 DOI: https://doi.org/10.5114/biolsport.2021.102932

Combining small-sided soccer games and running-based methods: A systematic review

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ABSTRACT: Small-sided games (SSGs) are often used in soccer to produce acute physiological and physical responses, while a tactical/technical stimulus is also employed. However, due to some limitations of SSGs, researchers have been testing this method combined with running-based training methods. This systematic review was conducted to assess the effects of combined SSG and running-based methods on soccer players' acute responses and adaptations after training interventions. A systematic review of Web of Science, PubMed, Cochrane Library, Scopus, and SPORTDiscus databases was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The database search initially identified 782 titles. From those, five articles were deemed eligible for the systematic review. The five included studies presented data from training load, reporting inconsistent greater values in combined SSG and running-based methods when compared to SSG-only formats. Considering the adaptations, studies comparing combined SSG and running-based methods with SSG-only methods revealed inconsistent differences in terms of the effects on aerobic performance and sprinting. Combining SSG and running-based methods can increase the acute mechanical load and high-intense running stimuli in players when compared to interventions that use only SSGs. However, the adaptations promoted by both methods are similar, and the differences are unclear. The order of combination (SSG and running-based method) does not seem to impact players' adaptations; however, the frequency of sessions did have a meaningful impact.

CITATION: Clemente FM, Sarmento H. Combining small-sided soccer games and running-based methods: A systematic review. Biol Sport. 2021;38(4):617–627.

Received: 2020-10-08; Reviewed: 2020-11-07; Re-submitted: 2020-11-08; Accepted: 2021-01-10; Published: 2021-02-11.

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Key words:
Football
Performance
Drill-based games
Conditioned games
High-intensity interval training

INTRODUCTION

Small-sided games (SSGs) are drill-based exercises often used in soccer training to promote intense acute physiological responses and improve tactical/technical dimensions [1]. These games are typically managed by coaches by changing the format of play (i.e., the numerical relationship between teams), pitch configuration (e.g., width and length ratio, pitch format), tactical/technical instructions (e.g., specific missions, instructions, type of marking), action restrictions (e.g., ball touch limitations, movement restrictions), or the type of training (e.g., continuous, intermittent, work-to-rest ratio) [2–4]. Considering that these task conditions can act concurrently, the acute effects of SSGs on players can vary significantly in terms of their physiological [5], physical [1], technical [6], and tactical [7] responses.

The use of SSG-based interventions can also affect adaptations in the physical fitness levels of players. The literature has consistently revealed that these drill-based games improve aerobic performance [8–11], whereas the evidence is not so consistent regarding other physical qualities (e.g., repeated-sprint ability, jumping, sprinting, change-of-direction) [12, 13]. Well-controlled study designs for this purpose are lacking, as most SSG-intervention studies are not controlled (i.e., they have no control group), and the vast majority of them have considered only youth players, who have with great trainability and potential for improvement.

Research findings support SSGs' beneficial effect on aerobic performance with no significant changes with running-based high-intensity interval training (HIIT) [8, 9]. However, some threats can be associated to SSGs. One drawback is that SSGs seem to be highly variable (i.e., intra- and inter-individual) in terms of high-intensity running demands, which may have a random effect on the physical demands and the mechanical and neuromuscular stimuli imposed on the players [14]. Additionally, it seems that SSGs significantly decrease players' exposure to high-intensity running (e.g., running above 19.8 km/h) because of the small longitudinal space of the modified pitch [15, 16].

Considering the above-mentioned drawbacks (i.e., high intra- and inter-individual variability and low high-speed running stimuli) [14],

some recent experimental approaches have been introduced to test the effects of training regimens that combine SSGs and running-based exercises (e.g., HIIT, sprinting) [17, 18]. This approach aims to add the mechanical stimulus of running-based HIIT to the beneficial physiological effects of SSGs in terms of aerobic performance.

Considering the recent appearance of original articles exploring the combination of SSGs and running-based exercises, it seems relevant to conduct a systematic review. Such a review will allow us to summarize the main evidence and identify useful directions for future researches. Additionally, it is important to show how the combination can be employed in practical scenarios. Based on these reasons, the purpose of this systematic review is to evaluate the effects of combined SSG and running-based training methods on soccer players' acute responses and adaptations after training interventions.

MATERIALS AND METHODS

This systematic review followed the Cochrane Collaboration guidelines [19]. The systematic review strategy was conducted according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines [20]. The protocol was published in INPLASY (International Platform of Registered Systematic Review and Meta-analysis Protocols) with the identification number of INPLASY2020100010 and DOI 10.37766/inplasy2020.10.0010.

