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SMALL-SIDED GAMES AS ADDITIONAL TRAINING IN ELITE BASKETBALL NONSTARTERS PLAYERS

JOGO REDUZIDO COMO TREINO ADICIONAL PARA JOGADORES RESERVAS DE BASQUETEBOL DE ELITE

JUEGOS REDUCIDOS COMO ENTRENAMIENTO ADICIONAL PARA JUGADORES SUPLENTES DE BALONCESTO DE ÉLITE

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ABSTRACT

Introduction: Among the main challenges faced by coaches of team sports are to create an environment and conditions that will enable players to reach their optimal level of physical performance at the start of the competitive season, and to maintain this level throughout the season. Objective: The purpose of this study was to assess the effects of six weeks of additional training with 3-against-3 (3v3) small-sided games (SSG) on the physical performance of elite nonstarter basketball players. Methods: Eleven professional basketball players (five starters and six nonstarters) performed the same training program throughout the regular season, with the only difference that after each game, the starters (S) performed low intensity shooting drills while the nonstarters (NS) performed half-court 3v3 SSG. At the start and end of the six-week period, the athletes were assessed for muscle power, speed, agility and aerobic power. Two-way analysis of variance and effect sizes were used. Magnitude-based inferential analyses were used to complement the parametric tests. Results: After the six weeks, the S and NS showed improvement ($p<0.05$) in the squat jump (S=5.8% and NS=7.1%), counter movement jump (S=3.7% and NS=3.6%), 20m-sprint (S=3.4% and NS=2.0%), agility T test (S=3.6% and NS=3.1%) and Yo-yo intermittent recovery (S=5.2% and NS=2.5%). No differences were found between groups and moments. The effect sizes showed moderate effect on agility and little effect on jumping ability, for both groups; moderate, for S, and little, for NS, on speed and aerobic conditioning. Magnitude-based inferences indicated that S were likely to outperform NS in terms of improvement in 20-m sprint ability and possibly also in agility. In regard to the other physical performance variables, the analyses of magnitude-based inferences were inconclusive. Conclusions: The results of this study showed that 3v3 SSG in the short-term on half-court, as an additional training routine for NS, can bring positive results for the physical performance for these players. ***Level of evidence II; Investigating the Results of Treatment.***

Keywords: Athletic performance; Physical fitness; Basketball.

RESUMO

Introdução: Um dos principais desafios dos treinadores de esportes coletivos é criar ambiente e as condições que permitam aos jogadores atingir seu nível ideal de desempenho físico no início da temporada competitiva e manter esse nível ao longo da temporada. Objetivos: O objetivo deste estudo foi avaliar os efeitos de seis semanas de treinamento adicional com jogo reduzido (JR) 3 contra 3 (3x3) sobre o desempenho físico de jogadores reservas do basquetebol de elite. Métodos: Onze jogadores profissionais de basquetebol (cinco titulares e seis reservas) realizaram o mesmo programa de treinamento durante a temporada regular, com a única diferença de que, depois de cada jogo, os titulares (T) realizavam exercícios de arremesso de baixa intensidade, enquanto os reservas (R) realizavam JR 3x3 em meia quadra. No início e no final do período de seis semanas, os atletas foram avaliados quanto à potência muscular, velocidade, agilidade e potência aeróbica. Foram usadas análises de variância e tamanhos de efeito de duas vias. As análises inferenciais baseadas em magnitude foram usadas para complementar os testes paramétricos. Resultados: Depois das seis semanas, o grupo T e o R mostraram melhora ($p < 0,05$) no salto com agachamento (T = 5,8% e R = 7,1%), salto contramovimento (T = 3,7% e R = 3,6%), sprint *de 20 metros (T = 3,4% e R = 2,0%), teste T de agilidade (T = 3,6% e R = 3,1%) e o teste de recuperação intermitente* Yo-yo *(T = 5,2% e R = 2,5%). Não foram encontradas diferenças entre grupos e momentos. Os tamanhos de efeito mostraram efeito moderado na agilidade e pequeno efeito na capacidade de salto para ambos os grupos; efeito moderado para o grupo T e pequeno para o R na velocidade e condicionamento aeróbico. Inferências baseadas na magnitude indicaram que o grupo T provavelmente superaria o grupo R em termos de melhora da habilidade de* sprint *de 20 m e possivelmente também em agilidade. A análise das inferências baseadas em magnitude foi inconclusiva em relação às outras variáveis. Conclusões: Os resultados deste estudo mostraram que o JR 3x3 em meia quadra como treinamento adicional para o grupo R pode ser positivo para o desempenho físico desses jogadores.* ***Nível de evidência II; Estudos terapêuticos – Investigação dos resultados do tratamento.***

