Combined futsal training: The combination of rotation play training with the HIIT protocol affects anaerobic endurance abilities

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ABSTRACT

A training model that combines physicality and tactics is really needed in futsal. This study aims to analyse the effect of rotation play training with HIIT Protocol on the anaerobic abilities of amateur futsal players. This research uses an experimental method with a two-group pre-test and post-test design. The sample in this study consisted of 30 amateur futsal players with an age of 19.23 ± 0.57 years, height of 165.60 ± 5.63 cm, body mass of 59.17 ± 5.24 kg, and BMI of 21.60 ± 1.93. Samples were divided randomly into an experimental group (EG) and a control group (CG). Data analysis used a Paired Sample T-test and an Independent T-test with a significance level of .05 and used Cohen's ES to measure the magnitude of differences between groups. This study used the running anaerobic sprint test (RAST). The variables in RAST that will be analysed are Peak Power (W); Mean Power (W); Peak Power per Weight (W.kg⁻¹); Mean Power per Weight (W.kg⁻¹); Fatigue Index (%); Total effort time (s). The paired sample t-test resulted in a significant difference in EG with significance values of Peak Power p = .010, Mean Power p = .007, Peak Power per Weight p = .011, Mean Power per Weight p = .008, Fatigue Index p = .045, and total effort time p = .011, while in CG all variables do not have significant differences. The Independent T-test found that there was a significant difference between EG and CG with a significance value of p < .05. This research concludes that the rotation play training model with HIIT Protocol has a positive effect on the anaerobic endurance of amateur futsal players.

Keywords: Performance analysis, Rotation play, High-intensity interval training, Anaerobic, RAST.
INTRODUCTION

Rotation play is one of the important things in the game of futsal. Futsal is an intermittent and dynamic sport that involves fast actions and precise movements based on physical parameters, techniques and tactics (Castagna et al., 2009; Mendes et al., 2022; Naser et al., 2017). Rotation play is used to describe the performance of tactics indicated by variables, space, time or tasks that most determine team cooperation and effectiveness in controlling the ball in the sport of futsal (Garganta, 2009). According to Da Cruz et al. (2020); Ohmuro et al. (2020), futsal is a high-intensity game with a short recovery time and requires sound technical and tactical abilities. For this reason, each player must have good skills to carry out tactics and strategies during the match. Specifically, futsal is characterized by players who are constantly moving and rotating positions because by rotating, the players can damage the opponent's defence and create much space to be utilized to score goals.

Anaerobic endurance is a very important physical component to help players perform rotation play quickly and precisely in futsal games because futsal is a sport that involves high-intensity locomotor activity which requires aerobic and anaerobic fitness in matches (Claus et al., 2017; Ribeiro et al., 2020; Rico-González et al., 2022). There have been several previous studies on futsal physical training, but it has not been combined holistically with technical and tactical training Campos et al. (2021); Soares-Caldeira et al. (2014); training focuses only on the physical Paz-Franco et al. (2017); Teixeira et al. (2019). It cannot be denied that the results of this research have had a positive impact on improving the performance of futsal players. However, if reviewed at tactical needs, where futsal requires structured rotation play. It seems necessary to develop training in a holistic direction, namely combining tactical and physical training in one training model. This is supported by previous research, which found that futsal games have certain organizational patterns Zagatto et al. (2009), both attacking and defending, depending on the match situation (Bueno et al., 2018).

In sports coaching, High-intensity interval training (HIIT) is very popularly used to improve physical abilities, especially anaerobic endurance. Previous research has proven that HIIT has a positive effect on players' anaerobic endurance (Kunz et al., 2019; Yan et al., 2022). If we look at the very high physical demands when doing rotation play, combining rotation play with HIIT is crucial, so it is necessary to scientifically review the impact of combining these exercises so that specific futsal training needs can be achieved. The results of this research can help coaches and players create more targeted training programs that combine the tactical and physical elements required in the game of futsal. This research can also provide valuable insight into how the game of futsal at the amateur level can improve.

