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Original Article

Standing and crouch starts training effects on beginners sprint performance

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Abstract
The study aimed to evaluate the effects of training with standing and crouch start on 10 m sprint performance in adolescents. Twenty subjects of both sexes (age 14.5 ± 1.3 years, weight of 54.7 ± 9.0 kg and height of 1.63 ± 0.09 m) were distributed into two groups: 1) standing start or 2) crouch start. Participants performed 12 training sessions twice a week. Six sprints of 10 m composed each session. The 10 m sprint time with standing and crouch start were evaluated before and after training. There was no difference between groups pre- and post-training values. After the training period, the standing start group improved the 10 m sprint time with the test performed at standing start, while the crouch start group improved the 10 m sprint time with crouch start. Both groups reduced the 10 m sprint time after 4th training session. Thus, six weeks of 10 m sprint training with standing or crouch start increased sprint performance in a specific way.
Keywords: running, velocity, physical education, athletics

Introduction

Athletics is an individual sport based on fundamental movements such as running, jumping and throwing (IAAF, 2000). However, athletics seems little contemplated by teachers when compared to court sports (MATTHIESEN, 2014; MARIANO, 2012). Even more, so when it comes to the teaching of sprints. It can be understood that this motor skill type is already stimulated and practiced by childrenduring some part of physical education classes. However, the planned and systematized teaching of these sprints are generally not sources of teacher concern (KIRSCH et al., 1983).

Sprint running, such as 100 m, need an own start type, known as crouch or block start. At the "take on markes" command, the runner leaves the standing position and squats in a crouched position with his hands resting on the floor and feet resting on the blocks. In this posture, the trunk is in front of the hip. At the "set" sign, the athlete raises the hip slightly above the shoulders, so that the body center mass is moved closer to the starting line (MERO et al., 1992). After the starting shot, the center of mass is shifted forward and up as a result of the "explosive" action of the leg and hip muscles (COH and TOMAZIN, 2006).This requires large levels of fast strength and balance sincethe body mass is distributed between legs and arms (COH and TOMAZIN, 2006). Currently, the block start is mandatory in the running until 400 m.

In addition to differences in body position, the standing and crouch start to present some advantages and disadvantages according to the runner level. Gagnon (1978) showed that more skillful athletes run 50 m 0.3 s faster when using crouch compared to standing start. High-level athletes take their center of mass faster in the first second after the starting shot when using the blocks, compared to standing start (DESIPRÉS, 1973). On the other hand, Salo and Bezodis (2004) found a greater horizontal velocity at the end of the first pass, as well as a greater length of the first and second strides in the standing compared to block start in university athletes. However, such changes did not affect the 10, 25 and 50 m print time.

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The empirical knowledge suggests that beginner athletes should not use blocks start at the early running instruction (ASEP, 2008; BLADE, 2006). The reason is the technical complexity and the physical demand for an effective crouch compared to standing star (ROGERS, 2000). Beginners often lack adequate strength and coordination and therefore, rather than assisting, block start would hinder the sprint development. According to Derse et al. (1995), the use of thecrouch start is only beneficial for running when the athlete reaches a level of strength capable of raising a resistance equal to or greater than his body mass in the squatting exercise. On the other hand, standing start becomes a simpler sequence, not requiring significant technical improvement, probably because this start type is naturally developed throughout life (ROGERS, 2000).

Thus, it has been suggested that beginner subjects with lower strength levels would benefit from standing start, whereas experienced subjects with high strength levels would be more successful using the low output (ROGERS, 2000, DERSE, 1995). However, this hypothesis is not scientifically supported, as there are no studies in the literature that has evaluated the effects of crouch and standing start training on the performance of short-distance sprints in untrained young. Evaluating this issue may contribute to coaches, physical trainers and physical education teachers to optimize their training programs and classes that aim to teach and train sprints.

