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Examination of the Effect of Different Warm-Up Protocols on Speed and Vertical Jump Performance in Child Soccer Players

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Abstract

The aim of this study was to examine the effects of dynamic and static warm-up exercises on speed and vertical jump performance in children. The ages of 22 licensed male athletes playing soccer voluntarily participated in the study are 11.77±.429 years; their heights are 145.27±7.382 cm; and their body weights are 36.00±5.050 kg. Three different warm-up protocols were applied to the participants at an interval of 48 hours. The warm-up protocol is designed as dynamic exercises (Method A), static exercises (Method B), and jogging (Method C). The participants' 30m long speed and vertical jump measurements were taken after each warm-up protocol. SPSS v24 software was used for statistical analysis. Effects of warming up methods on 30m speed and vertical jump values were examined by two-way analysis of variance (ANOVA). Among significant relationships, post-hoc comparisons were continued with Tukey HSD and the significance level was accepted as $p<0.05$. As a result, it was revealed that dynamic warm-up causes a significant increase in speed and vertical jump performances, while static stretching model and jogging warm-ups do not significantly affect performance.

Keywords: Child, performance, power, speed

1. INTRODUCTION

Warming up is a method used in all branches to increase performance by physically and mentally adapting the body to an activity (Bishop 2003; Fradkin, Zazryn and Smoliga, 2010) and to reduce the risk of injury during this activity (Tillaar, Lerberg and Heimburg, 2019). The effects of warming up on performance have been examined since the 1930s (Turki et al., 2012). Today, although it is stated that warming-up before training or competitions has a positive effect on athletic performance (Bishop 2003; Faigenbaum, et al., 2006; Mcmillan, et al., 2006), the structure of warming-up and the protocols used are still controversial (Abade et al., 2017).

Warm-up has been the subject of many studies such as determining motor performance (Sargeant and Dolan, 1987; Dawson, et al., 1997; Sander, et al., 2013; Taylor, Weston and Portas, 2013; Roland, Eirik and Erno, 2019, Harmancı et al, 2020), prevention of injuries (Herman, et al., 2012; Barengo, et al., 2014; Mayo, Seijas, and Alvarez, 2014; Rössler, et al., 2014; Silvers-Granelli, et al., 2015) and the effects of different warm-up methods (Bishop, 2003; Kilduff, et al., 2013; Towlson, Midgley, and Lovell, 2013; Wilson, et al., 2013; Edholm, Krustrup and Randers, 2015; Abade, et al., 2017) of athletes.

When the literature is reviewed, it has been found that most of the studies on warming up have focused on adult athletes. Similarly, in the soccer branch, studies on adult soccer players are more common. There are many studies especially on the effects of dynamic and static exercises on athlete performance during warm-up.

Most of these studies show that static exercises negatively affect sprint and jump performance (Smith, 1994; Cornwell, et al., 2001; Young and Behm, 2003; Fletcher and Jones, 2004; Sayers, et al., 2008., Behm and Chaouachi, 2011; Kay and Blazevich, 2012; Simic, Sarabon, and Markovic, 2013; Smirniotoy, et al., 2014), on the other hand, it is reported that dynamic stretching improved sprint and jump performance (Knudson, et al., 2001; Fletcher and Jones, 2004; Power, et al., 2004; Yamaguchi and Ishii, 2005; Little and Williams, 2006; Fletcher and Anness, 2007; Chaoucahi, et al., 2008; Holt and Lambourne, 2008; Chaouachi, et al., 2010; McNeal, Sands and Stone, 2010; Perrier, Pavol and Hoffman, 2011).

Given these findings, it's natural to wonder how dynamic and static warming-up, which has these effects on adults, can affect young soccer players. It is thought that revealing the results of the warm-up protocols to be applied to child athletes is important in determining the warm-up methods to be applied to children.

In light of this information, the aim of the study is to examine the effects of different warm-up protocols on speed and vertical jump performance in young soccer players.

