University of Macau
Faculty of Education

Master of Philosophy (Physical Education and Sport Studies)

The Effects of Yo-Yo Intermittent Recovery Test With Ball and Small-Sided Games (SSG) on Exercise Performance and Enjoyment in Adolescent Soccer Players

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Chapter 1 Introduction

1.1 Research Background

Football, as the most popular sport in the world, requires high athletic capacity. During a 90-minutes match, athletes must repeatedly perform high-intensity actions like prolonged running, sprints and decelerations (Jimenez-Iglesias et al., 2024). Simultaneously, they must execute technical skills like dribbling and passing under fatigue, which shows the need of training methods develop not only conditioning but also technical skills for players. However, conventional training programs often fail to combine these components efficiently, resulting in limited transfer to match performance (Akdoğan et al., 2021). This gap is vital during puberty — a key developmental period for a youth soccer player, in which athletes gain dramatically in strength, speed, endurance and skills under the scientific conditioning (Badenhorst, 2017; McBurnie et al., 2021). Therefore, it is crucial to find training strategies that can enhance both physical capacities and sport-specific skills.

Small-sided games (SSGs) seem to be a potential solution for integrating fitness and technical skills, has been widely used by soccer coaches during the last decade. SSGs require players execute passing, dribbling and shooting by simulating dynamic match in smaller pitches, thereby enhancing technical skills and maintaining physical capacities (Badenhorst, 2017; F. M. Clemente et al., 2023). Furthermore, their game-based design might be more attractive and enjoyable than traditional protocols for adolescents (Los Arcos et al., 2015). Despite of these advantages, SSGs may prioritize technical skills and anaerobic fitness like explosive power and agility over aerobic fitness (Thapa et al., 2023; Wen et al., 2024). Current evidence seems controversial: some researches demonstrated comparable endurance improvements between SSGs and traditional training, others suggest better promotion from

conventional aerobic training (Eniseler et al., 2017; Jastrzebski et al., 2014; Moran et al., 2019). Thus, the effectiveness of SSG in enhancing aerobic fitness requires further examination, and a more comprehensive training protocol should be developed.

To address the technical and physical deficit in SSGs and conventional conditioning, we develop a new sport-specific protocol: Yo-Yo with Ball Training. The original Yo-Yo Intermittent Recovery 1 (Yo-Yo IR1) was primarily designed to assess repeated sprint ability, has been demonstrated strong correlations with soccer athletes' aerobic and anaerobic capacities (Grgic et al., 2019). Moreover, when implementing this 40m increasing speed shuttle run as a high-intensity interval training (HIIT) tool , it could greatly improve individuals' aerobic and anaerobic performance (Delahunt et al., 2013).

However, traditional Yo-Yo protocol lacks the combination of physical and technical stimuli. While simulating real-match movements, like shuttle run involving acceleration, deceleration and 180° turns, they neglect ball-control skills, like dribbling and shielding, a critical factor of selecting talented and predicting match performance (Fuhre et al., 2022; Haroune et al., 2024). Crucially, previous research indicates that dribbling combined with interval training boost both aerobic capacity and anaerobic power (McMillan et al., 2005). By integrating ball dribbling into each shuttle run phase, the modified Yo-Yo protocol could enhance explosive power, physical endurance, change of direction and the stability of dribbling of youth soccer players simultaneously. This approach may not only not only promote physical capacities but also trains sport-specific skills. Considering this area lacks research, the further investigation is required.

1.2 Purpose of the Study

This study aims to investigate the differential effects of three training protocols:

traditional Yo-Yo intermittent training, ball-dribbled Yo-Yo intermittent training, and small-sided games (SSGs) on aerobic capacity, anaerobic and soccer-specific performance in adolescent soccer players following a 4-week intervention.

1.3 Research Questions of the Study

Q1: How do 4-week interventions of traditional Yo-Yo training, ball-dribble integrated Yo-Yo training, and small-sided games (SSGs) influence aerobic capacity in adolescent soccer players?

Q2: How do 4-week interventions of traditional Yo-Yo training, ball-dribble integrated Yo-Yo training, and small-sided games (SSGs) influence anaerobic performance in adolescent soccer players?

Q3: Are there between-group differences in the improvements across aerobic, capacities?

Q4: Are there between-group differences in the improvements across anaerobic capacities?

1.4 Hypothesis of the Study

H1: The aerobic capacity of adolescent soccer players will improve following a 4-week intervention.

H2: The anaerobic performance of adolescent soccer players will improve following a 4-week intervention.

H3: Aerobic adaptations will be equivalent between traditional Yo-Yo and ball-dribble Yo-Yo groups, with both superior to SSGs.