2.1. Information sources

Electronic databases (Web of Science, Scopus, SPORTDiscus and PubMed) were searched for relevant publications prior to the 4th October of 2020. Keywords and synonyms were entered in various combinations (i.e., "Soccer" OR "Football") AND ("small-sided games" OR "conditioned games" OR "SSG" OR "drill-based games" OR "small-sided conditioned games" OR "reduced games" OR "play formats") AND ("high-intensity interval training" OR "interval training" OR "high-intensity training" OR "endurance" OR "run" OR "sprint*"). Additionally, the reference lists of the studies retrieved were manually searched to identify potentially eligible studies not captured by the electronic searches. Finally, an external expert has been contacted in order to verify the final list of references included in this umbrella review in order to understand if there was any study that was not detected through our research.

2.2. Eligibility criteria

The inclusion criteria for this systematic review were as follows: (i) only combined training including SSG and other training method in the same protocol with no limitation to sex, age or competitive level; (ii) acute effects or adaptations resulted from combined SSG and purely running-based methods; (iii) only studies conducted in soccer (association football); and (iv) only original and full-text studies written in English.

The screening of the title, abstract and reference list of each study to locate potentially relevant studies was independently performed by the two authors (FMC and HS). Additionally, they reviewed the full version of the included papers in detail to identify articles that met the selection criteria. A discussion was made in the cases of discrepancies regarding the selection process.

2.3. Data Extraction

A data extraction was prepared in Microsoft Excel sheet (Microsoft Corporation, Readmon, WA, USA) in accordance with the Cochrane Consumers and Communication Review Group's data extraction template [21]. The Excel sheet was used to assess inclusion requirements and subsequently tested for all selected studies. The process was independently conducted by the two authors (FMC and HS). Any disagreement regarding study eligibility was resolved in a discussion. Full text articles excluded, with reasons, were recorded. All the records were stored in the sheet.

2.4. Data items

The following information was extracted from the included original articles: (i) type of study design, number of participants (n), age-group (youth, adults or both), sex (men, women or both), competitive level (if available), and type of original articles included (experimental, observational analytic or both); (ii) identification of the effects (acute or adaptations), dimension of analysis (internal load [the measure of biological response to a given physical demand imposed by the exercise [22]] or biological responses in exercise; external load [the measure of physical demand or neuro-mechanical load imposed by the exercise [22]] or physical demands in exercise; technical actions; tactical behavior; recovery/fatigue/readiness; psychological; fitness variations), outcomes explored, and main findings.

2.5. Assessment of methodological quality

For the case of intervention studies, The Physiotherapy Evidence Database (PEDro) scale [23] was used to assess the methodological quality of the intervention studies included in this systematic review. The scale scores the internal study validity in a range of 0 (high risk of bias) to 10 (low risk of bias). Eleven items are measured in the scale. The criterion 1 is not included in the final score. Points for items 2 to 11 were only attributed when a criterion was clearly satisfied. Two of the authors (FMC and HS) independently scored the articles. Disagreements in the rating between both authors was resolved through discussion. Aiming to control the risk of bias between authors, the Kappa correlation test was used to analyze the agreement level for the included studies. An agreement level of k = 0.94 was obtained.

For the case of cross-sectional studies, the appraisal tool to assess the quality of cross-sectional studies (AXIS) was used to classify the methodological quality of the articles [24]. The scale includes 20 items, in which 1 is related to the introduction, 10 are related to methods, 5 are related to results, 2 are related to discussion, and 2 consider other factors. Two of the authors (FMC and HS) independently screened and rated the included full articles. The agreement of both authors was tested using the *k* agreement rate. The Cohen's kappa coefficient (*k*) was executed, and revealed a k agreement of k=0.98.

RESULTS

3.1. Study identification and selection

The searching of databases identified a total of 782 titles. These studies were then exported to reference manager software (EndNote™ X9, Clarivate Analytics, Philadelphia, PA, USA). Duplicates (304 references) were subsequently removed either automatically or manually. The remaining 478 articles were screened for their relevance based on titles and abstracts, resulting in the removal of a further 461 studies. Following the screening procedure, 17 articles were selected for in depth reading and analysis. After reading full texts, a further 12 studies were excluded due to not meet the eligibility criteria (Figure 1).

3.2. Study characteristics

The characteristics of the included studies can be found in Table 1. Among the five included studies, four of them were interventions [17, 18, 25, 26] and one was cross-sectional [27]. Three of the studies were conducted in youth [17, 25, 27], one in professional [26] and one in semi-professional [18]. Three studies compared combined SSG and running-based methods with just SSGs [17, 26, 27], while two compared two types of combined SSG and running-based methods [18, 25]. The internal load (i.e., psychophysiological responses to exercise) was registered in the five included studies, while external load (i.e., physical demands imposed by the drills) was just monitored in two studies [17, 27]. The aerobic performance was the fitness variable with more reports (N=4) [17, 18, 25, 26]. The four intervention studies reported the effects on aerobic performance adaptations [18, 25, 26, 28]. Three of the studies [18, 25, 28] employed the final velocity achieved in the 30–15 Intermittent Fitness Test, while one [26] employed the final distance achieved in the Yo-Yo intermittent recovery test level 1.

