

Effect of training in SSG on the ability to repeat sprints in young football players

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Abstract

Introduction: Football is one of the most popular team sports worldwide. During a match, players perform varying acyclic activities at differing intensities in order to face the complex and dynamic competition requirements. For this reason, the aim of this study was demonstrate that training in small sided is an effective method for developing the ability to repeat sprints in young football players. **Material and Method:** Fifty-four male soccer players (U13, U15 and U17, n=18 in which group) at the youth level participated in this study. A program based on Small Sided Games (3vs3) during 6 weeks in a space of 30x25m was applied. A contrast of means, pre and post intervention, was carried out between control and the experimental group and segregating the sample by age group. **Results:** When analyzing the degree of relationship between RSA fatigue index and jump loss, no significant differences were found. We also studied the relationship between the jump power (CMJ) and the power of the best sprint performed at RSA. **Discussion:** These results are consistent with those obtained in previous studies (Clemente et al., 2014; Dellal et al., 2012; Owen et al., 2012) on elite players. **Conclusion:** It can be concluded that this program improves the capacity of recovery before high intensity efforts and allows, at the same time, to work on technical and tactical elements and to develop the physical profile of the players. This type of games provokes improvements in the vertical jump, generate more power in the (CMJ) and the capacity to repeat explosive efforts.

Keywords:team sports, speed, jump, motor space, RSA, CMJ.

Introduction

Football is one of the most popular team sports worldwide. It's played by men and women. During football matches, players perform varying acyclic activities at differing intensities. Its performance can be seen as the result of a long term training process designed to improve players and teams' skills in order to face the complex and dynamic competition requirements (Sampaio & Maçãs 2012). Recent studies suggest that soccer match-performance depends on the effective interaction of technical, tactical and physical demands of the game (Dellal et al. 2012ab). Performance of soccer teams and their final ranking in competitions are influenced by several factors, such as the physical (Clemente et al., 2018), psychological (Williams & Jackson, 2019), technical (Lago-Peñas, Lago-Ballesteros, & Rey, 2011) and tactical (Correia, et al., 2019; Drezner et al., 2020).

Team sports are very complex to train and analyze their performance, especially if performed as a whole. This complexity should be matched in the way players are trained, and several authors suggest that small-sided games (SSGs) adequately cater for this need (Dellal et al. 2011). SSGs effectively integrate the specific demands of soccer-match play and represent a useful solution to increase the efficiency of training (Sarmento et al., 2018). SSGs have become the most popular training drill for simultaneously improving fitness and technical skills (Hill-Haas et al. 2011). Several authors suggest that SSGs condense the number of actions and decisions players make, whilst maintaining the variability and contextual interference necessary for exposing them to match-like conditions (Gabbett et al., 2009). Aiming to develop players' technical and tactical skills, coaches and managers often make use of SSGs, since they are expected to make training sessions more objective, therefore encouraging the commitment of players, besides stimulating actions related to the tactical component that need to be constantly practised and developed (Reilly, 2005). Small-sided and conditioned games are commonly considered as modified games played on reduced pitch dimensions, often using adapted rules and involving a

smaller number of players than traditional games (representing manipulations of playing conditions) (Gabbett et al., 2009). SSGs in soccer offer many possibilities and combinations that increase the level of interaction among the players (Platt et al., 2001). The utilisation of SSGs, which are played on reduced pitch areas, often using modified rules and involving smaller player numbers than traditional competitive match play is now commonplace within team sports (Gaudino et al., 2014). These games are less structured than traditional fitness training methods but are a common methodology of training prescription (Hill-Haas et al., 2011). These modified games are a very popular training method for all ages and standards of play (Sampaio et al., 2014). The use of SSGs has been implemented worldwide and are well documented (Hill-Haas et al., 2011). The systematic exposure to SSGs during training sessions has been suggested to improve players' decisionmaking, technical skills, tactical awareness and physical conditioning through functional movements (Aguiar et al. 2012). However, there is a lack of knowledge regarding the tactical requirements elicited by SSGs, and their corresponding transfer to match performance (Hill-Haas et al., 2011). To improve conditioning among their players, sports team coaches add technical, tactical, fitness, and sport-specific types of practices. In recent years, they have introduced SSGs to develop fitness and skills in their athletes. Typically, SSGs are competitive games that generally involve fewer players than in normal games and are played in a smaller area.

