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Review

Analysis of the internal and external loads, and technical actions of small-sided games in soccer

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Abstract: The priority in team sport training like soccer is the acquisition and refinement of individual and group skills as well as tactics to transform the group into an effective competitive unit. To achieve these objectives, it is common for coaches to reduce both the number of players and the field dimensions to manipulate exercise intensity, catering for the specific needs of their players. The use of small-sided games (SSGs) that feature less participant has proven a practical tool for coaches, for the development of technical, tactical, and physical abilities. The objective of this paper is to conduct a review of the literature on the topic of small-sided games to analyze specific parameters such as physiological, technical, and movement duration. The effectiveness of SSGs in enhancing aerobic and anaerobic capacities as well as technical skills is often highlighted although their main benefit might be to practice decision-making and problem-solving under pressure, replicating game-like situations. Examining the psychological aspects during small-sided games, such as confidence, motivation, enjoyment, and cognitive engagement, could also provide insights into optimizing training programs and enhancing player development. In summary, small-sided games offer diverse benefits for physical, technical, tactical development in players across different age groups and skill levels for both training and/or learning purposes. Future research should thus focus on investigating the long-term effects of small-sided games on players' physical and technical development, as well as their transfer to actual match performance.

Keywords: ecological dynamics; constraint-led approach; nonlinear pedagogy; training manipulation

1. Introduction

Small-sided games (SSGs) are played with fewer players and in smaller areas than the official match [1]. They are a popular form of training for all ages and competitive levels, since changing their parameters like the dimensions of the playing area, the number of players, the training regime, the use of goalkeepers, coaches' feedback, and other rules of the game allow coaches to manipulate different physiological and perceptual responses in training [2]. Task constraints like rule modifications, game duration or space manipulations are important factors to be used in SSGs to alter player-environment interactions considering the training objective because they help achieving desired behaviors [3]. This suggests that training tasks should be representative of behaviors observed in the game. Therefore, it is important to know which task constraints lead players to better develop their abilities according to their age or technical level [4]. Such is the objective behind training driven by constraints with the renown Constraint-Led Approach (CLA).

There have been several attempts to explain how the manipulation of practical constraints influences physical conditioning and/or sports performance [5–7]: factors such as players' conditioning capacities, competition season, recovery before and after the game, team strategy, individual and collective technical levels of players should be considered when planning training tasks. The adequacy of exercise specificity in context is a key factor in predicting success in training, with exercise complexity depending on the combination of these factors [8]. Within the CLA framework, sports performance and skill acquisition both emerge from the interaction among constraints, participants, task, and environment [3,9]. This approach creates an environment that facilitates discovery, guiding the player through a variety of possible movement solutions in search of an optimal movement response. Such approach is player-centered, individual-specific, and involves minimal coach-player interaction. In sum, it shows a sharp contrast to more traditional didactic methods that emphasize verbal instructions, demonstrations, and task decomposition, generalizing learning strategies among groups of individuals [10].

It is however crucial to analyze the player on individual characteristics to achieve success through the use of CLA since individual constraints act upon intrinsic characteristics of a person, such as body morphology, chronological and biological age, fitness levels, skill or experience, perceptual-cognitive development, and others [9]. These unique characteristics play a relevant role in how players interact with external constraints in a specific performance context [11]. Activities featuring constraints restrict problem-solving with implications for individual and collective actions that are performed [12]. Coaches are then challenged to adopt creative solutions in finding the right parameters and crafting challenging and exciting learning environments, even by inspiring from other sports. In the same line of thought, coaches are also expected to design tasks in which players develop adaptive behaviors in order to respond to the local context and explore intrinsic dynamics [10]. For example, the manipulation of the number of players and field dimensions are the most commonly used constraints when analyzing effects on performance in SSGs as they are used with the intention of exposing players to particular situations and conditions that represent key aspects in competitive performance [13].

The planning and introduction of specific training tasks depend on a set of factors associated with the context of the team and its objectives [8]. There is then a need for coaches to design various types of SSGs for training to maximize players' technical and physical preparation [14]. This applies for instance to professional football players who are often exposed to periods of intense training, which can induce substantial stress and fatigue. These high-intensity stimuli are likely to lead to a lower state of well-being and poor recovery and, consequently, can affect players' performance. The subjective feelings of wellbeing and negative recovery (perceptions of fatigue) have an unfavorable impact on the technical and tactical performance of football players, despite the maintenance of training intensity [15].

Considering the complexity of configuring SSGs to achieve targeted training outcome(s), there is a clear need for evidence-based knowledge to feed coaches with useful recommendations. A knowledge base should provide balanced opportunities for training and learning, calibrated for varying levels of competence. Evidence of the effects of space and game rule modifications has accumulated in the literature but lacks of organization to be utilized and articulated by practitioners. To address the limited practicability of current evidence, we framed our investigation around the internal and external load patterns and technical components of performance in SSGs. The aim of this article is therefore to highight the effects of selected SSGs in soccer and their configured parameters on the participants and the outcome(s) in training. This review emphasizes the objectives, inclusion criteria, data extraction and data quality and evaluation of a selection of scientific studies about small-sided games in soccer. We structured our narrative to present the strengths and weaknesses of SSGs in training, the manipulation of constraints, and the structured review of the impact of the configuration of SSGs (i.e., the arrangement of aforementioned parameters of the play) on physical conditioning and technical skill acquisition and/or maintenance.

1.1. Benefits and limitations of SSGs

SSGs appear to be effective in combining motor learning, team cohesion and aerobic component training [16]. According to Iaia et al. [17], the ability of players to perform high-intensity interactions with the ball during the game can be a determining factor for success. It is therefore important to increase the number of contacts on the ball for every player during training and to perform these skills under conditions that replicate the physical and competitive demands of the match. One of the advantages of using specific high-intensity training in football, as featured in SSGs, is that coordination and technical-tactical skills are trained under conditions of fatigue of those observed in an official match. More specifically, some of the advantages of SSGs are usually considered with the increase of the exercise intensity to 90%–95% of HR_{max}, allowing the improvement of the specific football endurance and developing the muscles for specific situations of play. These outcomes add to benefits to improving the technical-tactical capacity in specific game conditions and enabling a better transfer to the official match.

Indeed, Krustrup et al. [18] found that participation in SSGs two to three times a week for 12 to 16 weeks improves performance in high intensity running, strengthens muscle mass (especially in the lower limbs), increases muscle capillarization and oxidative enzymes, reinforces the maximum dynamic muscle strength of the hamstrings and quadriceps, and improves postural balance. During this term, playing SSGs helps maintaining lean body mass and muscle mass of the lower limbs, improves maximum oxygen consumption (VO_{2max}), plantar strength, height jump and high-intensity running performance, and allows a decrease in mass body fat and muscle glycogen concentrations. Krustrup et al. [18] also suggested regular participation in SSGs in soccer led to a reduction in resting HR and systolic and diastolic pressure, an improvement in maximum oxygen (O_2) uptake and ventilation, a decrease in fat mass, a decrease in the amount of lipids in the blood, and an increase in bone mineral content in lower limbs. Hammami et al. [19] demonstrated that two to three SSG training sessions per week induce major improvements in specific skills and in physical fitness related to team sports, such as VO_{2max}, speed, agility, jumping and repeated sprint performance. These improvements seem independent of the level of play and can occur in the pre-competitive period or during the season. Given the time restrictions in team sports and the wide benefits of SSGs, in addition to the greater specificity and enjoyment in the game, this type of task can be suggested as an alternative to isolated fitness training.

In children and youth soccer, SSG training has been shown to increase intermittent exercise performance, coordination, and VO_{2max}. Regular participation in SSGs is a more efficient option to improve levels of physical capacity, health parameters, and self-esteem in obese children than a standard of the program of physical exercise. It is thought that the effort during SSGs is not stressful due to the enjoyable dynamics of the game [18]. Another study reports that the implementation of a training program of 14 sessions with SSGs led to an improvement in changes in direction and specific technical aspects, such as ball control and dribble, and these were transferable to match play. Thus, we can consider that SSGs are an appropriate and very advantageous method for training in the developmental stage of the training of football players [20]. Young players can potentially benefit from the practice of SSGs since high physiological responses (HR, La and Rating of Perceived Exertion (RPE)) were observed in pre-adolescent football players when they practiced these activities under different conditions [21].

Although SSGs show benefits as a high-intensity task, they are not an infallible training task, and coaches must be aware of this to use them properly, as some issues can arise from overuse [22]. For example, specificity is commonly argued as a benefit of using SSGs. However, to achieve adequate values of running at high speed or maximum speed in football players, the associated longitudinal space and opportunity must be appropriate, and it is difficult to guarantee such specific physical load in small formats and on small playing areas because they do not effectively stimulate the determinant variables [22]. The same author states that another interesting reality that differentiates SSGs from real game scenarios is the load level based on accelerations and decelerations: the smaller playing areas in SSGs can contribute to an increase in the frequency and volume of accelerations and decelerations compared to a real game. SSGs produce significantly lower external load in terms of high-speed running, sprinting and max speed, but they produce equivalent or greater external load in terms of accelerations and decelerations. In addition, small formats potentially ignore the need for individualization based on the demands and behaviors required by different playing positions, so it is important to consider the variability between teammates and, especially, the variability between sessions [22]. The effects of SSGs should also be interpreted based on the level of skill, fitness, competitive level and the age of the players, as there seems to be an age effect on the ability of players to be more or less efficient in their actions with the ball: (i) younger players seem to lose the ball more frequently than older players; (ii) older players appear to be more synchronized with their collective behavior during SSGs than younger players; and (iii) the benefits of SSGs may be greater in players with low levels of fitness than in those with high levels of fitness [22].

From a psycho-social perspective, SSGs promote low levels of anxiety and are considered fun and motivating as they promote social interaction and promote exercise adherence [23]. Sahli et al. [24] highlighted that SSGs induced higher physiological responses as well as rate of perceived exertion (RPE), which contributed to enjoyment and positive mood in players through positive verbal encouragement. This could support emotional responses which supports the research around players' ability to combat anxiety and thus positively impact self-confidence as SSGs bring added pressure and intensity through condensed playing areas. This links to further studies provided by Pop et al. [23], suggesting that youth players are intrinsically motivated by SSGs, which in turn could contribute to positive emotional responses and increased confidence. Finally, Castillo-Bellot et al. [25] suggested that soccer promotes social interaction and has the potential to increase long-term adherence to physical activity, without previous physical exercise. Acute high-intensity SSGs, which can be implemented through informed practice design can improve measures of inhibitory and neurophysiological control correlated with attention, and consequently improve the academic performance of young people. SSGs can thus be a relevant type of activity to facilitate positive experiences and active participation [26].

