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Effects of eight-week Pre Season period of High-Intensity Interval Training and Small-Sided Games on Repeated sprint ability and Wellness Status on amateur Soccer Young Players

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ABSTRACT
This study was designed to analyze the effect of soccer players repeated-sprint ability (RSA) and evaluate the of pre-season perceived wellness between HIIT and SSG during 8-weeks of training , with two groups of 16 young footballers (GE-SSG;HIIT) performed 16 specific training sessions SSG [4vs4] and HIIT [30/30] ,were recorded before and after the training programmers: RSSA 40m x 6 test, and after each training session were assessed using the profile of Wellness status, sleep and sleep, fatigue, and muscle soreness ,These results indicate that HIIT Group (30/30s) Have achieved greater improvements than the SSG (4vs4) group on the Repeated sprint ability ,the results also led us to influence the HIIT group in terms of fatigue and muscle soreness at the expense of training with Small sided games , But coaches should be aware that both training methods are applicable methodologies for improving performance and physical level while monitoring the state of health and training-load in amateur soccer players' under-17.

1. Introduction

The structure of soccer match play is intermittent in nature, whereby low-intensity activity (e.g., walking and jogging) is interspersed with high-intensity actions (e.g., sprinting, change-of-direction [movements, tackles, and jumping] (Mohr, Krustrup, Andersson, Kirkendal, & Bangsbo, 2008; I. Mujika, Santisteban, Impellizzeri, & Castagna, 2009).

high-intensity actions such as sprinting are often centered about key match situations, including ball possession and goal-scoring chances (Faude, Koch, & Meyer, 2012) and the repetitive nature of sprinting in soccer gives rise to a key physiological characteristic , repeated-sprint ability (RSA) is the capacity to repeatedly produce maximal or near-maximal efforts (i.e., sprints), interspersed with brief recovery intervals (rest or low- to moderate-intensity activity) (Girard, Mendez-Villanueva, & Bishop, 2011).

It is essential to develop sporting factors and improve football performance and psychological aspect among players therefore; several methods of specific training related to this sport have been established. For instance, various training programs, including high intensity interval training (HIIT) and small-sided games (SSG) have been applied and tested for soccer players in order to enhance the physical performance(Stephen V. Hill-Haas, Dawson, Coutts, & Rowsell, 2009). HIIT is a type of interval training that alternates between short bouts of very high intensity effort and recovery periods.

The SSG however, are games played on small fields with fewer players than the regular 11 versus 11 ones. These games are appreciated by players and coaches and very widely used across the world(S. V. Hill-Haas, Dawson, Impellizzeri, & Coutts, 2011). Indeed much evidence was found for the HIIT benefits on physical performance in soccer players, specifically in achieving higher aerobic fitness(Stephen V. Hill-Haas et al., 2009). Different HIIT structures (30s- 30s, 15s-15s, 10s-10s, 10s-20s, 5s-25s) were used as in a ‘significant way for achieving greater improvements in physiological responses since it allows individuals to perform activities at high intensities for definite durations (Dellal et al., 2008). Whereas, SSG could be used for specific aerobic endurance training while having the technical and tactical advantage of soccer specific training(Stephen V. Hill-Haas, Coutts, Dawson, & Rowsell, 2010).

In that regard, the pitch size, number of players, encouragement of the technical staff, and the presence of goalkeepers would directly impact the physical intensity of players' activity (Halouani, Chtourou, Gabbett, Chaouachi, & Chamari, 2014; E. I. Rampinini, Franco M. Castagna, Carlo Abt, Grant Chamari, Karim Sassi, Aldo Marcora, Samuele M., 2007). Although both HIIT and SSG could have comparable physiological responses(Dellal, Varliette, Owen, Chirico, & Pialoux, 2012), SSG is more specific to soccer and was shown to increase the motivation level of players(Allen, Butterly, Welsch, & Wood, 1998).

High-intensity interval training (HIIT) embraces a variety of interval protocols with varying duration and interspersed recovery breaks involving "repeated sprint training" (RST) with sprints of 3–7 s duration, interspersed with recovery periods of less than 60 s, and "sprint interval training" (SIT) with 30 s all-out sprints, and 2–4min of passive recovery periods, and HIIT with either short (<45 s) or long (2–4min) interval durations and depending on the intensity and duration of the exercise, as well as the recovery and the number of repetitions and sets (Buchheit & Laursen, 2013).

