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Non-traditional training in youth soccer players: Effects on agility and on sprint performance

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ABSTRACT

Soccer is a high-intensity activity requiring several physical and technical components such as agility, speed, strength, and power production. High-intensity functional training (HIFT) is a relatively new training modality that emphasizes functional, multi-joint movements that elicit greater muscle recruitment with respect to more traditional exercises. The aim of the study was to verify the effects of 8 weeks of non-traditional training, specifically HIFT, on agility and sprint performance in young soccer players. Twenty-eight male subjects (M age 12.6 ± SD 0.5 years) were divided into an experimental group that performed the HIFT (NTT, n = 14) and in a control group (TT, n = 14) that followed a traditional training. HIFT included functional exercises, High-Intensity Interval Training (HIIT), technical exercises, agility, and change of direction ability. Twenty meters sprint test and 21-m agility test were administered to assess sprint performance and agility, respectively. After 8 weeks of training a significant interaction Group x Time ($p < .01$) was found for NTT for agility and a non-significant improvement in relation to sprint performance ($p > .05$). No differences were detected in the TT. An 8-week NTT based on HIFT can represent an innovative and additional methodology to improve the agility performance of young soccer players.

Keywords: High-intensity functional training; Young players; Soccer; Agility; Sprint.

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INTRODUCTION

Sports performance requires the development of multiple fitness components to be trained simultaneously (Neto et al., 2019) and also technique consolidation (Esposito and Raiola, 2020). A common topic for sports is the limited amount of training time which requires a smart optimization process in order to maximize technical and tactical component together with physical abilities. Indeed, finding the most efficient way to develop the physical, technical, and tactical components simultaneously is a challenge that athletes and coaches must consistently face (Young, 2006).

Besides high intensity interval training (HIIT), which has shown to be effective in both individual, such as Crossfit, (Cataldi et al., 2021) and sports teams training (Faude et al., 2013), high intensity functional training (HIFT) is emerging as an effective alternative to improve physical fitness compared to traditional circuit training (Neto et al., 2019). HIFT incorporates functional exercises (those involving whole body, universal motor recruitment patterns and executed in multiple planes of movement) in sessions that are intense, short, and continuously varying that have the potential to stress different body systems in a balanced and integrated manner (Feito et al., 2018).

Although similar to HIIT, HIFT utilizes a mix of several exercises with different modalities, such as Olympic weightlifting, power training and body weight exercises, often combined with aerobic training, while HIIT is usually more unimodal.

Soccer is a well-known intermittent high-intensity activity requiring several physical and technical components such as agility, speed, strength, and power production (Bloomfield et al., 2007; Raiola et al., 2020; Bonavolontà et al., 2021). Soccer like other team and situational sports, it is considered an intermittent activity involving sudden changes in direction and parallel major changes in intensity (Stølen et al., 2005). In addition, data concerning the physical demands of soccer suggest that a high level of performance requires well-developed neuromuscular function (Silva et al., 2015) as well as development of speed and agility (Di Domenico et al., 2019). Indeed, according to the performance model, during a match, a soccer player performs sprints for an average duration of 1.7-4.4 s with rest time of 1 to 2 minutes between each. On average, 46-70 sprints are performed during the 90 minutes match, representing approximately 0.5 - 3.0% of the actual playing time and account for 1-11%. of the total distance covered (Bangsbø et al., 1991; Di Salvo et al., 2007).

Moreover, it has been proved that the number of CODs during a match influences directly the final score in professional soccer. (Faude et al., 2012) (Stølen et al., 2005). Consequently, the ability of making sudden changes of direction is deemed to be a valid criterion to the search of elite soccer players. (Reilly, 2005; Reilly et al., 2000; Stølen et al., 2005). The COD is therefore an important skill in many sports and, since it occurs repeatedly over the entire match, the ability of making repeated changes of direction (RCOD) can be an important component in soccer. Players can also make changes of direction in response to an external stimulus which requires a perceptive action (Stølen et al., 2005). Sheppard and Young (2006) have defined agility as the ability of executing an adequate COD in response to an external stimulus.

There is paucity of studies examining the effects of non-traditional training, HIIT and HIFT on soccer. Marín-Pagán et al. (2020) reported that high intensity resistance training based on circuit, elicited greater metabolic and cardiovascular responses respect to a traditional strength program. Another study in the soccer field compared 8 weeks of a traditional training with functional training in young individuals finding positive effects of the former on physiological and bio-motor properties even if the differences were not statistically significant

(Turna and Alp, 2012). Anyway, as advocated by Neto et al. (2019) there is a clear need for controlled and robust studies that put the focus on HIFT in order to assess its effectiveness in the athlete's population.