Due to the specific technical and physical variability of each SSG format, using the correct format with specific times in weekly planning will allow technical staff, sports scientists and fitness coaches to optimize planning and prepare players on technical, physical and tactical components according to their objectives. This can be beneficial to prevent injuries as well as to improve performance, taking into account the application of workloads to use different energy systems. Furthermore, this can induce high speeds at the correct time to minimize the risk of fatigue during competition [27].

1.2. Constraints manipulation

Sports coaches and fitness trainers usually manipulate task constraints in the laboratory (evaluations), gym (specific conditioning or rehabilitation training), and on the field (technical-tactical and physical conditioning in simulated game situations) [28]. It is however crucial to understand the effect of these manipulations in order to optimize the training process. Newell [29] defined constraints as characteristics that limit the degrees of freedom of a system and also described the three different types of constraints based on their origins: organizational constraints, environmental constraints, and task constraints. In soccer, individual constraints are those internal to the system being analyzed (player, subgroup, team, or match); environmental constraints are external to the analyzed system and may include factors such as weather, temperature, altitude, crowd support, friction, and the type of playing surface; task constraints are specific to the task being performed and are related to the objectives being pursued or the rules governing the task [30].

Although SSGs are well described in the literature, there is still limited research related to their effect on players' creative behavior. Up to date, very limited research has been conducted on developing training methods that can promote creative behavior in sports [31]. Constraints should be placed on tasks, allowing players to constantly adapt to the unpredictable behavior of opponents. Practical tasks should promote varied and flexible behaviors so that players learn to be more adaptable, and the inclusion of exploratory tasks can help them be more creative. These training scenarios explore tendencies inherent in self-organization and can simultaneously develop technical skills (related to players' body movement with the ball) and tactical behaviors (space-time movements related to shared task goals in attack or defense) in a competitive environment. The unpredictability of the game helps players maintaining higher levels of motivation compared to predictable training situations [31]. It is therefore important to design tasks that promote players' confidence and decision-making, which in turn may improve performance outcomes. Torrents et al. [31] refer to the possibilities that channel players' exploratory activity, as this strongly depends on the set of constraints imposed by the system. This approach is particularly relevant in team sports for the benefit of improvisation, the interaction between players, and the environment because exploratory behavior that arises in the play all depend on the availability of the individuals involved and the influence of the environment.

Torrents et al. [31] also highlighted that excessive manipulation of constraints might however hinder the achievement of specific task objectives and restricts the exploratory behavior of teams and players. It reduces the performance of movement configurations, since the emergence of such coordination patterns heavily depends on the resources perceived by players in their surrounding environments. Therefore, training tasks that have an excessive amount of manipulations may limit players' possibilities to act in dynamic performance environments, influencing their abilities to use specific information compatible with the execution of specific tactical game patterns [32]. The manipulation of important task constraints with younger players, or players with lower levels of skill, needs to stimulate players' exploratory behavior in an attempt to increase creativity, tactical awareness, and game understanding, rather than directing their actions towards a solution considered as the sole best one to a specific game problem. The effects that different constraints have on exploratory behavior, measured by the variety and quantity of different responses in a given game situation, are of utmost importance for successful performance in team sports [31].

2. Methods

To ensure the quality and comprehensiveness of the articles reviewed, a systematic search was conducted across five databases: SportDiscus, Taylor and Francis, Web of Science, Science Direct, and Europe PMC. The search spanned from 2011 to 2023 and utilized keywords such as 'small-sided games' combined with 'soccer' or 'football', along with terms related to technical, tactical, and physical skills (e.g., 'technical skills', 'tactical skills', 'physical skills').

The inclusion criteria for this review were as follows: peer-reviewed journal articles written in English, published between 2000 and 2023, and empirical studies. Studies had to expose participants to a soccer performance context involving SSGs in training, focusing on training processes involving SSGs, and the technical, tactical, or physical aspects of soccer players, analyzing skills across any age or experience level. Exclusion criteria included studies not focused on football or soccer, articles lacking relevant data, conference abstracts and citations, articles not written in English, and non-peer-reviewed sources such as letters, book reviews, theses, and magazine editorials.

A total of 74 papers meeting these criteria were identified and subsequently exported to a reference management tool (RefWorks). Data from these selected studies were extracted systematically, focusing on several key aspects: study design, participant characteristics, intervention details, outcomes measured, and key findings. The quality of the studies was assessed using the PEDro scale, which evaluates the methodological quality of clinical trials. Each study was scored based on criteria such as randomization, blinding, and the completeness of follow-up, ensuring a rigorous assessment of methodological quality.

The study selection process adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. This framework facilitated the structured identification, screening, and inclusion of eligible studies based on predefined criteria. The PRISMA flow diagram was used to visualize the study selection process, ensuring transparency and replicability of the review. The diagram detailed each phase of the review, from the initial search to the final inclusion of studies, providing a clear overview of the selection process.

The selected studies were analyzed chronologically from the oldest to the newest to identify trends and developments in the research on SSGs in soccer. A narrative synthesis approach was employed to integrate findings across studies, highlighting the benefits, limitations, and practical implications of SSGs for training soccer players. This synthesis included an examination of how SSGs influence physical fitness, technical and tactical skills, and psychological factors such as motivation and enjoyment.

This detailed methods section aligns with the feedback and the PRISMA guidelines, ensuring clarity, validity, and a structured approach to the systematic review of SSGs in soccer. By adhering to these rigorous standards, the review provides a comprehensive and reliable synthesis of the existing literature, offering valuable insights for coaches, researchers, and practitioners involved in soccer training and development.

3. Results and discussion

It has been shown in the selected studies that SSGs directly influence the internal and external responses of soccer players. We can understand that coaches typically use SSGs in their training programs to stimulate the physical, technical, and tactical requirements of competition, optimizing training time through the development of a set of physical requirements without compromising technical skills and decision-making [33]. In that sense, it is always recommended to monitor performance during training sessions in order to maintain or optimize team development and individual performance when changing parameters [34]. Manipulating the number of players, the configuration of the play, and type of finishing all influence game intensity in SSGs for young soccer players [35]. These parameters were systematically investigated for their effects on athletes of changes in variables or game rules, such as field size [36,37], inclusion/exclusion of different attack and defense zones [38,39], number of players [40], and duration of game formats [41], with other authors seeking to make combinations with these parameters [42–45].

For example, studies have shown that physiological responses, such as heart rate, lactate concentration, and rating of perceived exertion (RPE), as well as technical skills in SSGs, can be modified by altering some factors such as field dimensions, number of players, game rules, and coach encouragement [42,43]. For instance, large fields increase exercise intensity and the area size and exercise time should be determined by the training objective. Coaches generally tend to reduce area size relative to the number of players to create a situation where players need to act quickly under time pressure. Studies have on the one hand demonstrated that the use of a greater number of players is mostly used in improving technical-tactical aspects. On the other hand, SSGs with a reduced player number have been used to improve physical capacity [40]. Appropriate manipulation of SSGs (size of playing area, number of players, use of goalkeepers, or rule modification) allows adapting the intended intensity for competition, achieving physiological stimulation objectives for player development, and simultaneously working on technical and tactical aspects, as well as decision-making [46]. The scientific literature still lacks consistency in results from the manipulations used in SSG design, which limits the generalization of findings. Solid scientific knowledge is thus needed to assess the effects of manipulations on individual performance [47].

Other studies compare more variables associated to practice such as coach encouragement [43], touch limitation [48], different work regimes [49], and the introduction of defensive rules [50]. The most relevant constraints that increase task workload usually are, in order of influence: possibilities of interaction, degree of opposition, simultaneous participation, game space, competitive workload, and intensity. Due to their influence on player response, task constraints and decision-making parameters should be considered when quantifying training workload in soccer [28]. Thus, coaches should consider including activities with limited interaction possibilities in terms of opposition (SSGs or large formats (LSGs) with more than 4 players per team) during peak competitive training load periods. Conversely, periods close to competition should mainly include positional situations (corners or free kicks near the opponent's area) or individual games, such as shots on goal or technical exercises to maintain ideal physical condition [28].

Finally, the manipulation of constraints in SSGs helps provoke intended tactical behaviors, which makes these activities an effective strategy to facilitate the acquisition of certain collective and individual game principles [13]. The focus of practice in sports should be guiding athletes towards sources of information that specify goal achievement thorugh discovery and exploration of intrinsic and transactional degrees of freedom to succeed in performance [5]. To achieve this, coaches can modify the presence of goalkeepers, field dimensions, number of players, and the ability to put balls into play influence players' activity during SSGs [51]. In summary, in open sports, space is the variable that most influences decision-making and athletic performance. Therefore, different spatial configurations combined with modified rules create a variability environment that activates problem-solving processes during high-intensity exercises [52]. Small spaces in SSGs promote more decelerations, changes of direction, and accelerations, whilst larger spaces allow players to cover greater distances, practice actions with more space, less pressure, and more time. Moreover, larger spaces in SSGs increase distances between players and allow technical-tactical development without pressure, which is recommended for players with lower technical level. Small spaces rather decrease distances between players, allowing decision-making development under pressure, and should be used by players with high technical level [8]. It is therefore clear that manipulating the rules of SSGs to achieve high exercise intensities or to develop specific technical or tactical skills is at the heart of practice design. Appropriate manipulation of constraints can direct athletes to explore appropriate movement behaviors, culminating in functional decisions made by the individual. In this perspective, the coach's task is to identify: i) the athlete's level of knowledge in the task; ii) the functions (objectives) to be trained; and iii) the main constraints (organizational, task, and environmental) to be manipulated or taken into consideration during practice [5]. The following sub-sections were written to highlight the effects of physiological load and technique in the form of clear guidelines for practitioners.