2. METHOD

2.1. Study Smple of the Research

The age, height, and body weight of the 22 licensed soccer players who voluntarily participated in the study were respectively 11.77±429 years; 145.27±7.382 cm; 36.00±5.050 kg.

2.2. Model of the Research

Training Plan: 3 different warm-up protocols were applied to the participants at an interval of 48 hours. The warm-up protocol is designed as dynamic exercises (Method A), static exercises (Method B), and jogging (Method C).

Method A (Dynamic Exercises): Participants rested passively for 4 minutes after 5-minute jogging. After resting, the participants were given 15 dynamic type warm-up exercises (Table 1) in an area consisting of 4 cones (Figure 1) arranged on a straight line at 5 m width, 15 m length and 5 m intervals. After the participants were matched in 2 pairs, they applied each dynamic type of warm-up exercise for 15m with increasing intensity, and after 10-15 seconds of rest, they repeated the same exercise.

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After the dynamic warm-up exercise, the athletes were given a 4-minute passive rest and the tests were applied immediately afterwards.

Figure 1. Dynamic Warm-up Area

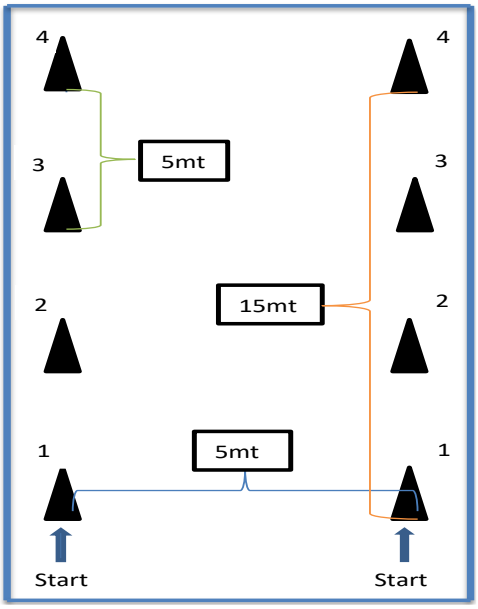

Table 1: Dynamic Warm-up Exercises

1. Running forward while doing butt kicks.
2. Knees are drawn to the chest as running forward.
3. Knees are twisted, and the leg rotates outward from the thigh.
4. Knees are twisted, and the leg rotates inward from the thigh.
5. Right arm is rotated.
6. Left arm is rotated.
7. The double arms are rotated forward.
8. The double arms are rotated backward.
9. The athlete rapidly performs skipping (low knee drill) at the starting point (1st cone) on command and proceeds until the next cone on command. The same procedure is followed in each cone, except the 4th cone, which is skipped and the exercise completes with the command.
10. Athletes come to the 2nd cone with slow running from the starting point (1st cone). Athlete turns around of the second cone, comes together with the matched partner in the middle, then they simultaneously jump with their shoulders contacting each other at the highest point. After the contact, the athlete turns around the same cone and applies the same protocol on the other cones.
11. The athletes start from the starting point (1st cone), running to the 2nd cone and take two turns around the 2nd cone then proceed to the 3rd cone and continue the same practice until