The details of the interventions and training regimens can be found in Table 2. The interventions had a minimum of four weeks [18, 25]

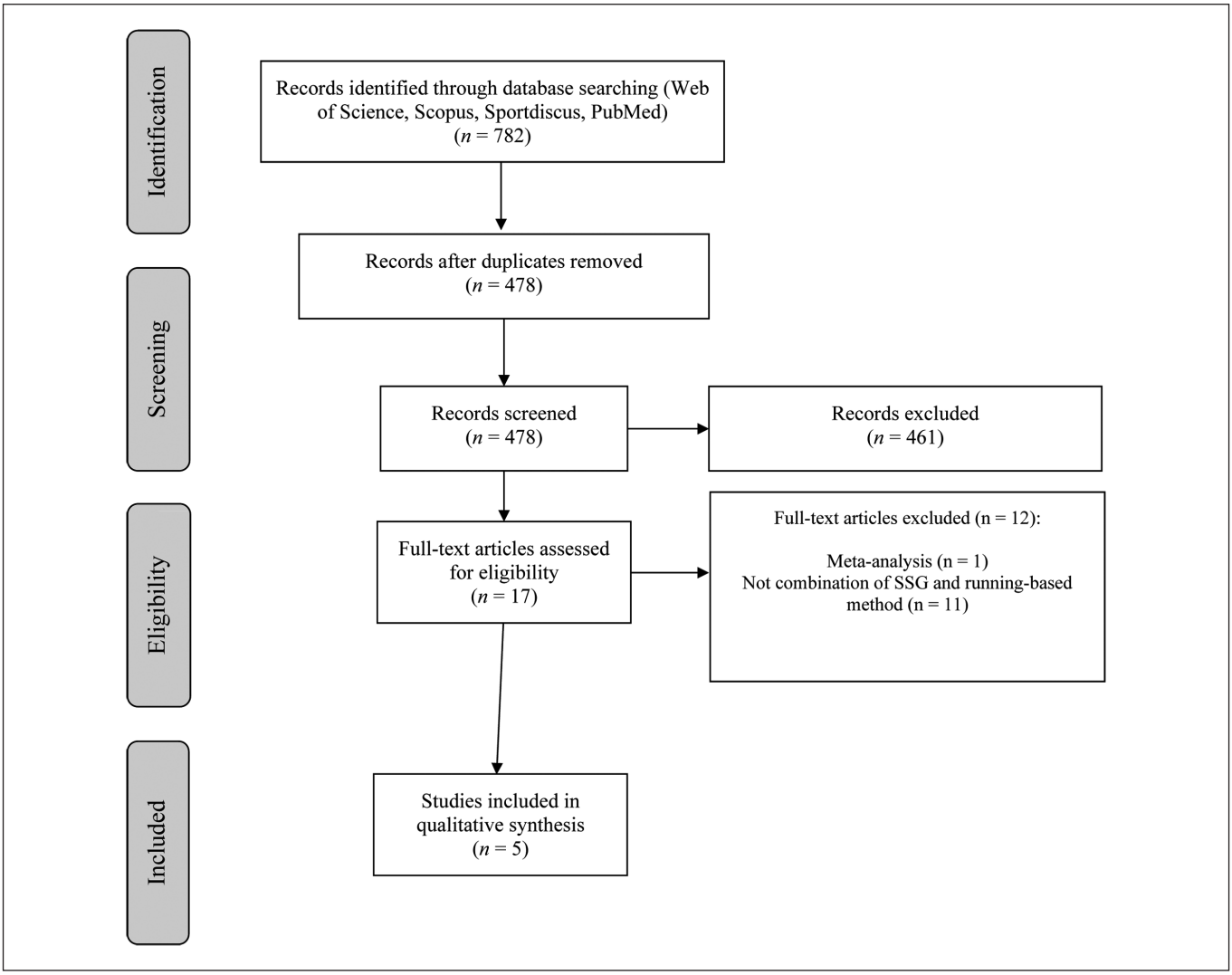

FIG. 1. PRISMA flow diagram highlighting the selection process for the studies included in the systematic review.

TABLE 1. Summary of the study characteristics.

