Small-Sided Game Training Improves Aerobic Capacity and Technical Skills in Basketball Players

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Key words
- passing
- repeated sprint
- agility
- explosive power
- shooting

Abstract

The aim of this study was to compare the effects of 2 training interventions based on small-sided games (SGG) and high-intensity interval training (HIT) on physical and technical performance of male junior basketball players. A secondary objective was to investigate if these effects were similar in starting and bench players. 18 players participated in a pre-testing session, 6-weeks intervention period and a post-testing session. Pre- and post-sessions involved assessments of aerobic fitness, repeated sprint ability (RSA), defensive and offensive agility, upper and lower body power, shooting and passing skills. Mixed-design analysis of variance (ANOVA) with Bonferroni corrected pairwise comparisons examined the effects of time and type of intervention on physical and technical performances. The main results showed that both interventions resulted in similar improvements in aerobic capacity (+3.4% vs. +4.1%), with greater improvements in bench players compared to starting players (+7.1% vs. +1.1%, $P<0.05$). However, RSA was unchanged after both interventions. In addition, compared to HIT, SSG resulted in greater improvements in defensive agility (+4.5% vs. −2.7%, $P<0.05$), shooting skills (+7.4% vs. −2.4%, $P<0.05$) and upper body power (+7.9% vs. −2.0%, $P<0.05$). These results suggest that SSG should be prioritized in physical conditioning of junior basketball players during the season. However, when RSA is targeted, more specific training seems necessary.

Introduction

Basketball players should have a good aerobic capacity to cover a distance of approximately 7.5 km per match, with mean heart rates (HR_{mean}) ranging from 87.0 to 94.4% of HR_{peak} [3, 24, 25, 27]. Aerobic capacity is also strongly correlated with high-intensity running during matches, and has been identified as one of the determinants of repeated sprint ability (RSA), [3, 10].

Training at intensities close to the maximal oxygen consumption (VO_{2max}) represents the best stimulus to develop aerobic capacity [4]. The most accurate training method is to perform high-intensity interval training (HIT, [4]). However, several authors have recently argued that small-sided games (SSG) are as efficient as HIT for developing aerobic capacity for team sport players [8, 9, 19, 20]. Indeed, with regard to basketball several studies reported that SSG elicited significantly greater HR_{mean} compared to simulated match (5v5) conditions, with the greatest HR_{mean} values observed for 2-against-2 (2v2, HR_{mean} ranging from 88.2 to 92.0% of HR_{peak}), compared to 3-against-3 (3v3 HR_{mean} ranging from 85.6 to 88.0% of HR_{peak}) and 4 against 4 (4v4 HR_{mean} of 82.7% of HR_{peak}) [2, 10, 14, 23, 28]. In addition, the main benefits of SSG is that they also develop or maintain technical skills, which is particularly important in younger players [2, 5, 22].

To our knowledge, no scientific study has compared the effects of SSG and HIT in basketball. However, Bogdanis et al. [5] showed that 4 weeks of specialised basketball training (SSG) and mixed training (specialised and aerobic circuit training) resulted in similar increases in estimated VO_{2max}, and better improvements in technical skills in the specialised group. However, this study was performed in the off season, and further studies are needed to characterize training adaptations of junior basketball players during the competitive season.

Most studies showed no in-season variation in VO_{2max} e.g., [15]. Interestingly, Caterisano et al. [11] observed that VO_{2max} was maintained during the season in starting players, but decreased by

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10% in bench players. This suggests that while endurance conditioning might not be necessary in starters, basketball players with lower match playing time might need additional conditioning during practice sessions. However, this study was undertaken before the change in the rules of the game, and further studies comparing starters and bench players are necessary.
Therefore the objective of this study was to compare the effects of SSG and HIT on aerobic fitness, RSA and technical skills of male junior basketball players. When similar effects between SSG and HIT on these variables were identified, a secondary objective was to investigate differences between starting and bench players.

Methods

Subject recruitment and eligibility

Male basketball players were recruited from 2 junior (U17) teams competing at regional level. Inclusion criteria were regular participation in practice sessions and competitions, and the absence of injury in the past 6 months. From an original sample of 27 (14 players from one team and 13 players from the other team), 24 players started the study, as described in **Fig. 1**. Both teams had comparable training loads and followed similar periodization throughout the season. At the time of the study, they were having 3 basketball practice sessions and 1 match weekly, with no additional strength and conditioning. Prior to testing, subjects and their legal guardians were informed of the study protocol and provided written informed consent. The study was approved by the local Ethics Committee and meets the ethical standards of the International Journal of Sports Medicine [18].