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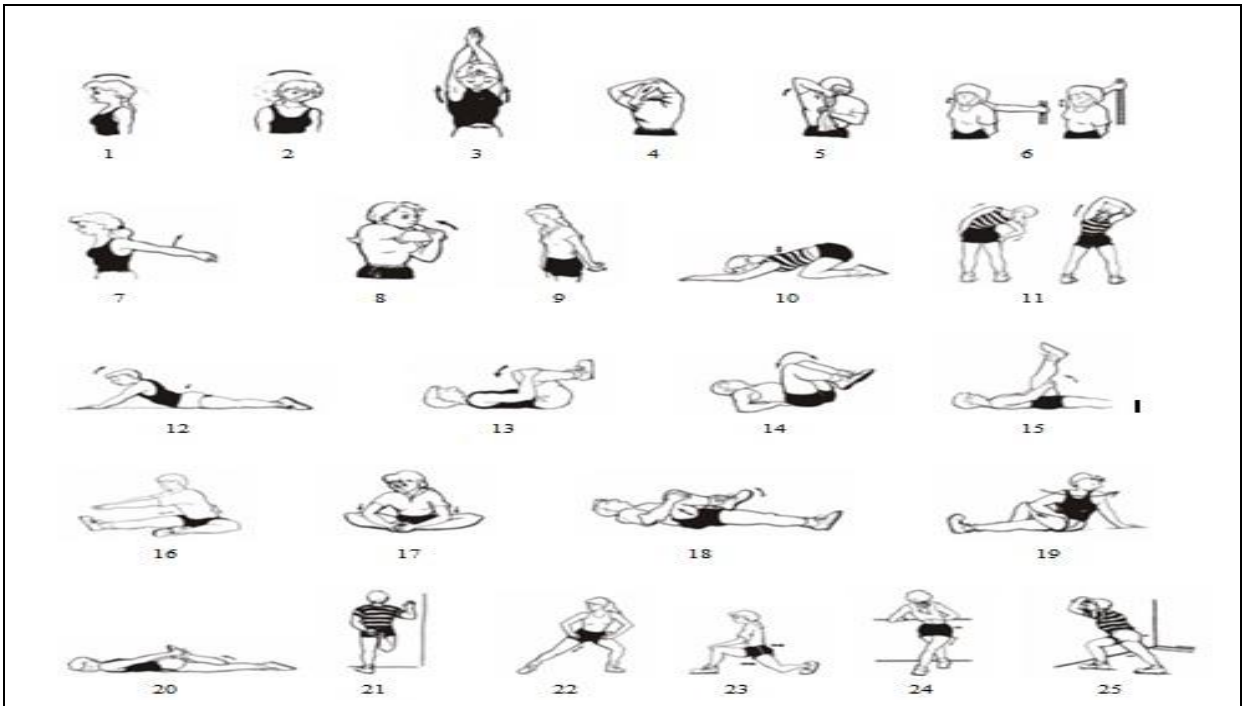
the 4th cone.

12. The athletes start from the starting point (1st cone), running to the 2nd cone and take two turns around the 2nd cone (this time the other way around) then proceed to the 3rd cone and continue the same practice until the 4th cone.
13. The athlete starts from the starting point (1st cone) and reaches to 2nd cone by making a meter-long jump, landing on his/her right foot. The athlete stays in this position for a second and then starts. The application continues up to the 4th cone in the same protocol respectively landing on one foot, a different foot each time.
14. Athletes run from the starting point (1st cone) to the 3rd cone. The athlete runs back from the 3rd cone to the 2nd cone then runs until the 4th cone.
15. Athletes run from the starting point (1st cone) to the 4th cone. The athlete runs back from the 4th cone to the 2nd cone and runs back to the 4th cone.

Method B (Static Exercises): Participants were given 25 static type warm-up exercises after 5 minutes of jogging (Figure 1). Stretching exercises were applied from head to toe and on both arms and legs 2 times for 15 seconds to the point of mild soreness. Between repetitions of static stretching, the leg was restored to its natural position with a 5 second rest period. After the dynamic warm-up exercise, the athletes were given a 4-minute passive rest and the tests were applied immediately afterwards.

Picture 1. **Static Exercises**



1. Neck Flexion / Extension Stretch. **2.** Neck Lateral Flexion Stretch. **3.** Latissimus Dorsi and the Anterior Section of the Deltoid Muscle Stretch. **4.** Triceps Muscle Stretch. **5.** Shoulder Rotators Stretch. **6.** Pectoral Muscles Stretch at 90 ° and 120 °. **7.** Biceps Muscle Stretch. **8.** Supraspinatus Stretch. **9.** Wrist Extensor Stretch. **10.** Thorax Extensor Stretch. **11.** Lateral Flexion Stretch. **12.** Extension and Abdominal Stretch in the Lumbar Region. **13.** Flexion Stretch in the Lumbar Region. **14.** Rotation in the Lumbar Region. **15.** Hamstring Stretch. **16.** Hamstring Stretch. **17.** Adductor Stretch. **18.** Gluteal Muscles

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Stretch. **19.** Gluteal and Lumbar Zone Rotation. **20.** Quadriceps Stretch. **21.** Quadriceps Stretch. **22.** Adductor Stretch. **23.** Hip Flexor Stretch. **24.** TFL Stretch. **25.** Gastrocnemius Stretch

Method C (Jogging): Participants were made to jog for 10-minute without any warm-up protocol, and a 4-minute period was given for passive rest, and tests were performed immediately afterwards.