H4: Anaerobic performance will be equivalent between ball-dribble Yo-Yo and SSGs groups, with both superior to traditional Yo-Yo.

Chapter 2 Literature Review

2.1 The Athletic Demands of Soccer Player

Modern soccer demands that players perform frequent high-intensity efforts—such as sprinting, turning, and rapid accelerations—interspersed with periods of lower-intensity activity. These actions vary according to match context and playing position. For instance, midfielders and wide attackers typically perform more high-speed runs than defenders or goalkeepers (Jerome et al., 2024; Sarmento et al., 2024). Although most existing studies focus on adult athletes, similar positional differences are observable in youth soccer players (Gil et al., 2007).

Adolescence is a period of rapid physical development. During puberty, boys experience substantial gains in height, strength, aerobic capacity, and muscular coordination. However, these gains do not occur uniformly and may temporarily disrupt motor control, increasing injury risk (Ribeiro et al., 2024). Therefore, the design of youth training programs must account for both the physiological demands of soccer and the biological variability among athletes.

2.2 Effects of Small-sided Games on Athletic Performance

Small-sided games (SSGs) have become a widely adopted training method in soccer, due to their ability to integrate physical, tactical, and technical demands in a game-representative environment (Halouani et al., 2014). Played on reduced pitch sizes with fewer players, SSGs simulate match situations that require frequent decision-making, ball-handling, and high-intensity efforts over short bursts, making them an effective method for improving agility, speed, and anaerobic power (F. Clemente et al., 2022; Thapa et al., 2023).

Recent randomized controlled trails have provided strong evidence of their efficiency. A study showed that that six weeks of 4v4 SSG training produced

significant improvements in VO_2 max and CMJ height in adolescent players, superior to traditional interval running protocols (Los Arcos et al., 2015). Similarly, a large-scale meta-analysis confirmed that SSGs can match the effects of traditional continuous running on aerobic performance, especially when game formats are properly structured to maintain high intensity (Moran et al., 2019).

However, the effectiveness of SSGs on aerobic development can vary depending on design variables such as pitch size, player numbers, and rest ratios. Research noted that these parameters must be carefully manipulated to ensure the physiological demands are sufficient for aerobic adaptation (Cherni et al., 2025).

In summary, SSGs is a powerful training tool for youth soccer, capable of simultaneously developing physical fitness and sport-specific skills. However, to optimize outcomes—particularly in aerobic conditioning—coaches should adjust SSG variables according to the developmental needs of the players and the targeted physical qualities.

2.3 Effects of Yo-Yo Intermittent Recovery on Athletic Performance

The Yo-Yo Intermittent Recovery Test Level 1 (Yo-Yo IR1) is one of the most widely used tools for assessing and developing soccer-specific endurance (Grgic et al., 2019). Designed to mimic the stop-start demands of competitive play, Yo-Yo IR1 consists of progressively faster shuttle runs interspersed with brief recovery periods, making it suitable for not only evaluation but also high-intensity interval training (HIIT).Studies have indicates its effectiveness in improving both aerobic and anaerobic capacities (Delahunt et al., 2013). However, despite its strong physiological basis, the use of Yo-Yo IR1 as a systematic training intervention remains relatively rare in empirical research.

High-intensity interval training (HIIT), on the other hand, has been extensively studied and validated as a highly effective approach to enhance endurance and

repeated sprint ability in soccer players. Meta-analyses have consistently shown that HIIT interventions produce significant improvements in VO_2 max, lactate threshold, and anaerobic performance in both youth and adult soccer populations, often outperforming moderate-intensity continuous training (Manuel Clemente et al., 2021).

Given that the Yo-Yo IR1 protocol is structurally a standardized shuttle-based HIIT format, its physiological effects can be reasonably inferred from the broader HIIT literature. The repeated accelerations, decelerations, and recovery intervals inherent to Yo-Yo IR1 align with the principles of effective HIIT, supporting its use as a time-efficient and sport-specific conditioning method. This provides a strong rationale for its inclusion in youth soccer training programs, even in the absence of extensive Yo-Yo-specific intervention trials.

Despite these benefits, traditional Yo-Yo protocols lack technical integration. The running patterns simulate match movement, but they do not include ball-handling or decision-making elements, which are essential to match performance. Emerging research highlights that integrating technical actions into physical training can lead to greater improvements in game-relevant performance variables, such as dribbling stability and reactive agility (Eraslan et al., 2025; Sun et al., 2022).

To address this research gap, ball-dribbled Yo-Yo intermittent training becomes a potential solution. Though lack of investigation, related research supports the idea that combining technical skills with interval training can enhance both anaerobic power and technical execution (Karahan, 2012).

