Effects of an 8-Week Futsal Training Program Based on Circuit Training and Small-Sided Games on Endurance and Passing Technique in Youth Futsal Players Aged 12–15

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ABSTRACT

Background. Futsal is a high-intensity game that requires both physical endurance and technical precision, particularly passing accuracy. Integrating circuit-based training with small-sided games is considered an effective strategy to enhance these aspects simultaneously. **Objectives.** This study aims to evaluate the effect of an 8-week circuit-based futsal training program on endurance capacity (mL/kg) and passing accuracy among novice futsal athletes. **Methods.** A total of 60 novice futsal players (aged 12–15 years) participated in this experimental study, divided into two groups: Group A received small-sided games training, while Group B received combined circuit and small-sided games training. The intervention lasted 8 weeks, 3 sessions per week, with each session lasting 90 minutes at moderate-to-high intensity (65–85% HRmax). Endurance was assessed using the multistage fitness test (mL/kg), and passing was evaluated through a standardized passing accuracy test. Data were analyzed with paired and independent sample t-tests, and effect sizes were calculated. **Results.** Group A showed significant improvements in endurance (Δ +6.2%, dz = 1.69) and passing accuracy (Δ +28.1%, dz = 1.83). Group B demonstrated larger gains in endurance (Δ +18.3%, dz = 1.24) and passing accuracy (Δ +34.5%, dz = 2.01). Between-group analysis confirmed that the combined program was more effective ($p < .001$). **Conclusion.** An 8-week futsal training program integrating circuit training and small-sided games produced large-to-very-large improvements in both endurance and passing performance. This approach is recommended as a targeted intervention for developing physical capacity and technical skills in young futsal athletes.

Keywords: Futsal, Endurance, Passing Accuracy, Circuit Training, Small-Sided Games

INTRODUCTION

Futsal is a game that requires technical, tactical and physical qualities (1) (2). Futsal is a high-intensity sport (3), concerning average total distance, recent studies showed values of 3060 m, 3868 m and 3749m in the Spanish and Portuguese leagues (4). The average total distance in this study is 3728 ± 1152 m (5). Futsal is an intermittent activity characterised by short Altogether it has been considered high intensity conducts of 2–3 s with low intensity work in between (6), as players must be able to withstand the high physiological demands of the game throughout the entirety of the match. The intensity and rhythm of the game are high and do not diminish as the games progress (7), futsal Athletes needs to have rapid recovery from high-intensity exercise (8). Futsal is a sport which high-intensity physical exertion is present in two 20-min periods of competition (9). An athlete's aerobic capacity plays the major part for the success of this game because it plays an important role during the recovery (10)

that enables delayed appearance of fatigue, permitting high intensity play to be sustained throughout the game (11).

The involvement of HFT increases the physical demands of the practice with effects on the technical and tactical aspects that may be less than desired when a futsal player has a low level of physical conditioning (12). In terms of skill qualities, passing is also the most determinant factor of a team success in term of chance creation and goal scored (13). Dribbling is important in setting up, starting an attack, maintaining the rhythm of game and, when to kick the ball (14). Pass is the decisive technique of match that makes distinction, if the pass technique of each player is good, it is easier that a team wins in the competition than loses (15). The work made by (14) has provided the average passing distance for short passes is 3.58 meters, the mean value for medium passes is 7.46 meters and for long pass is14.47 meters (16). Passing technique training in futsal is a fundamental component in developing young players' skills. Several studies have emphasized the importance of passing performance within the game context (17), including aspects such as passing distance and decision-making under pressure. However, many training approaches still treat physical conditioning and technical skill development as separate domains, often overlooking psychological aspects such as player engagement and motivation.

The training methods incorporating game-based elements such as small-sided games (SSG) and circuit training can simultaneously improve physical endurance and technical performance (18,19). Nonetheless, most of this research has focused on elite or adult players, with limited investigation into the effectiveness of such integrated training programs for youth futsal players aged 12–15. In amateur or youth-level futsal coaching, training programs often become monotonous and repetitive, reducing player motivation and engagement. This lack of variety can hinder improvements in both endurance and technical skill, ultimately affecting overall team performance.

Due to the large number of studies that have examined the games-based approach within futsal training programmes, it has proven to be considered an interesting alternative to enhance motivation of players. There is small-sided games-based training also contributes to improvement in passing, dribbling and shooting technique (20). Small-sided game (SSG) is also regularly used to develop the technical and tactical aspects of the player and, therefore, to offer a time-effective way to train the players physical fitness (21).