Study design and randomization

A randomized parallel matched-group design was used (**Fig. 1**). Prior to the start of the study, subjects undertook several tests to determine their baseline physical fitness and technical skill levels. Since it is well-established that basketball technical and physical skills are highly dependent on players' roles on the court [1, 14], the randomization process took this into account. Players in each team were matched according to their playing position (guard, forward and centre). Random allocation within each pair to either a small-sided training group (SSG, n=12) or a high-intensity interval training group (HIT, n=12) was then performed by tossing a coin. The study took place during the competitive season, with baseline testing performed in mid-October, followed by a 6-weeks training intervention period, and post-tests in early December.

Pre- and post-testing sessions

All tests were randomly presented, except the aerobic capacity and RSA tests, performed 48 h apart. Aerobic capacity was estimated by the 30–15 Intermittent Fitness Test (30–15_{IFT}, [6]), which has very good test-retest reliability [6]. The speed and HR attained in the last fully completed stage were recorded as maximal aerobic performance (V_{IFT}, km.h^{-1}) and HR_{peak} (beats. min^{-1}). The RSA test involved 6 repetitions of shuttle-run sprints of 20 m (10+10 m), departing every 20 s [7]. It was preceded by a familiarization and criterion score determination [10]. Total time (TT), ideal time (IT) and performance decrement (PD) were calculated [10]. Defensive agility was assessed by the T-test, known as a reliable test with basketball-specific footwork [26], while offensive agility was assessed by the Control Dribble Test (**Fig. 2**), [1]. Sprint times in these tests were measured by photocells (Wireless Speedtrap 2, Brower Timing Systems, Draper, Utah, USA). A 3-kg medicine ball 2-handed chest pass was used to measure upper body power. Subjects were required to sit

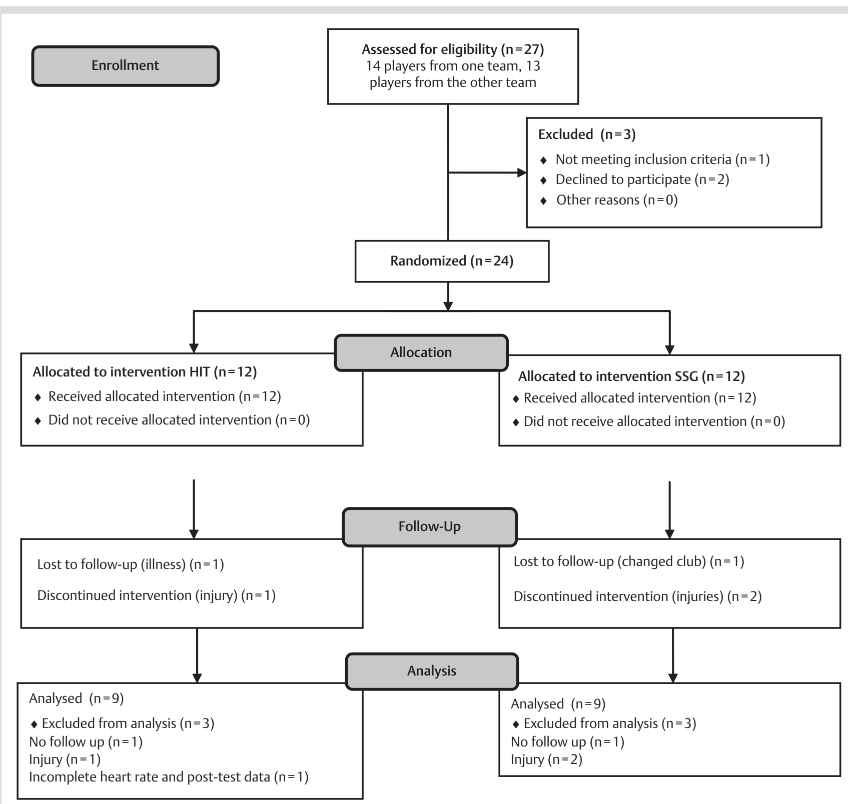

Fig. 1 Flow of participants through each stage of the study: enrollment, training group allocation, follow-up and analysis (SSG: small-sided game; HIT: High-Intensity Training).

