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Acute Effect of Small-Sided Game-Based Warm-Up on Change of Direction Speed Performance

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Abstract

This research aims to examine the acute effect of no warm-up versus a small-sided game-based warm-up on change of direction speed performance (Illinois agility test). Small-sided games prior to training and competition is a valid strategy used to improve performance. These benefits resulted from combined methods of small-sided games with passive rest. A total of seventy-one male subjects participated in the study between national team players of team sport and university students from regular sport class. A randomized crossover trial design was used to determine differences in change of direction performance between the two warm-up conditions. According to the random order assigned, all participants completed two conditions, warm-up and no warm-up. An analysis of variance in three ways with repeated measures in two factors was conducted to analyze data. The ANOVA interaction between group x treatment x measurement show no significant difference (F=0,081 sig= 0,778, p> 0.05). The present study concludes that the warm-up with small-sided games is not the causal factor in a change of direction test performance.
Keywords: Agility, Illinois test, Change of direction

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INTRODUCTION

It is common practice to prescribe a warm-up prior to training and competition. A warm-up has two clear objectives: 1) improving performance and 2) minimizing the probability of injury (Coledam et al., 2012; Sánchez et al., 2016; Zois et al., 2011). The benefits of warming up have been attributed to increasing muscle temperature, nerve conduction, and speed of metabolic reactions (Zois et al., 2011). Research done by Cilli et al., (2014) found that the specific sport warm-up may increase muscle temperature, nerve conduction velocity, and decreased muscle viscosity. These actions are intended to enhance sports performance in the competition as well as to improve one's physiological preparation to face the metabolic demands required during competition.

Many forms of a warm-up have been analyzed, including stretching, dynamic exercises, resistance exercises, and the traditional continuous run (or swimming, or cycling) at moderate intensity (Bishop & Middleton, 2013; Chaouachi et al., 2010; Samson et al., 2012; Sánchez-Sánchez et al., 2017; Sole et al., 2013; Topcu & Arabaci, 2017). Due to the difficulties in analyzing games in a real situation, or even simulated context, Researchers tend to focus on the isolated performance of tasks associated with the sport (Silva et al., 2018). Numerous researchers address alternatives to traditional continuous jogging in conjunction with stretching as a warm-up (Coledam et al., 2012, Blazevich et al., 2018, Pagaduan et al., 2012).

In team sports, the players execute skills while maintaining repeated high-intensity physical exertion; this is important for overall performance (Zois et al., 2011). Studies have been carried out with activities such as Small Side Games (SSG), which present a valid strategy for improving jumping performance (Silva et al., 2018). The studies of Behm et al. (2016) and Turki et al. (2011) hypothesized that increases in neural potentiation (central factors) might be induced with lower intensity dynamic movements (post-activation potentiation-PAP), like in sport-specific games, with a consequent increase rate of force development.

Many studies used different types of warm-ups to address a difference within pre-competition protocols. Typically, research has found no difference between pre-test and post-test, and their discussions are focused on the types of warm-up protocols. This practice attempts to demonstrate the differences between warm-ups and not the effect of the warm-up over performance directly (Blazevich et al., 2018; Cilli et al., 2014; Pagaduan et al., 2012; Sánchez-Sánchez et al., 2017; Stevanovic et al., 2019; Topcu & Arabaci, 2017).

Despite the limited evidence on the impact of warm-ups on sports performance, the present study aims to examine the acute effect of SSG exercises warm-up versus no warm-up on the performance of a Change of Direction (COD) Test. The Illinois test is measured by the time it takes to make a planned route with preplanned changes of direction included. The COD ability is associated with team-sport performance. The main hypothesis predicted a significant interaction between treatment, group, and test on the Illinois Agility Test's performance in team sports players.

METHODS

Research Model

The study was a randomized crossover trial carried out in April 2019. This study was designed to determine whether there is a difference in the COD test performance between an SSG-based warm-up condition and a no warm-up condition. In this design, the subjects were required to complete two protocols. The first protocol included no warm-up, where the players completed a pre-test, rested for 12 minutes, and repeated the post-test. The second protocol included subjects completing the pre-test and post-test, but with 12 minutes of an SSG-based warm-up instead of the rest. All subjects had to execute both protocols with eight days between one and the other.