Descritores: *Desempenho atlético; Aptidão física; Basquetebol.*

Associate Editor responsible for the review process: Paulo Sergio Martino Zogaib

RESUMEN

Introducción: Uno de los principales desafíos de los entrenadores de deportes colectivos es crear ambiente y las condiciones que permitan a los jugadores alcanzar su nivel ideal de desempeño físico al inicio de la temporada competitiva y mantener ese nivel a lo largo de la temporada. Objetivos: El objetivo de este estudio fue evaluar los efectos de seis semanas de entrenamiento adicional con juegos reducidos (JR) 3 contra 3 (3x3) sobre el desempeño físico de jugadores suplentes del baloncesto de élite. Métodos: Once jugadores profesionales (cinco titulares y seis suplentes) realizaron el mismo programa de entrenamiento durante la temporada regular, con la única diferencia de que, después de cada partido, los titulares (T) realizaban ejercicios de lanzamiento de baja intensidad, mientras que los suplentes (S) realizaban JR 3x3 en media cancha. Al inicio y al final de cada período de seis semanas los atletas fueron evaluados en cuanto a la potencia muscular, velocidad, agilidad y potencia aeróbica. Fueron usados análisis de variancia y tamaños de efecto de dos vías. Fueron usados análisis inferenciales basados en magnitud para complementar los tests paramétricos. Resultados: Después de seis semanas, el grupo T y el S mostraron mejora (p <0,05) en el salto con agachamiento (T = 5,8% y S = 7,1%), salto contramovimiento (T = 3,7% y S = 3,6%), sprint de 20 metros (T = 3,4% y S = 2,0%), test T de agilidad (T = 3,6% y S = 3,1%) y el test de recuperación intermitente Yo-yo (T = 5,2% y S = 2,5%). No fueron encontradas diferencias entre grupos y momentos. Los tamaños de efecto mostraron efecto moderado en la agilidad y pequeño efecto en la capacidad de salto para ambos grupos; efecto moderado para el grupo T y pequeño para el S, en la velocidad y acondicionamiento aeróbico. Las inferencias basadas en la magnitud indicaron que el grupo T probablemente superaría al grupo S en términos de mejora de la habilidad de sprint de 20 metros y posiblemente también en agilidad. El análisis de las inferencias basadas en magnitud no fue concluyente con relación a las otras variables. Conclusiones: Los resultados de este estudio mostraron que JR 3x3 en media cancha como entrenamiento adicional para el grupo S puede ser positivo para el desempeño físico de esos jugadores. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento****.*

Descriptores: *Rendimiento atlético; Aptitud física; Baloncesto.*

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INTRODUCTION

One major challenge for team sports coaches is enabling players to reach their optimal level of physical performance at the onset of the competitive season, as well as throughout the competition season.[1] Coaching staff must be aware that in-season training and competition schedule may affect differently physical fitness of starters (S) and nonstarters (NS) basketball players, since S usually have a larger playing time than NS.[2,3] Therefore, training load adjustments for each group could preserve NS physical conditioning.