Many of the actions that take place in football combine a movement, at greater or lesser speed, with a jump. Those moves should be as fast and explosive as possible. Hence the importance of their training seeking both the ability to develop them in quantity and quality. That's why the aim of this study was demonstrate that training in SSGs is an effective method for developing the ability to repeat sprints in young football players.

Material & methods

Participants

Fifty-four young elite male soccer players (U13; N = 18, U15; N = 18, U17; N = 18) and possessed the following characteristics: 14.85 ± 1.80 ages, 174.5 ± 7.6 cm, 66.07 ± 9.94 kg, playing at the youth level participated in this study. All the subjects passed their pre-season medical examinations. Their typical weekly training included 4-5 training sessions and 1 league game. The Ethical Committee of the University approved the study and a written consent form was obtained from the parent/guardian of each participant prior to the commencement of this study.

Instruments

For the measurement of CMJ, the MyJump App was used, whose reliability and validity has been demonstrated (Balsalobre et al., 2015). This variable was measured by performing a jump with the hands on the waist, performing a countermove up to a 90° knee flexion, jumping as high as possible and keeping the lower limbs extended during the entire flight phase (Bosco, Luhtanen, & Komi, 1983). The best of three attempts was recorded. From these results, it was calculated following Samozino's formula (Samozino & Morin, 2015), the maximum jumping power and the Maximum Power: maximum power capacity of the athlete's lower limbs (per unit of body mass) in the concentric and ballistic extension movement.

To measure the time of each RSA sprint which consisted of 6 20-meter sprints executed at the maximum possible speed and 20 seconds rest between each sprint (Aziz et al., 2007), a pair of photoelectric cells was used (Microgate, Italy). For its evaluation, the fatigue index from the first to the last sprint was calculated, as well as the muscular power generated in the best sprint. For these calculations, the formulas proposed by Barbero et al. (2006) were used.

Procedure

A pre-post study was conducted, consisting of a 6x20m linear repeat sprint test (RSA) with 20" recovery, following the proposal of (Aziz et al., 2007); and a vertical jump test with countermove (CMJ) immediately before and after RSA following the protocol established by Barbero et al. (2006) also measured the Fistsimons fatigue index (IF), total, and relative muscle power using the formula. In addition, the jumping power (CMJ) was calculated using the formulas presented by Samozino et al. (2012). Prior to the measurements in this study, all players performed a standard warm-up. In addition, all the tests were carried out on an artificial turf surface with the participants wearing their usual boots. In the case of the Experimental Group, it received a training progression composed of 12 sessions, based on SSGs (3vs3 with scoring (mini-goal), during 6 weeks (3 x 3' - 4 x 3' - 5 x 3' - 6 x 3' - 7 x 3' - 8 x 3' - 9 x 3' and 10 x 3'), in a space of 30x25m, 2 minutes of recovery and touches limited to three per player) following the protocol of Owen et al. (2012). Extra balls were placed around the field to allow a quick restart of the game in case the ball went out of bounds. Researchers provided verbal encouragement to athletes, but not technical or tactical instructions, limiting the number of touches to three, to encourage ball circulation.

Data analysis

First, the descriptive statistics TM: average time (seconds) in the RSA. IF: Percentage of Fatigue index; PM: maximum power (W.kg-1); PSV: vertical jump power (watts: W); DCMJ: difference of counter jump movement

(cm) were calculated. In order to determine the influence of training in small sided is an effective method for developing the ability to repeat sprints in young football players.