Reference	Study design	Partici-pants (N)	Age (yo; mean ± SD) and sex (M, W)	Competitive level	Acute effects (Outcomes)	Adaptations (Outcomes)
Castillo et al. [26]	Parallel study	16	25.6 ± 7.6 yo ND	Professional	Internal load (RPE)	Sprinting (5-, 10-, 15-, 20-, 30- and 40-m) Aerobic (YYIRT-L1)
Harrison et al. [17]	Parallel study	26	13.9 ± 0.3 yo Men	Youth	Internal load (HR) External load (BL)	Aerobic ($\dot{V}O_{2peak}$; V_{IFT}) Sprinting (5-, 20-m) Jumping (CMJ)
Köklü et al. [27]	Within-subject repeated measures	18	18.2 ± 0.5 yo Men	Youth	Internal load (HR, lactate and RPE) External load (TD; MS) Technical (touches of the ball, passes, tackles, turnover)	-
Paul et al. [25]	Parallel study	19	16.2 ± 0.8 yo Men	Youth	Internal load (HR)	Aerobic (V_{IFT}) Jumping (CMJ) Change-of-direction (modified L run test)
Rabbani et al. [18]	Parallel study	21	23.2–24.1 ± 2.2–3.7 yo Men	Semi-professional	Internal load (RPE)	Aerobic (V_{IFT})

ND: not described; M: men; W: women; HR: heart rate; RPE: rated of perceived exertion; TD: total distance; HI-MP: high intensity metabolic power; YYIRT-L1: yo-yo intermittent recovery test level 1; m: meters; BL: body load; $\dot{V}O_{2peak}$: maximal oxygen uptake; V_{IFT}: final velocity at 30–15 intermittent fitness test; CMJ: countermovement jump; MS: maximum speed; SD: standard-deviation

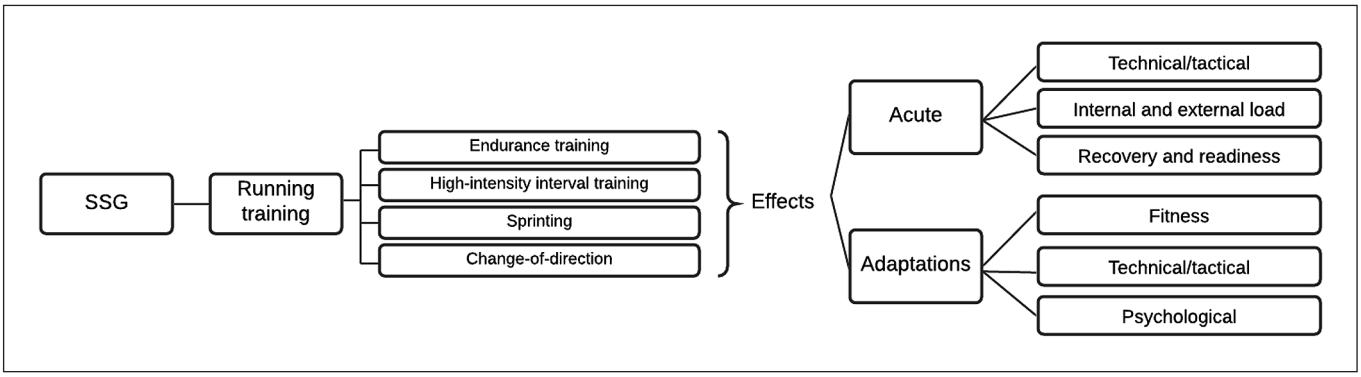

FIG. 2. Conceptual overview.

and a maximum of six [17, 26]. In three of training protocols, SSGs and running-based methods were combined in the same session [18, 26, 27], while in two studies the combination were made in different days (i.e., one day SSG and other HIIT) [17, 25]. The most common formats of SSGs were the 3 vs. 3 and 4 vs. 4 [17, 18, 25–27].

A conceptual overview elaborated by the authors of this systematic review can be seen in Figure 2. This overview aims to systematize the complexity of the field and presenting it in an intelligible manner.

3.3. Methodological quality

The overall methodological quality of the intervention studies can be found in Table 3. The four considered articles [17, 18, 25, 26] obtained a score of 6 points in ten possible.

The overall methodological quality of the cross-sectional studies can be found in Table 4. The study had 15 points in 20 possible.

3.4. Results of individual studies

The synthesis of results about the effects of combined SSG and running-based methods on internal and external load and technical/

TABLE 2. Characteristics of the training interventions combining SSG and other training method.