3.1. Analysis of internal load considering the manipulation of player number and playing area

Modern soccer requires the ability to perform repeated efforts at high intensity. In fact, the most successful teams perform a greater number of high-intensity actions in ball possession [17]. High performance soccer therefore demands high energy as it is an important and decisive factor of performance. The anaerobic system is repeatedly stimulated periods during the game and obliges players to develop the ability to perform efforts of maximum or near maximum intensity, which can be achieved through high-intensity aerobic training and speed endurance. Using SSGs as high-intensity training allows for adaptations in improving VO_{2max}, running economy, and lower blood lactate accumulation during exercise [23]. This means SSGs are an effective training modality of specific aerobic resistance in soccer [53]. Therefore, it is necessary to consider a set of intensity indicators to obtain complementary information that allows coaches to more reliably assess the internal load imposed on players to optimize the training process [54]. SSGs appear to be more physically demanding than conventional training, as demonstrated by the high heart rate responses that potentially evoke greater improvements in cardiovascular function and consequently aerobic capacity. These responses can be attributed to an increase in the physical component imposed on players during SSGs and possibly by the motivation and enthusiasm of the players [16].

Owen et al. [37] observed that 3v3 situations produce similar heart rates (HRs) to 11v11, whereas 1v1 and 2v2 situations produce higher HRs than 11v11, and 4v4 and 5v5 situations produce lower HRs. Accordingly, HRs tend to decrease when adding a player and keeping the same space. Rampinini et al. [43] found that 3v3 situations are more intense than 4v4 and 5v5 situations, with no differences between the latter two. These 4v4 and 5v5 situations rather generate higher values in %HRmax, lactate, and RPE compared to 6v6. Hill-Haas et al. [43] support these studies, stating that increasing the number of players in the same space reduces the average heart rate (HRavg). These authors consider that in 2v2 situations, lactate, HR, and RPE tend to be higher than in the others (4v4 and 6v6), with both parameters decreasing as the number in the SSG increases. In other words, as the number decreases and the space remains the same, internal loads tend to increase. Additionally, SSGs can produce large cardiac responses in athletes, especially in the 2v2 situation where as the cardiac response was the one that most resembled the formal game in 6v6 situations. As the number of participants decreases in SSGs, RPE and lactate tend to be higher, as the number of ball contacts, passes, and dribbles increase. Running with the ball imposes a higher physiological load than running without the ball.

Katis and Kellis' [40] study demonstrate that athletes participating in SSGs worked at high HR, where 3v3 being even higher than 6v6. The studies by Kalapotharakos et al. [55] also state that 4v4 situations demonstrate a higher %HRmax compared to 5v5, 6v6, 7v7, and 8v8. Sampaio et al. [2] state that SSGs with fewer players allow for increased HR, lactate, and RPE but less maximum speed than games in larger formats. Sannicandro and Cofano [56] mention that a smaller number of players allows for a higher internal load while formats with a larger number of participants increase the frequency of technical actions, and 3v3 is more effective for high-intensity aerobic training as it allows for cardiac responses of 90% of HRmax, while 5v5 is more effective for technical improvement. In Clemente et al.'s [57] study, it was found that a smaller formats players by youth players increases HR responses in SSGs.

Higher exercise intensity is also achieved with fewer players in playing areas of same dimensions, since technical actions are highly insensitive to field dimensions and the number of players, and because the use of smaller game formats increases HR, possibly due to greater individual participation of each player [53]. Therefore, coaches of young players need to pay more attention to signs of fatigue, especially when the main content of the game is to develop a specific tactical behavior or technical action. However, if the main objective is to develop players' anaerobic fitness, coaches can use formats such as 1v1 or 2v2 without goals to increase exercise intensity [53].

The field dimension is also a factor to consider when planning SSGs as it affects players' physiological responses [21]. Manipulating game rules and field dimensions altogether changes intensity and could be considered for different training goals [42]. Hill-Haas et al. [42] also state that increasing field size increases HR, lactate, and RPE. The results of Casamichana and Castellano [11] support the previous studies, stating that field dimension must be a factor to consider when planning training, influencing task intensity and athletes' motor response. As the field decreases, %HRmax and RPE tend to decrease. Clemente [22] supports the same ideas by stating that larger fields increase HR, lactate, RPE, distance covered, and distance covered at high intensities. However, and contrary to previous studies, the results of Kelly and Drust [45] demonstrate that area size does not seem to significantly alter HR responses due to the significant differences for both heart rate responses and the technical demands for 4 minute intervals of game play.

In summary, most studies reveal that larger areas of play lead to increased acute physiological loads (HR, lactate, and RPE) compared to small fields, regardless of game format or player age. Decreasing the number of players with constant field area as well as fewer players in larger areas are two types of situations that allow for increased intensity in SSGs [16]. Larger areas seem to be more suitable for increasing the physical demands of games, while also allowing for the development of tactical principles associated with lateral and longitudinal game exploration, in addition to representing a valid aerobic training stimulus [17] (see Appendix **Table A1**).

3.2. Analysis of technical actions considering the manipulation of player number and playing area

During a soccer game, all players will face situations requiring to jump, dribble, shoot, run at various speeds and in various directions, run with the ball, tackle, and control the ball under pressure. Each of these actions reflect different physical, technical, and tactical demand although their integrated development is still mandatory for achieving high performance during the game. Katis and Kellis [40] found that 3v3 situations allow players to practice technical skills such as passing, dribbling, and shooting more than in 5v5's. This suggests that different conditions in SSGs may present different responses and can be used for different training purposes. The results of this study demonstrate that the number of short passes, shots, tackles, dribbles, and goals scored are significantly higher in 3v3 situations than in 6v6. Thus, 3v3 situations offer superior stimuli for the development of physical capacity and technical skills compared to 6v6, recommending their use for training young footballers.

The study by Clemente et al. [15] revealed that 3v3 and 6v6 SSGs generated reproducible individual frequencies of technical actions, in young soccer players, except for shots. In addition to these applications, the same study also revealed that the 3v3 format moderately increased individual frequencies of defensive and offensive technical actions. For this reason, youth football coaches could benefit from the 3v3 format whenever the intention is only to promote individual technical actions in offensive and defensive phases. As said, a low number of players (1v1 to 4v4) significantly increases physiological demands and the number of technical actions performed compared to MSGs (medium formats) (5v5 to 8v8) and LSGs (> 9v9). In summary, according to Sgrò et al. [31], recent studies seem to show that there is an inverse relationship between the number of players and the frequency of technical actions per player. Usually, formats with low number of participants and smaller playing areas increase pressure exerted on the player with the ball and lead to more dribbling to create space and shoot on goal. In larger playing areas, players tend to make more long passes and headers. The SSG format with fewer players increases the opportunities to perform technical actions such as passing, dribbling, or shooting, while the format with more players allows for the development of defensive actions such as blocking and ball interception.

Kelly and Drust [45] demonstrate that there seem to be no significant changes in technical requirements when changing the space but keeping the same number of participants. Casamichana and Castellano [11] reveal that the performance of technical skills tends to increase in frequency as the field gets smaller. According to Sgrò et al. [31], some previous studies have shown that there are no significant effects between field dimensions and the improvement of technical parameters. However, the use of small playing areas seems to increase technical demands. The use of small playing areas allows for an increase in the frequency of actions such as dribbling, tackling, and shooting, as decision-making and execution will be faster due to proximity to other players whereas using large fields leads to more opportunities to maintain ball possession, more time spent looking for the best solution to score a goal, and a defensive line closer to the goal line. Clemente [22] supports this idea by stating that more frequent technical performances are found in smaller playing areas, suggesting that reducing space may increase the opportunity to perform more technical actions. Thus, players with lower technical ability need larger fields to perform certain actions without opponent pressure, while players with high technical level need smaller spaces with a higher number of players to improve execution speed and decision-making under pressure [33,58,59].

From an individual exploratory perspective, SSGs are often seen as institutionalized street soccer, as they are typically less structured and more fun than official games [60]. From an ecological dynamics approach, new and appropriate actions can emerge under variations of constraints that invite the individual to explore different ways to adapt to the task. For the reasons evoked in this section, coaches can therefore use SSGs to balance technical stimuli during training sessions, either by decreasing or increasing the number of participants in the play. Caso and van der Kamp (2020) also examined how the SSG format affects the number, variability, and creativity of individual actions among elite soccer players and found that SSGs in soccer actually stimulate the variability and creativity of individual actions when featured in smaller areas. This allows players to vary or explore more individual actions and express creative football actions in presumably facilitated environments. SSGs thus increase the variability of players' actions and expands the repertoire of individual actions (Appendix **Table A2).**

3.3. Analysis of external workload considering the manipulation of player number and playing area

GPS devices have improved the monitoring of external load, which includes important variables such as distance covered, high intensity running distance, sprint distance, and acceleration [61]. Studies have found that the type of game played, player position, or player skill can influence the number of sprints, total distance covered, and distances covered in different speed zones [11,62,63]. Changing game conditions (rules or game objectives) and game formats (number of players per team and/or area size) can alter the external load imposed on players [61,3]. It has also been reported that SSGs induce higher external loads than competitive match play whilst previous studies may have underestimated their demands [6].

Bout duration can affect players' responses and must be taken into account for intentional task control. If the training goal is to produce cardiovascular output, task prescription should have a high duration; conversely, short-duration tasks will encourage high-intensity activities [64]. In SSGs, it seems necessary to consider a set of intensity indicators to obtain complementary information and help coaches to more accurately assess the load imposed on players because, in most cases, there is only low and moderate correlation between various external load indicators, as well as between external and internal load indicators [54].

According to Hill-Haas et al. [36], in a 2v2 situation, the total distance covered at walking pace is higher than in 4v4 and 6v6, whereas a 6v6 SSG produced a greater distance run at higher speeds. A 4v4 SSG seems to best reflect the external demands of competitive match play. The results of Dellal et al. [65] also demonstrate that the total distance covered, distance covered in sprinting, and distance covered at high intensity are greater in 4v4 situations than in the other analyzed ones (2v2 and 3v3).

Casamichana and Castellano [11] state that as the field decreases in size, effective playing time, total distance covered, and distances covered at studied speeds (except walking) tend to decrease. Gaudino et al. [66] also note that total distance, distances covered at high speed, as well as absolute maximum speed, acceleration, and deceleration increased in larger playing areas (10v10 > 7v7 > 5v5). On the other hand, the number of moderate accelerations and decelerations, as well as the total number of speed changes, were in smaller game formats (5v5 > 7v7 > 10v10). SSGs induce faster game speeds but fewer repeated high-intensity efforts, sprints, and high-intensity running compared to LSGs [14].

Sannicandro et al. [56] analyzed the external load of different SSG formats with 6 extra players and found that 5v5 would be more beneficial on the first day of training after the game for players who did not play (or did not participate in the entire game) or for all players in the technical-tactical training on the second day of the weekly microcycle. In turn, a 6v6 format featuring low and moderate levels of running intensity seems to involve intermittent aerobic exercise and would be more beneficial on the first or third day of training after the game. A 7v7 format demanding significantly higher maximum speeds and distances covered at walking pace seems more useful if used on the fifth day of training.