The ability to repeat high-intensity, short duration efforts following short recovery periods has been termed 'repeated sprint ability' (RSA) (Fitzsimmons et al., 1993). RSA is an important element of the fitness requirements, especially in team sports (Gabbett, 2010; Spencer, Bishop, Dawson, & Goodman, 2005). To develop optimal RSA training programmers, it is important to know which fitness determinants (i.e. aerobic or anaerobic) are associated with performance.

The ability to perform a short-duration multiple sprints interspersed with short recovery times has been termed «repeated-sprint ability» (RSA)(Iñigo Mujika, Spencer, Santisteban, Goiriena, & Bishop, 2009) . Although debate exists regarding the main factors determining soccer performance (Reilly & Gilbourne, 2003), the importance of RSA is recognized (Iaia et al., 2015; Impellizzeri et al., 2008). For instance, significant correlation exists between very-high intensity running distances covered during matches and mean sprint time on a RSA test (E. Rampinini et al., 2007). Besides this, single and repeated sprint efforts are frequently involved in crucial moments of match-play (Oliver, Armstrong, & Williams, 2009), including creation of goal scoring opportunities. Therefore, constant evaluation of RSA throughout the season can provide valuable information to coaches and athletes. In addition to RSA, intermittent high-intensity endurance is also considered crucial to performance in soccer(Iaia, Rampinini, & Bangsbo,

2009). Although the importance of total running distance covered at high-intensity in soccer could be masked by the technical-tactical level of a team (Bradley et al., 2013), players at a higher standard of competition tend to perform significantly more high-intensity running than those at a lower standard (Bangsbo, Nørregaard, & Thorsø, 1991).

Also, through several studies, that analyzed psychological factors and the external load of players through questionnaires to monitor TL and wellness as a common practice for monitoring physiological and psychometric status of players has largely been credited as a practical and valid method in sport(Coutts & Reaburn, 2008; Hooper, Mackinnon, Howard, Gordon, & Bachmann, 1995) , and the physical effort is conceptualized as a psychobiological complex and that psychological factors play a crucial role in performance (Armstrong & VanHeest, 2002; Haddad et al., 2013; Thorpe et al., 2015).

These include the Profile of Mood States, The Recovery-Stress Questionnaire for athletes and Daily Analysis of Life Demands for Athletes and the Total Recovery Scale (Halson, 2014; Saw, Main, & Gastin, 2016). Accordingly, Hooper questionnaire which was validated initially in swimming (Hooper et al., 1995) and then used in soccer (Chamari, Haddad, Wong del, Dellal, & Chaouachi, 2012; Fessi et al., 2016; Haddad et al., 2013; Thorpe et al., 2016) and rugby sevens (Elloumi et al., 2012) represents a valid method based on self-analysis questionnaires involving the well-being ratings relative to sleep, stress, fatigue and delayed onset muscle soreness. Indeed, daily measurements of these alternative methods are simple, non-invasive and practical during training sessions. They are useful for the staff and fitness coaches to accurately schedule and adapt the TL to optimize training and performance (Moalla et al., 2016). Therefore, the main aim of the study was to analyze the effect of soccer players repeated-sprint ability (RSA) and evaluate the of pre-season perceived wellness between HIIT and SSG during 8-weeks of training. To our knowledge, there are very few studies evaluating and comparing both training methods on repeated-sprint ability (RSA) training and wellness Status between two groups of players of the same age and from the same football club, and such investigation is required to assess the physical exertion of players during training. Thus, a preference training with HIIT in terms of repeated-sprint ability (RSA), as well as wellness Status was reported.

2. Method and Materials:

2.1 Experimental approach to the problem:

To evaluate the effect of HIIT and SSG training on the performance of repeated sprint ability and Wellness status of young football players, the athletes were randomly assigned to two experimental groups (GE-HIIT) and (GE-SSG), and anthropometric measurements were worked out before and after the experimental program , (RSSA) fitness test was conducted to measure a player's ability Repeated sprint and we also monitored the players' health status by Hooper Index, sleep, cues, fatigue, and muscle soreness performed throughout the training period and assessing the dependent variables before and after training during the pre-season.