Despite its marked relevance, only few studies investigated this matter. Caterisano et al.[3] showed that college NS decreased while S maintained VO2max level throughout the season. Likewise, Gonzalez et al.[2] demonstrated that professional S improved vertical jump power, whereas NS worsened. Considering the high physical demands of matches, coaches should not take NS for granted,[4,5] instead, NS development could create a stronger opposition for S and boost their performance.[5]

In this sense, game-based conditioning training approach[6] have being suggested for basketball teams,[7] since physical performance can be enhanced through exercises that mimic specific sport movement patterns, with high internal load. At the same time, this approach improves technical-tactical skills, representing a better stimulus for practicing than traditional physical training.[8]

Small-sided games (SSG) methodology[9,10] follows this approach, inasmuch as a small number of players can perform similar efforts to short-term interval physical training. In addition, players may improve cognitive skills, as a result of the game constraints.[6,9] Young basketball players increased aerobic fitness after six weeks of 2v2 SSG.[11] Additionally, 3v3 SSG required higher cardiovascular and metabolic demands than 5v5 scrimmage of junior basketball players.[12] Consequently, assuming that SSG are effective to improve or at least maintain both aerobic and anaerobic NS performance, and to compensate unbalanced playing time and training load among S and NS basketball players, this study assessed the effects of six weeks of additional 3v3 SSG on physical performance of elite basketball NS players. It was hypothesized that NS players would display similar performance changes as S players.

METHODOLOGY

Sample

Sample consisted of 11 elite male basketball players (S = 5 and NS = 6; 25.1 ± 4.3 years, height: 195.4 ± 11.3 cm, body mass: 101.5 ± 22.0 kg, and training experience: 10.1 ± 4.2 years) from a Brazilian professional team (national vice-champions), being S = two guards, one forward and two centers; and NS = one guard, three forwards and two centers (Table 1). Players received information regarding study protocol and associated risks, and gave written consent for participation. The study followed Declaration of Helsinki and was approved by the institutional Research Ethics Committee (No. 639111/2014).

Study design

This study ascertained all training sessions and games played by a single team during the first phase of regular season. Following a 2x2 repeated measures design, S and NS players were assessed for power, speed, agility and aerobic conditioning before and after six weeks. In order to compensate a lower game playing time, NS players accomplished additional 3v3 SSG training sessions, at the day after each one of the 10 games. Throughout six weeks of intervention, coaching staff kept the same starting lineup. Cut-off points for individual playing time were

Table 1. Anthropometric characteristics for Starters and Nonstarters players (mean ± SD).

Variables	S	NS
Age (years)	26.6 ± 3.3	23.8 ± 5.0
Height (cm)	191.8 ± 11.7	198.3 ± 11.0
Body Mass (kg)	91.7 ± 17.5	108.0 ± 21.8
Lean Mass (kg)	79.7 ± 14.1	93.0 ± 16.7
Fat Mass (kg)	12.0 ± 4.3	15.0 ± 6.0
Body fat percentage (%)	12.8 ± 3.0	13.5 ± 3.0
Playing Time (min)	28.4 ± 3.4	8.3 ± 3.7*

*Significant difference to starters (p<0.05); S = starters; NS = nonstarters;

stablished as ≥25 min for S and ≤12.5 min for NS for exclusion criteria purposes (one NS excluded). This exclusion criteria was used to allow the NS to have a similar mean total time to that of the S.

a. Main Training Program: During a six-week period, players practiced once a day, either in the morning or at night. Resistance training took place once a week in a weight room, and was based on the following: bench press, half squat, leg press, shoulder press, stiff and lunge. In addition, twice a week, players performed core stability exercises, such as front plank, side plank, bird-dog, trunk hyperextension and abdominal crunch; and proprioceptive exercises (instability) for ankles, knees and hips, lasting no more than 10 minutes. No specific plyometric, power or sprint exercises were undertaken during this period. Technical-tactical training followed game-based conditioning approach, based on 2v2, 3v3, and 4v4 exercises, and 5v5 scrimmages, both half and full court. (Table 2)

b. Post-game training routines (24h post-game): All games were scheduled at night. Thus, in the day after each game, players rested in the morning and trained at night. Post-game training session consisted of core stability exercises followed by low intensity half court 5v5 scrimmage. After that, S performed spot-up shooting drills, while NS played half court 3v3 SSG (4 x 4 min with 3 min rest between bouts),[10] under FIBA official rules, except for shot clock (12 s limits) and with no free throws. To avoid wasting time on out-of-bounds situations, extra balls were located on sidelines. Players shot free throws and drunk water (ad libitum) between SSG bouts for recovery. This part of the practice took 25 minutes.

Table 2. Week training in regular season.