Therefore, aim of this study was to compare the effects of 8 weeks of non-traditional training, specifically HIFT, compared to a traditional program on agility and sprint performance in young soccer players.

METHODS

Participants

Twenty-eight male subjects (12.6 years ± 0.5) were recruited in a local soccer school and were randomly divided into two groups: HIFT group (NTT, n = 14; M height 153.3 cm ± 6.7; weight 45.7 ± 8.8 kg; BMI 19.2 ± 2.5) and the traditional training group (n = 14, TT, height 150.7 cm ± 10.8; M weight 45.4 kg ± 10.1; BMI 19.6 ± 2.8). Written informed consent was obtained by participants' parents.

Instruments and procedures

Two testing session were carried out before and after 8 weeks of intervention, as below reported, to evaluate young soccer players' agility and speed: 20 mt Test and 21 Agility sprint Test. Participants were tested in a synthetic grass outdoor soccer field with a temperature ranging from between 26°C to 30°C. Three attempts for each test were allowed, during which the subject was asked to perform at maximum speed; the best attempt recorded was then considered.

20-m sprint test

To assess agility sprint, 20-m sprint test (Nikolaidis et al., 2016) was used. The test starts as follows: the athlete stands in position, placing the favorite leg forward bent at 90 degrees, and the other leg flexed behind one foot away from the first; it is appropriate for the toe to be just behind the starting line (approximately 0.3 m) (Altmann et al., 2015) as if the distance is greater the athlete would have the opportunity to generate more speed. The athlete places the arm opposite the leg forward or rests it on the ground at the starting line (Cronin et al., 2007); at the signal athlete gives a push forward helping him in the stroke by swinging his arms.

21-m agility sprint test

To assess agility 21-m agility sprint test (Millefanti et al., 2016) was used. The test starts as follows, after the acoustic signal the athlete starts from point A (Fig. 1), the athlete runs at maximum speed towards point B, then, making a change of direction at 90°, sprints towards point C, so until reaching H, where the test ends. In the present study the time was manually detected with a stopwatch; to reduce the error gap, all the recordings were made by the same operator. The distance to be covered in this test is 21 meters (2+3+5+3+2 m, Figure 1) with three changes of direction to the right and three to the left. The best result of the 3 trials is recorded.

Intervention

For both groups, the duration of the intervention lasted 8 weeks with a frequency of 3 sessions per week (on Monday, Wednesday and Friday) and a total number of 24 sessions lasting 1 hour and half each. HIFT sessions content for NTT group is described in detail in Table 1. TT group performed, instead, a traditional form of training characterized by technical and tactical elements. All sessions were performed immediately after a 15-minutes specific warm up to ensure that the players were in an optimal state of activation in order to facilitate the benefits from the pre-established intervention program. Specifically, on Monday and Wednesday it was proposed a dynamic warm up while on Friday the warm-up focus was focused on mobility.

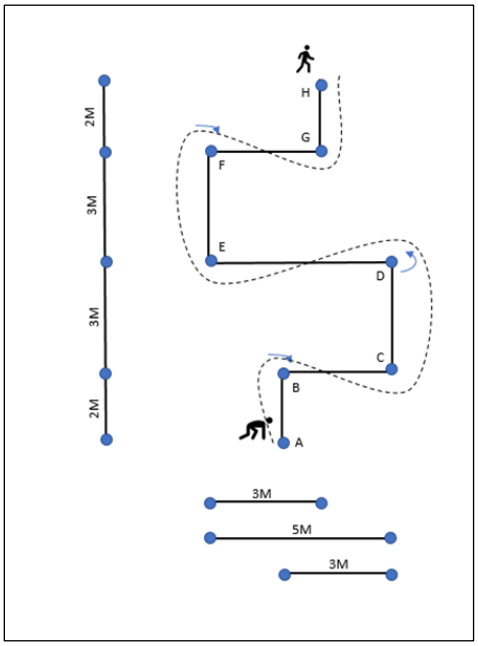

Figure 1. 21-m agility sprint test.

Table 1. Content of training session for NTT group.