Study	Combination	Duration (w)	d/w*	Total sessions	Type of training	Format/ pitch	Work duration*	Work intensity/ description	Relief duration	Relief intensity	Sets*	Reps*	Recovery between sets (duration)	Recovery between sets (intensity)
Castillo et al [26]	SSG+ endurance and speed training	6 (3w with SSG+ endurance and 3w with SSG+ speed)	4	24	SSG	3 vs.3, 4 vs.4 and 8 vs.8/ 25 x 20 to 64 x 40 m	3–6 min	ND	ND	ND	3	-	2–3 min	ND
					Endurance	Running	8 min	50-m maximal intensity 50-m active running	-	-	2	-	3 min	ND
					Speed	Running	ND	All-out	30 s	ND	3	4 of 15-m 4 of 30-m 4 of 40-m	3 min	ND
Harrison et al. [17]	SSG+ running-based HIIT	6	1	6	SSG	3 vs.3	16–24 min	ND	ND	ND	ND	ND	ND	ND
			1	6	HIIT	Running	15 s	90–95% V_{IFT}	15 s	Passive	2	16–22	3 min	Passive
Köklü et al [27]	SSG+ running drills	-	-	-	SSG	3 vs.3 and 4 vs.4/ 20 x 30 and 25 x 32 m	3 min and 30 s	ND	-	-	4	-	2 min	Passive
					Running	Running	15 s before and 15 s after the SSG	80 m covered	-	-	4	-	2 min	Passive
Paul et al [25]	SSG+ running-based HIIT	4	4	16	SSG	4 vs.4/ 30 x 25 m	4 min		-	-	4	-	1 min	Passive
			1	4	HIIT	Running	15–30 s	110–120% V_{IFT}	15 s	-	2	4–6 min (of 15–15 s and 30–15 s)	90 s	Passive
Rabbani et al [18]	SSG+ running-based HIIT	4	2	7	SSG	3 vs.3+GK/ 35 x 25 m	3 min	ND	-	-	2	-	3 min	Passive
					HIIT	Running	15 s	95–100% V_{IFT}	15 s	ND	2	3 min (15–15 s)	3 min	Passive

ND: not described; HIIT: high-intensity interval training; VIFT: final velocity at 30–15 Intermittent Fitness Test; m: meters; GK: goalkeeper

tactical dimensions can be found in Table 5. Among the included studies, it was observed that SSGs reported slight but not significant increases in heart rate in the combined forms. However, RPE and blood lactate concentrations were significantly greater in the combined forms. Regarding the external load, the most intense distances were significantly greater in combined SSG and running-based methods.

The synthesis of results about the effects of combined SSG and running-based methods on fitness dimensions (aerobic, sprinting, jumping and change-of-direction) can be found in Table 6. Overall, the effects of combined SSG and running-based methods are similar to only SSGs. Both are significantly beneficial for improving aerobic performance.

TABLE 3. Physiotherapy Evidence Database (PEDro) scale ratings.

	N.º1*	N.º2	N.º3	N.º4	N.º5	N.º6	N.º7	N.º8	N.º9	N.º10	N.º11	Total**
Castillo et al [26]	0	1	0	1	0	0	0	1	1	1	1	6
Harrison et al. [17]	0	1	0	1	0	0	0	1	1	1	1	6
Paul et al [25]	0	1	0	1	0	0	0	1	1	1	1	6
Rabbani et al [18]	0	1	0	1	0	0	0	1	1	1	1	6

*: PEDRro scale items number; **: the total number of points from a possible maximal of 10; N.º1: eligibility criteria were specified; N.º2: subjects were randomly allocated to groups; N.º3: allocation was concealed; N.º4: the groups were similar at baseline regarding the most important prognostic indicators; N.º5: there was blinding of all subjects; N.º6: there was blinding of all therapists who administered the therapy; N.º7: there was blinding of all assessors who measured at least one key outcome; N.º8: measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups; N.º9: all subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analyzed by "intention to treat"; N.º10: the results of between-group statistical comparisons are reported for at least one key outcome; and N.º11: the study provides both point measures and measures of variability for at least one key outcome. 1: yes; 0: no.

TABLE 4. Critical appraisal tool to assess the quality of cross-sectional studies (AXIS).

	N.º1	N.º2	N.º3	N.º4	N.º5	N.º6	N.º7	N.º8	N.º9	N.º10	N.º11	N.º12	N.º13	N.º14	N.º15	N.º16	N.º17	N.º18	N.º19	N.º20	Total
Köklü et al [27]	1	1	0	1	1	1	0	1	1	1	1	1	0	0	1	1	1	1	0	1	15

1: yes; 0: no

TABLE 5. Qualitative synthesis and summary measures considering the acute effects of combined SSG and running-based training methods.