Training		
Week day	**Morning session**	**Night session**
Monday	Rest	Physical training Resistance training in gymnasium Technical-tactical training Full court 5vs0 offensive and transition strategies + Half court SSG 2v2 and 3v3 + Full court 5v5 scrimmages
Tuesday	Rest	Physical training Core training + Proprioception exercises Technical-tactical training Half and Full court SSG 4v4 + Half court 5v5 scrimmages + Full court 5v5 scrimmages+ Basketball Shooting Drills
Wednesday	Rest	Technical-tactical training Half court 5v5 scrimmages + Full court 5v5 scrimmages + Basketball Shooting Drills
Thursday	*Technical-tactical training* *Warm-up:* Basketball Shooting Drills Half court 5v0 offensive strategies (set plays)	Game day
Friday	Rest	Physical training Core training Technical-tactical training Half court 5v5 scrimmages *STARTERS (five players) Basketball Shooting Drills * NONSTARTERS (six players) Half court SSG 3v3
Saturday	*Technical-tactical training* *Warm-up:* Basketball Shooting Drills Half court 5v0 offensive strategies (set plays)	Game day
Sunday	Rest	Basketball video Analysis of the next opponents + *STARTERS (five players) Basketball Shooting Drills * NONSTARTERS (six players) Half court SSG 3v3

Note: SSG - small-sided games.

Physical fitness evaluations were performed in the first and seventh weeks of regular season, after a 72 h resting period. All tests took place between 9:30 am and 12:00 pm by a single and experienced professional. Players were already accustomed to all procedures. Before testing, players warmed-up jogging and sprinting (progressive intensity), but no static stretching was allowed. Muscle power (vertical jumps) and running based capacities (speed, agility and aerobic power) were assessed on different days. Players were verbally encouraged to produce maximal effort.

Data Collection Procedures

Muscle Power

Muscle power was assessed by squat (SJ) and countermovement (CMJ) jumps.[11] Leap height was determined by flight time via Jump Test Pro® software, (version 1.02). Players kept both hands on the hips and attaining 90° knee flexion at the start of the push-off phase. After three trials, the highest leap of each jump was considered for analysis

Running Based Capacities

Players performed three bouts of both maximal 20-m sprints and agility T test, with 2-3 minutes recovery between bouts for each test. Time to conclude was recorded to the nearest one-hundredth of a second using timing gates (Cefise™, Brazil) placed 0.5 m above the ground. [12] Subjects stood 0.5m behind the first timing gate, and started to sprint whenever ready. T-test reliability and validity have been previously established.[13] Aerobic power was assessed by Yo-yo intermittent recovery test which consists of 20-m progressive velocities shuttle runs interspersed by 10s of active recovery, until exhaustion. Test ended after the player failed twice to reach the starting line before the time is over or by volitional fatigue. Maximal distance covered was used to determine VO2max.[14]

Internal Load

Internal load was assessed using the session-rate of perceived exertion (RPE),[15] which has been previously used in male professional basketball players.[16,17] Players informed individual's session-RPE 30 min after the practice to avoid influence of the last effort of the practice.

Statistical analysis

Shapiro-Wilk's and Levene's tests verified data normality and homogeneity, respectively. A 2x2 ANOVA followed by Tukey post hoc tests determined pairwise differences. Effect size threshold values were: 0.00–0.19 trivial; 0.20–0.59 small; 0.60–1.19 moderate; 1.20–1.99 large; >2.00 very large.[18] Magnitude-based inferential analyses were also used as a complement to parametric statistics in order to reduce results misinterpretation[19,20] due to small sample size (n = 11). Magnitude-based analysis procedures followed Batterham and Hopkins[19] instructions, using 90% confidence limits and considering probabilities of true value as positive, trivial or negative. Threshold values for a positive or negative effect were: <1%, almost certainly not; 1–5%, very unlikely; 5–25%, unlikely; 25–75%, possible; 75–95%, likely; 95–99% very likely; and >99% almost certain.[20] The statistical package SPSS version 21.0 was used for statistical calculations. Significance was set at 5%.