2.4 Summary

This chapter has reviewed the athletic demands of adolescent soccer players and the effects of various training interventions. Youth players' athletic performance

depends on a balance of aerobic endurance, anaerobic power, and technical proficiency, all of which undergo significant development during adolescence. Small-sided games could enhance technical and anaerobic qualities, though their aerobic impact may vary depending on format and intensity. Conversely, the Yo-Yo Intermittent Recovery protocol demonstrates strong potential for improving endurance through high-intensity interval training, but it lacks integration of sport-specific technical skills.

To bridge the gap between physical conditioning and technical development, emerging modifications such as incorporating ball-dribbling into interval-based training have been suggested. This approach may offer a more holistic training stimulus by simultaneously targeting aerobic, anaerobic, and technical domains. However, further research is needed to evaluate the effectiveness and practicality of such hybrid protocols, particularly in youth development contexts.

Chapter 3 Research Methodology

3.1 Participants

Participants should be recruited from middle school soccer teams. Participants shall fulfill all the following inclusion criteria to be included in the study: (1) be aged between 13and 18 years; (2) have received at least one year of formal football training; (3) have no history of major sports-related injuries; (4) be in good general health, without smoking or alcohol consumption habits; and (5) have no known psychological or psychiatric disorders that may affect participation; (6)have not participated in any similar intervention within the past year; (7) attend the training sessions regularly. participants should be excluded according to follow criteria: 1.are outside the age range of 13–18 years; 2.have less than one year of formal football training experience; 3.have a history of major sports-related injuries; 4.have chronic diseases or unhealthy habits such as smoking or alcohol consumption; 5.have known psychological or psychiatric disorders that may affect participation; 6.have participated in similar training interventions within the past year; 7.fail to attend at least 75% of the 12 training sessions.

The required sample size was calculated using G*Power 3.1 software based on a repeated-measures ANOVA (within-between interaction). The average effect size (f) was set at 0.25 (Cherni et al., 2025; Li et al., 2022), with a significance level of 0.05, and the desired statistical power of 0.80 achieved. The calculations indicated that a minimum of 42 participants are required in total, considering the 20% dropout, at least 50 participants should be recruited at the screening session.

The experimental procedures will be explained to participants and their parents at the screening-baseline. Before data collection, the written informed consent should also be provided. During the study, the participants will all attend regular schools and

football trainings. This research should receive approval from the Ethics Committee of University of Macau.