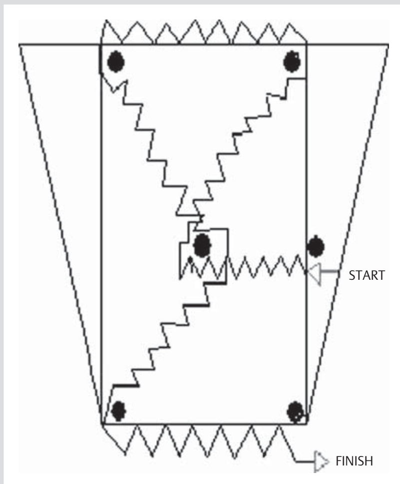

Fig. 2 Control dribble test, used in the assessment of offensive agility. The test consists of running with the ball as fast as possible while changing hands around 5 cones placed inside the key.

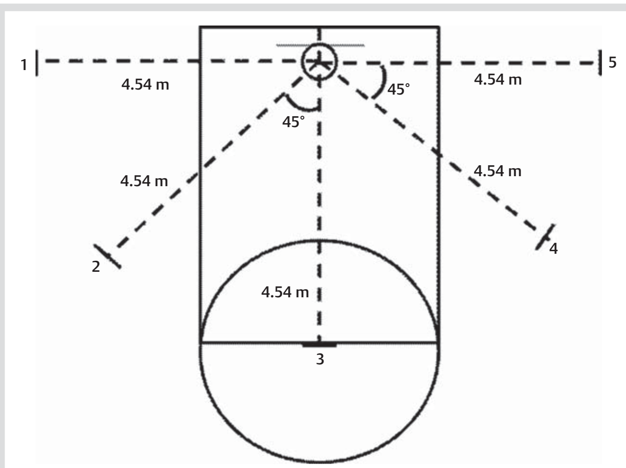

Fig. 3 Shooting skills assessment. Guidelines: Starting from any of the 5 positions, players were instructed to shoot, get their rebound and dribble to another position. No specific rules were given regarding the order in which the positions were used, except that players should attempt at least 1 shot per position. Players were allowed to attempt a maximum of 4 lay-ups during the test, but these could not be performed in succession. They received 2 points for each successful shot and one point when the ball touched the rim. Points awarded during the 60 s were then added and used as a performance indicator.

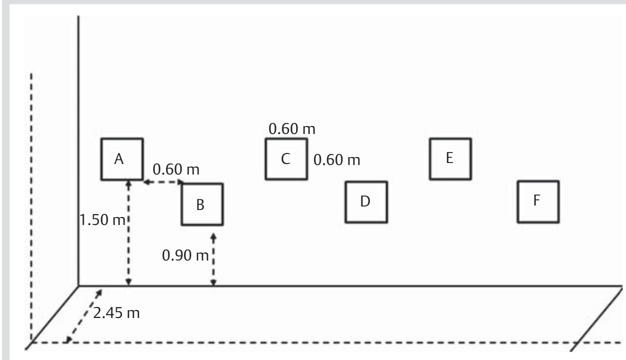

Fig. 4 Assessment of passing skills. Guidelines: The starting position was facing the furthest left target behind a line placed 2.45 m from the wall, and players were requested to place their feet as close as possible but behind the line while performing shuttles (side-shuffling) between the first and sixth target. Targets must be attempted in a succeeding manner (i.e., following the sequence order: A-B-C-D-E-F-F-E-D-C-B-A-A-B-…). 2 points were awarded when the ball landed within the target or on its border, while passes touching the spaces between targets were awarded one point. Points accumulated for 30 s s were used as a performance indicator.

against a wall, their legs resting straight horizontally to ensure reliability [13]. Lower body power was tested by the quintuple horizontal jump test (5JT). Literature has reported good reliability for this test in elite basketball players [12], and the reliability observed in the present study was also good (intraclass correlation coefficient of 0.90). To assess shooting skills, players attempted to score as many shots as possible in 60 s from 5 different positions (▶ **Fig. 3**), [29]. The assessment of passing skills consisted of performing as many 2-handed chest passes on targets as possible, while side-shuffling for 30 s [29], (▶ **Fig. 4**).