1.1. Data Collection Tools:

Height: Participants' heights were measured with a wall-mounted stadiometer with a graduation of 1mm while they were barefooted and in the frontal plane (Holtain Ltd. UK).

Body Weight Measurements: Participants' body weights were measured while they were wearing standard sportswear (shorts and t-shirts) and barefooted on a scale with a precision of 0.1 kg (Tanita TBF 401 A Japan).

30m Speed Measurements: The start and finish lines were pre-determined in 30m areas and measurements were made by placing a photocell (Newtest Powertimer) with a precision of 0.01 at the starting and finishing points of the test in 30m long areas, taking the best of the 2 trials with rest intervals.

Vertical Jump Measurement: The athlete was told to stand in front of the measuring panel with his feet together and his body upright and to stretch the tips of his fingers to the maximum point while the soles of his feet are in contact with the ground with both arms stretched. In this case, the highest point he reached was marked on the board, then he was told to turn 90º to the panel and stand on the previously marked 20 cm distance. The athlete was asked to first crouch where he was, and then to make the highest vertical jump possible, then touch to the board with the closer hand to the board. The distance between the previously marked point before the jump and the point that was reached during the jump have been determined. The investigator measured the best of the two trials in cm.

Collection of Data: The research sample consisted of athletes who trained at least 3 days a week. Before the research was conducted, all of the athletes were given a thorough explanation of the content of the study and were told not to exercise heavily on the day before the measurement. The height and body weight of the athletes were measured before the application. First of all, the athletes were made to jog for 10 minutes without any warm-up protocol, and 4 minutes were given to them to passively rest. After passive rest, the athletes were tested for vertical jump and 30 m speed, respectively. After the measurements, dynamic warm-up exercises and static warm-up protocol were applied to the athletes at 48-hour intervals, respectively, and the measurements were repeated after each protocol and the study was ended (Figure 2).