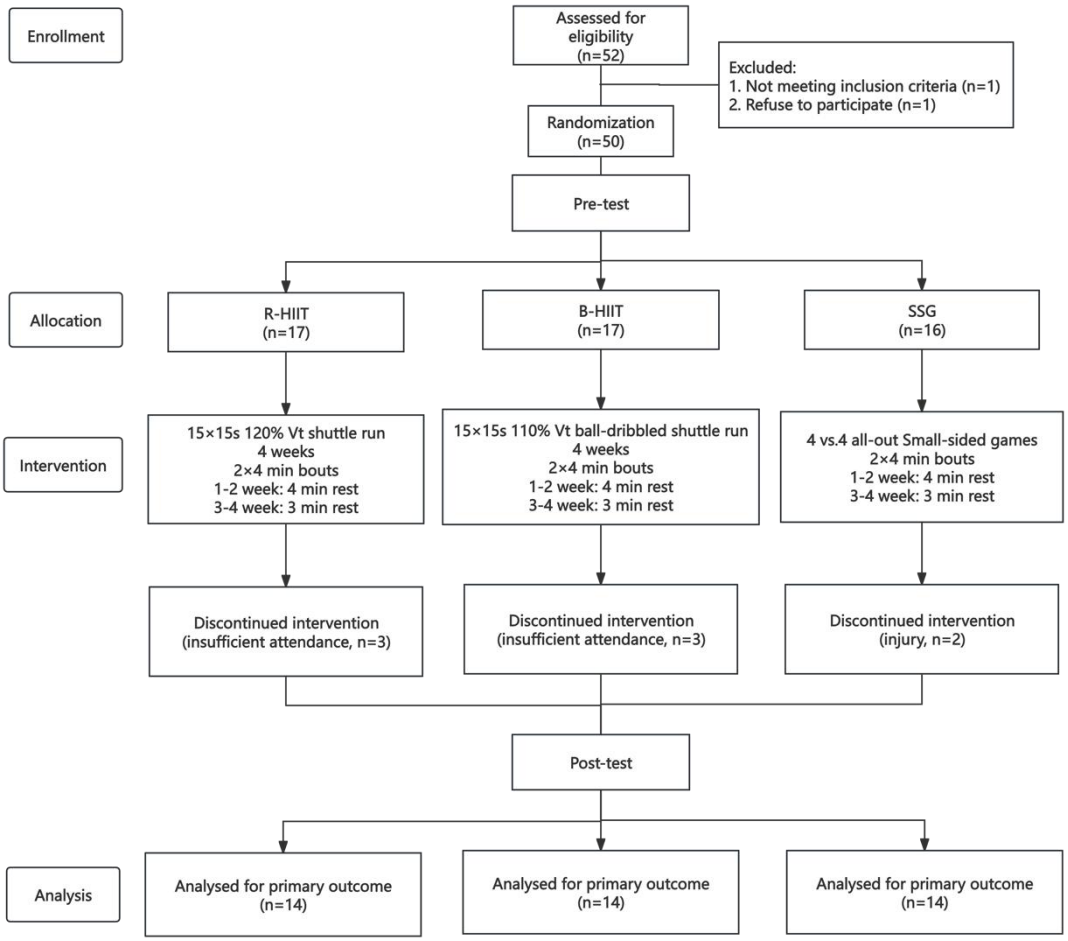
3.2 Study Design and Procedures

This is a randomized controlled trial (RCT) that employs an experimental mixed design where group (traditional Yo-Yo, ball-dribbled Yo-Yo, SSGs) serves as a between-subject factor, while time (pre, post) functions as a within-subject factor. The participants will be randomly assigned to one of the groups: the traditional Yo-Yo group, the ball-dribbled group, SSGs group utilizing computer-based random sorting and grouping, where each participant will receive a number and will then be randomly placed into one of the four groups using Research Randomize ((Karahan, 2012; Shaw et al., 2019) When randomly grouping, the researcher in charge does not participate in the pre- and post-tests.

This research will utilize a non-blinded grouping randomization. The recruited participants who achieve the inclusion criteria will firstly be numbered in sequence then randomly allocated to one of the four groups. Secondly, all participants should experience the baseline testing within 2-weeks before the intervention. The anthropometric parameters, aerobic and anaerobic abilities will be assessed during this stage. The anthropometric indexes and one anaerobic assessment (Wingate Anaerobic Test) will be conducted in kinesiology Laboratory, University of Macau. The aerobic ability and the other anaerobic assessment (Sprint test and Repeated Sprint Ability test) will take place in the playground of a middle school. Then, the intervention will last for four weeks, with 3 training session per week, 12 sessions in total, which will take place in the playground of a middle school. Finally, the post-test stage, all the measurements conducted in the pre-test should be completed within 1-week following the last training session. During the pre- and post-test period, the researchers involved in the test were not informed of the intervention

groups of the subjects.All the procedures are shown in the flow chart as follows (figure 1).

Figure 1 *Study Flowchart*



3.3 Intervention

Participants will receive traditional Yo-Yo training, ball-dribbled Yo-Yo training, SSGs training respectively. The intervention will last for 4-weeks, with 3 training sessions a week. These interventions will perform as regimens at the same time into the whole training. The first 2-weeks training consists of 2 sets 4-minutes exercise and a 4-minutes passive rest. During the last 2-weeks, the rest between exercise will be reduced to 3-minutes. While training, all the participants should

wear a heart rate belt (Verity Sensebi, Polar, Finland) to monitor the training intensity. Heart rate and RPE will be recorded before, during and after the training.

The Yo-Yo Intermittent Recovery 1 protocol will be implemented as a training tool. Participants should perform 4-minutes repeated 20-meter shuttle runs between two parallel lines, with running pace controlled by standardized audio cues, followed by a 10-second passive rest. The speed will initially start from 10 km/h, increasing by 0.5 km/h every stage. The termination rules will be cancelled, and participants should try to maintain maximum effort regardless of the cues.

The Ball-dribbled Yo-Yo Intermittent training requires participants performing repeated shuttle runs with a soccer ball, simulating dribbling with maximum effort in game. Each shuttle lasts 15 seconds, followed by 15 seconds of passive rest. The required shuttle distance per bout is calculated based on 110% of participant's baseline Yo-Yo IR1 terminal speed. Individualized bout distances will calculate as: $D = (V_t \times 110\% / 3.6) \times 15$ Where: D = Required shuttle distance per bout (meters), V_t = Terminal speed (km/h) from pre-test Yo-Yo IR1 (Appendix 1) and 3.6 = km/h to m/s conversion. The turning point of the shuttle run will be marked with cone for participant, where participants need to turn 180° with ball dribbled. To ensure continuity of play, two coaches will be positioned near the sidelines to provide replacement balls when necessary.