Research Groups

A total of seventy-one male subjects participated in the study. At the end of the study, fifty-nine subjects finished all protocols. This population sample was comprised of two distinct groups. In group 1, thirty-six participants were from Costa Rica national teams from indoor football, rugby, handball, and volleyball (23.82 ± 1.70 years). In Group 2, twenty-three university students (18.48 ± 1.96 years) were recruited for a physical activity class (once a week). The players train their normal practices (technical, tactical, and physical exercises) at least twice per week with the team club, twice per week with the national team, and eventually a game on weekends.

To be included in the study, the participants should have had the following characteristics: a) not taking any medication; b) have no relevant medical history that could affect testing results; c) maintained the same level of physical activity, diet, and supplementation during the study d) and not present any injury. Written informed consent was obtained from all the participants after receiving a verbal and written explanation of the experimental design and the potential risks involved in the study. The study was conducted according to the Declaration of Helsinki.

Data Collection

The standardized warm-up treatment used specific SSG for each team sport. The SSG was a continuous game designed with 3 vs. 3 in a reduced space from the regular size court of sport with the same sport's rules, and this way to be assured of reaching a high-intensity activity as a typical game. Due to the game's intensity, the SSC was played in four trials of two-minute durations with one-minute rest in-between. In total, there were 12 minutes of warm-up conducted.

All participants were instructed to refrain from strenuous lower body activities before and during the testing period. They wore the same pair of shoes for each testing condition in addition to comfortable athletic apparel. Participants were also required to maintain consistent eating, sleeping, and activity habits.

The time between each section (pre-test, warm-up/no warm-up, post-test) was approximately three minutes. Participants were permitted to consume plain water ad libitum throughout the testing sessions during this time. All sessions were conducted on the same kind of surface for the standardized test field.

Data Collection Tool

Illinois Agility Test: The Illinois Agility test (COD Test) is a planned path and does not consider perceptual factors like a stimulus has to respond by the subject. This test has interrater reliability of 0.96 and validity of 0.75 (Raya et al., 2013). The instrument used was the timing gates system (Fusion Sport Sumner Park, Brisbane, QLD, AUS trademark) for recording the time. The gates were activated with any movement. A mark was placed 45 cm before the gates line for the subjects to start the test. The test was administered exactly the same from pre-test to post-test. All participants were encouraged to perform both tests with maximum effort. Each subject had to complete two attempts, and the best was recorded for the final analysis.

Data Analyses

An analysis of variance (ANOVA) in three ways with repeated measures in two factors was conducted to analyze data. Two factors (warm-up /no warm-up) with pre-test and post-test and a factor of groups, one elite group (national team sport players), and university players group. Significance was set at $p<0.05$. Data were analyzed using Statistical Package for Social Sciences (SPSS) version 21.0. All data are presented as mean and standard deviation ($\bar{X} \pm SD$).

FINDINGS

Table 1 shows the results of applying the test in the two study groups and the conditions they were carried out. The elite group is data from national team players, and the second group is from university physical activity classes. The results are from pre-test and post-test in two conditions (no warm-up and warm-up).

Table 1. Means and S.D. for Illinois Agility Test (Units in seconds)

	No Warm-up		Warm-up	
	Pre- Test	**Post-Test**	**Pre- Test**	**Post-Test**
Elite (n=36)	16,12 ± 0,95	15,79 ± 0,99	16,34 ± 1,04	16,04 ± 1,06
University students (n=23)	17,82 ± 1,74	17,40 ± 1,70	17,67 ± 1,50	17,36 ± 1,39

The three way ANOVA shows a significant difference between measurements ($F_{(1,57)} = 17.155$ sig = 0,001); this shows a difference between the first measurement (pre-test) and the second measurement (post-test), taking the two treatments together (warm-up / non-warm-up), which may indicate an internal validity bias. While the analysis of treatments ($F_{(1,57)} = 0.316$ sig = 0.576) indicating that there is no statistically significant difference between treatments and the interaction between Groups x Treatment x Measurement ($F_{(1,57)} = 0.081$ sig = 0.778) does not show statistical significance in the interaction of the variables: groups, treatment, and measurements (Figures 1-3).