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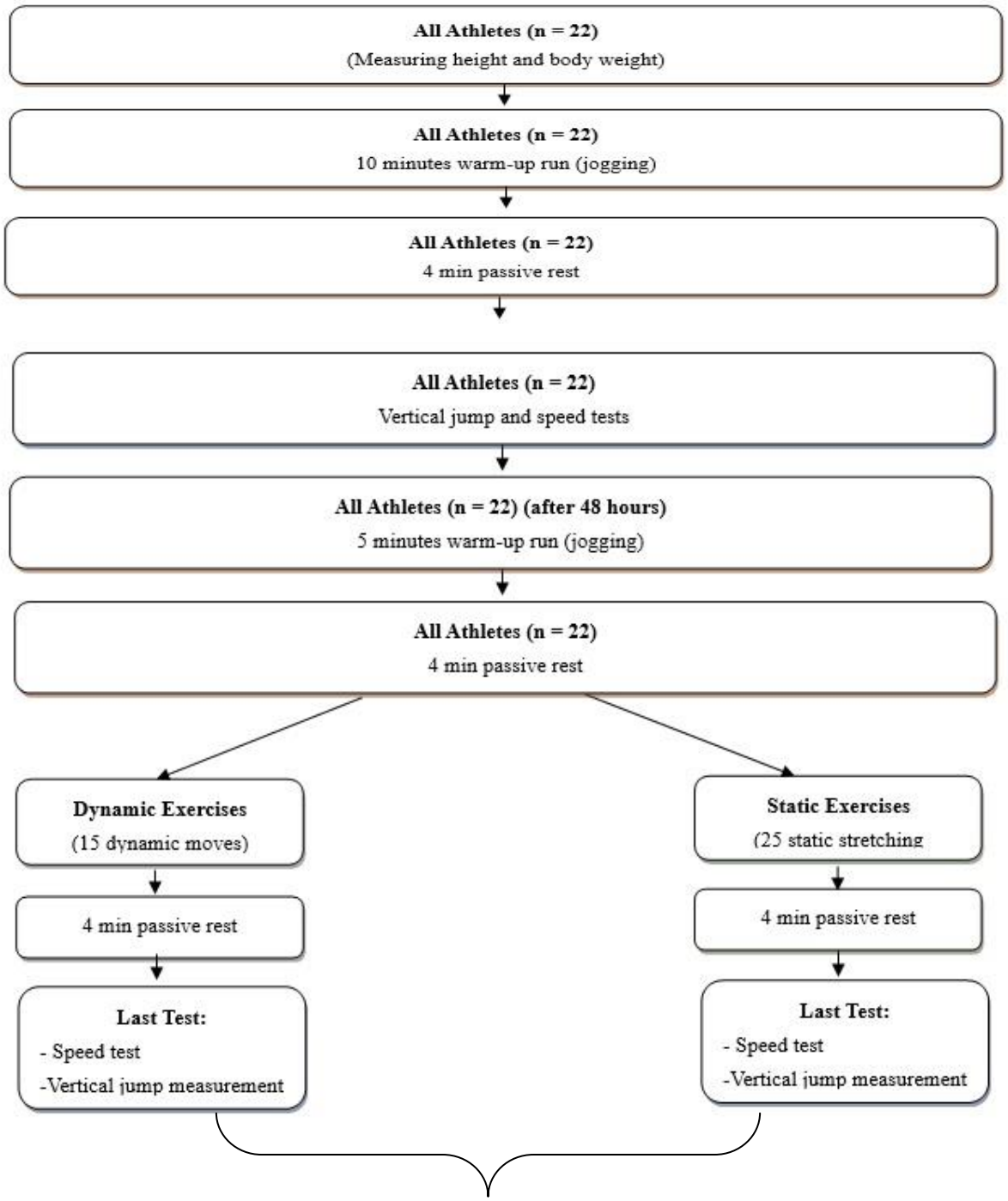
Figure 2. Study Design of Athletes for Different Warm-up Methods



2.3. Data Analysis

The data of the participants in the study were analyzed using IBM SPSS v23 software. Descriptive information of the participants in the groups was tabulated. The distributions of the test according to the methods of the variables were examined, and the Shapiro-Wilks test was used to determine the normality of the distributions and the homogeneity of the variances. Effects of warming up methods

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on 30 m speed and vertical jump values were examined by a two-way analysis of variance (ANOVA). Among significant relationships, post-hoc comparisons were continued with Tukey HSD, and the significance level was accepted as $p<0.05$.

3. FINDINGS

The age, height and body weight of the 22 male soccer players participating in the study were respectively determined as 11.77±429 years; 145.27 ± 7.382 cm; 36.00±5.050 kg.

Table 2: Analysis Results Related to 30 m and Vertical Jumping Values of Athletes After Different Warm Up Methods

Variables	Groups	Avg. ± sd	F	p
30 m speed (m/sec)	***KM***	5.25±.191	9.499	**.000*** (1-3, 2-3)
	SEM	5.37±301		
	DEM	5.08±.143		
Vertical Jump (cm)	***KM***	32.36 ± 5.491	5.631	**.006*** (1-3, 2-3)
	SEM	32.64 ± 3.646		
	DEM	36.36 ± 3.886		

KM: Control Method, **SEM:** Static Exercise Method, **DEM:** Dynamic Exercise Method

*p<0.05

Test values for 30 m and vertical jump for three different warm-up methods (running method, static and dynamic exercise method) are shown in Table 2. As a result of the analysis, a significant difference was found in the test scores of the 30 m speed ($F = 9.499$, $p<0.05$) and vertical jump ($F = 5.631$, $p<0.05$) values of the athletes who were subjected to different warm-up protocols. As a result, it was revealed that dynamic warm-up causes a significant increase in speed and vertical jump performances, while static stretching model and jogging warm-ups did not significantly affect performance.