Training interventions

HIT and SSG training interventions were performed during the season and added twice a week to basketball practice sessions for a total duration of 6 weeks. They were always performed at the start of the session, following a standardized warm-up, and matched for exercise duration (▶ **Table 1**). The HIT training sessions consisted of intermittent running at 95 % of players' V_{IFT} for 15 s, followed by 15 s of active recovery (jogging). The type of SSG used was 2v2 on full-length (28 m), and half-width (7.5 m) court. This configuration was used in a recent study [14] and 2v2 was chosen because of the greater intensity experienced in this type of drill compared to SSG involving more players [10, 14]. Another reason for using half the width of the court is because this space is often used by coaches during practice sessions to allow more players exercising simultaneously (up to 8 players performing 2v2 drills at the same time). Drills were played like a competition, with only man-to-man defence, and no free throws or time-outs. Scores were kept to encourage players' motivation and verbal encouragements were provided by the coach. The small-sided games included players participating in the study as well as other players taking part in the practice session. Players were then randomly allocated to pairs (composed of a guard and either a forward or a centre), and new pairs were created for each training session, so that each pair played 2 or 3 games together only. HR was continuously monitored (Suunto Pro Team Pack, Vantaa, Finland) during 1 weekly session, and mean heart rate (HR_{mean}) was calculated (beats.min^{-1} and % of HR_{peak}).

Statistical analyses

Shapiro-Wilk tests assessed the normality of distributions. A student T-test for independent samples compared HR values elicited by SSG and HIT. Then, a mixed-design factorial analysis of variance (ANOVA) with Bonferroni corrected pairwise comparisons examined the effects of time and type of intervention on physical and technical performances. The relationship between the variation in V_{IFT} (delta V_{IFT}) and RSA parameters (delta TT, delta IT and delta PD) between the pre- and post-tests was tested by Pearson correlation coefficient. If no difference in the various parameters recorded was shown between SSG and HIT, players when then divided into a "starters" group (n = 9, 5 from HIT and 4 from SSG) and a "bench" group (n = 9, 4 from HIT and 5 from SSG), according to Caterisano et al. [11]'s definitions. A mixed-design factorial ANOVA was applied to test the effects of time and group on V_{IFT} and RSA parameters. Statistical significance was set as $P < 0.05$. Effect sizes were calculated manually

Table 1 Description of the 6-weeks training programmes for the small-sided game (SSG) group and the high-intensity intermittent running group (HIT).

	HIT	SSG
subjects characteristics	N = 9 (4 guards, 3 forwards, 2 centres) Age: 16.0 ± 0.6 years Height: 181 ± 7 cm Body mass: 73.5 ± 6.9 kg Basketball training experience: 6.8 ± 3.1 years	N = 9 (4 guards, 3 forwards, 2 centres) Age: 16.3 ± 0.8 years Height: 182 ± 9 cm Body mass: 74.2 ± 6.3 kg Basketball training experience: 7.2 ± 2.9 years
week 1	2 × (8 min of 15″-15″ at 95 % of V_{IFT})	2 × (2 × 3 min45)
week 2	2 × (9 min of 15″-15″ at 95 % of V_{IFT})	2 × (2 × 4 min15)
week 3	2 × (10 min of 15″-15″ at 95 % of V_{IFT})	2 × (3 × 3 min)
week 4	2 × (11 min 30 s of 15″-15″ at 95 % of V_{IFT})	2 × (3 × 3 min30)
week 5	2 × (13 min of 15″-15″ at 95 % of V_{IFT})	2 × (3 × 4 min)
week 6	2 × (9 min of 15″-15″ at 95 % of V_{IFT})	2 × (2 × 4 min15)

15″-15″: 15 s of high-intensity running at a speed corresponding to 95 % of the speed attained in the last stage fully completed during the 30–15 intermittent fitness test (V_{IFT})

from SPSS outputs using eta squared (η^2), and interpreted according to Ferguson [16].

Results

27 subjects were assessed for eligibility, and only 24 were randomly assigned to the 2 training interventions after screening and matching. 6 participants (25 %) were then excluded from the final analysis, due to lack of follow-up or loss of data. The flowchart of participants is described in **Fig. 1**.