From another perspective, Casamichana et al. [8] mention that increasing depth instead of width in 5v5 games has a greater impact on player responses if increasing workloads since depth translates in greater physiological demands on players compared to width. This suggests that the distance between goals has a greater impact on physiological loads than the distance between sidelines. The studies by these authors revealed that using a deeper playing area increased distances covered in different speed categories, regardless of width. Covered distances increased in all speed categories for SSGs played in narrow areas, substantially increasing in all categories on wide playing areas. Thus, in all SSG formats, high cardiovascular demands can be obtained although coaches wishing to focus on neuromuscular responses associated with accelerations, decelerations, and changes of direction should design SSGs to be played in smaller playing areas, and those wishing to work on high-speed movements should design SSGs on larger playing areas, prioritizing depth over width for the same playing surface [8].

Therefore, using larger playing areas and having more players per team can lead players to increase their running distance, attempting to create longer passing lines or explore the length of the field [67,68]. However, smaller formats appear to be better for increasing exercise intensity and the number of acceleration and deceleration actions by players [58]. In this way, smaller formats reduce the available running and sprinting area and, therefore, may be more suitable for increasing player training load [69] (Appendix **Table A3**).

4. Limitations and future studies

According to Hill-Haas et al. [36], limitations of SSGs are reflected in well-physically prepared or highly skilled players for their ability to perform high-intensity exercise, to replicate highest intensity efforts for extended periods of time, and to perform individual tactical actions under pressure. Furthermore, coaches must also consider the risk of injuries during training due to physical contact. However, according to Wells et al. [70], young players are able to physically tolerate this type of small-sided game without increasing the risk of injury. There also exists a potential knowledge gap in mastering SSGs for the transfer between training and competition and for players' tactical learning. Therefore, for optimal use of SSGs, a meticulous manipulation of task constraints is highly recommended, with emphasis on careful control and real-time monitoring in the achievement of intended objectives [36]. Coaches should finaly consider the difficulty of monitoring SSGs as an additional limitation. Despite these limitations, Impellizzeri et al. [71] state that SSGs can still be used as an effective approach to training to improve both physical aspects and technical-tactical learning, with benefits for the performance in football matches. Further studies should be conducted to investigate the effects of training variables (intensity, frequency, and duration), the performance of individual tactical actions, the exploration of different action possibilities, and the different combinations between the physical component.

SSGs also present certain drawbacks for the development or training as means for preparation. One limitation is the potential lack of realism in the demands of the full game, especially regarding tactical aspects and decision-making under pressure. SSGs may not fully replicate the complexity of a real match, particularly in terms of player positioning, team tactics, and strategic interactions. The risk of injury during SSGs, particularly due to the higher intensity and physical contact inherent in these activities should be carefully considered and managed by coaches and medical staff. Moreover, the effectiveness of SSGs can be influenced by factors such as player motivation, adherence to game rules, and environmental conditions, which may vary from session to session. Therefore, while SSGs can be valuable tools in football training, coaches should approach their implementation with awareness of these limitations and consider them when designing training programs.

Research in the area has focused on analyzing players' technical, tactical, and physiological responses when certain factors are modified; more studies are needed to understand the interaction between these factors and how they can be better manipulated to optimize the training process in exploring decision-making and cognitive load during different SSG formats [16]. Additionally, the same authors mention that it is equally important to test periodization strategies in the use of SSGs and the long-term development of tactical learning, and to understand how to minimize associated risks of injury. A deeper understanding of the influence of manipulating variables to alter players' responses in SSGs would help coaches have better control during training and consequently, a more effective training planning, execution, and evaluation process [16]. For example, a player who is more physically developed may produce more explosive movements and influence the data collection process in external load compared to internal load and individual tactical actions [52]. In that sense, more research is needed to understand the effects of player maturation on their individual and collective performance (e.g., time and number of ball possessions) [72]. This can be achieved through the collection of data from other intensity indicators such as heart rate. Further complementary research should thus be conducted to explore the effects of task constraints in different SSGs across different age groups.

However, there is a lack of consistency among studies on SSGs, as they generally make use of small groups of players, at specific times, to investigate effects on different variables. In most cases, these same players are of lower levels [73]. The management of SSGs requires further research, as studying the different possibilities of manipulation and combination among task constraints in SSG studies would likely help promote a better understanding of the individual function of the factors and help researchers draw more solid conclusions [72]. Future studies should also include elite athletes and larger samples of different methods, using longitudinal studies to assess the effect of the learning process in a training environment and its subsequent transfer to competition [74]. Even if differences in collective tactical behaviors were found when manipulating the number of players, field size, number of goals, and numerical inequality in SSGs, tactical behaviors have too rarely been studied. Existing studies mostly consisted in investigating the effect of manipulating of the number of allowed touches, coach encouragement, introduction of a goalkeeper, individual marking, formats without goals (e.g., scoring by stopping the ball at the end line). Other studies have brought to light the effect of continuous or interval regimes as these manipulations have been extensively studied from physical, physiological, and notational analysis perspectives. Future studies should be conducted to examine their effects on individual and collective tactical behavior of players to complement existing knowledge [30].

Additionally, it is important to highlight the limitations around psychological factors which can promote coach encouragement and player motivation in SSGs [23]. It is crucial to investigate more closely these factors to determine whether player behaviour is impacted depending on physical load due to the size of playing area or SSG formats [24]. Future studies could focus on investigating the longer-term effects of small-sided games on players' physical and technical development, as well as their transfer to actual match performance. Furthermore, examining the psychological aspects closely linked to performance outcomes, such as confidence, motivation, enjoyment, and cognitive engagement, during small-sided games could provide insights into optimizing training programs and enhancing player development.

5. Conclusion

Soccer players need to develop and improve their physical abilities to be able to perform technical skills in the game. Physiological factors depend not only on the intensity of the game but also on the direct involvement of activities with the ball. Training with small-sided games promotes better ball contact and more opportunities to improve technical performance, such as passing, shooting, and dribbling, allowing for the practice of decision-making and problem-solving linked to tactical demands. The use of small-sided games in specific preparation programs during the sports season is thus strongly recommended as a training methodology [41].

Amongst many reasons, small-sided games are proven important for improving the physical parameters of footballers for their benefits on workload because high heart rate responses are at the root aerobic capacity improvements. As the format decreases in small-sided games, physiological parameters tend to increase and thus, situations of 2×2 or 4×4 can be used to increase aerobic and anaerobic capacity and cause physiological stress, whilst situations with increased numbers like 6x6 can rather be useful to improve specific game movements. In addition, exercise intensity during small-sided games in football can be manipulated by varying the type of exercise, field dimensions, and coach encouragement. By using different combinations of these factors, coaches can modulate exercise intensity within the high-intensity zone and simultaneously control aerobic training [43]. The results of Hill-Haas et al. [42] and Casamichana and Castellano [11] even suggest that the use of small-sided games provides stimuli for aerobic training development. Overall, small-sided games represent a valuable training tool in football, offering diverse benefits for physical, technical, and tactical development in players across different age groups and skill levels.

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Appendix

Table A1. Representative studies of SSGs considering changes in the various physiological parameters.

Study	Sample	Age	Weigth (kg)	Heigth (m)	Small-side game format	Duration	Playing area (m)	HR (bpm)	%HR$_{max}$	La (mmol/L)	RPE
(Sassi et al., 2004)	9				GK + 4v4 + GK		30 × 25	178 ± 7		6.4 ± 2.7	
					GK + 8v8 + GK		60 × 40	168 ± 3		3.3 ± 1.2	
Aroso et al. (2004) (cited by Hill-Haas et al. (2011))	14				2v2	3 × 1.5min, 90s act rec	30 × 20		84.0 ± 5.0	8.1 ± 2.7	16.2 ± 1.1**
					3v3	3 × 4min, 90s act rec			87.0 ± 3.0	4.9 ± 2.0	14.5 ± 1.7**
					4v4	3 × 6min, 90s act rec			70.0 ± 9.0	2.6 ± 1.7	13.3 ± 0.9**
Owen et al. (2004)	13	17.5 ± 1.1			1v1 + 2	3min, 12min act rec	5 × 10		86		
							10 × 15		88		
							15 × 20		89		
					2v2 + 2		10 × 15		84.2		
							15 × 20		87.4		
							25 × 20		88.1		
					3v3 + 2		15 × 20		81.7		
							20 × 25		81.8		
							25 × 30		84.8		
					4v4 + 2		20 × 25		72		
							25 × 30		78.5		
					5v5 + 2		25 × 30		75.7		
							30 × 35		79.5		
							35 × 40		80.3		
Jones and Drust (2007)	8	7 ± 1	25.3 ± 3.8	1.3 ± 0.2	4v4	10min	30 × 20	175 ± 10	83		
					8v8		60 × 40	168 ± 6	79		

Table A1. (*Continued*).

Study	Sample	Age	Weigth (kg)	Heigth (m)	Small-side game format	Duration	Playing area (m)	HR (bpm)	%HR_{max}	La (mmol/L)	RPE
Rampinini et al. (2007)	20	24.5 ± 4.1	73.1 ± 8.6	1.79 ± 0.05	3v3	3 × 4min, 3min act rec	12 × 20		87.6 ± 1.7	4.4 ± 1.1	6.6 ± 0.4*
					3v3		15 × 25		88.6 ± 2.9	4.6 ± 1.0	7.0 ± 0.6*
					3v3		18 × 30		89.1 ± 1.8	5.0 ± 1.5	7.2 ± 0.7*
					4v4		16 × 24		86.5 ± 3.4	4.2 ± 1.6	6.3 ± 0.5*
					4v4		20 × 30		86.7 ± 3.0	4.3 ± 1.4	6.6 ± 0.6*
					4v4		24 × 36		87.2 ± 2.8	4.7 ± 1.2	6.8 ± 0.5*
					5v5		20 × 28		86.0 ± 4.0	3.9 ± 0.9	5.9 ± 0.7*
					5v5		25 × 35		86.1 ± 3.7	4.1 ± 1.4	6.2 ± 0.8*
					5v5		30 × 42		87.2 ± 2.8	4.6 ± 1.7	6.2 ± 0.6*
					6v6		24 × 32		83.8 ± 5.0	3.4 ± 1.0	4.8 ± 0.9*
					6v6		30 × 40		85.1 ± 3.3	3.9 ± 1.4	6.0 ± 1.4*
					6v6		36 × 48		85.0 ± 3.6	3.6 ± 1.5	5.9 ± 0.5*
Sampaio et al. 2007 (cited by Hill-Haas et al. (2011))	8				2v2	2 × 1.5min, 90s rec	30 × 20		83.7 ± 1.4		15.5 ± 0.6**
					3v3	2 × 3min, 90s rec			80.8 ± 1.7		15.8 ± 0.2**
Williams and Owen (2007)	9				1v1		20 × 15	183 ± 7			
					2v2			179 ± 7			
					3v3			164 ± 12			
					2v2		25 × 20	180 ± 5			
					3v3			166 ± 9			
					4v4			152 ± 14			
					3v3		30 × 25	171 ± 11			
					4v4			165 ± 5			
					5v5			152 ± 6			

Table A1. (*Continued*).