Therefore, the aim of the present study was to evaluate the of sprint training with standing and crouch start effects on 10 m sprint performance in untrained adolescents. Considering the biomechanical changes that occur with crouch start CohandTomazin(2006) and the low strength level of untrained (ROGERS, 2000; DERSE, 1995), it is expected that standing start sprint training will result in a greater gain in sprint performance than crouch start sprint training.

Material & methods

Participants

Twenty subjects of both sexes (age 14.5 ± 1.4 years, height of 1.6 ± 0.1 m, body mass of 54.7 ± 9.6 kg) participated in the study. The study procedures were in accordance with National Health Council resolution, Brazil. (466/2012) and was approved by the research ethics committee of the Belo Horizonte University Center, Brazil (No. 2.633.939).

Experimental design

In order to evaluate the 10 m sprint training effect with different start techniques on the sprint performance, the adolescents were randomly distributed in two groups: 1) Standing start (SS), 10 m sprint training with standing start; and 2) crouchstart (CS), 10 m sprint training with crouch start. Initially, an anthropometric evaluation and familiarization with the study procedures were performed. Then both groups performed a total of 12 sessions of 15 m sprint training distributed two training sessions per week. The performance in the 10 m run was measured pre- and after the 12 training sessions. Both training sessions and pre- and post-training tests were conducted in the morning (9:00 - 10:30 a.m.), and participants wore shorts, shirt, and sneakers and/or barefoot. Participants were instructed to maintain their physical activity habits and not engage in other types oftraining program.

Familiarization

All participants performed a total of six sprints of 15 m, three sprints with each start type, in a randomized and balanced order. The subjects received verbal instruction and demonstration (performed by the researcher himself) about the start techniques until they were as close as possible to the technique described in the checklist. In order to reduce the discomforts attributed to different heights, the blocks were adjusted in short, medium or long positions. On the shortblock, the rear edge of the front block has been aligned with the leading edge of the rear block. In the middle block, the rear edge of the front block was 10 cm from the front edge of the rear block. On the long block, the rear edge of the front block was 20 cm from the front edge of the rear block. The type of block position in which the subject felt most comfortable was recorded and replicated during the training, as well as in the pre- and post-training tests. In addition, the dominant leg was used as the hind leg in all study procedures.

Anthropometric evaluation

Body mass was measured using a previously calibrated scale (Hospital Mechanic, Filizola®, São Paulo, Brazil), with an accuracy of 0.2 kg and the stature was measured with a tape measure fixed on a flat wall. Such measures were performed with the participant barefoot, wearing light clothing. During the measurement of the body mass and height, the participants remained immobile in an anatomical position.

10-meter sprint training protocol

Both groups performed six weeks of training, with a total of 12 training sessions divided into two sessions per week. In each training session, the participants performed 6 sprints of 15-m sprints, with 2 min interval after the three first sprints Before each sprint participants were encouraged to run as fast as possible, but without any encouragement during the sprints. Feedback was given as to the correct position in the starting blocks. In addition, the participants did not perform any preparatory activity before the training sessions. The SS group started the sprints upright, with an anteroposterior spacing of the feets, trunk and knees slightly flexed and arms flexed above the hip. At the beep the participants moved the rear leg first, while the arms performed the opposite movement of the legs. The CS group started each of the sprints according to the following checklist

(BENNETT-YEO et al., 2007; IAAF, 2000) : a) "To their marks": feet in blocks, rear knee on the floor, elbow extended with hands on the floor and parallel to forward of the body; b) "Ready": elevation of the hip slightly above the shoulder line, feet resting on the block, looking at the ground and between the hands; c) "Start": moving from the center of mass forward, maintaining the trunk in flexion, movement of the hind leg, maximum extension of the knee and ankle of the front leg, contralateral swing of the arms in relation to the legs. The starting blocks were positioned taking into account the participant's foot so that the block closest to the starting line was a foot and a half away from it.