No difference was shown between HR_{mean} measured during the 2 training interventions (P = 0.349). Values were 183.2 ± 5.6 beats.min^{-1} (90.5 ± 2.2 % of HR_{peak}) and 184.7 ± 7.8 beats.min^{-1} (90.6 ± 2.6 % of HR_{peak}) for HIT and SSG groups, respectively. Average playing times during the intervention period were 27.9 ± 6.3 min in starters and 9.7 ± 6.7 min in bench players.

Both interventions induced an increase in V_{IFT} (+3.4 % to +4.1 %, P < 0.05) with no difference between interventions or interaction effect (P > 0.05). No effects of time, group or interaction were observed on TT IT or PD (P > 0.05, **Table 2**). No effect of time or group was shown on defensive agility (P > 0.05). However, there was an interaction effect (P < 0.05), with SSG improving agility performance (−4.5 %) and HIT performing slightly worse (+2.7 %) in the post- compared to pre-test. Both HIT and SSG involved improvements in offensive agility times (−4.3 % to −7.2 %, P < 0.05), but no group or interaction effects were observed (P > 0.05, **Table 2**). No effect of time and group was shown on upper body power (P > 0.05). However, there was an interaction effect (P < 0.05), with the SSG group improving performance by 7.9 % between pre- and post-tests, while a 2.0 % decrease was observed in the HIT group. There was no effect of time, group or interaction on lower body power (P > 0.05, **Table 2**). No effect of time and group was shown on shooting skills (P > 0.05). However, an interaction effect was shown (P < 0.05), with a +7.4 % improvement in the SSG group and a −2.4 % decrease in the HIT group between pre- and post-tests. A significant effect of time was observed on passing skills (+6.7 % to +9.8 %, P < 0.05). However, there was no group or interaction effects (P > 0.05, **Table 2**).

Differences between starting and bench players are shown in **Table 3**. An effect of time (P < 0.05) was shown on V_{IFT}, while no group effect was evidenced (P > 0.05). In addition, an interaction effect was observed, with bench players increasing performance more than starting players (+7.1 % vs. +1.0 %, respectively for these 2 populations, P < 0.05). No significant effects of time, group or interaction were observed on TT, IT and PD (P > 0.05). Regarding technical parameters, an effect of time was observed on offensive agility and passing skills, with significantly better performances achieved in the post- compared to pre-test (P < 0.05). A group effect was also observed on passing skills only, showing significantly poorer performances of bench players compared to starters throughout the testing period (P < 0.05). No significant interaction effect was evidenced for these variables (P > 0.05). Finally, no significant effect of time, group or interaction was revealed on lower body power (P > 0.05). There was no significant correlation between delta V_{IFT} and delta TT (r = −0.313, P = 0.298), delta V_{IFT} and delta IT (r = −0.448, P = 0.125) and delta V_{IFT} and delta PD (r = 0.023, P = 0.939).

Discussion

The main results of this study showed that an in-season training intervention based on SSG was as efficient as HIT for increasing aerobic capacity in junior basketball players, with greater benefits occurring in bench players compared to starters. In addition, compared to HIT, SSG resulted in greater improvements in defensive agility, shooting skills and upper body power. These results were mostly associated with moderate effects sizes. This suggests that SSG should be prioritized for in-season development of aerobic capacity and technical skills in junior players.

The similar (3.4 % vs. 4.1 %) improvement in V_{IFT} following SSG and HIT is consistent with previous studies [5, 8, 19, 20]. In basketball, Bogdanis et al. [5] showed that two 4-week training programmes consisting of SSG or mixed training (SSG and aerobic circuit training) both resulted in a 4.9 % improvement in estimated VO_{2max} in junior basketball players. In soccer and handball literature, the improvements ranged from 6.3 to 7.0 % [8, 19, 20]. The amount of change in aerobic capacity following a training programme depends on various factors, including intervention duration, baseline fitness level or time of the season [5, 8, 19, 20]. Within this context, we showed that adding physical conditioning in the form of SSG twice a week was enough to promote an improvement in the aerobic capacity of male junior players after 6 weeks during the season. The HR observed in the present study are within the range reported in basketball literature [14, 22, 25, 27] and are consistent with the suggestion made by several authors that training at intensities above 90 % of HR_{max} was preferable to lower intensities for promoting an increase in endurance capacity in junior team sport players [19, 20]. We observed greater standard deviations in HR values achieved

Table 2 Effects of time (pre vs. post) and training intervention (high-intensity interval training, HIT vs. small-sided games, SSG) on physical and technical performances of male junior basketball players (V_{IFT}: maximal aerobic performance; RSA: repeated sprint ability).