Week	Monday	Wednesday	Friday
Week 1/2	- Dynamic activation -Agility + Strength (speed ladder) - Free body exercises Bipodalic exercises - Linear repetitions 5'/35'' - Small side games 5vs5	- Prevention (activation) - Running technique (athletics drills) - Bipodalic explosive exercises - Exercises with elastic bands x2 set (active recovery) - Small side games 5vs5	- Ankle/Hip Mobility - COD - Contact Games - L and 90° COD - Small side games 5vs5
Week 3/4	- Dynamic activation - Agility + Strength (speed ladder) - Free body 4 rep x2 set Bipodalic exercises - Linear repetitions 5'/30'' - Small side games 5vs5 short field	- Prevention (activation) - Running technique (athletics drills) - Bipodalic explosive exercises - Exercises with elastic bands x2 set (active recovery): - Small side games 5vs5	- Ankle/Hip Mobility - "*Boccolini's COD*" - Contact Games 5'30'' - L and 90° COD 6 rep x2 set - Small side games 5vs5
Week 5/6	- Dynamic activation - Agility + Strength (speed ladder) - Free body exercises - Monopodalic exercises - Linear repetitions 5'/25'' - Small side games 5vs5	- Prevention (activation) - Running technique (athletics drills) - Monopodalic explosive exercises - Exercises with elastic bands (active recovery) - Small side games 5vs5 short field	- Ankle/Hip Mobility - "*Boccolini's COD*" - Contact Game 5'25'' - L and 90° COD - Small side games 5vs5
Week 7/8	- Dynamic activation - Agility + Strength (speed ladder) - Free body exercises - Monopodalic exercises - Linear repetitions 5'/20'' 2 set - Small side games 5vs5	- Prevention (activation) - Running technique (athletics drills) - Monopodalic explosive exercises - Exercises with elastic bands x2 set (active recovery) - Small side games 5vs5	- Ankle/Hip Mobility - "*Boccolini's COD*" - Contact Game 5'20'' - L and 90° COD - Small side games 5vs5

Statistical analysis

A 2x2 (Pre/Post x NTT/TT) repeated measures ANOVA was applied to check for any differences between and within groups. The interaction of Group (NTT/TT) x Time (Pre/Post) was also verified. When significant interaction was found a paired t-test was applied as post hoc analysis.

Statistical significance was set at $p < .05$. IBM SPSS 23.0 was used for all statistical analysis.

RESULTS

A significant ($p < .05$) "*Group x Time*" interaction was found in relation to agility in NTT group; Student's t test for dependent groups was then applied in order to assess whether there was a significant change in performance between Pre- and Post-intervention in the HIFT ($p < .001$). Regarding sprint performance a non-significant improvement for the same group was found in relation to sprint performance ($p > .05$). No statistical nor tendency to differences were detected for the TT group.

DISCUSSION

Aim of the study was to compare different training modalities on agility and sprint performance in young soccer players, namely a non-traditional training based on HIFT vs a traditional program based on technical and tactical abilities.

Previous studies showed that HIFT is an alternative method to improve physical fitness in sports respect to a traditional circuit training (Neto et al., 2019) also in the soccer context (Turna and Alp, 2012). Strenght training has been reported to be effective to several sport disciplines (Young et al., 2006; Fischetti et al., 2019; 2020) including soccer.

Moreover, small-sided games (SSG), that were a fundamental part of NTT intervention (Table 1), have been largely reported as highly beneficial for the development of several soccer-specific qualities such as physical and technical variables (Sannicandro and Cofano, 2017) as well as to monitor and to practically quantify internal and external load (Sannicandro et al., 2018; 2020 a, b).

The result of the present study seems to confirm previous evidence. Indeed, our intervention based on functional exercises and on HIIT, technical exercises, agility, and change of direction ability induced better improvements on agility and on sprint, even if not significantly, when compared to a traditional off-season program which has not shown no differences in relation to the measured variables.

In other words, data analysis showed that an NTT protocol can be used in the off-season with the aim of increasing the ability to respond to a stimulus, accelerate, decelerate and make changes of direction without losing speed; in short, improve agility.

The use of HIIT, focusing on the needs of young athletes, can lead to benefits not only sports-related but also on the psychosocial sphere. In this sense, a time-saving approach with reducing volume and increasing intensity has been shown to be beneficial for children, reducing time without compromising performance (Gibala et al., 2014) (Laursen, 2010). Therefore, a HIFT training has the potential to optimize time and performance, while allowing to focus on the physical development of motor skills and abilities in a long-term perspective.

Future studies could extend the present study also through the evaluation of the enjoyment that has shown to play a key role in sports practice also during pandemic (Bonavolontà et al., 2020). Moreover, it would be interesting to investigate on the effects of training load on fluid consumption, as proposed by Cesanelli et al., (2021) as well as the impact of previous practice on performance (Sgrò et al., 2018) and on cognitive functioning (Latino et al., 2021) in youth soccer players.

In conclusion, an NTT program based on HIFT could represent a time-effective training program useful to develop both physical and sport-specific abilities and, at the same time, technical and tactical skills in youth soccer.

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