Games based training includes elements of competition, teamwork and imitation of specific aspects of the real game. It makes learning more enjoyable while players develop their physical and technical skills at the same time as they are applied in a suitable game situation. Hence this is proved to be superior when compared to the traditional manner of training where physical and technical training is taught separately.

Previous research has shown that both small-sided games (SSG) and circuit training independently improve physical and technical performance in football and futsal. However, the combination of these two methods offers a more comprehensive approach by simultaneously targeting endurance, strength, and technical skills in game-like situations. Unlike traditional drills or high-intensity interval training (HIIT), this combined approach not only builds fitness but also develops decision-making and passing under pressure skills that are critical in futsal. Recent studies support the use of integrated training methods to enhance match-specific performance (22,23). Despite its potential, little research has focused on combining circuit and game-based training specifically for futsal. This study aims to fill that gap and provide practical insights for coaches working with youth players, where maximizing limited training time is essential for long-term development (24). Circuit training-based training is designed to combine several forms of exercise in one series so that physical and technical elements can be improved intensively by selecting a series of movements that can be determined according to the training objectives (25)(26). Futsal requires players to have both

strong endurance and accurate passing due to the game's high intensity and confined playing space. While circuit training is effective for improving physical fitness, and small-sided games (SSG) enhance technical and tactical skills under pressure, few studies have explored the combined effect of these methods—especially in futsal. Compared to traditional drills or HIIT, combining circuit training and SSG offers a more integrated approach, developing both physical and technical abilities simultaneously. Despite the potential benefits, research on this combination in futsal remains limited, particularly regarding its impact on endurance and passing skills. This study aims to address this gap and provide practical insights for coaches seeking efficient training strategies that reflect real-game demand.

MATERIAL & METHODS

Study design. This study employed a quasi-experimental design with a two-group pre-test and post-test approach to investigate the effects of different training interventions on endurance and passing ability in youth futsal players. Participants were randomly assigned to one of two groups. Group A underwent training based solely on small-sided games (SSG), while Group B followed a combined program of circuit training and SSG. Although both groups received active training interventions, the study did not include a pure control group, which limits the ability to attribute observed improvements exclusively to the interventions. This limitation is acknowledged and discussed. To minimize bias, outcome assessors were blinded to the group assignments during testing.

Participants. Sixty non-elite male futsal players aged between 12 and 15 years participated in the study. Group A consisted of 30 players with a mean age of 13.6 ± 1.2 years, average weight of 41.8 ± 6.5 kg, and average height of 153.6 ± 5.1 cm. Group B included 30 players with a mean age of 13.1 ± 1.3 years, average weight of 43.4 ± 5.4 kg, and average height of 152.1 ± 4.6 cm. In addition to basic demographic data, participants' training experience averaging 2 to 3 years of recreational futsal practice and baseline fitness levels, assessed by pre-intervention VO_2max estimation, were recorded. All participants were medically cleared to participate and free from injury.

Measurements. The training program lasted eight weeks, with three sessions per week, each approximately 90 minutes in duration. Each session began with a 10-minute warm-up consisting of dynamic stretching and agility ladder drills. Group A then engaged in 60 minutes of small-sided games focusing on 3v3 and 4v4 formats designed to improve passing accuracy, spatial awareness, and decision-making under pressure. Group B followed a combined approach, beginning with 30 minutes of circuit training featuring six stations targeting aerobic endurance, agility, and core strength. Each station involved 30 seconds of high-intensity work followed by 30 seconds of rest, repeated for two to three rounds. After the circuit, Group B completed 30 minutes of the same small-sided games drills as Group A. Both groups concluded training with 15 minutes of small match play in 5v5 or 6v6 formats to simulate realistic game conditions, followed by a 5-minute cool-down involving light jogging and static stretching. The training intensity was progressively increased weekly by adjusting circuit rounds, reducing rest times, and enhancing the tactical complexity and duration of the game.

Endurance was measured using the Multistage Fitness Test (Beep Test), a widely accepted field test for estimating VO_2max. The test was conducted according to standardized protocols with incremental running speeds until exhaustion. Passing ability was assessed using a standardized futsal passing test that evaluated accuracy and consistency by requiring players to pass the ball to designated targets under timed conditions. Both tests were administered before and after the intervention by assessors blinded to group allocation.

Statistical analyses. Data analysis was performed using SPSS software. Prior to analysis, data normality was assessed using the Kolmogorov–Smirnov test and homogeneity

of variances was checked using Levene's test. Descriptive statistics were reported as mean ± standard deviation. Paired-sample t-tests were used to compare pre- and post-intervention results within each group. To further quantify the magnitude of changes, effect sizes (Cohen's d) and 95% confidence intervals were calculated. Statistical significance was set at $p < 0.05$.