The sprint time session was recorded by manual chronometer (Digital, Unilab®, São Paulo, Brasil).For this, the evaluator positioned perpendicularly in the line of 10 m and supported the chronometer with the hand below the xiphoid process. The start and end buttons were always pressed with the thumb of the dominant hand so that it was constantly in contact with the button. The timer was fired at the "already" command and spiked when the participant crossed the trunk on the finish line. The minor sprint time of each training session was considered for statistical analysis.

10 m sprint performance pre- and post-training

The 10 m sprint time was measured before and after the training period using photocells (Mult Sprint, Hidrofit®, Belo Horizonte, Brasil). The photocell 1 was positioned in the start line and photocell 2 at a 10 m distance of start line. At the equipment beep signal, the participant was instructed to run 15 m as fast as possible in order to avoid deceleration before reaching the 10 m mark. All participants performed a total of six sprints, being three sprints with each type of start (standing or crouch), with randomized and balanced order. The minor sprint time of each start style was considered for statistical analysis.

Statistical analyses

Distribution normality and homogeneity of the data were initially assessed by using the Shapiro-Wilk and Levene's tests, respectively. Data were expressed as the mean ± standard deviation, and the level of significance adopted for all analyses was $P < 0.05$. ANOVA two way with repeated measurements (group vs. sessions) was used to analyse the performance among the sessions and group. The training effect on 10 m sprint was evaluated through of ANOVA three-way with repeated measurements (group [SS x CS] vs. start type in the 10 m test [standing x crouch] vs. time [pre- x post-training]). In case of significant difference, Tukey post hoc was used. Cohen's effect size was calculated by the difference between the pre- and post-training values divided by the pooled standard deviation[16]. The values found were defined as trivial ($d < 0.2$), small ($0.2 < d < 0.5$), moderate ($0.5 < d < 0.8$) and large ($d > 0.8$) (COHEN, 1988).

Results

There is not differences between groups for age (t= 0.49, p= 0.62), weight(t= 0.83; p= 0.41) and height(t= 1.79, p= 0.09) (Tab.1).

Table 1.Mean ± sd e [95% reliability interval] of physical characteristics.

	SS group	CSgroup	p
Age (yrs)	14.3 ± 1.1 [13.6; 15.0]	14.6 ± 1.4 [13.7; 15.5]	0.62
Weight (kg)	56.4 ± 4.9 [53.4; 59.5]	53.0 ± 11.4 [45.9; 60.0]	0.41
Height (m)	1.66 ± 0.07 [1.62; 1.70]	1.59 ± 0.09 [1.53; 1.65]	0.09

Table 2 shows the 10 m sprint performance with standing and crouch starts in both groups, before and after the 12 training sessions. There was interaction between the group x type of start x time (F = 9.4, p = 0.006). The SS group presented a minor 10 m sprint time after the training period in the test performed with standing start (p < 0.05). The CS group, on the other hand, presented a minor 10 m sprint time after training when the test was performed with crouch start (p < 0.05). There was no difference between groups. In addition, the SS group training effect was small, both for the test performed with standing (d = 0.36) and with crouch starts (d = 0.24). On the other hand, the training effect on CS group was small in the test performed with crouch start (d = 0.22) but was moderate in the crouch start test (d = 0.59).

Table 2.Mean ± sd and [95% reliability interval] of 10 m sprint performance pre- and post-12 training sessions.

Group	10m Sprint	Pre(s)	Post (s)	Δ (%)	p	*d*of Cohen
SS	Withstanding start	2.75 ± 0.29 [2.57; 2.93]	2.63 ± 0.34 * [2.42; 2.84]	11.6 ± 8.4†	0.005	0.,36
	With crouch start	2.77 ± 0.29 [2.59; 2.95]	2.69 ± 0.38 [2.,45; 2.92]	8.3 ± 15.9	0.072	0.24
CS	With standing start	2.81 ± 0.26 [2.65; 2.97]	2.75 ± 0.27 [2.58; 2.92]	5.9 ± 12.1	0.35	0.22

With crouch start	2.79 ± 0.31 [2.6; 2.98]	2.61 ± 0.29 * [2.43; 2.79]	18.4 ± 10.3†	0.0002	0.59

(*) $p < 0.05$; minor than pre-training.(†) $p < 0.05$; training effect.