RESULTS

Both S and NS showed improvement on physical performance after six weeks of training, although no differences were found between groups ($p > 0.05$). The improvement on agility was moderate, and on jumping ability was small, based on effect sizes, for both groups. Training period resulted in a moderate increase on speed and endurance for S, whereas NS presented only a small development. (Table 3) Figure 1 illustrates the individual post-training responses and the overall improvement for both S and NS players. All players showed an enhanced performance on

Table 3. Physical tests performance before (pre) and after (post) six weeks of competition for starters and nonstarters players [mean ± SD].

Variables	S			NS			
	Pre	Post	ES	Pre	Post	ES	*P*
SJ (cm)	33.3 ± 5.6	35.2 ± 4.7*	0,35	33.5 ± 5.4	35.9 ± 3.7*	0,44	0,885
CMJ (cm)	38.7 ± 5.9	40.1 ± 4.8*	0,24	39.9 ± 5.9	41.3 ± 5.0*	0,25	0,716
20-m sprint(s)	3.20 ± 0.16	3.09 ± 0.11*	0,67	3.28 ± 0.27	3.21 ± 0.20*	0,24	0,426
Agility T-test (s)	9.09 ± 0.43	8.76 ± 0.52*	0,75	9.44 ± 0.45	9.14 ± 0.51*	0,66	0,228
VO_2max (mL·kg^{-1}·min^{-1})	46.4 ± 3.2	48.8 ± 3.3*	0.75	47.0 ± 2.7	48.2 ± 3.4*	0,44	0,979

*Significant difference to pre ($p<0.05$); S = starters; NS = nonstarters; ES = effect size; SJ = squat jump; CMJ = counter movement jump; VO_2max = maximal oxygen consumption.