2.2 Participants

The data are presented from sixteen soccer player's means ± standard deviation, representing a team Under-17 Football (USTebessa) all players have over 6 years' experience of training, and competing at National Amateur Football League for youth. GE: SSG N = 08 (age 15.31±0.5, height 160± 0.07cm, weight 59.41± 7.44 Kg and BMI 23.43± 2.1 kg/m^2) and GE: HIIT N=08 (age 15.81±0.4 height 160±0.05cm, weight 59.64±4.57 kg and BMI 23.34±2.83 kg/m^2) and for guards with SSG and HIIT program is excluded **(Table 1).**

Table 1. Demographic characteristics of study sample

Sample	*Number*	*Age*	*Height (cm)*	*Weight (kg)*	*BMI*	*Level*
GE (SSG)	*08*	*15.31±0.5*	*160± 0.07*	*59.41± 7.44*	*23.43± 2.1*	*Amateur*
GE (HIIT)	*08*	*15.81±0.4*	*160±0.05*	*59.64±4.57*	*23.34±2.83*	

GE: Group Experimental, SSG: Small Sided Game, HIIT: High Intensity Interval Training, BMI: Body Mass Index

2.3 Materials:

Training and match data were collected over an 8-week in-season period (between September and November). For the purposes of the present study, all the sessions carried out as the main team sessions were considered.

The training program contains (pre and post program with sixteen training units of SSG and HIIT play, eight technical tactical sessions and eight preparation matches), and during the training period, The type of training was determined for HIIT 30/30s group with different intensity between

(100% to 110% MAS) and 4vs4 for SSG with different playing pitch Space between 600 m^2 and 1000 m^2 as shown in **Table 2**.

The number of repetitions and series has gradually increased, taking into account training loads after each week, as well as taking into account the type of recovery, each training session included the warm-up, main phase and slow-down phase plus stretching.

- **Anthropometric measurements:**

The weight was measured in kg to the nearest 0.1 kg using a regularly calibrated electronic balance. It is recommended to leave without shoes and in light clothing. Height was measured in centimetres to the nearest 0.5 cm using a wall chart. The body mass was estimated to be near 0.1 kg and the height to be close to 0.1 cm.

- **Repeated Shuttle Sprint Ability (RSSA):**

Repeated Shuttle Sprint Ability (RSSA) was tested to assess players' ability to cope with the specific sprinting demands of soccer. This test includes changes-of direction tasks, which is a characteristic movement pattern in soccer. After a 15- min warm up, players completed 6 × 40 maximal sprints interspersed with 20 s of passive recovery. Sprint times were recorded with a chronometer. The best sprint time was recorded and used for further analysis (RSSAbest).In addition, the dependent variables included the mean time obtained over six sprints and the decrease in performance (The RSSA decrement = ([RSA mean]/[RSA best] 100) – 100)] (Impellizzeri et al., 2008).

Table 2. The number of weeks, training sessions per week, training days and over 8 weeks included in the study.

Pre-season	*GE-SSG*	*GE-HIIT*
Study time	*The start of the study during the pre-season period from 09/14/2021 to 02/11/2021, where the post-test was applied to the players.*	
Weeks(n)	*eight week*	*eight week*
Training sessions per week (n)	*2 sessions SSG + session Tec tac + match*	*2 sessions HIIT + session Tec tac + match*
Training Type	*4 vs. 4 in an area between 600 m^2 to 1000 m^2 and a total training time between 20 minutes to 24 minutes and passive recovery between training series.*	*30/30 work intensity between 100% VMA and 110% MAS (running with change of direction in a 70-meter run), total training time between 20 minutes and 24 minutes , and passive recovery between training series.*
1.1Number of training sessions during the pre-season period	*16 sessions of SSGs with different rules and loads from week to week+ 8techno-tactic sessions + 8 matches at the end of the week.*	*16 sessions of HIIT with different rules and loads from week to week+ 8 techno-tactic sessions + 8 matches at the end of the week.*

- **Wellness Status:**

The 4-item wellness questionnaire used for the football and rugby league data identified perceived ratings Sleep, stress, fatigue and muscle soreness monitoring Psychometric variable was assessed using the Hooper questionnaire (Hooper et al., 1995). The questionnaire was completed before the daily first training session or before the match and was reflective of the response to the preceding training day. In fact, each player was asked to fill in Hooper questionnaire, which consists of the four following items: (1) the quality of sleep during the preceding night, (2) the rating of stress, (3) fatigue and (4) muscle soreness. Each of these parameters was measured separately using subjective rating scales ranging from 1 to 7: from ‘very low-or good’ (i.e. point 1) to ‘very high-or-bad’ (i.e. point 7). The Hooper’s score (HS) was then calculated as the total score of these four items.

2.4 Statistical Analysis

Data are summarized as the mean and standard deviation of the mean (mean ± SD). Statistical analysis was performed using IBM SPSS version 22 statistical software. After a normal distribution test (Kolmogorov-Smirnov test), and in application The student test apiaries for dependent samples was used to compare all parameters measured before and after training, pre and post-test between training groups. A p value <0.05 was accepted as the

minimum statistical significance, and it was calculated when calculating the ES, the pooled standard deviations (SD) were used (Cohen's d = [M1-M2]/pooled SD). ES with values of 0.2, 0.5 and 0.8 were considered to be small, medium and large, respectively.