	Time	HIT	SSG	P values and Effect sizes (eta squared η^2)	Confidence interval limit
V_{IFT} (km.h^{-1})	PRE	17.4 ± 0.7	17.2 ± 1.7	**Time: P = 0.028, η^2 = 0.395** Group: P = 0.814, η^2 = 0.006	HIT: 16.2–18.6 SSG: 16.0–18.4
	POST	18.0 ± 1.0	17.9 ± 1.5	Interaction: P = 0.765, η^2 = 0.006	HIT: 16.9–19.1 SSG: 16.8–19.0
total time RSA (s)	PRE	27.1 ± 1.9	27.9 ± 2.4	Time: P = 0.300, η^2 = 0.070 Group: P = 0.230, η^2 = 0.108	HIT: 25.5–28.8 SSG: 26.2–29.7
	POST	27.0 ± 1.8	28.7 ± 1.9	Interaction: P = 0.146, η^2 = 0.144	HIT: 25.6–28.4 SSG: 27.2–30.2
ideal time RSA (s)	PRE	26.1 ± 1.8	26.3 ± 1.9	Time: P = 0.667, η^2 = 0.013 Group: P = 0.490, η^2 = 0.037	HIT: 24.7–27.5 SSG: 24.8–27.8
	POST	25.8 ± 1.7	26.9 ± 1.9	Interaction: P = 0.208, η^2 = 0.117	HIT: 24.4–27.1 SSG: 25.4–28.3
performance decrement RSA (%)	PRE	3.75 ± 1.99	5.83 ± 2.53	Time: P = 0.399, η^2 = 0.055 Group: P = 0.162, η^2 = 0.145	HIT: 2.03–5.48 SSG: 3.99–7.67
	POST	4.35 ± 2.51	6.33 ± 4.26	Interaction: P = 0.938, η^2 = 0.001	HIT: 1.72–6.98 SSG: 3.52–9.14
defensive agility (s)	PRE	10.32 ± 1.16	10.36 ± 0.72	Time: P = 0.558, η^2 = 0.018 Group: P = 0.432, η^2 = 0.045	HIT: 9.6–11.0 SSG: 9.6–11.2
	POST	10.60 ± 0.97	9.89 ± 0.40	**Interaction: P = 0.037, η^2 = 0.270**	HIT: 10.0–11.2 SSG: 9.3–10.5
offensive agility (s)	PRE	8.33 ± 0.34	8.48 ± 0.50	**Time: P = 0.001, η^2 = 0.700** Group: P = 0.895, η^2 = 0.001	HIT: 8.03–8.63 SSG: 8.14–8.81
	POST	7.97 ± 0.42	7.87 ± 0.24	Interaction: P = 0.131, η^2 = 0.047	HIT: 7.71–8.22 SSG: 7.58–8.16
shooting skills (points)	PRE	29.4 ± 3.4	29.7 ± 3.7	Time: P = 0.151, η^2 = 0.086 Group: P = 0.195, η^2 = 0.117	HIT: 27.7–31.2 SSG: 27.7–31.7
	POST	28.7 ± 4.0	31.9 ± 3.6	**Interaction:P = 0.006, η^2 = 0.394**	HIT: 26.6–30.7 SSG: 29.6–34.2
passing skills (points)	PRE	97.7 ± 9.0	95.7 ± 4.2	**Time: P = 0.004, η^2 = 0.452** Group: P = 0.541, η^2 = 0.027	HIT: 88.4–106.8 SSG: 85.4–106.1
	POST	107.3 ± 6.9	102.3 ± 5.4	Interaction: P = 0.504, η^2 = 0.018	HIT: 99.4–115.2 SSG: 93.3–111.2
upper body power (m)	PRE	5.91 ± 1.83	6.10 ± 1.34	Time: P = 0.223, η^2 = 0.080 Group: P = 0.532, η^2 = 0.029	HIT: 4.74–7.08 SSG: 4.77–7.43
	POST	5.79 ± 1.49	6.58 ± 1.29	**Interaction:P = 0.048, η^2 = 0.231**	HIT: 4.78–6.80 SSG: 5.43–7.71
lower body power (m)	PRE	10.7 ± 1.3	10.7 ± 1.0	Time: P = 0.094, η^2 = 0.179 Group: P = 0.734, η^2 = 0.009	HIT: 9.8–11.5 SSG: 10.2–11.5
	POST	10.9 ± 1.0	11.2 ± 0.8	Interaction: P = 0.401, η^2 = 0.042	HIT: 9.7–11.6 SSG: 10.5–12.0