Table 2. Anova 3-Ways mixed independent groups for an Illinois Test

	Factor	gl	F	Sig.
1	Treatment	1	0,316	0,576
2	Test	1	17,155*	0,001
3	Group (inter-subjects)	1	25,152*	0,001
4	Treatment * Group	1	1,918	0,171
5	Test * Group	1	0,108	0,744
6	Treatment * Test	1	0,229	0,634
7	Treatment * Test * Group	1	0,081	0,778

*p< 0.05

Table 2 shows the results of each of the factors that make up the three-way ANOVA. Each F corresponds to the factors of Treatment (no warm-up/warm-up), Test (pre-test/post-test), and Group (elite/students), and the resulting interactions between the factors: Treatment x Group; Treatment × Test; Test x Group, and principal the Treatment x Group x Test interaction. The interactions will indicate if there is a difference between the conditions and the group according to the moment of measurement.

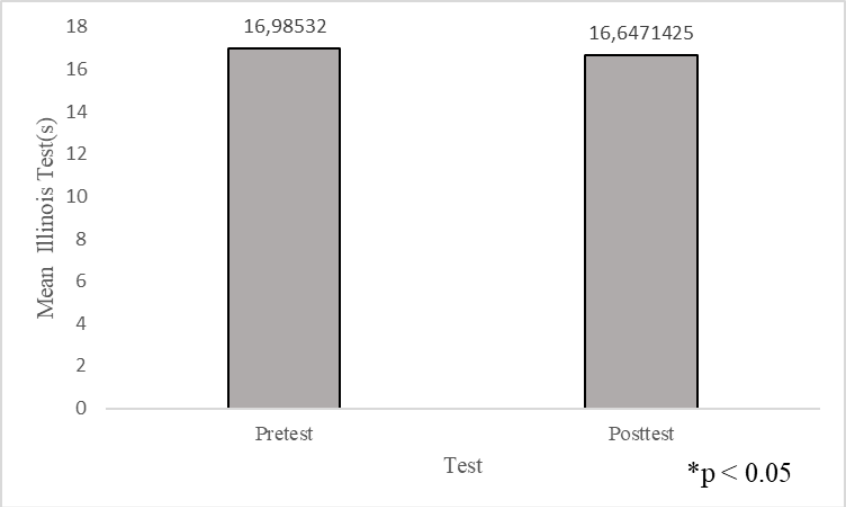

Figure 1. Difference between Pre-test and Post-test on agility test

Figure 1 shows the comparison of both groups together of the two conditions together at the two measurement moments. This result cannot have a specific interpretation since it indicates a significant difference from the pre-test to the post-test, with the post-test being test a better result. But as indicated, both conditions are together as well as the groups.