MATERIAL AND METHODS

Study participants
A total of 30 male futsal players at amateur futsal clubs participated in this research. He is 19.23 ± 0.57 years old, with a height of 165.60 ± 5.63 cm, a body mass of 59.17 ± 5.24 kg, and a BMI of 21.60 ± 1.93. All samples involved have experience playing in amateur leagues. Then, all samples were divided randomly into an experimental group (EG) and a control group (CG).

Study protocol
The treatment and control groups were given a pre-test to determine their initial anaerobic endurance abilities. Next, the treatment group was given rotation play exercises with HIIT protocol for six weeks with a frequency of three times a week. The control group was not given special treatment but continued to undergo exercise with the same duration and frequency as the treatment group. After six weeks of carrying out the research,
in the final week, the treatment and control groups were given a post-test to determine the difference in anaerobic endurance ability with rotation play training with HIIT protocol. This study used RAST. The variables in RAST that will be analysed are Peak Power (W), Mean Power (W), Peak Power per Weight (W.kg⁻¹), Mean Power per Weight (W.kg⁻¹), Fatigue Index (FI) (peak power – minimum power/peak power) x 100), Total effort time (s) (Zagatto et al., 2009).

**Treatment protocol**

The treatment group is divided into three groups, which will then take turns carrying out rotation play with HIIT Protocol. Group 1 does rotation play with a predetermined movement pattern with an intensity of 90-95% of the maximum heart rate, while groups two and three wait their turn while passing with moderate intensity. Polar verity sense is used to monitor HRmax at a predetermined intensity. The interval used in this treatment is 1:3. Each group does rotation play at high intensity for 2 minutes before taking turns with the next group. In the first and second weeks, each group did eight sets of rotation play, ten sets in the third and fourth weeks, and twelve sets in the fifth and sixth weeks.

**Data analysis**

The data in this study are presented in the form of mean and standard deviation. The prerequisite tests in this study used the normality test and homogeneity test. The normality test uses the Shapiro-Wilk test, and the homogeneity test uses the Levene test. The percentage change (Δ%) between the results before (Pre) and after (Post) during the training period was calculated using the following formula: Δ% = ((Post-Pre)/Pre)*100. Next, the paired sample test was used to see the differences in the averages of each group and the independent sample test was used to compare the differences in the averages of the experimental group and the control group. Statistical significance was set at p < .05. The magnitude of the differences between groups, this study used Cohen's ES. An ES above 0.8 is considered large, between 0.8 and 0.5 is considered moderate, between 0.5 and 0.2 is considered small, and less than 0.2 is considered insignificant (Cohen, 2013).

**RESULTS**

Table 1 above describes the characteristics of the two research sample groups. Furthermore, the normality test carried out using the Shapiro-Wilk test showed that all variables in the EG group and CG group had a normal distribution with a significance value of Sig > .05. The same thing was also found in the homogeneity test using the Levene test, showing a significance result of > .05.

<table>
<thead>
<tr>
<th>Group</th>
<th>Age (year)</th>
<th>Height (cm)</th>
<th>Body Mass (kg)</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>EG</td>
<td>19.00 ± 0.53</td>
<td>163.47 ± 5.38</td>
<td>60.47 ± 4.16</td>
<td>22.65 ± 1.60</td>
</tr>
<tr>
<td>CG</td>
<td>19.47 ± 0.52</td>
<td>167.73 ± 5.19</td>
<td>57.87 ± 6.00</td>
<td>20.55 ± 1.67</td>
</tr>
</tbody>
</table>