Study	Purpose	Internal load	External load	Tactical/technical
Castillo et al [26]	Compare exclusive SSGs and combined SSGs+endurance and speed	RPE (A.U.) The RPE was recorded during the weekly sessions. On Tuesday, the combined approach was significantly higher in terms of RPE (7.8 ± 0.5 A.U.) comparing to only SSGs. However, in the remaining days, no significant changes were found.	-	-
Harrison et al. [17]	Compare exclusive SSGs and combined SSGs+HIIT	HRpeak (%) The HRpeak was 91% in HIIT sessions, while was about 89% in SSGs sessions.	Body load (A.U.) The body load measure was about 400 A.U. in HIIT, while was about 320 in SSGs sessions.	-
Köklü et al [27]	Compare exclusive SSGs and combined SSGs+running drills	HR (bpm) No significant differences in 3 vs.3 and 4 vs.4 formats HRmax (%) No significant differences in 3 vs.3 and 4 vs.4 formats Blood lactate (mmol/L) Significant greater values in combined version in both 3 vs.3 and 4 vs.4 formats RPE (A.U.) Significant greater values in combined version in both 3 vs.3 and 4 vs.4 formats	Distance 0–7.1 km/h (m) No significant differences in 3 vs.3 and 4 vs.4 formats Distance 7.2–14.3 km/h (m) No significant differences in 3 vs.3 but significant greater in only SSG in 4 vs.4 Distance 14.4–19.7 km/h (m) Significant greater values in combined version in both 3 vs.3 and 4 vs.4 formats Distance > 19.8 km/h (m) Significant greater values in combined version in both 3 vs.3 and 4 vs.4 formats	Touches of the ball (n) Significant greater values in only SSGs version in both 3 vs.3 and 4 vs.4 formats Total passes (n) No significant differences in 3 vs.3 and 4 vs.4 formats Successful passes No significant differences in 3 vs.3 and 4 vs.4 formats Tackles No significant differences in 3 vs.3 and 4 vs.4 formats Turnover No significant differences in 3 vs.3 and 4 vs.4 formats

TABLE 5. Continue

Study	Purpose	Internal load	External load	Tactical/technical
			Total distance (m) Significant greater values in combined version in both 3 vs.3 and 4 vs.4 formats Maximum speed (km/h) Significant greater values in combined version in both 3 vs.3 and 4 vs.4 formats	
Paul et al [25]	Compare concentrated combined SSG+HIIT (four sessions SSG + one of HIIT) with regular training with only one SSG+HIIT session	HRmax (%) Average heart rate was significantly greater in concentrated SSG+HIIT (83.7%) than in the single session SSG&HIIT (73.4%) Session-RPE (A.U.) Average load was significantly greater in concentrated SSG+HIIT (344 A.U.) than in the single session SSG&HIIT (253 A.U.)	-	-
Rabbani et al [18]	Compare combined SSG+HIIT and HIIT+SSG	Session-RPE (A.U.) Unclear and trivial differences were found between SSG+HIIT and HIIT+SSG	-	-

RPE: rated of perceived exertion; A.U.: arbitrary units; HIIT: running-based high intensity interval training; HRpeak: peak heart rate; m: meters; km/h: kilometers per hour; n: number

TABLE 6. Qualitative synthesis and summary measures considering the adaptations promoted by the combined SSG and running-based training methods.

Study	Purpose	Aerobic	Sprinting	Jumping	Change-of-direction
Castillo et al [26]	Compare exclusive SSGs and combined SSGs+endurance and speed	YYIRT-L1 (m) Combined (post-pre: 0.32%, no significant differences) Just SSG (post-pre: 1.79%, significant differences) No significant differences between groups were found ($p > 0.05$)	5-m test (s) Combined (post-pre: -2.62%, no significant differences) Just SSG (post-pre: -4.24%, no significant differences) 10-m test (s) Combined (post-pre: -2.59%, no significant differences) Just SSG (post-pre: -2.96%, no significant differences) 15-m test (s) Combined (post-pre: -2.38%, no significant differences) Just SSG (post-pre: -1.97%, no significant differences) 20-m test (s) Combined (post-pre: -1.00%, no significant differences) Just SSG (post-pre: -1.65%, no significant differences) 30-m test (s) Combined (post-pre: -1.29%, no significant differences) Just SSG (post-pre: -2.54%, no significant differences) 40-m test (s)	-	-