The SSGs should conduct on a 25 × 35-meter rectangular field, featuring two teams of four players each (4v4 format). Participants will be instructed to maintain maximal effort throughout the matches while prioritizing sustained ball possession. To ensure continuity of play, two coaches should be positioned near the sidelines provide replacement balls when necessary. Matches shall conduct without goalkeepers, and players are permitted unrestricted movement across the entire playing area.

The overall training plan of this study is shown in Table 1.

Table 1 *Description of 4-Week Training Program*

Weeks	Sessions	Yo-Yo IR1	Ball-dribbled Yo-Yo	SSGs
1	Baseline-Tests			
2				
3 4	1-6	Increasing speed shuttle run 10s rest between shuttles 2 × 4 min bouts 4min passive rest between bouts	15s 110% max velocity of YYIR1 ball-dribbled shuttle run 15s rest between shuttles 2 × 4 min bouts 4min passive rest between bouts	4 vs.4 Small-sided games 25 × 35-meter field 2 × 4 min bouts 4min passive rest between bouts
5 6	7-12	Increasing speed shuttle run	15s 110%YYIR1 speed	4 vs.4 Small-sided games

		ball-dribbled shuttle run	
	10s rest between shuttles	15s rest between shuttles	
	2 × 4 min bouts	2 × 4 min bouts	2 × 4 min bouts
	3min passive rest between bouts	3min passive rest between bouts	3min passive rest between bouts
7	Post-Tests		

3.4 Measurement

3.4.1 Aerobic Capacity

The aerobic ability will be assessed via Yo-Yo Intermittent Recovery 1 test. Participants should perform repeated 20-meter shuttle runs between two parallel lines, with running pace controlled by standardized audio cues, followed by a 10-second passive rest. The speed will initially start from 10 km/h, increasing by 0.5 km/h every stage. When participants fail to keep up with the set speed for the first time, they will be warned. If they fail to keep up for the second time, the test will be terminated, and complected distance shall be recorded. Participants will be requested to complete the shuttle runs before the cues sound and try to maximize the number of completed

shuttles. Heart rate (HR) and rating of perceived exertion (RPE) will be recorded before, every end of the stage, and once after the test. The participants' VO_{2max} will be calculated by a regression equation: VO_{2max} = distance(m) × 0.0084 + 36.4 $ml \cdot kg^{-1} \cdot min^{-1}$ (Nalbant & Özer, 2018).

3.4.2 Anaerobic Capability

The anaerobic capability will be measured via three tests: Wingate Anaerobic Test (Wingate), 10-meters and 30-meters Sprint test (ST) and Repeated Sprint Ability test (RSA).

The Wingate test will conduct on a Monark 894 E ergometer (Monark, Sweden). Participant should first warm up 5-minute by cycling against a resistance of 4% body weight, followed with 2-minutes passive rest. Then, participants are required to sprint maximally for 30-seconds against 7.5% body weight resistance. Standardized strong verbal encouragement will be provided by researchers across the trials. HR and RPE will be recorded immediately pre- and post-trial, while peak power output (PPO) and mean power output (MPO) will be extracted from the sprint data.

For acceleration and maximum velocity, participants should perform 10-meter sprint and 30-meters sprint test for 3 times respectively with maximal effort on synthetic turf, 2-minute passive recovery are available between trials. Best and mean sprint times will be recorded using Witty timing System (Microgate, Italy) positioned at 0m, 10m, or 30m marks.

Sprint performance will be evaluated using three maximal trials each of 10m and 30m sprints on synthetic turf, with 2-min passive recovery between trials. Sprint times will be recorded using a custom-built infrared timing gate system (Omron E3JK-R4M1; OMRON, Japan) positioned at 0m, 10m, and 30m. Both best and mean sprint times were recorded for analysis.

Repeated sprint ability (RSA) will be evaluated through 6 × 40-meter shuttle sprints (20m + 20m with 180° turn), each shuttle separated by 20-second passive recovery. The timing gate will place at 0m and 20m position to record split times. Prior to formal testing, participants will complete a baseline 40-m maximal sprint. Trials will be postponed to 5-minutes later if the first sprint time exceeded the participants' baseline sprint time by more than 3%. The mean shuttle times, best shuttle times and decrement (decrement = mean/best) will be calculated (Michailidis et al., 2023).

3.4.3 Perceived enjoyment

Acute psychological responses will be assessed using the Affect Scale (AS), Felt Arousal Scale (FAS), Exercise Enjoyment Scale (EES), and an 8-item version of the Physical Activity Enjoyment Scale (PACES-8) following each training session (Lee et al., 2018). Scales will be provided every Saturday, immediately after the training. Before completing the questionnaires, participants received standardized instructions and were asked to reflect on their immediate feelings related to the activity just performed.

