Effects of a short High-Intensity Interval Training Shock Microcycle at the beginning of the pre-season in a semi-professional soccer team

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HIITsm | Block Periodization | Soccer

Headline

A pre-season in soccer is usually shorter than most sports and, during this time, teams already play a big number of friendly matches and sometimes tournaments (1). It is, therefore, necessary to prepare the players for higher training intensities and to play a 90 minutes match in the smallest amount of time possible. Some research has been made on the potential benefits of implementing HIIT during the pre-season conditioning process, which represents the opportunity to enhance aerobic capacity during this period (2–4). During this period, players' condition has to be established, as well as the technical and tactical elements of the sport, and this is where block periodization might come into action, integrating HIIT with both technical and tactical practices (5,6).

Aim

The aim of this study was to evaluate the effects of a short HIIT shock microcyle (HIITsm) at the beginning of the pre-season in a semi-professional soccer team.

Methods

Participants

15 healthy male soccer players (age: 26 ± 5.10 years; height: 1,78 ± 0,06 m; weight: 76 ± 8.5 kg) competing in a semi-professional Portuguese soccer team participated in this study. All players had at least 8 years of training experience. Before the training intervention, athletes had 5 weeks of individual training, without collective practices. All subjects were informed about the investigation and gave their written consent to participate in the study. The study protocol was conducted in accordance with the declaration of Helsinki.

Design

The study consisted of a single group experimental design. The intervention consisted of 2 periods (HIITsm and Recovery period) (Tables 1 and 2) lasting a total of 19 days. The Small-sided games (SSG) were performed in a 25 x 30 m pitch (7) with goalkeepers (4 vs. 4 + GK) to make the drills more competitive, the players motivated and a higher transfer effect to the reality of the sport (8). Specific fitness tests were conducted before the HIITsm period and after the Recovery period. At least 72h separated the last vigorous training session from the fitness tests. The technical practices consisted of predominantly technical drills, the tactical practices involved more drills related to the playing process and the technical/tactical practices were composed of both types of drills.

Testing

The 30-15 Intermittent Fitness Test was used to evaluate the players' endurance capacity and as the main tool to prescribe and to individualize HIIT intensities. The last stage (speed) that a player would reach was recorded as his VIFT and would then be used to calculate the distance he needs to cover for a given time and intensity of work (9). The T-Test Agility was modified to be more specific to the soccer movement patterns. Instead of reaching the first cone and then running sideways, the players were instructed to reach the first cone and then turn to the next one and run in a straight line and repeat the process for all the cones. The 20- and 40-meters straight-line sprint time was recorded during a single sprint. The subjects had 2 opportunities for each test (T-Test Agility and 20 and 40 m straight-line sprint time), the best time in each test was kept. The same protocol was applied to the Countermovement Jump (CMJ) test, where subjects performed 2 jumps and the best performance was recorded.

Monitorization

The internal load was monitored during the intervention by collecting players' individual rating of perceived exertion (RPE) using Borg's category ratio scale (CR10) after each training session (10). Player RPE was collected at least 15 minutes after the training session to ensure that the perceived effort reflected the whole training session and not the last exercise performed (11). The overall training load was calculated using the session-RPE (s-RPE). This is calculated by multiplying the RPE score (in arbitrary units) by the individual duration of the training session, in minutes (Session duration x RPE) (12). Fatigue, muscle soreness, stress, and sleep quality were assessed using the Hopper Index wellness questionary (13). Players answered the questionary every morning, whether there was a practice/game that day or not. A familiarization of both methods (RPE scale and Hooper Index) was conducted before the intervention began.

Statistical Analyses

Statistical analyses were performed using the Statistical Package for Social Science statical software (version 27, IBM SPSS Statistics, Chicago, IL, USA). Descriptive data are presented as means ± standard deviation (± SD). The normality of the data was checked using the Shapiro-Wilk test. Paired T-Test was used to determine the effects of the training dependent variables (30-15 VIFT; t-tests Agility time; 20 and 40 m straight-line sprint time and CMJ height). The level of confidence was set at $p \leq 0.05$. Cohen's effect size (d) was also calculated for the comparison of pre- and post-intervention. The thresholds for small, moderate, and large effects were defined as 0.20, 0.50, and 0.80, respectively.

Table 1. Types of HIIT that were used through the HIITsm and Recovery periods.

Type	Set number x interval time (min)	In-set running interval/rest duration (s)	Working interval intensity	Resting interval intensity	Between sets recovery time (min)	Recovery type	HIIT interval mode
A	4 x 3	Continuous	85% VIFT	-	4	Active: low-intensity jogging	In-line
B	2 x 8	15/15	95/100% VIFT	Passive	6	Passive	In-line
C	3 x 3	7/25	All-out	Passive	10	Active: rondos	1 180°
D	4 x 4	Continuous	-	-	4	Active: low-intensity jogging	SSG (4 vs. 4 + GK)

Table 2. Organization of the HIITsm and the Recovery period with HIIT types (refer to Table 1) and soccer session type.

