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Short Communication

Warm-Up on Postural Stability

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Abstract

Athletes perform warm-up prior to any physical activity to enhance their performance, but also to prevent injuries. However, the effects of postural stability as a prevention injury parameter remain unclear. This study aimed to analyze the effects of two different warm-up protocols on postural stability of athletes. Forty-six athletes were classified into three groups: Warm-up Group 1 (n = 16), who performed a 15-minute warm-up; Warm-up Group 2 (n = 14), who performed a 30-minute warm-up; and Control Group (n = 16), who rested. Before and after the intervention, all the athletes carried out a monopod postural stability test. Results showed that athletes from Warm-up Group 2 had higher values of length covered by the center of pressure right after the 30-minute warm-up compared to baseline (P = .023) and Warm-up Group 1 (P = .036). As a conclusion, a longer warm-up protocol may deplete the monopod postural stability of athletes.

ABBREVIATIONS

WU1: Warm-Up Group 1; WU2: Warm-Up Group 2; CONT: Control Group; Cop: Center of Pressure

INTRODUCTION

Warm-up is the most common process before any sports practice, but also the most controversial one between sports and health professionals regarding its duration and effects [1]. Although the main purpose of warm-up is to prepare athletes for an optimum performance, it is also included to prevent injuries [2]. Many authors reported improvements of countermovement jump, reaction time or sprint, which changed with the warm-up duration [3,4]. However, very few studies reported the effects of different warm-up duration protocols on postural stability as injury prevention parameter [2]. Thus, the purpose of this study was to analyze the monopod postural stability of sprinters after different warm-up protocols.

MATERIAL AND METHODS

An experimental study with two intervention groups and a control group, and pre-post measures was designed. Thirty-two male athletes who competed at national level in 400 m, 200 m or/ and 100 m events (26.2 ± 5.9 years old) were randomly classified into three groups: WU1 - Warm-up group 1 - (n = 16: athletes performed a 15-minute warm-up), WU2 - Warm-up group 2 - (n = 14: athletes performed a 30-minute warm-up) and CONT - Control group (n = 16: athletes rested). The group assignment was determined using the Epidat 3.0 software. Before and after interventions, all athletes carried out a monopod stability test. All athletes signed the informed consent, according to the Declaration of Helsinki [5].

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Keywords

- Warm-up
- Postural stability
- Sprinters
- Injury prevention

PROCEDURE

Postural stability

Athletes stood on each of their lower limbs for 10 seconds (left leg first) on the center of a FreeMed© BASE model baropodometric platform (Rome, Italy). Calculations of center-of-pressure (CoP) movements were performed with the FreeStep© Standard 3.0 (Italy) software. The parameters recorded were: length (Length) and area (Area) of the path described by the center of pressure, and the position of the center of pressure in the medial-lateral (Xmean) and anteroposterior (Ymean) planes. These variables are marked "l" or "r" to indicate whether they belong to the left or right leg, respectively [6].

Warm-up protocols

The 30-minute warm-up protocol consisted of 10 minutes of jogging (8km/h), 10 minutes of dynamic stretching and 10 minutes of exercises that athletes performed while they ran 30 meters (Figure 1).

The 15-minute warm-up protocol consisted of 5 minutes of jogging (8km/h), 5 minutes of dynamic stretching and 5 minutes of exercises that athletes performed while they ran 30 meters (Figure 1).

Statistical analysis

Mean and SD were included in the data description of continuous variables. Kolmogorov-Smirnov test was used to analyze the normal distribution of quantitative variables. For the morphological variables, Student's t-test for independent samples was used in continuous variables. A general linear model was used to assess the effect of the intervention groups, with time and intervention group as intra- and inter-subjects variables

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respectively. For the variables which showed significant baseline differences, the basal measures (pre-treatment) was used as a covariate. Significance was determined at p < 0.05. Data were analyzed using SPSS for Windows, version 17; SPSS, Inc., Chicago. An MedCalc 12.1. (Mariakerke, Belgium).

RESULTS AND DISCUSSION

All the anthropometric characteristics of athletes were similar in the baseline (P > .05) (Table 1).

Table 2 shows the stabilometric values on left-leg and rightleg monopodal support. ANOVA showed a significant time*group interaction (P = .039), in which athletes performing a 30-minutes warm-up had higher length covered by center of pressure on left-leg monopodal support compared to baseline (P = .023) and compared to WU1 (P = .036) (Figure 2). Also, we found differences compared to control group close to statistical significance (P = .074) (Table 2). No differences were found in the rest of variables (P > .05).

The main findings of this study suggest that 30-minutes warmup increased the postural sway of athletes, however a shorter warm-up did not affect the postural stability. We agree with authors who reported deleterious effects after a more prolonged



Figure 1 Exercises of both warm-up protocols. (A) - Gastrocnemius dynamic stretching; (B) - Hamstring dynamic stretching; (C) - Adductors dynamic stretching; (D) - Quadriceps dynamic stretching.