during SSG compared to HIT (7.8 vs. 5.6 beats.min^{-1}), which is also similar to previous investigations [8,19]. It has been suggested that SSG could either have a ceiling effect for fitter player [8] or could not allow other players to reach the required intensity because of poor technical skills or specific requirements due to their playing position [14]. However, in the present study, this effect was minimized because the SSG drills chosen were 2-against-2, which are more intense that 3-against-3 regardless of playing position [14]. In addition, from a practical point of view, these court settings could allow more players to train simultaneously.

In the present study, a significantly greater improvement in aerobic capacity was observed in bench compared to starting players, with a moderate effect size. Caterisano et al. [11] observed that when no specific physical conditioning intervention was undertaken VO_{2max} was maintained during the season in starting players, but decreased by 10% in bench players. This, together with our results suggest that extensive playing times during weekly matches help maintain aerobic capacity, but additional physical conditioning during practice sessions is necessary for players with less playing time.

No change in RSA was observed following both interventions in the present study. There are contrasting results in the literature on the effects of SSG and HIT on RSA in team sport players, with one study reporting decreases in TT, IT and PD after both SSG and HIT [8], and another [17] showing no effect of HIT on RSA parameters. Furthermore, in this latter study [17] RSA was unchanged after 7 weeks of HIT training, but improved after specific RSA training of the same duration. These findings suggest that although aerobic capacity has been identified as one determinant of performance of RSA [10], more specific training at higher intensities might be necessary for inducing significant improvement in RSA performance. This is in accordance with the absence of significant correlation observed in the present study between the variation of aerobic capacity and RSA following the training intervention.

Alongside aerobic capacity, other physical skills are crucial for basketball performance, including agility and explosive power

Table 3 Maximal aerobic capacity, repeated sprint ability (RSA) and technical changes following a 6-weeks training intervention in starting and bench players (V_{IFT}: maximal aerobic performance; RSA: repeated sprint ability).

	Time	Starting players	Bench players	P-values and Effect sizes (eta squared: η^2)	Confidence interval limit
V_{IFT} (km.h^{-1})	PRE	17.6 ± 0.7	17.0 ± 1.7	**Time: P = 0.028, η^2 = 0.395** Group: P = 0.907, η^2 = 0.001	Starting: 16.4–18.8 Bench: 15.8–18.2
	POST	17.8 ± 0.7	18.2 ± 1.6	**Interaction:P = 0.037, η^2 = 0.222**	Starting: 16.6–18.9 Bench: 17.1–19.3
total time RSA (s)	PRE	27.6 ± 2.3	27.1 ± 2.2	Time: P = 0.099, η^2 = 0.205 Group: P = 0.268, η^2 = 0.060	Starting: 24.5–27.7 Bench: 27.1–30.3
	POST	28.5 ± 2.0	27.1 ± 2.2	Interaction: P = 0.640, η^2 = 0.171	Starting: 25.2–28.8 Bench: 27.1–30.7
ideal time RSA (s)	PRE	26.1 ± 1.9	25.9 ± 1.9	Time: P = 0.542, η^2 = 0.034 Group: P = 0.689, η^2 = 0.017	Starting: 23.5–26.1 Bench: 26.0–28.5
	POST	26.6 ± 1.8	25.8 ± 2.1	Interaction: P = 0.269, η^2 = 0.105	Starting: 23.8–27.0 Bench: 25.5–28.7
performance decrement RSA (%)	PRE	5.64 ± 2.45	4.18 ± 2.30	Time: P = 0.179, η^2 = 0.169 Group: P = 0.433, η^2 = 0.121	Starting: 2.68–7.26 Bench: 2.81–7.39
	POST	6.84 ± 1.75	4.78 ± 4.49	Interaction: P = 0.128, η^2 = 0.019	Starting: 2.76–8.77 Bench: 3.19–9.21
offensive agility (s)	PRE	8.20 ± 0.31	8.52 ± 0.32	**Time: P = 0.001, η^2 = 0.767** Group: P = 0.170, η^2 = 0.180	Starting: 7.86–8.55 Bench: 8.17–8.87
	POST	7.82 ± 0.24	8.04 ± 0.25	Interaction: P = 0.518, η^2 = 0.010	Starting: 7.56–8.09 Bench: 7.78–8.31
passing skills (points)	PRE	58.8 ± 5.4	51.3 ± 5.4	**Time: P = 0.031, η^2 = 0.386** **Group: P = 0.036, η^2 = 0.003**	Starting: 52.8–64.8 Bench: 45.3–57.3
	POST	63.0 ± 4.6	55.2 ± 4.7	Interaction: P = 0.919, η^2 = 0.001	Starting: 57.9–68.1 Bench: 50.0–60.3
lower body power (m)	PRE	10.3 ± 1.0	10.7 ± 1.0	Time: P = 0.133, η^2 = 0.170 Group: P = 0.951, η^2 = 0.002	Starting: 9.2–11.4 Bench: 9.6–11.7
	POST	10.9 ± 0.7	10.6 ± 0.7	Interaction: P = 0.113, η^2 = 0.193	Starting: 10.0–11.7 Bench: 9.8–11.5