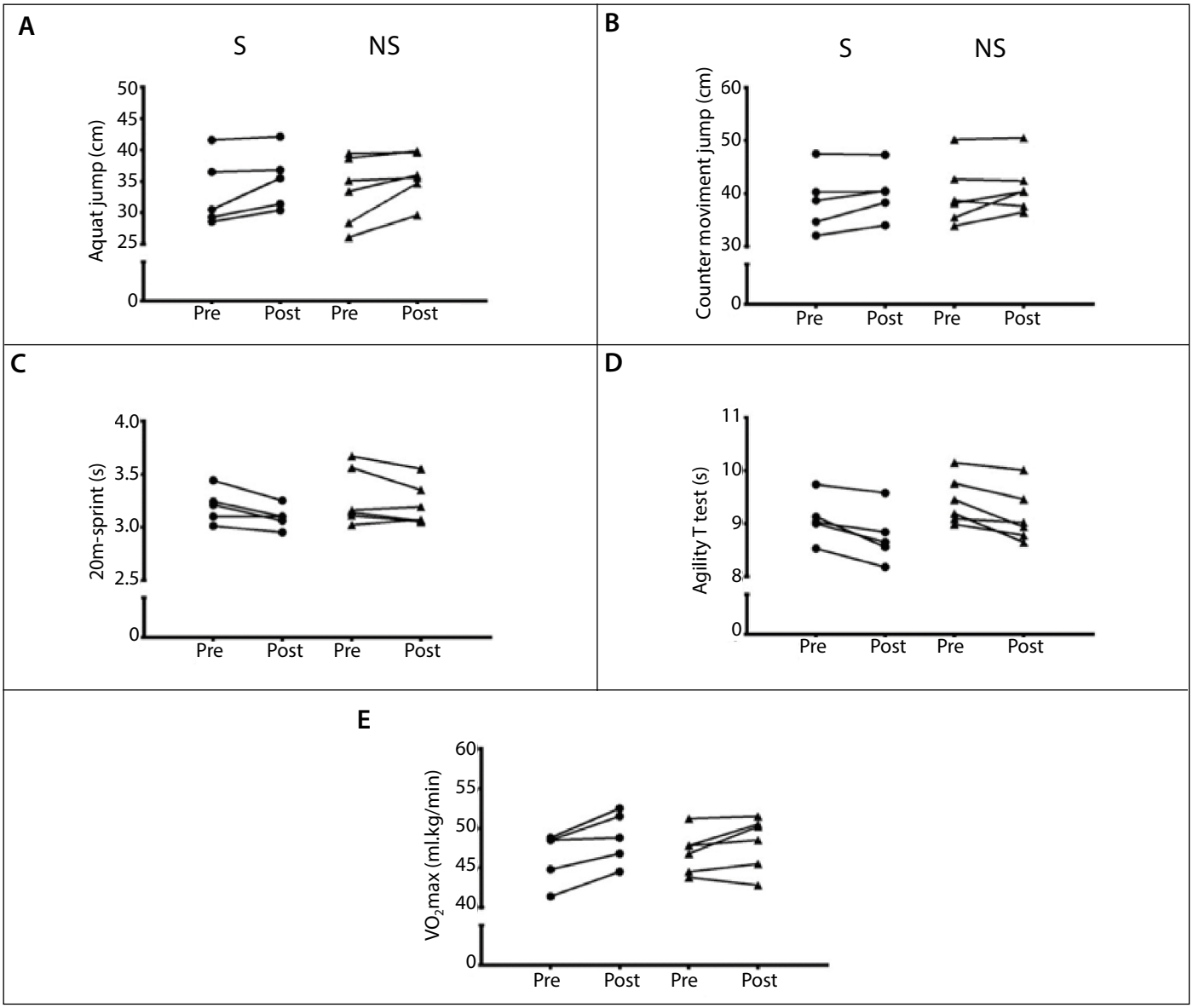

Figure 1. Individual changes post intervention.

squat jump and agility test. Likewise, all players, except one, increased performance on CMJ, sprint, and VO_2max.

Magnitude-based inferences confirmed that S were likely to outperform NS improvement on 20-m sprint ability after six weeks of training and competition period. It is worthwhile to mention that an individual analysis also revealed that four out of five S and four out of six NS finished the 20-m run faster at the post-test. Magnitude-based inferences also indicated that it is possible for a starter to increase agility performance more than a nonstarter after six weeks training and competition period. Analysis were inconclusive about all other physical performance variables. (Table 4)

Table 4. Magnitude-based inferences on performance changes during six weeks of competition in starters vs. nonstarters.

S vs. NS	Mean increase in starters (%)	Clinical Inference	Percent positive	Percent negligible/ trivial	Percent negative
SJ	6.38	Unclear	26.6	28.9	44.5
CMJ	4.15	Unclear	26.3	17.5	56.2
20 m sprint	-3.30	Likely	76.0	17.2	6.8
Agility T-test	-3.60	Possibly	69.3	26.5	4.2
VO_2max	5.26	Unclear	39.6	41.5	18.8

S = starters; NS = nonstarters; SJ = squat jump; CMJ = counter movement jump; VO_2max = maximal oxygen consumption.

There were no statistical differences between S (491.4 ± 56.2 a.u.) and NS (475.9 ± 60.4 a.u.) on week internal load throughout the six weeks period (p>0.05). (Figure 2)

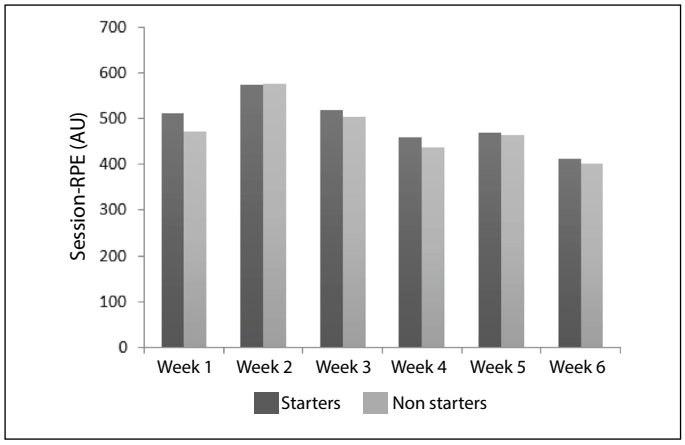

Figure 2. Session-rate of perceived exertion (RPE) training load profile of the training week that comprised 2 games a week.