Table 1:	Baseline	characteristic	of athletes.
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	Control group (n=16) Mean ± SD	Warm-up Group 1 (n=16) Mean ± SD	Warm-up Group 2 (n=14) Mean ± SD
Age (y)	24.7 ± 3,4	25.0 ± 3.6	27.6 ± 7.6
Height (m)	1.78 ± 0.04	1.78 ± 0.05	1.74 ± 0.06
Weight (kg)	72.7 ± 12.2	71.5 ± 9.2	68.5 ± 11.4
BMI (kg/m ²)	22.8 ± 3.5	22.7 ± 3.0	22.3 ± 2.7

Abbreviations: Warm-up Group 1 = athletes performing 15-minute warm-up protocol; Warm-up Group 2 = athletes performing 30-minute warm-up protocol; y = years; SD = Standard Deviation

Table 2: Stabilometric values before and after the intervention.

	Control Group (n=16)	Warm-up Group 1 (n=16)	Warm-up Group 2 (n=14)
	Pre – Post	Pre – Post	Pre – Post
Left (mm)			
Length*	270.8 ± 68.2 – 278.0 ± 81.4	305.0 ± 194.1 – 261.7 ± 76.4	256.2 ± 86.0 – 345.5 ± 119.5
Area	370.1 ± 213.8 – 355.5 ±217.7	608.3 ± 991.9 - 436.0 ± 266.2	391.4 ± 520.4 – 609.5 ± 889.8
Xmean	$2.9 \pm 3.4 - 2.8 \pm 4.9$	$1.6 \pm 4.6 - 2.2 \pm 5.1$	8 ± 4.82.1 ± 10.6
Ymean	-15.0 ± 12.612.5 ± 15.7	-12.2 ± 9.46.9 ± 11.5	-6.2 ± 7.1 – -6.9 ± 11.0
Right (mm)			
Length	285.4 ± 86.2 - 305.6 128.5	292.5 ± 66.5 - 321.0 ± 78.3	229.9 ± 35.7 – 259.0 ± 56.1
Area	384.7 ± 280.0 - 612.3± 688.9	382.2 ± 280.7 – 547.4 ± 644.8	266.5 ± 140.7 – 372.3 ± 199.2
Xmean	3.5 ± 15.1 – 3.1 ± 19.0	.4 ± 4.43 ± 4.4	.6 ± 4.31.1 ± 4.0
Ymeanψ	-14.1 ± 11.216.7 ± 12.5	.5.5 ± 7.1 – -6.1 ± 6.9	-3.0 ± 11.03.4 ± 11.6

Abbreviations: Results are given as Mean \pm SD; Left = postural stability parameters on left-leg monopod support; Right = postural stability parameters on right-leg monopodal support; Length = length covered by center of pressure movement; Area = surface covered by center of pressure movement; Xmean = Positioning of center of pressure in the medial-lateral plane; Ymean = Positioning of center of pressure in the anterior-posterior plane; Pre – Post = results prior and after the intervention. Warm-up Group 1 = athletes performing 15-minute warm-up protocol; Warm-up Group 2 = athletes performing 30-minute warm-up protocol; ψ variable adjusted with pre-measure as covariable due to differences in baseline among athletes; * significant differences (P < .05).

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Figure 2 Length on left-leg monopod support after the intervention in the three groups (Pre = before intervention; Post = after intervention; WU1 = Warm-up group 1; WU2 = Warm-up group 2; CONT = Control group); *: Statistical differences compared to warm-up group 1, P < .05; #: Statistical differences compared to baseline, P < .05).

exercise protocol on postural stability because of fatigue, which could be a potential factor for poorer postural balance performance, that would explain why a larger warm-up slightly blunted the unipodal stance of athletes [7]. However, since we did not measure participants' fatigue, more studies are needed for further conclusions. The deterioration of proprioceptive skills such as antipodal postural stability may cause an increase in injury risk. Romero-Franco et al. showed that those athletes with increased postural sway during off-season showed higher impact of injuries during the season [8]. Similar results were shown by McGuine et al, in which the postural balance of basketball players was analyzed at the pre-season period and a follow-up was done during the rest of the season. These authors concluded that those basketball players who performed higher values of postural balance at the pre-season period suffered more ankle sprains during the rest of the season [9].

We designed warm-up protocols similar to those performed by athletes prior to any training session or competition to adjust the best warm-up duration prior to any physical activity. According to the results, a 15-minute warm-up would be the most appropriate protocol duration to optimize the proprioceptive skills. Also, we consider that a shorter warm-up makes athletes able to perform more intense exercise without blunting the postural stability. Several authors have reported that specific intense actions increases the rate of reaction to perturbations of muscle length and injury prevention [10].

Since a 30-minute warm-up could deteriorate postural stability, coaches and health professionals should consider specific and short warm-up routines to optimize the subsequent performance and prevent injuries.

CONCLUSION

A 30-minutes warm-up slightly deteriorates monopod postural stability of athletes. A shorter warm-up has a neutral effect in the postural stability. This study had some limitations: the lack of follow-up hamper the knowledge of duration of depleting effects of warm-up on postural stability. Further studies are needed to control postural stability deterioration after a more prolonged warm-up. Also, we did not include female population because we preferred to focus in male athletes. We recommend the female inclusion in future investigations.

Our study slightly clarifies the effects of different warm-up protocol durations on postural stability, which may be useful to prevent injuries during training. However, more studies are needed to analyze these effects in the injury incidence.

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