RESULTS

According to the descriptive statistics of pretest and posttest scores, the mean and standard deviation of the pretest for endurance score is Group A 27.57 ± 1.21 and for passing technique plays is 28.5 ± 3.09 and Group B 27.83 ± 1.21 and for passing technique plays is 28.3 ± 2.8 while before the exercise game based training programs in 30 persons. The average and standard deviation of endurance Group A (29.28 ± 1.62) and the passing technique (36.5 ± 7.09) and endurance Group B (32.9 ± 2.8) and the passing technique (38.1 ± 2.64) significantly increased after the intervention circuit and games based training programme, for more details, see Table 1 and Table 2. This implies that there might be beneficial effects of these training programmes on endurance and passing ability in futsal. The higher mean score obtained on the Posttest reflects continuous improvement after the exercise intervention, but repeated hypothesis testing is required to determine the statistical significance of this improvement. The findings of this study indicated that combined circuit and games-based futsal training may be effective to enhance the endurance and passing performance of futsal players between the ages of 12 and 15 years.

Table 1. Statistical results Results of statistical computation Group A and B.

Group	Outcome	n	Pre Mean	Pre SD	Post Mean	Post SD
Group A	Endurance (mL/kg)	30	27.57	1.21	29.28	16.2
Group A	Passing (score)	30	28.5	3.09	36.5	7.09
Group B	Endurance (mL/kg)	30	27.83	1211	32.9	2.8
Group B	Passing (score)	30	28.33	2.8	38.1	2.64

Table 2. Paired Samples Test

Group	Outcome	Test	Correlation	Sig.	Cohen's dz	Hedges' g_av
Group A Small-sided games	Endurance	Pre-test Post-test	0.782	0.000	1.69	1.36
	Passing	Pre-test Post-test	0.858	0.000	1.83	1.25
Group B Circuit + Small-sided games	Endurance	Pre-test Post-test	0.893	0.000	1.24	2.09
	Passing	Pre-test Post-test	0.494	0.000	2.01	3.56