HIIT shock microcycle										
Day	1	2	3	4	5	6	7	8	9	10
HIIT Type	D and B	C	Off	A	B	Off	Off	D and B	C	Off
Session Type	Tec	Tec	Tact	Tec	Tec	60 min Game	Off	Tec	Tec	Tec/ Tac
Recovery period										
Day	11	12	13	14	15	16	17	18	19	
HIIT Type	Off	Off	Off	Off	B	Off	Off	Off	Test	-
Session Type	Tec/ Tac	Tec	90 min Game	Off	Tec	Tac	90 min Game	Tec/ Tac	Off	-

Tec = technical practice; Tac = tactical practice; Tec/Tac = technical and tactical practice.

Table 3. Changes in the fitness tests performed pre-HIITsm (Pre) and at the end of the recovery period (Post). Values are presented as mean ± SD.

	Pre (mean ± SD)	Post (mean ± SD)	Change (mean ± SD)	*d*
30-15 VIFT (km/h)	19.6 ± 1.6	20.4 ± 1.2†	0.83 ± 0.99	0.55
T-Test sprint time (s)	9.43 ± 0.3	9.39 ± 0.4	- 0.04 ± 0.33	0.11
20 m sprint time (s)	3.01 ± 0.2	2.99 ± 0.2	- 0.03 ± 0.23	0.1
40 m sprint time (s)	5.40 ± 0.2	5.55 ± 0.2*	0.15 ± 0.11	0.75
CMJ (cm)	34.2 ± 4.2	35.3 ± 4.8	1.07 ± 3.40	0.24

* $p < 0.001$;
† $p = 0.005$

Results

Statistically significant changes were observed in the 30-15 IFT and 40 m results ($p = 0{,}005$ and $p < 0.001$ respectively) with positive improvements in the 30-15 IFT (Figure 1) contrasting with impairments in the 40 m straight-line sprint time (Figure 2). A moderate effect size was obtained in the 30-15 IFT results ($d = 0.55$) while an almost large effect size ($d = 0.75$) was observed for 40 m sprint time. The rest of the tests showed no significant changes between pre- and post-intervention ($p = 0.70$; $p = 0.68$; $p = 0.27$) for the T-Test sprint time, 20 m straight-line sprint time, and CMJ height, respectively. Cohen's d was trivial for the T-Test and the 20 m straight-line sprint times ($d = 0.11$; $d = 0.1$, respectively) and moderate for the CMJ height ($d = 0.24$). Higher levels of fatigue and muscle soreness were observed during the HIITsm, with both variables' values dropping during the recovery period. Sleep quality and stress kept a relatively steady state during the whole intervention period (Figure 3). Higher total training loads were reported during the HIITsm (difference of -1998 ± 891.8 AU from the HIITsm to the recovery period). Even though the recovery period was a day shorter than the HIITsm, daily average training loads were still higher during the HIITsm (difference of -181 ± 103.4 AU from the HIITsm to the recovery period) (Figure 4)

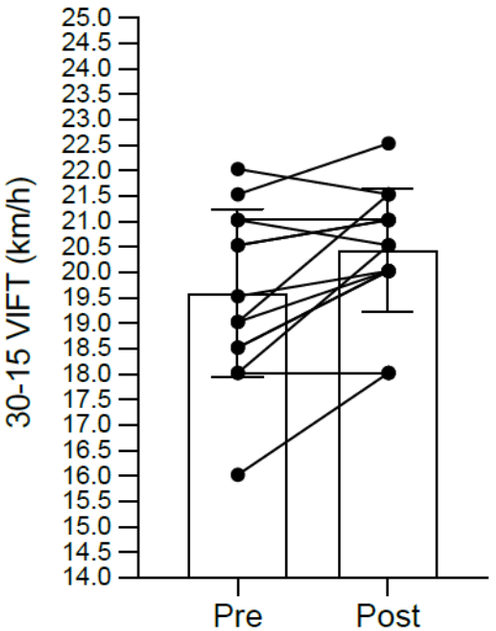

Fig. 1. Changes in the 30-15 Intermittent Fitness Test pre- and post-intervention. Mean (bars) and individual (circles). Values are presented as mean + SD for the bars.

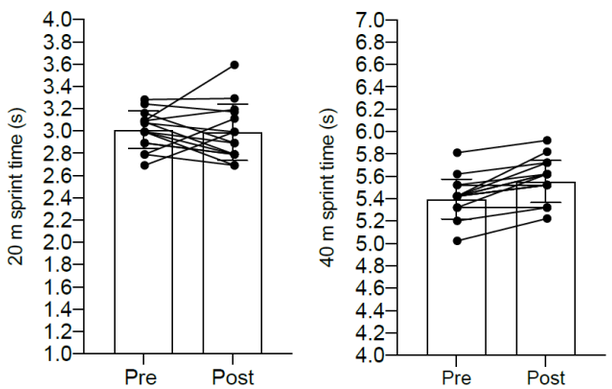

Fig. 2. Changes in the 20 m straight-line sprint time (A) and 40 m straight-line sprint time (B) pre- and post-intervention. Mean (bars) and individual (circles). Values are presented as mean + SD for the bars.