A contrast of means of the studied variables, pre and post intervention, was carried out, differentiating between the Control Group (who trained with a traditional methodology) and the Experimental Group (who trained with a methodology based on SSG). The Mann-Whitney U test was used for paired samples in the variable that follows a normal distribution: mean time of the ARS and maximum power of the best sprinkling performed at the ARS. For the remaining variables, the non-parametric test was used for paired samples. Finally, the Spearman correlation coefficient was used to analyze the degree of relationship between the variables fatigue index at RSA and loss of jump; jump power (CMJ) and best sprint performed at RSA. The critical level for all contrasts was set at $p \leq .05$. The software used for the statistical analysis was the SPSS, version 21.0 (SPSS Inc., Chicago, IL, USA).

Results

Table 1 shows the mean values, their deviations, as well as the p-values of the mean comparisons and the effect size, considering the variables studied, organized according to the category and the intervention performed on the participants. All variables were distributed in a normal way, except for the pre-intervention variables: jump loss and maximum jump power; and the post-intervention RSA fatigue index variable.

Table 1. Descriptive and comparison between the experimental group (SG) and control group (CG) the different variables (U-13, U-15 and U-17).

Variables	Moment (Media±(SD))	SG (n = 9) (Media ± SD)			CG (n = 9) (Media ± SD)			P-Value (Effect size (Cohen d))		
		U13	U15	U17	U13	U15	U17	U13	U15	U17
TM	Pre	4.07± .15	3.24 ± .14	3.16 ± .31	4.37 ± .36	3.24 ± .15	3.15 ± .14	.04	.93	.89
	Post	3.70 ± .32	3.07 ± .15	2.82 ± .29	4.34 ± .35	3.25 ± .15	2.97 ± .16	.00 (-1.92)	.02 (-1.22)	.31
	P-Value (Cohen d)	.001 1.49	.01 1.35	.01 1.14	.55	.86	.002 1.18			
IF	Pre	4.64 ± .89	3.85 ± 1.40	2.93 ± 1.13	4.81 ± .85	3.13 ± 1.25	3.01 ± 1.04	.68	.27	.89
	Post	4.17 ± .91	3.72 ± 1.34	2.46 ± 1.09	4.71 ± .88	3.21 ± .87	2.97 ± .66	.22	.35	.25
	P-Value (Cohen d)	.000 .52	.01 .10	.001 .42	.02275 .12	.67	.85			
PM	Pre	3355.45 ± 764.55	3787.53 ± 883.07	4342.14 ± 611.00	3454.35 ± 684.24	3695.95 ± 257.41	3998.84 ± 403.89	.78	.70	.31
	Post	3763.05 ± 739.45	3934.60 ± 801.16	4613.96 ± 655.42	3540.58 ± 638.53	3734.99 ± 167.90	4196.71 ± 427.85	.50	.49	.13
	P-Value (Cohen d)	.00 -.54	.001 -.17	.00 -.43	.02 -.13	.11	.01 -.48			
PSV	Pre	16298.46 ± 4949.96	19826.54 ± 6140.19	24070.05 ± 3282.44	16580.61 ± 4981.38	16914.30 ± 2066.68	21087.49 ± 4262.57	.82	.57	.06
	Post	17690.16 ± 4907.74	20069.50 ± 6121.80	24398.75 ± 2933.28	16558.40 ± 5162.38	16968.11 ± 2058.12	22089.56 ± 4064.42	.64	.57	.19
	P-Value (Cohen d)	.01 -.28	.01 -.04	.57	.95	.01 -.03	.02 -.24			
DCMJ	Pre	-15.96 ± 1.66	-13.37 ± 1.35	-15.26 ± 6.23	-16.61 ± 1.82	-20.51 ± 6.14	-10.36 ± 1.63	.44	.01	.04
	Post	-12.10 ± 1.63	-9.94 ± 1.91	-8.96 ± 4.94	-16.01 ± 1.37	-17.96 ± 4.98	-9.89 ± 1.98	.00 (2.60)	.01 (2.13)	.61
	P-Value (Cohen d)	.00 -2.35	.00 -2.07	.001 -1.12	.01 -.37	.002 -.45	.65			

TM: average time (seconds). IF: Fatigue index (%) PM: maximum power (W.kg-1) PSV: vertical jump power (W) DCMJ: difference of counter jump movement (cm).