Figure 1shows the better sprint time of each training session in both groups. There was no difference between the groups ($F = 1.38$, $p = 0.25$), however, both groups presented a decrease in sprint time during the training sessions ($F = 27.92$, $p <0.001$).

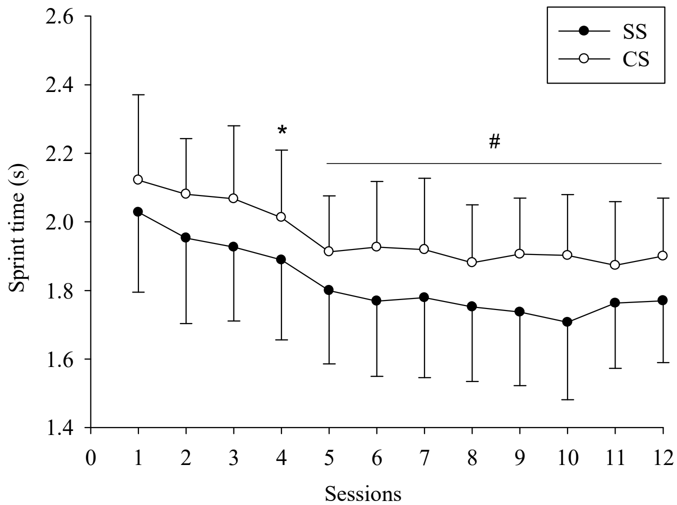

Figure 1: M ; minor than 1st session.(#) p < 0.001; mi

Discussion

The present study aimed to evaluate the effects of training with standing and crouch on 10 m sprint performance in untrained adolescents. Considering the lower technical demand required at thestandingstart (ROGERS, 2000), and that experience and a moderate level of strength are required for efficient crouch start (ASEP, 2008), was expected that CS group showed better 10 m sprint performance compared to the SS group at the end of the training. However, there was no difference in 10 m sprint performance between groups. Thus, the initial hypothesis and the teaching process suggested in the literature were refuted by the present study. In addition, the training effect was moderate in the CS group with the test performed at crouch start and small in the SS group independent of the test.

The present study appears to be the first to investigate the effects of sprint training with different start techniques in school young. In order to compare the effects of different start types on sprint performance, Salo and Bezodis (2004) evaluated biomechanical parameters during 10, 25 and 50 m sprints at university sprinters. The mass location center, the distance between the feet, the first and second strides length, the mass horizontal velocity center at the moment in which the feet leaves the floor and the knee and hip maximum angles in the start moment were higher at the standing compared to crouch start. According to the authors, the first stride of the standing start resulted in a longforce production time, and so, a higher impulse (SALO and BESODIS, 2004).

However, the difference in the technical aspects observed between both start styles did not change the performance in any of the evaluated distances, since there was no difference in the horizontal velocity and the sprint time between the starts. Another study reported that the forward foot pulse duration, as well as the block clearance velocity, increased progressively with increasing distance between the blocks (Henry, 1952). Slawinskia et al. (2016) compared the kinetic and kinematic parameters of standing and crouch in 8 physical education students (24 ± 4 years). The 5 m sprint time, start time , maximal power and the ground reaction force were higher in the crouch start compared to the standing start.

Mero et al. (1992) concluded that the force level applied to the block at the clearance time is more important than the time to produce it. Thus, in the crouch start the subject may take a little longer to leave the block, however, this would be compensated by the increase of the force and consequently greater impulsion. However, as in the present study, such variables were not measured, it is not possible to indicate which of them were altered in each start types.

Although the current study did not evaluate any parameters related to the running technique, the performance data corroborate those of Salo and Bezodis (2004). On the other hand, Ostarello (2001) found higher performance in the standing when compared to the crouch start in the 3 m initials of the sprint. However, suggest caution in the interpretation of these data, since only one subject was evaluated, with a four-year interval between the two evaluations, 1996 and 2000, respectively. In the first evaluation the athlete was 16 years old and in the second 20 years, indicating maturation effect in the results reported.