[3]. Our results showed greater benefits of SSG compared to HIT for defensive agility and upper body power. While the absence of similar studies on basketball does not allow any comparison of our results, a study on soccer highlighted the greater benefits of SSG than HIT for match-specific actions, including defensive agility [20]. These authors suggested that these benefits might be due to the activation of specific muscles involved in changes of direction during SSG but not HIT. It seems surprising that HIT training resulted in a slight decrease in performance (−2.0% to −2.7%) in defensive agility and upper body power, as well as another technical aspect (shooting skills). However, additional statistical tests (Student T-tests for paired samples) performed on the HIT group only revealed that these variations were not significant. In addition, in-season decrements in upper and lower body power have been previously reported in the literature when no additional power or strength conditioning was performed, in particular in bench players [11, 15]. Therefore the absence of improvement or slight decrement in performance in the HIT group in the present study is in agreement with previous investigations. Regarding upper body power, it could be hypothesized that the various passes and upper body isometric actions (screens, taking position, blocking out) taking place during the full-court SSG drills might be responsible for the significantly greater upper body power performances achieved during SSG vs. HIT. In contrast, no significant improvement in lower body power was shown in the present study for any of the interventions used. The 5JT was used to assess this aspect of performance, since it has been recently used on basketball players [12, 21] and showed similar variations as vertical jumps after training interventions [21]. However, this test relies on coordination as well as lower body power, and this could partly explain the absence of significant differences observed in the present study. This highlights the need for further research involving this test in non-elite junior basketball players.

Many authors have highlighted that the main benefit of SSG conditioning is the improvement or maintenance of technical skills, in particular in junior players [29]. The results of the present study showed a significantly better improvement in shooting skills after SSG than HIT, while passing skills were similarly increased by both training methods. This is consistent with the study of Bogdanis et al. [5], showing improvements in various technical skills ranging from 17% to 27% after basketball-specific or mixed basketball and circuit training. The greater increases observed by these authors might be due to the fact that their study was conducted during the pre-season, and therefore players' baseline level was poorer prior to training. They also reported a tendency for better improvement in shooting skills in the group undertaking only specific basketball training, which is similar to our results. As mentioned previously, the absence of differences in passing skills between training groups in the present study might be due to the shuffling movements associated with this test, which involve coordination and leg power in addition to passing ability.

The main limitations of the present study were a relatively small sample size and the fact that we did not use any control group. However, the absence of a control group is quite common in studies comparing training interventions [5, 8, 16, 18, 19]. Nevertheless, this aspect should be taken into account when interpreting our results.

In conclusion, using SSG over HIT during the season would appear to be more beneficial for junior basketball players, because in addition to similar improvements in aerobic capacity, it increased basketball-specific skills. Bench players benefit more from this type of fitness training. However, when RSA is the target, more intense sessions should be undertaken.

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