1. Results:

- **Anthropometric characteristics:**

No statistically significant in anthropometrics differences were found for the training group with SSG and HIIT in the pre and post tests for the following measures, as for the SSG and HIIT group before and after training.

- **Repeated Shuttle Sprint Ability (RSSA):**

The data in **Table 4** show descriptive data for the RSSA test where there is a statistical significance and very significant positive improved between pre and post-test HIIT group with RSSA mean ($p = 0.04$; ES = 1.25) and RSSA best ($p = 0.02$; ES = 1.17) and no statistical significance was found for RSSA decrement% ($p = 0.2$; ES = 0.4) and the results showed that there was no significant improvement for SSG group, and there was a significant difference in the post test between HIIT and SSG at RSSA best ($p = 0.02$; ES = 0.9) for the benefit of the HIIT group.

Tables 4: statistics data of repeated shuttle sprint ability test before and after the period of training between HIIT and SSG.

RSSA test	*GE-SSG*				*GE-HIIT*			
	Pre test	*Post test*	*P value*	*ES*	*Pre test*	*Post test*	*P value*	*ES*
RSSA mean (s)	*8.12±0.43*	*8.15±0.24*	*0.9*	*0.08*	*8.18±0.1*	*7.9±0.3*	*0.04*	*1.25*
RSSA best (s)	*7.8±0.42*	*7.81±0.4*	*0.9*	*0.02*	*7.8±0.3*	*7.5±0.2[a]*	*0.02*	*1.17*
RSSA decrement (%)	*4.22±2.21*	*4.4±2.5*	*0.8*	*0.07*	*5.3±2.5*	*6.8±3.44*	*0.2*	*0.4*

a: significant difference between GE-SSG vs. GE-HIIT pre and post program.

- **Wellness status:**

Changes in wellness scores in different training periods are presented in Table 4. The stress score in the HIIT group assessed by the Hooper questionnaire was lower than the SSG group during the period ($p = 0.02$, ES

= 0.5). Moreover, the SSG vs. HIIT fatigue score increased (p = 0.006, ES = 1.16). The DOMS score increased during the training period in the HIIT group compared with the SSG group (P 0.006, ES = 1.5). Also, there was a difference significative between the HIIT and SSG groups in the stress score during the different training periods (p = 0.02, ES = 0.5). Finally, the Hooper index increased significantly after the training period comparing HITT and SSG (P = 0.01, ES = 1.3).

Tables 5: statistics data of pooled subjective ratings of sleep, stress, fatigue and muscle soreness during the pre-season weekly training between HIIT and SSG.

index variables	*GE-SSG*	*GE-HIIT*	*P value*	*ES*
Stress	*1.79±0.18*	*1.68±0.21*	*0.02**	*0.5*
Sleep	*2.02±0.20*	*1.84±0.26*	*0.001***	*0.7*
Fatigue	*2.64±0.34*	*3.24±0.40*	*0.006***	*1.16*
DOMS	*2.76±0.36*	*3.55±0.65*	*0.006***	*1.50*
Hooper score (HS)	*9.23±0.73*	*10.33±0.94*	*0.01**	*1.30*

GE: Group Experimental, SSG: Small Sided Game, HIIT: High Intensity Interval Training.

2. Discussion :

The purpose of this study was to analyze the impact of footballers' ability to run frequently (RSA) and assess preseason perceived wellness between HIIT and SSG within 8 weeks of training. The results shown indicate that the HIIT Group (30/30) has made greater improvements than the SSG Group (4vs4) about the repeated ability of the sprint and the players after training had some muscle pain and fatigue compared to the SSG Group and the sleep quality was good after training as well as there was no clear concern according to a questionnaire compared to SSG.

The results of our study also agreed with these studies that demonstrated In the five investigations of (Engel, 2018) that evaluated responses of HIIT on the repeated sprint ability of young athletes, a small effect size was observed (mean g = 0.35 ± 1.48; range: −1.27– 2.69) (Buchheit et al., 2009; Buchheit et al., 2008; Delextrat & Martinez, 2014; S. V. C. Hill-Haas, A. J. Rowsell, G. J. Dawson, B. T., 2009; Tønnessen, Shalfawi, Haugen, & Enoksen, 2011).