A contrast of means of the studied variables, pre and post intervention, was carried out, differentiating between the control group and the experimental group and segregating the sample by age group. The t-student test was used for paired samples in the variable that follows a normal distribution: mean time of the RSA and maximum power of the best sprinkling performed in the RSA. For the remaining variables, the non-parametric test for paired samples (Mann-Whitney U) was used.

The Spearman correlation coefficient (the distribution of the variables is not within normality) was used to analyze the degree of relationship between the variables, RSA fatigue index and jump loss, finding no association between these variables. We also studied the relationship between the jump power (CMJ) and the power of the best sprint performed at RSA.

As for the average time of the RSA, statistically significant differences are seen in all the age segments considered in the Experimental Group, and statistical significance is only seen in the U17 of the Control Group. Likewise, it can be seen how the time taken to perform this test is reduced as age increases, both before and after the intervention and in both groups (experimental and control). It should be noted that in the U15 age segment of the Control Group ($3.24 \pm .14s$ vs. $3.25 \pm .15s$) performance in the post-intervention period worsens (although

these results are not significant). In this sense, significant differences are observed for U13 ($p=.00$; $d=-1.92$) and U15 ($p=.02$; $d=-1.22$) when comparing the post-intervention data.

The rate of fatigue decreases with age and between pre and post-intervention. Appreciating statistical significance in the experimental group in all three age segments pre and only for U13 in the Control Group ($p<.05$; $p=.02$).

If we look at the maximum power in the same way as the previous groups, in a descriptive way it increases with age and with the intervention performed. We found that there are no significant differences for U15 of the control group with respect to the intervention developed ($p>.05$; $p=.11$). Likewise, when analyzing the jumping power, in a descriptive way it increases with age, except in U15 of the Control Group that decreases ($16914.30 \pm 2066.68W$ vs. $16968.11 \pm 2058.12W$) and with the intervention performed. We found that there were no significant differences for U13 of the Control Group with respect to the intervention carried out ($p>.05$; $p=.95$) and for U17 of the Experimental Group ($p>.05$; $p=.57$).

Finally, if we pay attention to the difference of counter jump movement for the post-intervention of the Experimental Group, a decrease is observed, as the age increases; being the biggest difference between pre-intervention and post-intervention for U17 ($-15.26 \pm 6.23cm$ vs. $-8.96 \pm 4.94cm$). Only U17 in the Control Group shows no significant difference between pre-intervention and post-intervention ($p>.05$; $p=.65$).

Discussion

The aim of the present study was to investigate the effect of 6-week training in small spaces on the physical condition of young football players. The results revealed that the intervention of periodical training in reduced spaces significantly improved the ability of players to recover from high intensity efforts, as well as increased vertical jumping power with counter movement (CMJ). These results are consistent with those obtained in previous studies (Clemente et al., 2014; Owen et al., 2012) on elite players. No significant improvement was obtained with respect to the mean time of the RSA test. Therefore, and being cautious with this statement, it appears from this study that the intervention of periodical training in reduced spaces could have a positive effect on the anaerobic and aerobic system in football players. And this is related to a lower incidence of injury (Kellmann et al., 2018) and better recovery, which will undoubtedly have an impact on greater sports performance, since (Clemente et al., 2014, Williams & Jackson, 2019) they have found that greater muscle power is related to a higher rate of fatigue in running and is associated with a greater capacity of the system to produce anaerobic energy, which will give a competitive advantage, especially in situations of maximum competitive stress (two games per week). Likewise, touch limitation was chosen as this causes a higher speed of play, which translates into an increase in exercise intensity as previous studies have shown (Casamichana et al., 2013).