*Note. Data are presented as mean ± SD.*

Table 2. The above shows the differences between the EG and CG pre-test and post-test. In the EG group there were significant differences in Peak Power (p = .010, ES = 0.73), Mean Power (p = .007, ES = 0.79), Peak Power per Weight (p = .011, ES = 0.72), Mean Power per Weight (p = .008, ES = 0.77), Fatigue Index (p = .043, ES = 0.55), and Total effort time (p = .011, ES = 0.73). In CG, all variables do not have significant differences.
interval training (HIIT) is a time-saving strategy to increase anaerobic capacity. Therefore, HIIT has become a suitable resistance training method for anaerobically dominant sports such as futsal. Increasing anaerobic endurance is influenced by controlling the contribution of anaerobic energy during training sessions; this is crucial in planning training programs, adjusting training loads, session duration, and its relationship with lactic acid production in muscles, especially after undergoing high-intensity intermittent training (Buchheit & Laursen, 2013). Futsal is a sport that requires good physical condition, especially endurance, because it uses high intensity, so the players need intense training. In the sport of futsal, the intensity used in matches is 75% of playing action, while more than 83% of the rest interval is with a work-to-rest ratio of approximately 1:1, where half of the work is at high intensity, 83% of playing time has been spent above 85% maximum heart rate (HRmax) Amani-Shalamzari et al. (2019); Kunz et al. (2019); Therapy et al. (2011). The findings of this study are in line with research Avar et al. (2019), which states that high-intensity interval training (HIIT) is a time-saving strategy to increase anaerobic capacity. Therefore, HIIT has become a suitable resistance training method for anaerobically dominant sports such as futsal.
Intensive training is a routine that is usually carried out by elite athletes in order to improve their physical condition. HIIT may be useful for restoring body composition and quality of physical fitness. However, to optimize performance, intensive training and proper recovery are needed (Gómez et al., 2023). The effort required by each player depends on several factors, such as physical and individual performance, because every futsal sports training program involves aerobic and anaerobic training (Borges et al., 2022). By using 90%-95% intensity for six weeks, players can experience significant improvements in their anaerobic endurance. Intermittent exercise that achieves ≥90% of maximum heart rate and maximum oxygen uptake (VO\textsubscript{2max}), separated by recovery or rest periods, is an exercise model that is trending towards improving physical condition and fitness (Atakan et al., 2020; Engel & Sperlich, 2014; Faude et al., 2013). High-intensity interval training (HIIT) is defined as a 'near maximal' effort generally performed at an intensity that produces ≥80% (but often 85-95%) of maximal heart rate (Macinnis & Gibala, 2016). The frequency of three times a week is important in this study. It is in line with previous research, which reports that HIIT is effective when performed for three sessions per week for at least six weeks to reduce the phenomenon of negative reactions caused by glycogen depletion, metabolite accumulation in muscles, and neuromuscular tension and so on increasing endurance and athlete performance (Yan et al., 2022).

Anaerobic endurance is continuous with the level of fatigue with a good anaerobic level, it influences the small risk of injury due to fatigue, which results in a decrease in an athlete's performance Güler et al. (2020); Lopes et al. (2019), in line with a significant reduction in the fatigue index of the experimental group who received rotation play training with HIIT Protocol. High-intensity interval training (HIIT) is an effective exercise regimen for improving several physiological parameters important for performance, including cardiometabolic function, oxygen uptake kinetics, strength and anaerobic capacity, ion transport capacity, and muscle fatigue resistance (Hostrup & Bangsbo, 2023).

CONCLUSION

Based on the results of research and discussions about rotation play training with HIIT Protocol, it was concluded that this training method had a positive effect on increasing Peak Power, Mean Power, Peak Power per Weight, Mean Power per Weight, as well as reducing Fatigue Index and Total effort time. Rotation play training with HIIT Protocol can be an alternative physical exercise without eliminating the characteristics of playing futsal.

AUTHOR CONTRIBUTIONS

As-Safa, Kusuma, Pramono conceived and designed the experiments. Syafii, Prianto and Triardhana performed the data collection and analysis. All the authors wrote the paper and approve the final submission.

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DISCLOSURE STATEMENT

No potential conflict of interest were reported by the authors.
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