Study	Sample	Age	Weigth (kg)	Heigth (m)	Small-side game format	Duration	Playing area (m)	HR (bpm)	%HR_{max}	La (mmol/L)	RPE
Little and Williams (2007)	28				2v2	4 × 2min, 2min rec	27 × 18		88.9 ± 1.2	9.6 ± 1.0	16.3 ± 0.9**
					3v3	4 × 3.5min, 90s rec	32 × 23		91.0 ± 1.2	8.5 ± 0.8	15.7 ± 1.1**
					4v4	4 × 4min, 2min rec	37 × 27		90.1 ± 1.5	9.5 ± 1.1	15.3 ± 0.7**
					5v5	4 × 6min, 90s rec	41 × 27		89.3 ± 2.5	7.9 ± 1.7	14.3 ± 1.5**
					6v6	3 × 8min, 90s rec	46 × 27		87.5 ± 2.0	5.6 ± 1.9	13.6 ± 1.0**
					8v8	4 × 8min, 90s rec	73 × 41		87.9 ± 1.9	5.8 ± 2.1	14.1 ± 1.8**
Dellal et al. (2008)	10	26 ± 2.9			1v1	4 × 90s, 90s rec	10 × 10		77.6 ± 8.6		
					2v2	6 × 150s, 150s rec	20 × 20		80.1 ± 8.7		
					GK + 4v4 + GK	2 × 4min, 3min rec	30 × 25		77.1 ± 10.7		
					GK + 8v8 + GK	2 × 10min, 5min rec	60 × 45		80.3 ± 12.5		
					8v8	4 × 4min, 3min rec	60 × 45		71.7 ± 6.3		
					GK + 10v10 + GK	3 × 20min, 5min rec	90 × 45		75.7 ± 7.9		
Mallo and Navarro (2008)	10				3v3	1 × 5min, 10min rec	33 × 20	173			
					GK + 3v3 + GK			166			
Hill-Haas et al. (2009)	16	16.3 ± 0.6	65 ± 9.8	1.74 ± 0.08	2v2	24min	28 × 21		89 ± 5	6.7 ± 2.6	13.1 ± 1.5**
					4v4		40 × 30		85 ± 4	4.7 ± 1.6	12.2 ± 1.8**
					6v6		49 × 37		83 ± 4	4.1 ± 2.0	10.5 ± 1.5**
Kelly and Drust (2009)	8	18 ± 1	73.3 ± 6.2	1.80 ± 0.1	GK + 5v5 + GK	4 × 4min, 2min act rec	30 × 20	175 ± 9	91 ± 4		
							40 × 30	173 ± 11	90 ± 4		
							50 × 40	169 ± 6	89 ± 2		
Katis and Kellis (2009)	34	13 ± 0.9	62.3 ± 15.1	1.65 ± 00.6	GK + 3v3 + GK	10 × 4min, 3min act rec	15 × 25		87.6 ± 4.8		
					GK + 6v6 + GK		30 × 40		82.8 ± 3.2		

Table A1. (*Continued*).

Study	Sample	Age	Weigth (kg)	Heigth (m)	Small-side game format	Duration	Playing area (m)	HR (bpm)	%HR$_{max}$	La (mmol/L)	RPE
Casamichana and Castellano (2010)	10	15.5 ± 0.5	62.9 ± 3.7	1.74 ± 0.07	GK + 5v5 + GK	8min	32 × 23		93.0 ± 5.7		5.7 ± 1.0***
							50 × 30		94.6 ± 3.4		6.7 ± 0.8***
							62 × 44		94.6 ± 4.3		6.7 ± 0.8***
Dellal, Jannault, et al. (2011)	20	27.4 ± 1.5	79.2 ± 4.2	1.81 ± 0.02	2v2 + 4	4 × 2min, 3min act rec	20 × 15	182 ± 4	90.0 ± 2.3	3.4 ± 0.2	7.6 ± 0.6***
					3v3 + 4	4 × 3min, 3min act rec	25 × 18	181 ± 4	89.6 ± 2.2	3.0 ± 0.5	7.5 ± 0.5***
					4v4 + 4	4 × 4min, 3min act rec	30 × 20	171 ± 4	84.7 ± 2.7	2.9 ± 0.2	7.2 ± 0.5***
Kalapotharakos et al. (2011)	16	25 ± 5	75.7 ± 5.3	1.79 ± 0.1	4v4	4 × 4min, 2min rec	30 × 40		93 ± 1.7		
					5v5	4 × 6min, 3min rec	35 × 45		90.7 ± 2.5		
					6v6	3 × 7min, 3min rec	40 × 50		89.7 ± 2		
					7v7	3 × 8min, 3min rec	50 × 60		88.1 ± 3		
					8v8	3 × 8min, 3min rec	50 × 60		85.3 ± 2.2		
Dellal, Lago-Penas, et al. (2011)	20	27.4 ± 1.5	79.2 ± 4.2	180.6 ± 2.3	4v4 + 4	4 × 4min, 3min pass rec	30 × 20		82.7 ± 2.6	2.4 ± 0.3	6.3 ± 0.5***
									84.1 ± 2.6	3.1 ± 0.2	7.1 ± 0.5***
									85.1 ± 2.6	3.3 ± 0.2	7.3 ± 0.7
									86.8 ± 2.9	4.5 ± 0.3	8.2 ± 0.9***
da Silva et al. (2011)	16	13.5 ± 0.7			3v3	3 × 4min, 3min rec	30 × 30		89 ± 4.8		
					4v4				89.8 ± 2		
					5v5				86.9 ± 3		
Dellal, Chamari, et al. (2011)	20	27 ± 2			2v2	2 × 4min	20 × 15		90.7	3.5	
					3v3	3 × 4min	25 × 18		89.3	3.3	
					4v4	4 × 4min	30 × 20		85.5	2.8	
Owen et al. (2012)	15	26.3 ± 4.9			3v3	3 × 5min, 4min rec	30 × 25		94 ± 2.7		
					9v9		60 × 50		89 ± 4.8		

Table A1. (*Continued*).

Study	Sample	Age	Weigth (kg)	Heigth (m)	Small-side game format	Duration	Playing area (m)	HR (bpm)	%HR_{max}	La (mmol/L)	RPE
Brandes et al. (2012)	17	14.9 ± 0.7			2v2	3 × 4min	28 × 21		93.3 ± 4.2	4.6 ± 1.8	
					3v3	3 × 5min	34 × 26		91.5 ± 3.3	3.4 ± 1.3	
					4v4	3 × 6min	40 × 30		89.7 ± 3.4	4.2 ± 1.8	
Dellal et al. (2012)	27	16.5 ± 0.5			2v2	8 × 2min, 1min rec	20 × 25		80.1 ± 3.6		
					3v3	6 × 30s, 90s rec	25 × 30		81.5 ± 4.3		
					4v4	4 × 4min, 2min rec	28 × 38		70.6 ± 5.9		
Köklü (2012)	20	16.6 ± 0.5	65.9 ± 5.6	176.2 ± 4.6	2v2	3 × 2min	15 × 20	174.9 ± 5.4	88.6 ± 3.8	7.8 ± 1.6	
					2v2	6min		175.4 ± 7.7	88.8 ± 3.2	8.1 ± 1.7	
					3v3	3 × 3min	18 × 24	181.7 ± 5.7	92.0 ± 2.0	6.8 ± 1.3	
					3v3	9min		180.1 ± 6.7	91.2 ± 2.6	7.2 ± 1.5	
					4v4	3 × 4min	24 × 36	177.8 ± 5.9	90.1 ± 2.5	6.7 ± 1.5	
					4v4	12min		176.3 ± 5.3	89.3 ± 2.7	6.9 ± 1.8	
Evangelos et al. (2012)	9	17.2 ± 0.5	65.0 ± 4.8	170 ± 0.04	3v3	4 × 3min, 12min act rec	20 × 25	185.8 ± 8.0	92	8.4 ± 3.3	
					3v3 + 1A			183.8 ± 5.9	90	9.1 ± 3.3	
					3v3 + 1D			188.8 ± 5.9	95	8.4 ± 2.1	
					4v3			178.6 ± 7.5	87	6.7 ± 1.6	
					4v4		25 × 30	177.0 ± 7.8	90	4.1 ± 1.5	
					4v4 + 1A			171.3 ± 7.4	80	3.1 ± 2.6	
					4v4 + 1D			174.0 ± 8.0	86	3.3 ± 2.3	
					5v4			176.3 ± 7.1	89	3.5 ± 1.4	

Table A1. (*Continued*).