Also, it has been shown (Abrantes, Maças & Sampaio, 2004) that young people show a lower capacity to develop anaerobic efforts, presenting lower concentrations of lactate in both blood and muscle than adults for exercises of the same relative intensity; since they present a lower capacity to form lactate. This may be one of the reasons for the lower performance, based on age, in RSA test.

In this sense, we find similar results in other studies where finds that the performance in an RSA behaves like a balance; where improving the athlete's VO_{2max} improves his recovery capacity and decreases his fatigue rate in an RSA which has been related to an improvement in the average time of sprinkles by some authors (Da Silva, Guglielmo, & Bishop, 2010; Garbi et al., 2015; Rampinini et al., 2009); although this affects the quality of the race. Likewise, other authors (Balsalobre et al., 2015; Dellal & Wong, 2013; Di Salvo et al., 2010), have found a relationship between explosive force, maximum power in short duration and high intensity actions demanded by football, such as: stops, starts, changes of direction, jumps, sprints, etc. (Michailidis et al. 2020). Hence, the importance of the correct monitoring, control and development of the variables studied for the improvement of performance. Similarly, the ability to improve recovery from such efforts can positively promote the need to integrate games in small spaces as part of a football club's conditioning programme during the season.

On the other hand, numerous studies (Haugen, Tonnessen & Seiler, 2013; López-Segovia et al., 2014) have related that the greater capacity of a player to develop explosive force (mainly measured through CMJ) is related to race results, either in a single sprint or in an RSA; being these explosive actions where subjects must manifest a great capacity to accelerate and reach high peaks of power.

Secondly, the values of the variables studied improve progressively with age in the selected sample. This is undoubtedly due to physiological factors (bone and muscle maturation of the subject) and/or factors intrinsic to the sport itself. In this case, and considering that the sample is composed of adolescent athletes, it is known that in the infantile-cadet stage a crisis in the aerobic processes is produced, producing a stagnation and even a decrease in the VO_{2max} . It is in the juvenile stage where an increase in the VO_{2max} begins (Helgerud et al., 2001), hence the great differences appreciated between the groups U12 and U15, with respect to U17. In addition, the capacity to develop anaerobic efforts is lower in young people (Abrantes et al., 2004), a fact that can be seen in this study. However, this study does not look at the values found in research (Harley et al., 2012), which found that cadet players show higher values for RSA fatigue rates than youths. Thirdly, and as far as we

know, there are no field studies with these tests, with which to compare the results obtained, as well as to generalize the data, it is necessary to consider various aspects: expand the sample to different ages and competitive levels, add female participants and consider the demarcation of the athlete. Similarly, there would still be a lack of factors to take into account such as the speed of reaction or decision making or the fact of the influence of limiting the number of ball touches on players' tactical behaviour and network properties during football small-sided games (Brito et al., 2019) who also recommend two-touch SSCG to increase the use of ball circulation strategies and free-play SSCG in reduced pitch sizes for improving principles related to a direct-play style (due to a faster transition to the opponents' goal). In the same way, the increase in defensive situations reported in the SSCG with one goal compared to the double-goal (two goals per team) condition (Brito et al., 2019).

In this respect, it has also been suggested that SSCG can be useful for developing players' tactical skill (Drummond et al., 2019). However few studies have investigated the tactical demands of the different formats of SSCG. It is expected that the oldest players will present more effectively manoeuvre in an effort to an in-depth ball progression by dribbling and passing (in the offensive phase) and provide protection for the most important pitch zones (in the defensive phase) due to their better comprehension of the game logic (Borges et al., 2017). As a result, the more cooperative game is also expected in older groups.