Another important finding of the present study concerns the decrease in sprint time of 10 m throughout the training sessions. There was an improvement in performance from the 4th training session in both groups, which was stabilized from the 5th training session. Thus, based in the training overload principle (Kirby, 2010), the results indicate that the training stimulus (ie, intensity, duration, training frequency, etc.) is modified after the 4th training session so that performance improvement (DeWEESE et al., 2015).

Previous studies that varied the distance, number of sets and/or repetitions performed per training session, also found post-training improvement in sprint performance. Young et al.(2001) showed improvement from 4.47 ± 0.18 to 4.34 ± 0.18 in the 30 m sprint after six training weeks (5 to 6 repetitions of 20 to 40 m distance) performed twice a week in young men (24 ± 5.7 years). Lockie et al. (2012) found improvement of 9 to 10% in the running time of 10 m after six weeks of training (1 to 3 sets, 4 to 5 repetitions, 30 to 120 m distance) performed twice a week in young men (23.1 ± 4.2 years). The authors attribute this improvement to the increase in horizontal power, thestride frequency and feet contact time at the floor. Another study showed improvement of 2.5% at the 50 m and 4.5% at the 100 m sprint after eight weeks run training (3 sets for each distance, 95% of the maximum speed) carried out three times a week in university students (23 ± 1 years) (CALLISTER et al., 1988).

In contrast, Zafeirids et al. (2005) did not find changes in 40 m sprint time after a 4-series 20-m and 4-series 50-m series performed three times a week in young men. Similar results were presented by Rimmer and Sleivet (2000), who found no difference in 10 and 40 m sprint time after eight training sessions (3 to 8 repetitions, 35 to 50 m distance) performed twice a week. There was a decrease in the stride frequency, but not in the stride length for the 10 m distance. Factors such as the change in length and stride frequency, and floor contact time may be associated with participant improved performance following a sprint training program. In the study developed by Lockie et al. (2012), the group that trained sprints with different distances, but without any type of overload, increased the horizontal power, the stride length and floor contact time. In addition, there was a decrease in flight time. According to the authors, the change in horizontal power would have contributed to the increase of floor contact time, which in turn, would allow the generation of force necessary to prolong the stride at the same time that the flight time decreases. Although the present study used a lower training volume than the other studies (Lockie et al., 2012; Young et al., 2001; Callister et al., 1988), a greater performance gain was found, above 10%, which can be explained by the low-performance levelof the subjects. In contrast, the subjects in the present study were not trained. It is known that the level of training is a factor that affects the magnitude of the response to the training program (ACSM, 2009).

The present study is not free of limitations. Biomechanical variable or running technique was not measured, which limits understanding the causes of the decrease in sprint time after training. According to Majumdar and Robegers(2011), the variables that influence running velocity include response time, technique, training, strength, and structure of muscles. In addition, these authors suggest that performance can also be influenced by external factors such as shoe types and the running surface (BRECHUE et al., 2005). As described previously, some of these variables were not recorded or controlled, except for the running surface and footwear, which is a limitation of the study. Thus, future studies are needed to investigate the effect of different start types on variables other than sprint performance.

Conclusion

The present study showed that six weeks of sprint training with standing or crouch start increased performance in the 10 m sprint only to same start type used in the training. It is important to note that the improvement the groups performance occurred from the 4th training session. From a practical point of view, the results suggest that sprint training should be prescribed taking into account the need for the start type of the modality. To athletics velocity running,is suggested to perform sprint training sessions with crouch start. Sports modalities that do not require this type of start, it is suggested to training sessions with standing start. Finally, future studies should investigate the effect of different sprint starts types with distances over 10 m. In addition, kinetic and kinematic variables must be measured to better understand the effects of the start types on sprints performance.

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