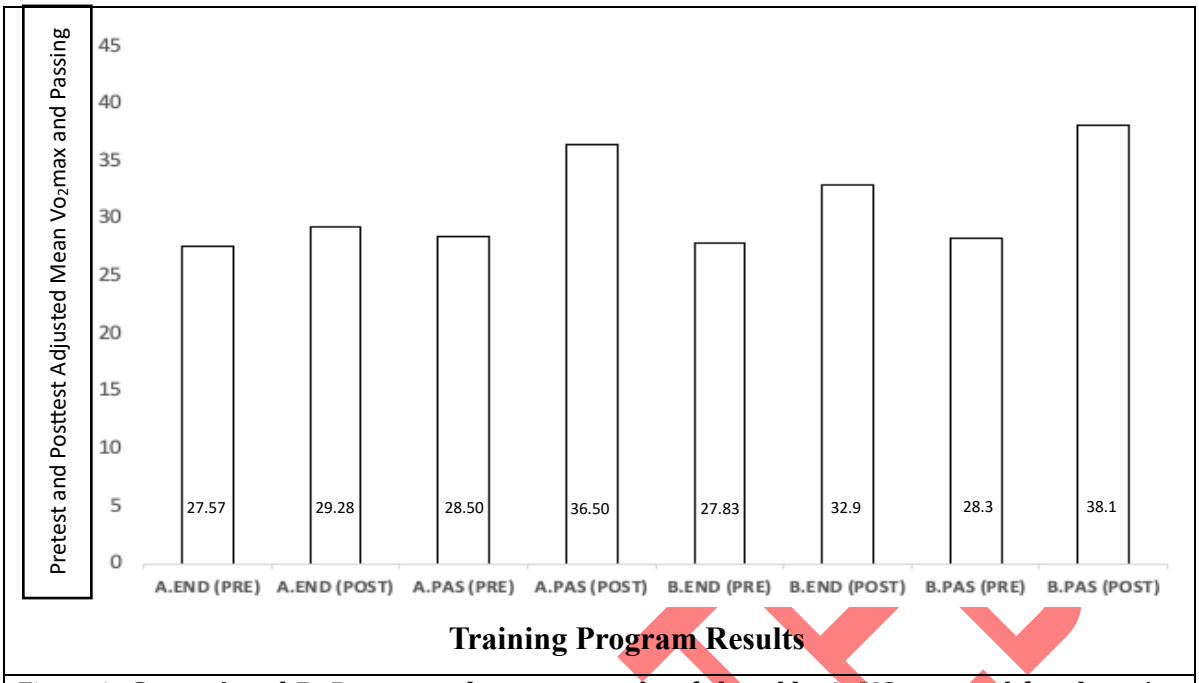

Figure 1. **Group A and B. Pre-test and post-test results of the athlete's VO_2max and futsal passing variables.** A.END (PRE): Group A Endurance pre-test. A.END (POST): Group A Endurance Posttest. A.PAS (PRE): Group A Passing Pre-test. A.PAS (POST): Group A Passing Posttest. B.END (PRE): Group B Endurance pre-test. B.END (POST): Group B Endurance Posttest. B.PAS (PRE): Group B Passing Pre-test. B.PAS (POST): Group B Passing Posttest. The picture explains the comparison results of the increase in pre-test and post-test results for the VO2max and passing variables from Group A (small sided games) and Group B (circuit and small sided games training).

The results of the research in group A, Independent Sample T-Test through SPSS application. 26 The Sig value is feasible according to the table 3. (2-tailed) = 0.000 < 0.05 then it can be said that there is a mean difference between pre-test and posttest of endurance and pass techniques in futsal players. The average change in the pre- and post-test is then (endurance 1.717) and (passing technique 8.000). According to the t column, the t value of endurance can achieved on 9.266 and passing technique 10.048. The results of the research in group B, Independent Sample T-Test through SPSS application. 26 The Sig value is feasible according to the table 3. (2-tailed) = 0.000 < 0.05 then it can be said that there is a mean difference between pre-test and posttest of endurance and pass techniques in futsal players. The average change in the pre- and post-test is then (endurance 5.080) and (passing technique 9.800). According to the t column, the t value of endurance can achieved on 6.766 and passing technique 11.008.

Based on table 3, Group A's endurance is 1.717 < 5,080 Group B's endurance. Group A's passing is 8.000 < 9.800 Group B's passing, thus the improvement obtained by group B (circuit training and small games) shows better results compared to group A (small game training). From these results, we can infer that it is a training intervention that improves endurance and pass technique. The suggestion fromthese findings is that the use of specific and systematic training is key to increasing the technical skill level of futsal players in the discipline of futsal sport. Data from the second study also corroborate the initial hypothesis that the circuit and games-based training can have a substantial effect on futsal endurance and passing task demands, consistent with futsal research described in the research aims.

Based on table 1, the data displayed is the average and highest score between the pre-test and post-test from group A and group B, using endurance and passing techniques as

variables. Results It can be seen that there is a remarkable improvement from this research, in group A the data shows that the average endurance value which was previously 27.57 has now become 29.28 and then in the passing technique variable the average has decreased from 28.5 to 36.5. The results obtained from group b show that the average endurance value which was previously 27.83 has now become 32.9 and then in the passing technique variable the average has decreased from 28.3 to 38.1. From this research it can be concluded that passing skills experienced a greater improvement compared to the endurance of players from group A and group B.

DISCUSSION

The results of the research in group A, there was a real increase in endurance and futsal passing technique with an average increase of 1.717 ml/kg and 8.000. Emphasizing the findings revealed an increase of 7.6417 ml/kg for athletes aged 18-20 years on the SSG training program method (27). The results of the research in group B, there was a real increase in endurance and futsal passing technique with an average increase of 5.080 ml/kg and 9.800. While these participants received a different game treatment to the one delivered in the present investigation, the load and volume were still low, and all exercises were performed at maximal velocity. It is clear that training load suitable for the age of the futsal players becomes a controlling factor in enhancing the endurace of futsal players aged 12-15 years in the beginner category. The findings in the present study show that is possible to induce a major improvement in various physical performance variables of male 12-15 year old futsal players by using relatively low to moderate loads and conducting a large number of repetitions in each set with maximum execution velocity.

Findings of multiple investigations about impact of different training modalities on endurance and futsal passing techniques are contentious. These discrepancies are probably due to certain methodological aspects; the experimental groups are of different age, the basic physical fitness is different, the training programs vary, their duration and the inadequate dietary control, as well as the seasons of the year. Thus, it is not easy to compare results among studies and determine an overall relationship between the mode of training applied and the final effect of an exercise program. The 8 week games based training programme utilized in our trial was effective for weight loss, endurance and passing skill.