The AS is a single-item measure of affective valence during exercise, rated on a bipolar 11-point scale from -5 (very unpleasant) to +5 (very pleasant) (Hardy & Rejeski, 1989). The FAS is also a single-item measure of perceived physiological arousal, rated on a 6-point scale from 1 (low arousal) to 6 (high arousal) (Svebak & Murgatroyd, 1985). The EES assesses session-specific enjoyment using a 7-point scale ranging from 1 (not at all) to 7 (extremely) (Stanley & Cumming, 2010). These scales demonstrate established construct validity and sensitivity to exercise-related affective responses (Kilpatrick et al., 2015; Van Landuyt et al., 2000).

Overall session enjoyment was further evaluated using the PACES-8, by asking participants to rate how they feel about the physical activity they have been doing.

Items are scored on a 7-point Likert scale from 1 (unpleasurable) to 7 (pleasurable), with two items reverse-coded (Kendzierski & DeCarlo, 1991). Total scores ranged from 8 to 56, with higher scores indicating greater enjoyment. This abbreviated version has demonstrated excellent internal consistency and construct validity across populations (Mullen et al., 2011; Teques et al., 2020).

3.5 Statistical Analysis

Data analysis will be conducted using SPSS 29.0. First, descriptive statistics will be performed to summarize sample characteristics. Independent samples t-tests will be used to compare baseline differences between groups. The Shapiro-Wilk test will be applied to assess normality; if data violate normality assumptions, appropriate adjustments will be implemented.

A two-way repeated measures ANOVA (group × time) will be utilized to examine between-group effects, time effects, and interaction effects on outcomes including aerobic and anaerobic performance. If significant interactions are detected, Bonferroni post-hoc tests will be conducted to identify simple main effects.

Effect sizes will be reported as partial eta-squared (ηp^2) for ANOVA results, with $\eta p^2 < 0.06$ considered small, 0.06-0.14 moderate, and >0.14 large. Within-group effect sizes will be calculated using Cohen's d, where d = 0.2, 0.5, and 0.8 represent small, medium, and large effects, respectively. Statistical significance is set at $\alpha = 0.05$, and results will be presented as mean ± standard deviation (Mean ± SD).

References

Akdoğan, E., Yılmaz, İ., Köklü, Y., Alemdaroğlu, U., & Cerrah, A. O. (2021). The effect of isolated or combined small-sided games and speed endurance training on physical performance parameters in young soccer players. *Kinesiology*, *53*(1), 78–85. https://doi.org/10.26582/k.53.1.10

Badenhorst, J. (2017). *The effect of the growth spurt on strength, power, speed and agility training in boys during mid-adolescence* [PhD Thesis, North-West University (South Africa), Potchefstroom Campus]. https://repository.nwu.ac.za/handle/10394/30657

Cherni, B., Marzouki, H., Selmi, O., Gonçalves, B., Chamari, K., Chen, Y.-S., & Bouassida, A. (2025). Fixed pitch size small-sided games in young soccer players: Effects of different age categories and competitive levels on the physical and physiological responses. *Biology of Sport*, *42*(2), 187–197. https://doi.org/10.5114/biolsport.2025.144298

Clemente, F. M., Praça, G. M., Aquino, R., Castillo, D., Raya-González, J., Rico-González, M., Afonso, J., Sarmento, H., Silva, A. F., Silva, R., & Ramirez-Campillo, R. (2023). Effects of pitch size on soccer players' physiological, physical, technical, and tactical responses during small-sided games: A meta-analytical comparison. *Biology of Sport*, *40*(1), 111–147. https://doi.org/10.5114/biolsport.2023.110748

Clemente, F., Praça, G. M., Aquino, R., Castillo, D., Raya-González, J., Rico-González, M., Afonso, J., Sarmento, H., Silva, A. F., Silva, R., & Ramirez-Campillo, R. (2022). Effects of pitch size on soccer players' physiological, physical, technical, and tactical responses during small-sided

games: A meta-analytical comparison. *Biology of Sport*, *40*(1), 111–147. https://doi.org/10.5114/biolsport.2023.110748

Delahunt, E., Callan, L., Donohoe, J., Melican, R., & Holden, S. (2013). The yo-yo intermittent recovery test level 1 as a high intensity training tool: Aerobic and anaerobic responses. *Preventive Medicine*, *56*(5), 278–282. https://doi.org/10.1016/j.ypmed.2013.01.010

Eniseler, N., Şahan, Ç., Özcan, I., & Dinler, K. (2017). High-intensity small-sided games versus repeated sprint training in junior soccer players. *Journal of Human Kinetics*, *60*, 101–111. https://doi.org/10.1515/hukin-2017-0104