Discussion

The main findings of this investigation indicate that a 10 days HIITsm is an effective approach to enhance athletes' endurance capacity in a short period of time, showed by the improvements in performance during the 30-15 IFT. Similar improvements were observed by Wahl et al., 2014 (4), even though the authors utilized a different approach to the HIITsm. This type of block periodization has been effective in other sports, with studies showing similar results (14–17). The fact that CMJ and the T-Test showed no significant and substantial changes could mean that there was no overload on the neuromuscular system, with these tests involving more quadriceps and gluteus actions. On the other hand, the higher times reported in the 40 m straight-line sprint may suggest an overload on the locomotor system and the muscles involved in

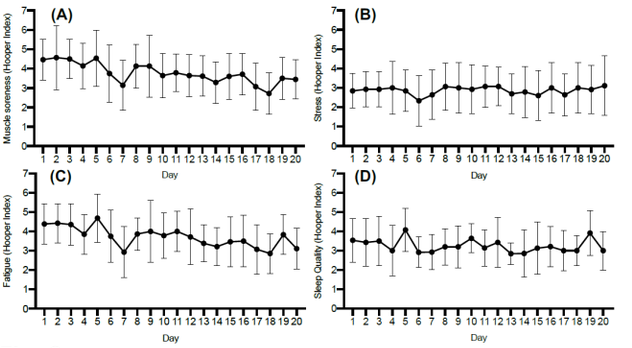

Fig. 3. Mean (dots) and ± SD (lines) for the levels of muscle soreness (A), stress (B), fatigue (C), and sleep quality (D). 1 meaning the lowest level of muscle soreness, stress, and fatigue, and 7 the highest. 1 meaning the best sleep quality and 7 the worst.

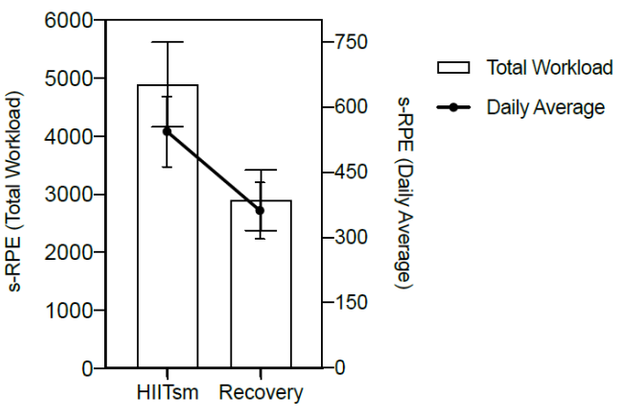

Fig. 4. Total (bars) and daily average (dots) workload for each period (HIITsm and recovery). Values are presented as mean ± SD.

sprinting, like the hamstrings, the rectus femoris, the vastus lateralis, etc. Again, HIIT training by itself is hard and very demanding (18,19) and, during the HIITsm it is important to consider secondary HIIT-related training stimuli which might affect the neuromuscular/neuromechanical system, increasing the risk of overstress and injuries during a period with such limited recovery (20). Protocols that involve running at high intensities and/or all-out intensities might be more traumatic for the joints, impose a higher muscular stress and increase the risk of injuries such as ankle and knee sprains (20). The high demands of the HIITsm are shown in Figure 3 and reveal that during the HIITsm, fatigue levels, as well as muscle soreness, go up. A similar decrease in wellness has been reported by other studies (21–23). Although acute fatigue effect during an HIITsm is expected, and functional overreaching symptoms have been observed (24), they don't appear to be a limiting factor for the application of this type of training block, since these effects usually dissipate within a few days of recovery. The design of the present HIIT shock microcycle pretended to give more insight into what type of strategies were being used and when, filling some gaps in the literature regarding this training methodology. Furthermore, the present study did not use a control group performing other regular training during the pre-season period, which is a limitation shared with other similar studies. Anyhow, the performance improvements suggest that the strategy used in the present study has prac-

tical application and is viable to use with lower lever athletes, although a sufficient recovery phase must be planned to allow a complete athlete recovery.

Practical Applications

- Overall, HIITsm is a viable strategy to improve players' fitness capacity in a short amount of time
- Coaches and/or S&C coaches can adopt this strategy in situations where time is limited, like short pre-seasons, where fitness needs to be developed quickly so more focus can be put on tactical and technical work;
- Loads should be carefully planned and monitored, as this method is very demanding from the players.

Limitations

- The fact that there was no control group performing the traditional soccer practices was our biggest limitation
- The lack of objective training load measures was also a limitation. Having access to heart rate data, as well as GPS information would make it possible to better monitor the training load as well as making this paper more robust
- Better fatigue and wellness monitoring could also have been made. The use of actigraphy devices, for example, would give us a lot more information about how athletes were sleeping during this stressful period.

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