In any case, these aspects, which in part represent some of the limitations of the study, do not undermine its potential, considering that it can serve those responsible for the physical preparation of clubs to prevent injuries and extend the sporting life of athletes (De Albuquerque et al. 2020). For example, (Impellizzeri et al., 2006) they found that running speed remained practically the same throughout the season; the time before starting the season being the best; while the percentage of fatigue between the first and last sprint did improve notably throughout the season.

It is also necessary to develop longitudinal studies that relate the predictive capacity of the variables (PM, PSV and/or DCMJ) in sports performance in real competition situations. In the same way, new lines of research related to the transfer of the tests considered (RSA, CMJ) in the real game are being opened up, and the demarcation of players, how players position themselves in relation to the field and other players, the team's playing style, and the coaches' encouragement can also be considered (Hill-Haas, et al., 2011; Sarmiento et al., 2018), the momentary scoreboard, the inclusion of goals and goalkeepers, the spatial orientation of the field, etc., which can help establish different systems of play and cope with the demands of competition and provide key information on different styles of play (Castellano, Álvarez, & Blanco-Villaseñor 2013).

This information could help to understand how teams have achieved their ranking, as more experienced players tend to perform better. The competitive situation in the context of practice can be used to evaluate and design the performance of teams in competitions with formal games. Finally, a found limitation is when the teams faced each other in the tournaments of accumulated points system with different numbers of teams, because the different moments (beginning or end of the tournament) may have conditioned the level of the teams' involvement in the matches. This information could help in the understanding on how teams have conquered their ranking, as more experienced players tend to perform better (Correia et al., 2019).

After what has been exposed in this work, the results show the importance of training the technique, the tactic, the physical condition; and even the volitive thing in a joint way. It is understood that in football there is no point in running without a reason, without making a decision or reacting to a stimulus. It is doubtful whether with this type of tasks in which the technical-tactical and the conditional are combined, the same benefits are achieved at the physiological level as with the classic training methodologies, analyzed previously (Dellal et al., 2012a). Therefore, future research should consider the tactical performance of players and their physiological implications considering different situations as momentary unfavourable markers or numerical inferiority of the teams, which conditions the behaviour of players in competition (Castellano et al., 2011).

Conclusions

These studies allowed demonstrating that top teams are more effectiveness in maintaining ball possession and finalising to the goal than the other teams (Maleki et al., 2016). In this sense, Silva et al. (2013) affirm that the winning teams made better the movements that allow to: (1) ensure defensive stability and, (2) allow the team to defend unity. As a result, these teams are able to play more without the ball, in order to recover its possession, and to have more chances on the opponent's goal. Therefore, competitive situations in the training context can stimulate the adaptations of the players and the teams to different game situations. Moreover, the specific movements of the players indicate the team's adaptation to different match contexts. During the offensive phase, the champions' teams performed more support movements to the ball carrier, besides using and seeking to extend the effective game width and length and allowing the team to attack in unity against the runner-up teams. SSG can be used to improve the effectiveness of players and teams due to the transfer of learning in these matches for application in the formal game. Finally, a found limitation is when the teams faced each other in the tournaments of accumulated points system with different numbers of teams, because the different moments (beginning or end of the tournament) may have conditioned the level of the teams'

involvement in the matches. This information could help in the understanding on how teams have conquered their ranking, as more experienced players tend to perform better.

The application of this program improves the capacity of recovery before high intensity efforts and allows, at the same time, to work on technical and tactical elements and to develop the physical profile of the players. This type of games provokes improvements in the vertical jump power with counter movement (CMJ), as well as the capacity to generate more power in the (CMJ) shows a high relation with the maximum power generated in the race and the capacity to repeat explosive efforts is considered important during the intermittent sport practice, as it is football. Finally, it can be stated how reduced games, as an alternative training modality the generic exercises, are able to improve the physical fitness characteristics in young football players.

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