Eraslan, M., Gürkan, A. C., Aydın, S., Şahin, M., Çelik, S., Söyler, M., Altuğ, T., & Mülhim, M. A. (2025). The effect of proprioceptive training on technical soccer skills in youth professional soccer. *Medicina*, *61*(2), Article 2. https://doi.org/10.3390/medicina61020252

Fuhre, J., Øygard, A., & Sæther, S. A. (2022). Coaches' criteria for talent identification of youth male soccer players. *Sports*, *10*(2), Article 2. https://doi.org/10.3390/sports10020014

Gil, S. M., Gil, J., Ruiz, F., Irazusta, A., & Irazusta, J. (2007). Physiological and anthropometric characteristics of young soccer players according to their playing position: Relevance for the selection process. *The Journal of Strength & Conditioning Research*, *21*(2), 438–445.

Grgic, J., Oppici, L., Mikulic, P., Bangsbo, J., Krustrup, P., & Pedisic, Z. (2019). Test–retest reliability of the yo-yo test: A systematic review. *Sports Medicine*, *49*(10), 1547–1557. https://doi.org/10.1007/s40279-019-01143-4

Halouani, J., Chtourou, H., Gabbett, T., Chaouachi, A., & Chamari, K. (2014). Small-sided games in team sports training: A brief review. *The Journal of Strength & Conditioning Research*, *28*(12), 3594–3618.

Haroune, D., Ali, B., & Chachou, S. (2024). The relative importance of morphological, physical and skill requirements for selecting talented U13 football players. *SPORT TK-Revista EuroAmericana de Ciencias Del Deporte*, 38–38. https://doi.org/10.6018/sportk.611651

Jastrzebski, Z., Barnat, W., Dargiewicz, R., Jaskulska, E., Szwarc, A., & Radzimiński, Ł. (2014). Effect of in-season generic and soccer-specific high-intensity interval training in young soccer players. *International Journal of Sports Science & Coaching*, *9*(5), 1169–1179. https://doi.org/10.1260/1747-9541.9.5.1169

Jerome, B. W. C., Stoeckl, M., Mackriell, B., Dawson, C. W., Fong, D. T. P., & Folland, J. P. (2024). Contextualised physical metrics: The physical demands vary with phase of play during elite soccer match play. *European Journal of Sport Science*, *24*(11), 1627–1638. https://doi.org/10.1002/ejsc.12209

Jimenez-Iglesias, J., Owen, A. L., Cruz-Leon, C., Campos-Vázquez, M. A., Sanchez-Parente, S., Gonzalo-Skok, O., Cuenca-Garcia, M., & Castro-Piñero, J. (2024). Improving change of direction in male football players through plyometric training: A systematic review. *Sport Sciences for Health*, *20*(4), 1131–1152. https://doi.org/10.1007/s11332-024-01230-8

Karahan, M. (2012). The effect of skill-based maximal intensity interval training on aerobic and anaerobic performance of female futsal players. *Biology of Sport*, *29*(3).

Los Arcos, A., Vázquez, J. S., Martín, J., Lerga, J., Sánchez, F., Villagra, F., & Zulueta, J. J. (2015). Effects of small-sided games vs. Interval training in aerobic fitness and physical enjoyment in young elite soccer players. *PloS One*, *10*(9), e0137224. https://doi.org/10.1371/journal.pone.0137224

Manuel Clemente, F., Ramirez-Campillo, R., Nakamura, F. Y., & Sarmento, H. (2021). Effects of high-intensity interval training in men soccer player's physical fitness: A systematic review with meta-analysis of randomized-controlled and non-controlled trials. *Journal of Sports Sciences*, *39*(11), 1202–1222. https://doi.org/10.1080/02640414.2020.1863644

McBurnie, A. J., Dos'Santos, T., Johnson, D., & Leng, E. (2021). Training management of the elite adolescent soccer player throughout maturation. *Sports*, *9*(12), Article 12. https://doi.org/10.3390/sports9120170

McMillan, K., Helgerud, J., Macdonald, R., & Hoff, J. (2005). *Physiological adaptations to soccer specific endurance training in professional youth soccer players*. https://doi.org/10.1136/bjsm.2004.012526

Michailidis, Y., Ganotakis, C., Motsanos, N., & Metaxas, T. (2023). The effects of an HIIT program on young soccer players' physical performance. *International Journal of Sports Science & Coaching*, *18*(4), 1155–1163. https://doi.org/10.1177/17479541221102530

Moran, J., Blagrove, R. C., Drury, B., Fernandes, J. F. T., Paxton, K., Chaabene, H., & Ramirez-Campillo, R. (2019). Effects of small-sided games vs. Conventional endurance training on endurance performance in male youth soccer players: A meta-analytical comparison. *Sports Medicine*, *49*(5), 731–742. https://doi.org/10.1007/s40279-019-01086-w

Nalbant, Ö., & Özer, K. (2018). Evaluation of the relationship between body composition and aerobic fitness in youth soccer players. *Physical Education of Students*, *5*, 258–264.