TABLE 6. Continue

Study	Purpose	Aerobic	Sprinting	Jumping	Change-of-direction
			Combined (post-pre: -4.48%, no significant differences) Just SSG (post-pre: -1.10%, no significant differences) Overall, no significant differences between groups were found ($p > 0.05$)		
Harrison et al. [17]	Compare exclusive SSGs and combined SSGs+HIIT	$\dot{V}O_{2peak}$ (mL/Kg/min) Combined (post-pre: 5.5%, large magnitude of change) Just SSG (post-pre: 1.6%, unclear changes) V_{IFT} (km/h) Combined (post-pre: 6.6%, large magnitude of change) Just SSG (post-pre: 4.2%, small magnitude of change)	5-m (s) Combined (post-pre: -1.1%, unclear changes) Just SSG (post-pre: -5.1%, small magnitude of change) 20-m (s) Combined (post-pre: -1.2%, unclear changes) Just SSG (post-pre: -2.7%, unclear changes)	CMJ (cm) Combined (post-pre: 4.7%, unclear changes) Just SSG (post-pre: 1.4%, unclear changes)	-
Paul et al [25]	Compare concentrated combined SSG+HIIT (four sessions SSG + one of HIIT) with regular training with only one SSG+HIIT session	V_{IFT} (km/h) Concentrated SSG+HIIT (post-pre: 8.2%, significant differences) One session SSG+HIIT (post-pre: 1.7%, no significant differences)	-	CMJ (cm) Concentrated SSG+HIIT (post-pre: 1.5%, no significant differences) One session SSG+HIIT (post-pre: 2.9%, no significant differences)	Agility right (s) Concentrated SSG+HIIT (post-pre: -3.1%, no significant differences) One session SSG+HIIT (post-pre: -0.3%, no significant differences) Agility left (s) Concentrated SSG+HIIT (post-pre: -1.7%, no significant differences) One session SSG+HIIT (post-pre: -0.8%, no significant differences)
Rabbani et al [18]	Compare combined SSG+HIIT and HIIT+SSG	V_{IFT} (km/h) SSG+HIIT (post-pre: 6.2%, moderate magnitude of change) HIIT+SSG (post-pre: 6.9%, moderate magnitude of change) Trivial between group differences	-	-	-

YYIRT-L1: yo-yo intermittent recovery test level 1; m: meters; s: seconds; $\dot{V}O_{2peak}$: maximal oxygen uptake; V_{IFT}: final velocity at 30–15 intermittent fitness test; CMJ: countermovement jump; HIIT: high-intensity interval training; SSG: small-sided games

DISCUSSION

The present systematic review aimed to summarize research on the use of combined SSG and running-based training methods on soccer players. From the five included studies, three compared combined forms with only SSGs; the other two have compared one type of combination with another type of combination. The discussion of the main evidence is presented below.

4.1. Discussion of evidence: acute effects

All the studies included in this systematic review monitored the training loads of players during training sessions. Interestingly, all five studies monitored the internal load. The rate of perceived exertion (RPE) was the most commonly assessed variable among the studies (four of the five studies have used perceptive scales of effort). Heart rate was monitored in three of the studies [25, 27, 28], and the blood lactate was considered in just one [27]. Generally, the studies comparing combined forms (SSG+running-based methods) with only SSGs reported slight but not significant increases in heart rate in the combined forms [27, 28]. Meanwhile, RPE was significantly greater in the combined forms [26, 27]. Additionally, the study that observed blood lactate found significantly greater values in the combined training group in comparison to the SSG-only group [27]. These results can be explained by the greater volume of high-intensity running present in the combined forms of training [27, 28]. Possibly, the high effort promoted by running-based methods justifies the increased anaerobic synthesis, thus increasing blood lactate levels [29]. Finally, the study comparing the effects of combination order (i.e., running-based method+SSG vs. SSG+running-based method) applied in the same training session revealed no meaningful effects in terms of perceived effort [18].

Naturally, the study that tested the acute impact of combined forms vs. only SSG found that the number of ball touches was significantly greater in the SSG-only format [27]. However, the results were not standardized, as the SSG-only exercise lasted four minutes, while the combined method entailed three minutes and 30 seconds of SSG and 30 seconds of running. Additionally, no significant differences were found in the numbers of total passes, successful passes, tackles, and turnovers [27].

4.2. Discussion of evidence: adaptations

The study comparing combined form (SSG+endurance and speed running) and only SSGs presented no significant differences between interventions, even though the SSG-only group exhibited significant within-group improvements after the intervention (+1.79%) [26]. On the other hand, the study comparing a combined form (SSG+running-based high-intensity interval training) and only SSGs revealed that the group exposed to the combination improved by 6.6%, while those exposed only to SSGs improved by 4.2% [28]. Possibly, the effects of both training methods (combined and SSG-only) have similar effects of aerobic performance, particularly considering the consistent findings reporting the similar effects of SSGs vs. methods that involve only running-based training [8, 9]. The justification can be associated with the metabolic and cardiorespiratory taxing of both methods.

The study comparing participants exposed to five combined sessions (concentrated group) vs. only one [25] revealed significant effects on the concentrated group (+8.2%) and no significant effect on the single SSG+running-based high-intensity interval training group (+1.7%). Thus, frequency influences the magnitude of adaptations. However, the order of the combination (tested within the same training session) does not seem to produce differences between players, while both interventions (i.e., either SSG+running-based high-intensity interval training or its opposite order) meaningfully improved the final velocity in the 30–15 Intermittent Fitness Test [18].