This study showed that combining circuit training with small-sided games significantly improved endurance and passing skills in 12–15-year-old futsal players. These improvements align with previous findings, though the current study used moderate training loads, suggesting age-appropriate training can be effective. Aerobic gains likely resulted from the continuous high-effort circuit training, while passing improvements stemmed from repeated execution under game-like pressure. However, the absence of a control group, small sample size, and lack of control over external factors are important limitations. Variability in previous studies may be due to differences in age, training duration, and design, making direct comparisons difficult. Future studies should include control groups and larger samples to better isolate training effects.

The total running performance can be between 3000 and 4000 m in several professional leagues (28). Obtaining results from the player's time was 37.10 ± 13.60 minutes and the total distance was 3375 ± 1139 m (29). Futsal players' endurance are available to be enhanced by different training programs and one of them is small-sided games. This training modality could improve the aerobic capacity of futsal players (27) and develop basic futsal skills in passing, control, and shooting (30). Smallsided games induce higher values of total acceleration in comparison with conventional drills (31).

Other researchers reported that different training models would help improve endurance and futsal technique, while training with eccentric loads improves the performance of futsal players as well (32). Circuit and Fartlek training enhances the aerobic endurance of Teenage Futsal Players (33). Indeed, the present study found that six weeks of resistance training comprised exclusively of squats at low loads and low volume induced significant enhancements in SPrinting abilities, jumping performance, strength, intermittent and ball kicking and cardiovascular endurance (34).

Thus, the 8-week neuromuscular training including PAP induction contributes to acute and chronic enhancement of strength, and the protocol can be used as alternative and efficient method for sports enhancement (5). The purpose of this study was to examine the effects of SSG performed with HIIT on anaerobic endurance in student futsal players. The training was performed during 1 month and 2 weeks, 3 sessions per week and followed the prin- cipals of training and progression of load on weekly basis (35). Endurance has a direct effect in improving the way you pass. Players with good endurance will stay focused and execute passes until the final seconds of the game. A combined circuit and game-based method, where you are taught both things at once, will produce more holistic results than just training one thing.

The findings of this study provide practical insights for futsal coaches working with young players. Based on the results, coaches can structure training sessions by incorporating small-sided games (SSG) that emphasize high-intensity efforts and rapid decision-making. A recommended structure could include 3-4 SSG sessions per week, each lasting 30-45 minutes, with a focus on maintaining maximal execution velocity and limited rest between repetitions. Additionally, coaches should aim for progressive increases in intensity throughout the 8-week training program, starting with moderate-intensity sessions and gradually introducing more challenging drills to further improve aerobic capacity and passing technique. These training methods offer a practical and effective approach for enhancing the endurance and technical skills of young futsal players

CONCLUSION

The combination of using circuit training methods and small-sided games in physical training can provide a significant increase in the aerobic capacity of futsal players, which also contributes to performance and physical endurance during matches. Apart from that, the athlete's passing technique has also improved significantly. Good passing techniques will enable the team to build attacks when competing. Additionally, improved Vo_2Max means players are able to maintain their best performance throughout the game, reducing fatigue and injury. These findings support the relevance of variety and good training planning with futsal training programs, to improve aerobic endurance and overall technical performance in training. The findings from our study will allow strength and conditioning specialists to prescribe individualized exercises to elicit appropriate physiological responses (adaptations) according to the physical demands a player faces per exchange rotation in the game.

Based on the results of this study, it can be concluded that the 8-week small-sided game (SSG) training program significantly improved aerobic capacity (VO2max) and futsal passing technique among young players aged 12-15 years. These findings support the idea that training methods focusing on both endurance and technical skills can lead to measurable performance improvements. However, further research is needed to explore the impact of such training on other variables, such as fatigue and injury prevention, as these aspects were not measured in this study.

APPLICABLE REMARKS

Results suggest that a structured learning, circuit and game-based training program using futsal is able to improve both endurance and passing velocity and accuracy in young futsal players, and therefore could be a useful tool for coaches involved in skill development in a period of intensive development in adolescent players.

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CONFLICT OF INTEREST

Conflict of interest statement The authors declare no conflict of interest.

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ETHICAL CONSIDERATION

(a) Informed consent was obtained from all patients for the inclusion in the report, (b) reported research has been performed in compliance with the institution's human research committee, and (c) the study protocol complies with the ethical guidelines of the 1975 declaration of Helsinki as reflected in a priori approval by the institution's human research committee.

ROLE OF THE SPONSOR

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USE OF ARTIFICIAL INTELLIGENCE (AI).

It did not use either past or AI-assisted tools in this research.

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