Study	Sample	Age	Weigth (kg)	Heigth (m)	Small-side game format	Duration	Playing area (m)	HR (bpm)	%HR_{max}	La (mmol/L)	RPE
Bekris, Sambanis, Milonys, Sarakinos, and Anagnostakos (2012)	8	17.4 ± 0.6	64.0 ± 6.8	173 ± 0.05	1v1	4 × 2min, 12 min act rec	10 × 15	184 ± 5.65		12.4 ± 1.8	
					1v1 + 1A			177.3 ± 8.62		8.3 ± 3.60	
					1v1 + 1D			178.7 ± 7.57		10.2 ± 2.70	
					2v1			174.7 ± 8.38		7.3 ± 2.90	
					2v2		15 × 20	180.7 ± 3.4		9.4 ± 3.4	
					2v2 + 1A			180.7 ± 3.4		9.4 ± 3.4	
					2v2 + 1D			176.3 ± 6.5		9.0 ± 1.7	
					3v2			177.0 ± 5.4		6.9 ± 2.0	
Abrantes, Nunes, Maçãs, Leite, and Sampaio (2012)	16	15.8 ± 0.5			3v3	4 × 4min, 2min rec	20 × 30				16.6 ± 0.3**
					4v4		20 × 40				16.0 ± 0.5**
Aguiar, Botelho, Gonçalves, and Sampaio (2013)	10	18.0 ± 0.67			2v2	3 × 6min, 1min rec	150m^2 per player		87.5 ± 7.5		17.0 ± 2.9**
					3v3				89.6 ± 3.2		17.0 ± 2.9**
					4v4				85.9 ± 6.0		15.0 ± 2.3**
					5v5				84.6 ± 7.6		13.5 ± 2.7**
Castellano, Casamichana, and Dellal (2013)	14	21.3 ± 2.3			3v3	3 × 3min, 5min rec	43 × 30		94.6 ± 3.0		
					5v5	3 × 5min, 5min rec	55 × 38		94.6 ± 4.1		
					7v7	3 × 7min, 5min rec	64 × 46		94.9 ± 5.4		
Halouani, Chtourou, Dellal, Chaouachi, and Chamari (2014)	12	14.0 ± 0.7	51.8 ± 8.0	164 ± 7	3v3 small goals	4v4min, 2min rec	20 × 15	174 ± 3		4.2 ± 1.0	6.6 ± 0.9***
					3v3 end zone			178 ± 3		4.7 ± 1.0	7 ± 0.7***

Table A1. (*Continued*).

Study	Sample	Age	Weigth (kg)	Heigth (m)	Small-side game format	Duration	Playing area (m)	HR (bpm)	%HR_{max}	La (mmol/L)	RPE
Köklü et al. (2015)	16	16,5 ± 1,5	63,0 ± 6,9	175,5 ± 5,2	GK + 2v2 + GK	4 × 2min, 2min rec	15 × 27		86,0 ± 2.8	7.4 ± 1.9	6.0 ± 2.0*
					2v2				88.0 ± 2.9	8.4 ± 2.2	7.3 ± 1.4*
					GK + 3v3 + GK	4 × 3min, 2min rec	20 × 30		86.9 ± 2.8	6.5 ± 1.9	4.6 ± 0.8*
					3v3				89.1 ± 2.6	7.3 ± 2.2	6.5 ± 1.4*
					GK + 4v4 + GK	4 × 4min, 2min rec	25 × 32		88.7 ± 2.5	6.1 ± 1.3	5.1 ± 1.8*
					4v4				90.1 ± 2.7	6.9 ± 1.5	5.7 ± 1.6*
Casamichana, Roman-Quintana, Castellano, and Calleja-Gonzalez (2015)	18	23.4 ± 4.5	74.4 ± 6.1	178.7 ± 5.6	3v3	6min	19 × 29	165.7 ± 8.4	92.0 ± 3.9	5.8 ± 2.0	2.0 ± 0.6*
					6v6		40 × 28	164.2 ± 8.2	91.5 ± 3.9	7.1 ± 1.9	4.3 ± 0.8*
					9v9		55 × 30	159.2 ± 11.8	88.9 ± 4.7	9.0 ± 2.6	7.2 ± 1.2*
Cihan (2015)	18	19.6 ± 0.5	71.9 ± 7.5	178.3 ± 4.6	3v3	3 × 4min	20 × 35	166.4 ± 25.5	75.0 ± 7.3		
					3v3 Ind Mar			178.4 ± 14.8	84.8 ± 4.7		
					4v3			184.9 ± 9.9	88.5 ± 2.3		
Halouani et al. (2016)	16	13.2 ± 0.6	52.5 ± 7	163.4 ± 6	4v4 end zone	4 × 4min, 2min pas rec	10 × 15	167.2 ± 3.0	80.6	7.1 ± 1.0	6.2 ± 1.0*
							15 × 20	172.3 ± 2.9	83	7.3 ± 1.0	
							20 × 25	175.4 ± 3.1	84.5	7.8 ± 0.9	
					4v4 small goals		10 × 15	164.5 ± 3.0	79.2	6.5 ± 1.0	5.8 ± 0.9*
							15 × 20	169.2 ± 3.1	81.6	6.8 ± 1.2	
							20 × 25	171.1 ± 2.7	82.6	7.1 ± 0.8	
Sannicandro and Cofano (2017)	10	15,6 ± 0,5	66 ± 7,3	172 ± 5	3v3	3 × 4min 90sec pas rec	18 × 30		87.2 ± 3.3		17.5 ± 0.7**
					4v4	3 × 6min, 90sec pas rec	24 × 36		83.8 ± 3.8		16.4 ± 1.3**
					5v5		30 × 42		83.7 ± 3.6		15.8 ± 1.1**

Table A1. (*Continued*).

Study	Sample	Age	Weigth (kg)	Heigth (m)	Small-side game format	Duration	Playing area (m)	HR (bpm)	%HR_{max}	La (mmol/L)	RPE
Halouani, Chtourou, Dellal, Chaouachi, and Chamari (2017)	18	13.5 ± 0.7	63.1 ± 7.7	168.9 ± 6.1	2v2 end zone	4 × 4min, 2min rec pas	20 × 25	178 ± 2.9	86	7.58	7.75*
					2v2 small goals			174 ± 3.1	84.2	7	7.33*
					3v3 end zone			181 ± 2.9	87.5	7.25	7.41*
					3v3 small goals			176 ± 2.7	85	6.75	7.08*
					4v4 end zone			175 ± 3.1	84.7	6.5	7.16*
					4v4 small goals			171 ± 2.1	82.5	6.16	6.83*
Clemente, Nikolaidis, and Silva (2017)	6	20.3 ± 4.8	69.3 ± 13.0	175.2 ± 7.5	1v1 1st	2min	10 × 15	171.0 ± 15.0	92.4 ± 5.3		
					1v1 2nd	2min		174.2 ± 11.3	94.3 ± 4.7		
					1v1 3rd	2min		177.3 ± 11.3	93 ± 12.8		
					3v3 1st	3min	19 × 24	174.2 ± 12.7	95.3 ± 4.7		
					3v3 2nd	3min		172.3 ± 9.9	93.3 ± 3.4		
					3v3 3rd	3min		175.0 ± 7.6	94.9 ± 2.5		
Arslan et al. (2017)	16	16.9 ± 0.3	62.4 ± 2.6	176.7 ± 3.2	2v2	4 × 2min, 3min act rec	12 × 24	171.6 ± 1.3	88.0 ± 1.1	7.8 ± 1.0	13.2 ± 0.4**
						4 × 2min, 3min pas rec		173.3 ± 1.4	88.9 ± 1.0	10.3 ± 1.8	15.1 ± 0.5**
					3v3	4 × 3min, 3 min act rec	18 × 30	169.9 ± 3.2	87.2 ± 2.2	6.9 ± 1.2	13.0 ± 0.4**
						4 × 3min, 3 min pas rec		170.2 ± 3.3	87.3 ± 1.5	8.8 ± 2.1	14.2 ± 0.4**
					4v4	4 × 4min, 3min act rec	24 × 36	168.3 ± 2.3	86.4 ± 1.6	5.9 ± 1.6	12.3 ± 0.5**
						4 × 4min, 3min pas rec		168.4 ± 2.4	86.5 ± 1.2	7.7 ± 1.2	13.0 ± 0.5**

Table A1. (*Continued*).

Study	Sample	Age	Weigth (kg)	Heigth (m)	Small-side game format	Duration	Playing area (m)	HR (bpm)	%HR$_{max}$	La (mmol/L)	RPE
Yucesoy et al. (2018)	16	22.37 ± 1.69	67.4 ± 7.5	171.0 ± 6.0	4v4	3 × 6min, 3min rec	26 × 34	179.9 ± 6.0	94.1 ± 4.9	11.3 ± 1.7	13.8 ± 0.7 ***
						18min		176.6 ± 12.4	90.8 ± 8.8	9.8 ± 2.8	13.6 ± 1.2 ***
Casamichana, Bradley, and Castellano (2018)	20	21.5 ± 5	72.7 ± 3.7	176.8 ± 1.9	5v5	4 × 6min, 8min pas rec	40 × 25		83.4 ± 5.1		3.8 ± 1.5*
							66 × 25		84.3 ± 4.8		4.9 ± 1.0*
							40 × 50		87.7 ± 4.0		6.3 ± 1.4*
							66 × 50		86.5 ± 4.5		6.6 ± 1.2 ± *
Halouani et al. (2019)	16	18.3 ± 0.7	73.4 ± 7.2	176.5 ± 6,3	4v4 end zone	4v4min, 2min rec	20 × 25	180 ± 2.8	89.7 ± 3.7		
					4v4 small goals			173 ± 3.02	85.8 ± 1.4		
Rabano-Munoz, Asian-Clemente, Saez de Villarreal, Nayler, and Requena (2019)	30	24.1 ± 3.5	70.3 ± 8.2	177.2 ± 5.9	4v4	4 × 4min, 2min pas rec	40 × 30	160.4 ± 9.7			
					4v4 + 2			152.5 ± 21.7			
		17.7 ± 0.9	65.7 ± 7.4	175.1 ± 6.4	4v4			170.6 ± 13.5			
					4v4 + 2			155.8 ± 17.0			
		16.0 ± 0.6	60.5 ± 6.0	171.2 ± 5.6	4v4			155.5 ± 17.7			
					4v4 + 2			132.6 ± 25.6			
Clemente, Nikolaidis, Rosemann, and Knechtle (2019)	10	23.7 ± 1.1	72.1 ± 4.9	178.2 ± 5.3	5v5	3 × 6min, 2min rec	42 × 22	169.7 ± 10.1			6.0 ± 0.8*
						6 × 3min, 2min rec		169.5 ± 9.8			5.3 ± 0.9*

HR – Heart Rate; %HR$_{max}$ - Percentage of Maximum Heart Rate; La – Blood Lactacte RPE – Rate of Perceived Exertion; Rec – Recovery; Pas Rec– Passive Recovery; Act Rec–Active Recovery; D – Defender; A – Attacker; GK – Goalkeeper; Ind Mar– Individual marking; * Borg Scale CR10; ** Borg Scale 6-20; *** Foster Scale CR10.

Table A2. Representative studies of SSGs considering changes in the various technical parameters.