And the results of our study indicated a significant effect of HIIT compared with SSG, and this was confirmed by these studies that proved The single investigation that examined repeated sprints (S. V. C. Hill-Haas, A. J. Rowsell, G. J. Dawson, B. T., 2009) observed a trivial effect of HIIT in comparison to SSG, i.e., SSG and HIIT appear to improve this ability to a similar extent. From a practical point of view, shorter intervals of HIIT or SSG at intensities close to that of repeated sprints may be sufficient to improve such performance. In the one investigation on change-of-direction performance (Faude, Steffen, Kellmann, & Meyer, 2014) , HIIT had a large positive effect in comparison to SSG, in contrast to other findings of greater improvement of this sort with SSG (Kannekens, Elferink-Gemser, & Visscher, 2011).

While there are similarities between SSGs and real games, several factors differentiate them (Clemente, 2020). Determinant external load outcomes, such as high-speed running, sprinting, or accelerations, reveals that SGGs underexpose soccer players to the typical demands of a real game (Casamichana, Castellano, & Castagna, 2012; F. M. Clemente et al., 2019; Dalen et al., 2021; Gabbett & Mulvey, 2008). Regarding sprinting, it is necessary to have longitudinal distance as well as opportunities to reach velocity (Nassis, Brito, Figueiredo, & Gabbett, 2019) and such fact it is difficult in SSG scenarios in which the pitch is smaller than that of a normal game.

In 4 vs. 4 and 6 vs. 6 SSG formats, players achieved a mean of 0.2 m/min (vs. 1.7 m/min in an official match) (Dalen et al., 2021) . Thus, it is expected that even in larger SSGs(S. Hill-Haas, Rowsell, Coutts, & Dawson, 2008) , the variability of the games may not expose players to a significant amount of linear sprinting. This, in turn, may have consequences related to the adaptations promoted by SSG-based interventions when compared to running-based interventions (e.g., HIIT) this is what was shown by our study that training on HIIT improves the results of repeated sprints compared to SSG, which has its own specificity in training.

The ratings of sleep, stress, and fatigue and muscle soreness in pre-season were higher than those observed during in-season ($p < 0.01$) whereas the feeling score was lower ($p < 0.01$). Furthermore, training sessions, including technical/tactical work, induced an improved feeling score but linked with a lower training load when compared with sessions focus on physical emphasis ($p < 0.01$). Pre-season period of training induces a significantly more strenuous and exhausting demands on professional soccer players compared with the in season period at the elite level (Fessi et al., 2016).

The present study revealed there a significant difference in HI parameters HIIT and SSG between training days for amateur football players. Consistent with our results, recent studies reported no intra-week variations (between match day and training sessions) in wellness variables in elite soccer players (Oliveira et al., 2020; Oliveira et al., 2019). In our study, measures of wellness were observed to range from 1 to 3 on average during the football players' training session. This result was consistent with the study by Clemente et al (Filipe Manuel Clemente et al., 2019) stated that basketball players showed similar health profiles in both training and matches during normal and congested weeks, and the health profiles of the players (very low DOMS, fatigue, and stress and very good sleep quality, around 2 on average) were quite well stated. This shows that both training sessions and matches have similar effects on players and do not sufficiently trigger stress factors. This result is also supported by Clemente et al(Filipe Manuel Clemente et al., 2019).

The results of our study also agreed with that of Salemi et al. that there was no significant relationship between the variables scored before the first daily training session and the variables noted after the SSG training sessions, which showed that perceived internal intensity and psychometrics are not affected by differences in recovery status, good sleep rating and fatigue from Fatigue, stress, and DOMS during specific soccer training (Selmi, Gonçalves, Ouergui, Sampaio, & Bouassida, 2018).

In the study to Renato Fernandez et al of professional football, it was found that wellness there was no significant differences in the Hooper Index parameters between the training days and match days ($p > 0.05$). This study confirmed the highest intensity values during MD and the lowest on the training session before the MD (MD-2). Moreover, higher training intensities were found in the beginning of the training week sessions which were then reduced when the MD came close. Wellness parameters showed no variation when compared to intensity measures (Fernandes et al., 2022).

3. Conclusion :

The results of the current study show the importance of working on HITT to develop the physical fitness, as well as taking into account the work of SSG because it has an importance on the psychological and physical fitness of the players, as the results of the study showed us. Players can not only use HIIT to develop physical performance, but they can also do so to maintain stable mood and health via SSG, and the effects on repetitive sprinting ability, altering direction performance and state of mind require further scientific evaluation, and future studies should be conducted to investigate the long-term, chronic effects of use on the psychiatric and clinical outcomes associated with HIIT and high-intensity SSG exercise.

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