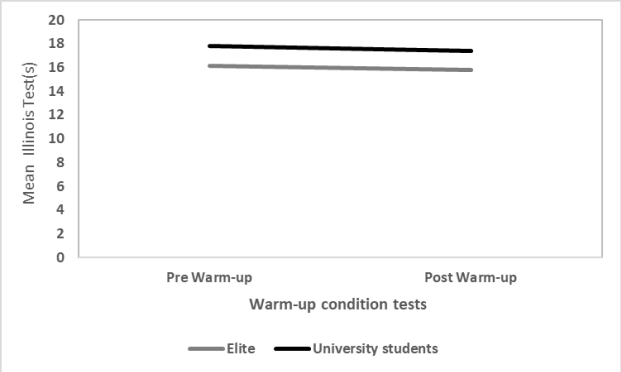

Figure 2. Interaction between Test, Group, and Condition

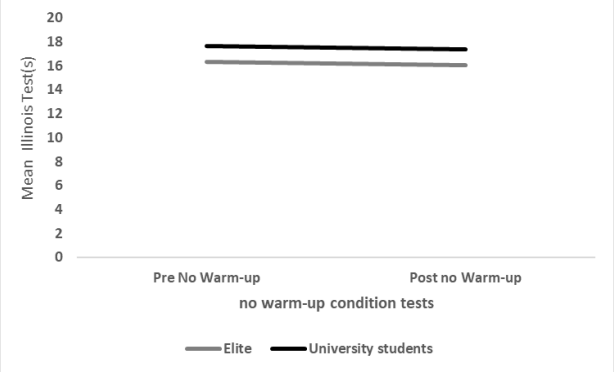

Figure 3. Interaction between Test, Group, and Condition

The interaction between the 3 factors that make up the ANOVA shows no influence of one factor on any of the other two. As it is an interaction with 3 factors, a three-dimensional design, it is not possible to graph it in two dimensions, so two figures of two-dimensional graphs are made, showing how the factors behave with each other. Likewise, it presents a non-significant interaction, which shows that no factor influenced another factor (Figures 2 and 3).

DISCUSSION

This study aimed to compare warm-up with SSG with no warm-up. The results indicate no significant difference between both conditions on the Illinois Agility Test performance. Both warm-up and non-warm-up treatments improved the Illinois Test's performance in the two groups studied, indicating that the treatment factor did not influence the performance of the selected test.

The present study compares agility performance after a warm-up intervention with no intervention. Comparison of the results from the current investigation to previous literature is difficult due to the unique nature of the protocol used. However, previous research has employed a control group which is not genuinely a pure control group because it incorporated a self-selected warm-up rather

than no warm-up at all, like a 3-minute to 5-minute run or a personal stretching (Atkinson et al., 2005; Gogte et al., 2017; Sánchez-Sánchez et al., 2017; Young & Behm, 2003). These studies did not show significant differences between the experimental and control groups in sports performance using dependent variables such as jumping, repeated sprints, or another performance-related test.

The study by Takizawa et al., (2018) presents similar characteristics to the present study in the treatment condition but without a pre-test measure; it was a randomized crossover study with university runners. This study included three different warm-up treatments and a no-warm-up condition. The warm-up intensities were established as 60%, 70%, and 80% of the VO2max. The warm-up consisted of running for 15 min with variable intensity. They applied a submaximal RUN Test, where the subjects had to run at 90% of VO2max until exhaustion, and the dependent variables were the exhaustion time and the distance covered. Results showed no significant difference between each of the conditions of the applied treatments. It shows that regardless of the intensity of the warm-up or the non-warm-up, it was not an influencing factor in a sub-maximal running test's performance. These results are similar to those found in the present study, indicating that warm-up protocols or lack thereof do not influence performance.

A significant test effect was obtained, indicating an overall improvement between the pre-test and post-test. The Control group -the no warm-up condition- showed a decrease in the execution time. This result could be due to the test's learning, as Blazevich et al., (2018) indicated. According to the present results, it is reasonable to suppose that other conditioning factors are more important for enhancing agility performance. This study was done with two groups of subjects, one composed of elite national players, and another composed of physically active students. Although there is a difference in the group analysis, which indicates that the national teams players have a better score in the Illinois test, neither of the two groups improved the test score with the proposed warm-up. This shows that the training level is not a factor that influences the result of the test score used.

CONCLUSIONS

This study shows that the warm-up with small-sided games is not the causal factor in a change of direction test as the Illinois Test. Therefore, regardless of whether this kind of warm-up is performed, the result is similar in terms of sports performance.

APPLICATIONS IN SPORT

When looking at the evidence provided by this study, it is not necessary to perform a warm-up with SSG to improve performance in actions where changes of direction are involved, as is the case with the Illinois test. Therefore, coaches and other sports practitioners may refrain from warming up with SSG before practice or competition concerning changes of direction because performance in these skills would be the same compared to no warming up.

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Authors' Contribution: Study Design-RC, Data Collection- RC, WS, Statistical Analysis- RC, WS, Manuscript Preparation- RC, WS. All authors read and approved the final manuscript.

Ethical Clearance (Approval): All subjects were asked to sign an informed consent for the study. No subject was injured with the application of the treatment or during the execution of the tests.

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