Study	Sample (N)	Age	Small-sided game format	Duration	Playing area (m)	Passing (N)	Reception (N)	Turn (N)	Dribble (N)	Heading (N)	Tackle (N)	Block (N)	Interception (N)
Rudolf and Vaclav (2009)	20	8.1 ± 0.4	5v5	30min	40 × 20	143 ± 17.9					64 ± 16		
			8v8		60 × 48	143 ± 10.2					43 ± 6.1		
			11v11		96 × 60	135 ± 6.8					51 ± 4.6		
Kelly and Drust (2009)	8	18 ± 1	GK + 5v5 + GK	4 × 4min, 2min act rec	30 × 20	± 70	± 180		± 50		45 ± 10		± 38
					40 × 30	± 100	± 180		± 60		15 ± 4		± 40
					50 × 40	± 80	± 140		± 57		31 ± 7		± 38
Casamichana and Castellano (2010)	10	15.5 ± 0.5	GK + 5v5 + GK	8min	32 × 23	14.5 ± 6.6			5.2 ± 1.7	4.0 ± 2.1	3.0 ± 2.7		11.2 ± 3.1
					50 × 35	16.8 ± 6.1			4.5 ± 1.5	2.3 ± 2.2	4.5 ± 2.1		8.3 ± 2.6
					62 × 44	18.7 ± 4.3			1.7 ± 0.8	1.7 ± 1.0	3.0 ± 0.9		6.3 ± 1.5
da Silva et al. (2011)	16	13.5 ± 0.7	3v3	3 × 4min, 3min act rec	30 × 30	19 ± 4			4 ± 2	1 ± 1	2 ± 1		
			4v4			20 ± 4			2 ± 1	1 ± 1	2 ± 1		
			5v5			22 ± 4			2 ± 1	1 ± 1	2 ± 2		
Abrantes et al. (2012)	16	15.8 ± 0.5	3v3	4 × 4min, 2min act rec	20 × 30	84.2 ± 1.9	94.1 ± 1.0			70.1 ± 4.8	42.9 ± 5.1		68.5 ± 5.8
			4v4		20 × 40	86.4 ± 1.7	96.3 ± 0.7			70.0 ± 5.0	45.5 ± 6.8		55.4 ± 6.2
Evangelos et al. (2012)	9	17.2 ± 0.5	3v3	4 × 3min, 12min act rec	20 × 25	18.0 ± 9.9	15.5 ± 3.5	13,0 ± 4.3	3.5 ± 2.1	0.0 ± 0.0	0.0 ± 0.0	3.0 ± 0.0	6.5 ± 2.1
			3v3 + 1A			27.0 ± 4.24	16.0 ± 2.82	12.0 ± 2.8	1.5 ± 0.7	1.0 ± 0.7	0.0 ± 0.0	3.5 ± 0.7	5.5 ± 2.1
			3v3 + 1D			18.0 ± 1.4	18.0 ± 5.7	12.0 ± 5.7	5.0 ± 1.4	0.5 ± 0.7	0.0 ± 0.0	2.0 ± 0.0	4.5 ± 3.5
			4v3			18.0 ± 2.8	17.0 ± 2.8	12.5 ± 0.7	5.0 ± 4.2	0.0 ± 0.0	0.0 ± 0.0	3.5 ± 0.7	8.0 ± 1.4
			4v4		25 × 30	24.0 ± 2.8	17.0 ± 1.4	15.0 ± 5.7	3.0 ± 0.0	1.0 ± 1.4	0.0 ± 0.0	6.5 ± 0.7	8.5 ± 0.0
			4v4 + 1A			25.0 ± 9.9	15.0 ± 1.4	8.5 ± 0.7	1.5 ± 0.7	0.0 ± 0.0	0.0 ± 0.0	3.5 ± 0.7	6.0 ± 1.4
			4v4 + 1D			22.5 ± 10.6	18.0 ± 9.9	11.0 ± 1.4	2.5 ± 0.7	1.0 ± 0.0	0.0 ± 0.0	6.0 ± 2.8	8.0 ± 2.8
			5v4			30.0 ± 14.1	19.5 ± 9.2	12.0 ± 1.4	6.0 ± 2.8	1.5 ± 0.7	0.0 ± 0.0	8.0 ± 2.8	9.0 ± 1.4

Table A2. (*Continued*).

Study	Sample (N)	Age	Small-sided game format	Duration	Playing area (m)	Passing (N)	Reception (N)	Turn (N)	Dribble (N)	Heading (N)	Tackle (N)	Block (N)	Interception (N)
Bekris et al. (2012)	8	17.4 ± 0.6	1v1	4 × 2min, 12 min act rec	10 × 15	0.0 ± 0.0	0.0 ± 0.0	9.5 ± 0.7	2.0 ± 0.0	0.0 ± 0.0	1.5 ± 0.7	0.0 ± 0.0	6.5 ± 2.1
			1v1 + 1A			15.5 ± 4.9	14.0 ± 0.0	5.0 ± 2.8	1.5 ± 0.7	0.0 ± 0.0	2.5 ± 0.7	6.5 ± 2.1	5.5 ± 2.1
			1v1 + 1D			3.0 ± 0.5	10.5 ± 3.5	16.0 ± 5.7	3.0 ± 1.4	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	3.0 ± 1.4
			2v1		15 × 20	10.0 ± 14.1	10.5 ± 14.8	14.0 ± 1.4	2.5 ± 0.7	0.0 ± 0.0	3.0 ± 1.4	4.5 ± 6.4	4.5 ± 2.1
			2v2			12.0 ± 1.4	19.5 ± 0.7	12.0 ± 2.8	3.5 ± 2.1	0.0 ± 0.0	0.5 ± 0.7	6.0 ± 0.0	9.5 ± 0.7
			2v2 + 1A			20.5 ± 14.8	19.5 ± 3.5	11.5 ± 0.7	1.0 ± 1.4	0.0 ± 0.0	0.0 ± 0.0	4.0 ± 2.8	5.0 ± 0.0
			2v2 + 1D			7.0 ± 1.4	9.0 ± 4.2	11.5 ± 2.1	5.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	4.0 ± 2.8	3.5 ± 0.7
			3v2			28.5 ± 37.4	20.0 ± 19.8	9.0 ± 4.2	4.0 ± 2.8	0.0 ± 0.0	1.0 ± 0.7	5.0 ± 0.0	4.0 ± 2.8
Owen et al. (2014)	10	27.6 ± 4.1	4v4	3 × 5min, 3min rec pas	30 × 25	199.0 ± 5.7	166.5 ± 7.8	28.5 ± 3.5	31.0 ± 0.1	5.0 ± 1.4	18.5 ± 3.5	4.0 ± 2.8	7.5 ± 2.1
			5v5		46 × 40	170.5 ± 0.7	129.0 ± 12.7	29.5 ± 2.1	23.0 ± 2.8	1.5 ± 0.7	11.0 ± 0.1	8.5 ± 0.7	21.5 ± 0.7
			6v6		50 × 44	170.0 ± 9.9	138.5 ± 17.7	33.5 ± 3.5	22.5 ± 7.8	2.5 ± 2.1	13.5 ± 0.7	7.0 ± 1.4	21.0 ± 0.1
			7v7		54 × 45	146.0 ± 2.8	114.5 ± 3.5	30.5 ± 2.1	10.5 ± 2.1	4.0 ± 0.1	7.5 ± 0.7	9.0 ± 1.4	17.5 ± 0.7
			8v8		60 × 50	126.5 ± 10.6	98.5 ± 7.8	29.5 ± 3.5	10.0 ± 1.4	4.5 ± 0.7	6.0 ± 1.4	7.5 ± 2.1	17.0 ± 1.4
			9v9		70 × 56	115.5 ± 2.1	92.5 ± 2.1	26.0 ± 5.7	13.0 ± 4.2	7.5 ± 3.5	9.0 ± 0.1	8.0 ± 2.8	20.0 ± 2.8
			10v10		80 × 70	122.5 ± 3.5	95.5 ± 0.7	27.0 ± 2.8	18.0 ± 0.1	10.0 ± 1.4	10.5 ± 0.7	9.0 ± 1.4	21.5 ± 0.7
			11v11		100 × 74	125.5 ± 0.7	94.0 ± 2.8	34.0 ± 7.1	19.0 ± 1.4	10.0 ± 1.4	11.5 ± 2.1	11.0 ± 1.4	29.5 ± 10.6
Sannicandro and Cofano (2017)	10	15.6 ± 0.5	3v3	3 × 4min 90sec rec pas	18 × 30	196					33		
			4v4	3 × 6min, 90sec rec pas	24 × 36	312					39		
			5v5		30 × 42	323					59		
Yucesoy et al. (2018)	16	22.4 ± 1.7	4v4	3 × 6min, 3min rec	26 × 34	50.6 ± 13.5			5.4 ± 4.1		1.3 ± 1.3		7.0 ± 3.2
				18min		40.9 ± 6.7			2.0 ± 2.0		0.6 ± 1.06		4.6 ± 4.0

Rec – Recovery; Pas Rec– Passive recovery; Act Rec– Active recovery; D – Defender; A – Attacker; GK – Goalkeeper.

Table A3. Representative studies of SSGs considering changes in the various external workload parameters.