Ribeiro, N., Martinho, D. V., Pereira, J. R., Rebelo, A., Monasterio, X., Gonzalo-Skok, O., Valente-dos-Santos, J., & Tavares, F. (2024). Injury risk in elite young male soccer players: A review on the impact of growth,

maturation, and workload. *The Journal of Strength & Conditioning Research*, *38*(10), 1834–1848.

Sarmento, H., Martinho, D. V., Gouveia, É. R., Afonso, J., Chmura, P., Field, A., Savedra, N. O., Oliveira, R., Praça, G., Silva, R., Barrera-Díaz, J., & Clemente, F. M. (2024). The influence of playing position on physical, physiological, and technical demands in adult male soccer matches: A systematic scoping review with evidence gap map. *Sports Medicine*, *54*(11), 2841–2864. https://doi.org/10.1007/s40279-024-02088-z

Shaw, D. M., Merien, F., Braakhuis, A., Plews, D., Laursen, P., & Dulson, D. K. (2019). The effect of 1,3-butanediol on cycling time-trial performance. *International Journal of Sport Nutrition and Exercise Metabolism*, *29*(5), 466–473. https://doi.org/10.1123/ijsnem.2018-0284

Sun, H., Soh, K. G., Mohammadi, A., Wang, X., Bin, Z., & Zhao, Z. (2022). Effects of mental fatigue on technical performance in soccer players: A systematic review with a meta-analysis. *Frontiers in Public Health*, *10*, 922630.

Thapa, R. K., Clemente, F. M., Moran, J., Garcia-Pinillos, F., Scanlan, A. T., & Ramirez-Campillo, R. (2023). Warm-up optimization in amateur male soccer players: A comparison of small-sided games and traditional warm-up routines on physical fitness qualities. *Biology of Sport*, *40*(1), 321–329. https://doi.org/10.5114/biolsport.2023.114286

Wen, X., Song, F., Yang, L., & Xu, Q. (2024). Small-sided soccer games promote greater adaptations on vertical jump and change-of-direction deficit and similar adaptations in aerobic capacity than high-intensity interval training in females. *Journal of Sports Science & Medicine*, *23*(2), 445–454. https://doi.org/10.52082/jssm.2024.445

Participant Information and Consent Form

Dear Parent/Guardian,

We sincerely invite your child to participate in a research study titled "The Effects of Yo-Yo Ball Dribbling and Small-Sided Games on the Athletic Performance of Youth Soccer Players." This study aims to scientifically evaluate the impact of different training methods on young athletes, providing evidence-based insights to enhance training effectiveness. Your child's participation will contribute significantly to this research.

1. Purpose and Study Details

The study will compare the effects of Yo-Yo ball training and small-sided games on the aerobic and anaerobic capacity of youth soccer players. During the study, your child will undergo periodic testing and evaluations.

2. Participant Rights and Safeguards

Your child may voluntarily participate or withdraw at any time without affecting their regular activities.All personal information will remain strictly confidential and used solely for research purposes.The study will be conducted under the supervision of certified coaches and medical staff to ensure safety.

3. Potential Benefits

Participants may experience improvements in their aerobic and anaerobic fitness, technical skills, and overall training motivation. The study is also designed to expose young athletes to structured and scientifically informed training programs under professional supervision.

4. Potential Risks

As with any physical training program, there may be a small risk of temporary muscle soreness, fatigue, or minor injuries (e.g., sprains). All training sessions will be designed within appropriate intensity levels for youth athletes, and safety precautions will be strictly followed under the guidance of certified coaches and medical personnel.

5. Parent/Guardian Responsibilities

Please carefully review and understand the study's objectives, procedures, potential risks, and benefits before providing consent on behalf of your child. During the study, we encourage you to:

1. Maintain communication with the research team.

2. Provide updates on your child's health status.

3. Support your child's active participation in the training sessions.

We deeply appreciate your trust and support and look forward to collaborating with you to witness your child's progress!

Consent Form

I, _____ (parent/guardian name), have thoroughly read and understood the Participant Information provided above. After detailed explanations by the research team, I am fully aware of the study's purpose, procedures, potential risks, and safeguards. Voluntarily, I consent to my child's participation in the study "The Effects of Yo-Yo Ball Training vs. Small-Sided Games on the Athletic Performance of Youth Soccer Players" and agree to cooperate with the research team for testing and evaluations.

Participant (Signature):

Parent/Guardian (Signature):

Contact Number:

Date: