.014±0.315
Complex Training	Long legs	10	1.449±0.313
	Short legs	10	0.916±0.265

Table 2. Two-way Anova test.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2.001	3	0.667	7.619	0
Intercept	45.732	1	45.732	522.462	0
Training	0.513	1	0.513	5.861	0.021
Leg	0.435	1	0.435	4.966	0.032
Training * Leg	1.053	1	1.053	12.03	0.001
Error	3.151	36	0.088		
Total	50.884	40			
Corrected Total	5.152	39			

Discussion

The first hypothesis shown that there is a difference in sprint increase in the two training groups. The complex training group had better sprint results compared to the plyometric training group. This is in accordance with Markovic & Mikulic (2010), complex training which combination of plyometric training and strength training, has more potential to improve various athletic performances such as sprinting. Carter & Greenwood (2014) explain that by implementing complex training, it brings out the properties of the neurological, muscle and/or psychomotor systems to enable individuals to produce more power in the next lighter set, this because complex training can stimulate motor unit excitability, allowing the myofilaments to become more sensitive to calcium and ultimately allowing further power output to be increased.

The second hypothesis shown that there is a difference in sprint increase in the two leg groups. The long legs group had a higher increasing in sprint results than the short legs group. The long legs group has higher potential than players with short legs. Leg length is a modality for sprint training. The longer legs will produce a greater endpoint velocity for a certain angular velocity, apart from that it also affects stride length and stride frequency which are factors in faster maximum sprinting speed kinematics (Toyoshima & Sakurai, 2016).

The third hypothesis shown that there is an interaction between the training group and the leg group and can be seen in Figure 1. The effectiveness of training method in the sprint training is affected by the player's long and short legs. Based on Figure 1, it turns out that players who have long legs with

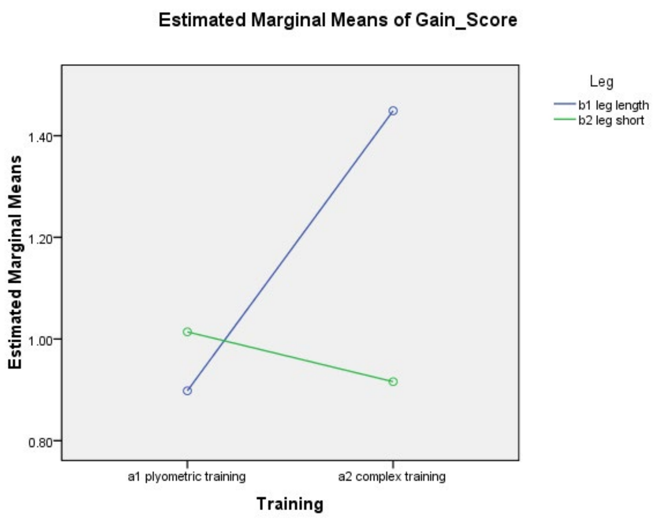

Figure 1. Interaction of training methods and legs.

complex training have an increase in sprint results of 1,449 which is better than long legs players who received plyometric training of 0.898. Meanwhile, players who had short legs with plyometric training had an increase in sprint results of 1.014 which was better than players with short legs who received complex training of 0.916.

Conclusion

Based on the data analysis, it can be concluded that plyometric training and complex training for 8 weeks can improve the sprinting ability of futsal players, where complex training provides a better improvement than plyometric training. Long legs also have a better effect on the sprinting ability of futsal players than short legs. If it was related to the training method and the legs of each player, it shown that there is an interaction between the training method and the leg length on sprinting ability, where players with long legs are more suitable given complex training, while players with short legs are suitable given plyometric training.

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