Study	Sample (N)	Age	Small-sided game format	Duration	Playing area (m)	Total distance (m)	Distance 0–6.9 km/h (m)	Distance 7.0–12.9 km/h (m)	Distance 13–17.9 km/h (m)	Distance > 18 km/h (m)
Jones and Drust (2007)	8	7 ± 1	4v4	10min	30 × 25	778 ± 160	181 ± 72	315 ± 86		143 ± 64
			8v8		60 × 40	693 ± 103	187 ± 77	334 ± 69		71 ± 7
Hill-Haas et al. (2009)	16	16.3 ± 0.6	2v2	24min	28 × 21	2574 ± 16	1176 ± 8	933 ± 21	411 ± 13	44 ± 24
			4v4		40 × 30	2650 ± 18	1128 ± 10	1041 ± 25	436 ± 15	65 ± 36
			6v6		49 × 37	2590 ± 33	1142 ± 16	925 ± 37	442 ± 22	71 ± 36
Casamichana and Castellano (2010)	10	15.5 ± 0.5	GK + 5v5 + GK	8min	32 × 23	695.8 ± 37.1	401.7 ± 27.7	238.9 ± 41.7	50.2 ± 21.0	4.9 ± 5.5
					50 × 35	908.9 ± 30.6	390.6 ± 30.4	329.3 ± 54.0	155.4 ± 41.4	28.5 ± 33.3
					62 × 44	999.6 ± 50.0	378.2 ± 37.2	366.3 ± 74.8	180.9 ± 42.6	74.2 ± 58.9
Dellal, Jannault, et al. (2011)	20	27.4 ± 1.5	2v2 + 4	4 × 2min, 3min rec pass	20 × 15	1157.7 ± 82.9			245.4 ± 37.8	177.5 ± 21.8
			3v3 + 4	4 × 3min, 3min rec pass	25 × 18	2013.9 ± 154.5			422.4 ± 33.4	315.6 ± 52.6
			4v4 + 4	4 × 4min, 3min pass rec	30 × 20	2663.6 ± 236.6			482.7 ± 71.2	331.8 ± 56.5
Owen et al. (2014)	10	27.6 ± 4.1	4v4	3 × 5min, 3min pas rec	30 × 25	1709 ± 54	534 ± 9	963 ± 32	200 ± 9	9 ± 2*
			5v5		46 × 40	1552 ± 91	650 ± 10	711 ± 91	185 ± 8	5 ± 1*
			6v6		50 × 44	1570 ± 62	620 ± 22	753 ± 26	190 ± 17	8 ± 2*
			7v7		54 × 45	2045 ± 31	738 ± 1	1012 ± 3	281 ± 2	21 ± 1*
			8v8		60 × 50	1606 ± 41	618 ± 24	805 ± 56	168 ± 13	12 ± 4*
			9v9		70 × 56	1847 ± 20	562 ± 33	909 ± 19	341 ± 23	26 ± 4*
			10v10		80 × 70	1750 ± 128	599 ± 32	836 ± 110	254 ± 26	48 ± 19*
			11v11		100 × 74	1798 ± 47	572 ± 8	871 ± 12	301 ± 26	42 ± 13*
Gaudino et al. (2014)	26	26 ± 5	5v5	4min	30 × 30	402 ± 47				
			GK + 5v5 + GK		27 × 27	419 ± 28				
			7v7		45 × 35	412 ± 38				
			GK + 7v7 + GK		37 × 37	443 ± 37				
			10v10		66v45	441 ± 31				
			GK + 10v10 + GK		52 × 52	466 ± 45				

Table A3. (*Continued*).

Study	Sample (N)	Age	Small-sided game format	Duration	Playing area (m)	Total distance (m)	Distance 0–6.9 km/h (m)	Distance 7.0–12.9 km/h (m)	Distance 13–17.9 km/h (m)	Distance > 18 km/h (m)
Praça, Custódio, and Greco (2015)	18	16.4 ± 0.7	3v3	4min	36 × 27	427.1 ± 48.94	40.08 ± 7.40	43.63 ± 6.44	14.97 ± 5.04	1.32 ± 1.84
			3v3 + 2			420.3 ± 46.36	41.17 ± 6.90	43.68 ± 5.66	14.32 ± 5.28	0.83 ± 1.39
			4v3			386.3 ± 51.84	45.87 ± 8.7	39.6 ± 6.55	13.24 ± 5.37	1.29 ± 2.15
Casamichana and Castellano (2015)	18	23.4 ± 4.5	3v3	6min	19 × 29	685.4 ± 90.9				
			6v6		40 × 28	748.7 ± 73.3				
			9v9		55 × 30	762.6 ± 73.3				
Cihan (2015)	18	19.6 ± 0.5	3v3	3 × 4min	20 × 35	1612.3 ± 140.8	455.0 ± 57.3	795.0 ± 134.2	314.6 ± 87.3	47.7 ± 37.8
			3v3 Ind Mar			1751.3 ± 203.5	405.2 ± 71.6	834.3 ± 104.3	437.6 ± 182.1	74.2 ± 42.0
			4v2			1783.6 ± 192.1	441.9 ± 54.6	731.7 ± 95.0	484.9 ± 168.7	125.1 ± 69.3
Köklü et al. (2015)	16	16.5 ± 1.5	GK + 2v2 + GK	4 × 2min, 2min rec	15 × 27	941.0 ± 85.6	358.2 ± 29.8	431.9 ± 81.8	122.1 ± 23.3	28.8 ± 17.6
			2v2			1048.0 ± 86.3	328.3 ± 24.9	529.3 ± 70.6	156.1 ± 44.0	34.3 ± 26.8
			GK + 3v3 + GK	4 × 3min, 2min rec	20 × 30	1376.4 ± 143.8	561.2 ± 52.4	610.1 ± 124.0	175.2 ± 63.9	30.0 ± 17.6
			3v3			1587.1 ± 185.5	509.6 ± 48.5	807.0 ± 154.9	221.3 ± 72.0	49.2 ± 32.9
			GK + 4v4 + GK	4 × 4min, 2min rec	25 × 32	1947.7 ± 236.2	766.8 ± 75.5	878.5 ± 192.9	251.5 ± 93.0	50.9 ± 34.7
			4v4			2153.9 ± 226.5	651.3 ± 78.0	1090.3 ± 192.4	352.2 ± 101.9	60.2 ± 49.3
Clemente, Nikolaidis, et al. (2017)	6	20.3 ± 4.8	1v1 1st	2min	10 × 15	240.4 ± 15.4	91.0 ± 6.0	127.1 ± 13.0	22.1 ± 18.4	0.2 ± 0.5
			1v1 2nd	2min		218.8 ± 22.1	102.1 ± 10.7	102.2 ± 25.2	14.5 ± 9.2	0.2 ± 0.4
			1v1 3rd	2min		227.2 ± 23.8	93.0 ± 12.8	115.1 ± 33.3	18.9 ± 8.9	0.4 ± 0.8
			3v3 1st	3min	19 × 24	456.2 ± 51.2	189.3 ± 22.5	205.2 ± 61.2	59.5 ± 23.2	2.3 ± 4.4
			3v3 2nd	3min		420.0 ± 55.6	196.9 ± 21.1	169.0 ± 54.7	48.5 ± 29.5	1.0 ± 0.9
			3v3 3rd	3min		427.5 ± 60.2	202.1 ± 21.6	184.9 ± 63.6	37.1 ± 23.8	3.4 ± 5.9

Table A3. (*Continued*).

Study	Sample (N)	Age	Small-sided game format	Duration	Playing area (m)	Total distance (m)	Distance 0–6.9 km/h (m)	Distance 7.0–12.9 km/h (m)	Distance 13–17.9 km/h (m)	Distance > 18 km/h (m)
Arslan et al. (2017)	16	16.8 ± 0.3	2v2	4 × 2min, 3min act rec	12 × 24	1134.4 ± 34.7	254.6 ± 27.5	652.9 ± 40.0	197.2 ± 32.6	29.0 ± 23.6
				4 × 2min, 3min rec pas		1070.2 ± 63.4	259.6 ± 31.2	611.9 ± 56.3	177.4 ± 498.2	23.0 ± 21.2
			3v3	4 × 3min, 3 min act rec	18 × 30	1735.2 ± 107.2	344.7 ± 73.3	1046.8 ± 133.9	293.7 ± 74.7	47.3 ± 24.3
				4 × 3min, 3 min pas rec		1681.3 ± 103.7	360.9 ± 67.0	1008.4 ± 140.9	260.8 ± 56.0	42.1 ± 19.1
			4v4	4 × 4min, 3min act rec	24 × 36	2342.9 ± 27.0	393.7 ± 54.4	1442.9 ± 45.4	382.8 ± 20.1	121.9 ± 23.7
				4 × 4min, 3min rec pas		2257.8 ± 112.3	473.4 ± 80.8	1344.6 ± 151.1	335.2 ± 42.6	94.9 ± 37.5
Clemente, Owen, et al. (2017)	10	23.4 ± 3.9	11v11	30min	54 × 68	2511.2 ± 279.8	1171.2 ± 90.5	898.4 ± 191.6	348.0 ± 109.7	93.6 ± 43.5
					108 × 68	3136.7 ± 323.8	1204.7 ± 130.6	1072.7 ± 240.5	603.1 ± 157.1	256.2 ± 76.2
Halouani et al. (2019)	16	18.3 ± 0.7	4v4 end zone	4v4min, 2min rec	20 × 25	2580 ± 220.3	1120.8 ± 100.2	1020.4 ± 199.0	350.3 ± 87.4	63.1 ± 31.3
			4v4 small goals			2230 ± 210	1005.7 ± 122.2	880.5 ± 160.9	285.8 ± 103.7	47.7 ± 32.7
Clemente, Nikolaidis, et al. (2019)	10	23.7 ± 1.1	5v5	3 × 6min, 2min rec	42 × 22	98.4 ± 7.5			8.0 ± 3.3	0.6 ± 0.4
				6 × 3min, 2min rec		107.6 ± 6.0			11.3 ± 1.9	0.8 ± 0.5
Rabano-Munoz et al. (2019)	30	24.1 ± 3.5	4v4	4 × 4min, 2min pas rec	40 × 30	1957.0 ± 145.5	671.1 ± 62.5	960.2 ± 131.8	288.6 ± 81.7	37.1 ± 23.9
			4v4 + 2			1508.8 ± 160.0	740.3 ± 106.0	616.6 ± 74.1	144.9 ± 36.4	7.0 ± 3.5
		17.7 ± 0.9	4v4			1963.6 ± 119.7	705.5 ± 72.9	936.5 ± 134.9	293.1 ± 93.1	20.7 ± 16.5
			4v4 + 2			1725.8 ± 223.3	758.4 ± 72.9	751.3 ± 294.2	201.2 ± 16.7	14.6 ± 1.2
		16.0 ± 0.6	4v4			1733.2 ± 167.6	749.4 ± 58.6	818.4 ± 190.3	159.6 ± 31.0	5.4 ± 3.6
			4v4 + 2			1513.7 ± 116.7	846.7 ± 34.8	643.6 ± 100.1	38.7 ± 13.5	3.2 ± 2.8
Sannicandro et al. (2019)			GK + 5v5 + GK + 6	4 × 3min, 1min rec pas	60 × 35	1658.4 ± 101.7	622 ± 54.3	630.8 ± 62.5	302.3 ± 59.8	92.2 ± 21.1
			GK + 6v6 + GK + 6			1603.8 ± 178.5	630.3 ± 35.5	718.6 ± 108.4	221.5 ± 75.8	33.3 ± 22.1
			GK + 7v7 + GK + 6			1575.3 ± 156.6	724.1 ± 40.7	617.7 ± 99.7	177 ± 77.9	43.1 ± 22.7

Rec – Recovery; Pas Rec– Passive recovery; Act Rec– Active recovery; GK – Goalkeeper; Ind Mar –Individual marking *The study did not consider sprinting distances.