4. DISCUSSION

In this study, the effects of different warm-up protocols on speed and vertical jump performance were investigated in youngsters playing soccer. In the study, a jogging warm-up was compared to a static stretching warm-up and a dynamic stretching warm-up. Measurements of the youngster soccer players' anaerobic performances were taken in the study, though measurements of their aerobic performances could have been taken as well.

When the literature is examined, it is observed that professional athletes do not attach importance to warm-up times as much as athletes participating in amateur and recreational activities (Fradkin, Finch and Sherman, 2003; Fradkin, Cameron and Gabbe, 2007; Fradkin, Zazryn and Smoliga, 2010) and that at many sports branches warm-up is not applied as a standard model (Silva, et al., 2018). It is known that warm-up practices are mostly based on individual experiences (Fradkin, Zazryn and

Smoliga, 2010; Kilduff, et al., 2013). These experiences are also applied to child athletes, paying attention to the training load as is the case with adult athletes.

In studies conducted on adult soccer players, whether professional or amateur, it has been found that dynamic warming, has a positive effect on intensive strength activities, namely, vertical jump and speed performances (Little and Williams, 2006; Barengo, et al., 2014; Taher and Parvow, 2017). In addition to achieving similar results in studies on athletes of different branches other than soccer (Cornwell, et al., 2001; Power, et al., 2004; Fletcher and Anness, 2007; Fradkin, Zazryn and Smoliga, 2010; Perrier, Pavol and Hoffman, 2011;), it has been suggested to avoid static warm-up as the only activity in a warm-up routine (Young and Behm, 2003; Simic, Sarabon and Markovic, 2013). When the studies on young soccer players were examined, it was concluded that dynamic warm-up was more effective than static warm-up in performances requiring explosive strength (Molacek et al., 2010; Alikhajeh, et al., 2011; Alikhajeh, 2012).). In summary, considering all these studies, it can be said that dynamic warm-up is a more effective warm-up method for adult and young soccer players than a static warm-up.

Contrary to the results of studies mentioned above and the limited number of studies in the literature, it was concluded that static warm-up has a positive effect on the jump and speed performances (Power, et al., 2004; Unick, et al., 2005; Young, Elias and Power, 2006; Robbins and Scheuermann, 2008) or that it does not have a negative effect (Perrier, Pavol and Hoffman, 2011; Gürses and Akgül, 2019). However, it is known that because static warm-up affects muscle viscosity and stiffness (Behm and Chaouachi, 2011), it changes the biomechanical structure of the muscle-tendon, making it softer and indirectly decreasing the strength generation rate, and causing delays in muscle activation (Kubo, Kanehisa and Fukunaga, 2001; Gelen, 2008).

In our study, no change was found in the speed and vertical jump performances of child soccer players in the static warm-up and the jogging warm-up. In the dynamic warm-up, a significant increase was found in vertical jump and speed values. Again in a study on children, it has been recommended that children do dynamic exercises of medium to high intensity before performing activities requiring high strength output (Faigenbaum, et al., 2005). Looking at all these results, we can say that the effects of dynamic and static warm-up on an adult or young athletes are similar to those on child soccer players. However, it is important for science to increase the number of studies that support or refute this hypothesis.

5. CONCLUSION

Most of the studies revealed that warm-ups, which do not contain static stretches, positively affect strength and speed performances (Shrier, 2004). Therefore, practitioners and coaches should avoid static stretching while designing warm-up routines (Felipe, et al., 2012). The results of scientific studies on warming up on child soccer players will guide practitioners and coaches in designing warm-up routines to improve children's performance. As a result, it was determined that dynamic warm-up increases the vertical jump and speed performances of child soccer players.

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