Comparisons of the adaptations promoted by combined forms and only SSGs in players' sprinting performance revealed no significant or meaningful between-group or within-group differences [26, 28]. Interestingly, in the study conducted in professionals, speed training was used, with no significant impact observed [26]. Additionally, the effects of two types of approaches (combined vs. SSG-only) revealed no meaningful within-group changes in lower-limb power as measured by the countermovement jump [28]. A similar absence of a significant impact on countermovement jump was found in the study that compared a concentrated group vs. a single combined session group [25]. Finally, in the same study [25], no significant effects were found in change-of-direction performance. Thus, it could be that both the combined format (i.e., SSG+running-based method) and the SSG-only format of training do not have a meaningfully beneficial impact on neuromuscular-dependent variables such as sprinting, jumping, and change-of-direction performance.

4.3. Study limitations

The present systematic review has two main limitations. One of these limitations is the fact that only five original studies were included. Such a small number of original studies should be considered when attempting to generalize or interpret the results. The other main limitation is that only studies written in English were included, thus excluding literature written in other languages. An additional possible limitation is related to the variety of study purposes and designs included in this systematic review.

The original studies included in this systematic review also present their own limitations. The majority of the studies used small sample sizes and did not report *a priori* sample size estimations. Additionally, no mention was made of whether the processes carried out during the assessment, intervention, and statistical reporting were blind. For the studies that applied interventions, the absence of pre-register protocol is also noteworthy. Finally, the absence of responder and non-responder profiles and the lack of organization of results/statistical reports considering such a fact can be considered further limitations.

4.4. Future research and practical applications

Future research should identify the effects of different combinations of SSGs and running-based methods. For example, researchers could use sprint interval training or repeated sprint training as alternative running-based drills to explore their effects on sprinting performance. Additionally, different combination and prescription interventions should be compared considering the following factors: (i) SSGs used in one session and running-based training in the other vs. SSGs running-based training used in the same session; (ii) extreme-to-small SSGs (with larger or smaller pitch dimensions) + different running-based methods vs. moderate-to-large SSGs (with larger or smaller pitch dimensions) + different running-based methods; and (iii) the effects of training on different days of the week while considering recovery.

Alternatively, researchers could use running-based methods to complement high-intensity running stimuli [30]. Considering that playing roles conduct to different physical demands in a match, it would be interesting to individualize the stimuli and loads based on players' needs. This could be done by comparing a standard combination vs. an individualized combination (in which the dose of running-based training is adjusted based on the typical value of the player). As part of this approach, external load monitoring should be considered.

Finally, a combination method that includes non-running methods (e.g., strength training) should be considered. Two recent studies [31, 32] have tested the effects of combinations of SSGs and strength training on players. This approach could solve the issue of the unclear and trivial benefits of combined SSGs and running-based methods on neuromuscular-dependent variables such as sprinting, change-of-direction, and jumping.

CONCLUSIONS

The present systematic review revealed that the extant evidence of differences in the acute internal loads of combined training methods (SSGs+running-based training) and SSG-only methods is inconsistent. However, external load is significantly intensified by combined training, and coaches should consider this when planning training sessions. Regarding adaptations, combined forms of training and SSGs seem to yield similar benefits in terms of aerobic performance. Meanwhile, none of the approaches significantly improved neuromuscular-dependent variables such as sprinting, change-of-direction, or jumping performance.

Additionally, the results revealed that the order of combination does not influence adaptations in players' acute psychophysiological responses. However, the frequency of sessions does seem to play an important role in aerobic performance adaptation, with a higher frequency leading to greater benefits.

Funding

Filipe Manuel Clemente: This work is funded by Fundação para a Ciência e Tecnologia/Ministério/Ministério da Ciência, Tecnologia e Ensino Superior through national funds and when applicable co-funded EU funds under the project UIDB/50008/2020. Hugo Sarmento gratefully acknowledge the support of a Spanish government subproject Integration ways between qualitative and quantitative data, multiple case development, and synthesis review as main axis for an innovative future in physical activity and sports research [PGC2018-098742-B-C31] (Ministerio de Economía y Competitividad, Programa Estatal de Generación de Conocimiento y Fortalecimiento Científico y Tecnológico del Sistema I+D+i), that is part of the coordinated project 'New approach of research in physical activity and sport from mixed methods perspective (NARPAS_MM) [SPGC201800X098742CV0]'. No other specific sources of funding were used to assist in the preparation of this article.

Conflicts of interest/Competing interests

Filipe Manuel Clemente and Hugo Sarmento declare that they have no conflicts of interest relevant to the content of this review.

Authorship Contributions

FMC lead the project, run the data search and methodological assessment, and wrote and revised the original manuscript. HS run the data search and methodological assessment and wrote and revised the original manuscript.

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