DISCUSSION

Schedule is a major concern for coaches of elite teams due to the great amount of matches over the season. To the best of our knowledge, this is the first study to investigate the effect of 3v3 SSG additional training on nonstarters' physical performance in-season. This is even more worrisome as regards to NS, due to a typical reduced playing time.[2] The main findings showed that, after this training strategy, NS presented similar improvements to S in terms of muscle power, speed, agility and aerobic power.

Therefore, our results point out that the inclusion of 3v3 SSG as an additional training routine for NS seems to be an appropriate choice for physical fitness maintenance. The 2v2 SSG additional training (during six weeks) was proved to be effective to enhance defensive agility skills.[21] It is suggested that this improvement on agility may be due to a proper execution of motor actions during SSG, such as change of direction runs. Agility is a feature skill which contributes directly to basketball performance success and is associated with improved muscle power,[12] as seen in our results (improvement in jumping tests). Despite the benefits for physical performance, a review study underscored the importance of SSG in developing technical and tactical skills, especially when different formats are used in the different phases of the season.[6] For example, 3v3 SSG format significantly increased the volume of play, efficiency index and performance score when compared with 5v5 SSG format on young basketball players.[22]

There was no significant differences ($p < 0.05$) between S and NS in all variables at the post short term period. Data showed that S showed higher effect size on speed than NS. Likewise, the magnitude-based inferences indicated that the increased playing time on official games promoted a likely beneficial effect on speed, and possibly beneficial effect on agility T-test for S over NS. It is speculated that the displacements occurred in the official game, when compared to the SSG 3v3 in the half court, were able to promote greater number of specific situations in a larger court area. Another possible justification relates to the free play rule used in the 3v3 SSG of the present investigation, which may decrease the number of sprints performed, as observed in another study with soccer players.[23] Furthermore, during the official basketball game, sprints with maximum acceleration are performed interspersed by 33 s each, contributing to increased acceleration, speed and agility.[24–27]

In the present study, the same improvement in aerobic capacity was observed in S and NS, but S showed a moderate effect size, while in NS was small. Previous studies have demonstrated heart hate (HR) close to 90% of the HRmax during SSG 3v3, highlighting the high intensity of efforts.[22,28,29] Another study reported higher physiologic impact in SSG 3v3 than SSG 4v4, demonstrating that SSG has a positive influence on the different physiological variables in basketball players, unmonitored responses in this study.[10] It is expected that the smaller number of players participating in SSG (3v3 to 2v2), besides inducing a higher cardiovascular impact, would lead to an improvement in VO_2max.[7,28,30] It is worth noting that because we have analyzed elite basketball players, who participate in two official games per week, there is concern in controlling the physical stress imposed by the training sessions.[17] In this way, increasing the training load of NS players without proper control, especially using SSG, could compromise player performance, in addition to the increased risk of exposure to player injuries due to intense physical contact.[27]

Another important finding from the present study regarding session-RPE is that the SSG 3v3 applied in NS was effective to induce a similar level of week internal load as compared to S. In the present investigation, was used 25min of SSG 3v3 playing time (16min of effective game) for NS, as used in one study,[10] because the goal was to allow the same amount of time estimated by S in the games.

Our study has certain limitations as follows: (a) impossibility of other evaluation moments; (b) a small sample size; (c) and impossibility of control group. However, the players included in the present study are considered to be a representative sample of professional elite basketball players, which allows the observation of the behavior of physical performance variables during a competition for an elite national team, which is rare in the sport sciences. Looking at the basketball practice, some observations are relevant: a) additional training routine with 3v3 SSG performed on NS players, associated with the main training program and games, may be beneficial for improvement and maintenance of physical conditioning; this study has found that 3v3 SSG could be a good strategy when applied on day after game, to improve the performance levels in NS elite basketball players, with low or no playing time; and coaches may find this information useful when designing sport specific conditioning programs aiming to develop different performance related qualities.

CONCLUSIONS

Inclusion of 3v3 SSG on half court as an additional training routine for NS could be positive for the physical performance for these players, showing similar improvements of elite basketball starters players in six weeks. In summary, further studies could focus on different SSG formats, notably using differences in court area and number of players than that used in the present investigation, to better understand the effect on physiological responses, physical performance and technical-tactical analysis on NS elite basketball players.

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