

Effects of mini-band resistance training on linear speed and coordination ability in youth soccer players

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ABSTRACT

This study aimed to determine the effects of an 8-week mini-band resistance training program on linear speed and coordination ability in U13 youth soccer players. Twenty U13 youth soccer players participated in this study. They were randomly divided into an experimental group and a control group (10 players in each group). The experimental group performed resistance band training, while the control group followed conventional training. The 30-meter sprint test and the Akramov coordination test were applied. Independent and paired t-tests, along with two-way ANOVA, were used for statistical analysis. The results of this study showed significant improvements in both linear speed and coordination ability for both groups ($p < .05$; ES ranging from 0.568 to 3.531). Main time effects were also significant for both linear speed and coordination ability ($p < .05$; η^2 ranging from 0.385 to 0.935). However, coordination ability improved significantly more in the experimental group compared to the control group ($p < .05$; $\eta^2 = 0.693$).

Keywords: Performance analysis, Mini-band, Resistance training, Speed, Coordination, Soccer athletes.

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INTRODUCTION

The path to producing high-level soccer players undoubtedly begins with properly developing a qualified generation. In this regard, early childhood training is the key to building a strong foundation, as most children at this stage have a higher capacity to develop fundamental motor skills.

When discussing the essential skills and motor abilities required by young soccer players, two key qualities stand out: speed and coordination ability. Speed is one of the most critical components for soccer players of all ages, as it is a fundamental factor in many sports. In fact, sprinting ability is often a distinguishing feature of successful performance (Reilly et al., 2000). Developing speed is a primary goal of many training programs. While speed is a broad term referring to the ability to move quickly, in team sports like soccer, it has been further classified into first-step speed (Cronin, & Hansen, 2005), acceleration, maximum speed, and linear and game speed. Research suggests that all these components of speed are likely to develop during childhood as children grow and mature (Oliver et al., 2013).

Coordination ability is another essential motor skill, especially during early childhood. Many researchers emphasize that developing coordination in childhood should be a key strategy for promoting long-term obesity prevention, increasing physical activity levels, and expanding children's motor skill base. Additionally, fundamental motor skills have been positively associated with health benefits and increased physical activity. Therefore, early detection and continuous monitoring of children's motor competence are crucial (Lopes et al., 2012). Coordination ability is closely related to speed and other motor skills. A player with a high level of motor coordination can overcome various challenges with minimal effort and in the shortest time possible, allowing them to handle the ball efficiently in different situations (Ceruso et al., 2019).

Several factors influence the development of coordination ability in children and adolescents, including age, gender, weight status, geographical region, living environment, home setting, and socioeconomic status (Klein et al., 2016). Coordination development plays a crucial role in participating in sports that require complex motor tasks and fundamental skills. An adequate level of coordination enables children to engage effectively and successfully in sports activities (Biino et al., 2023). While sports participation positively influences coordination ability, certain training methods can also enhance it.

Coaches utilize various training methods for youth players depending on their objectives and the characteristics of the target age group. One modern training tool gaining popularity is resistance bands. Resistance bands provide external resistance to the working and opposing muscle groups during movement tasks. They are used for warm-ups, skill improvement, physical and motor development, and rehabilitation after sports injuries (Aloui et al., 2019).

A study comparing resistance band training and traditional resistance training found that resistance bands significantly increased strength and power compared to conventional methods (Anderson et al., 2008). Another study reported a 21.5% improvement in jumping ability following resistance band training (Cronin et al., 2003).

From a motor performance perspective, resistance band training has also been shown to enhance movement speed. A study by Bogy et al. (2023) found a 17.8% increase in front kick speed when using red resistance bands. Additionally, research on javelin throwing demonstrated that resistance band strength training improved speed, balance, vertical jump, agility, and throwing accuracy (Sarici, & Gencer, 2024).

To the best of our knowledge, there are few studies analyzing the effect of mini-band resistance training on soccer players, especially in the U13 category. Therefore, the aim of this study is to determine the effects of an 8-week mini-band resistance training program on linear speed and coordination ability in U13 youth soccer players.

MATERIALS AND METHODS

Study participants

Twenty U13 youth soccer players from an Algerian academy in Jijel province were voluntarily participated in this study. The participants were free from injuries and diseases. Author explained the experiment objectives, duration, equipment, and the potential risks to the players and their coaches. All players gave an informed written consent to participate in this study. This study followed the rules of Helsinki declaration (World Medical Association, 2013). The participants were randomly divided into two groups, the experimental group and the control group. Each group had 10 players. Table 1 showed the characteristics of the participants.

Table 1. Participants' characteristics.

Variables	Experimental group (n = 10) Mean $\pm$ SD	Control group (n = 10) Mean $\pm$ SD
Age (year)	12.89 $\pm$ 0.23	12.82 $\pm$ 0.26
Height (cm)	144.9 $\pm$ 7.53	143.2 $\pm$ 7.48
Body mass (kg)	34.4 $\pm$ 4.58	34.7 $\pm$ 3.91
BMI (kg/m ²)	16.54 $\pm$ 1.19	16.33 $\pm$ 1.26

Note. No differences between groups were observed in these variables. SD: Standard deviation; BMI: Body Mass Index; m: meter; Kg: Kilogram; Kg/m²: Kilogram/meter².

Design and procedures

This experimental study was conducted to investigate the effect of 8 weeks of training using resistance bands on both linear speed and coordination ability in U13 soccer players. The sample consisted of 20 players who were randomly divided into two groups: a control group and an experimental group. The study began in mid-December 2023, where anthropometric measurements (height, weight, body mass) and age were collected. Pre-tests were conducted on both the control and experimental groups at the end of December. Afterward, exercises using resistance bands were introduced into the training sessions of the experimental group, with two sessions per week for 8 weeks. The control group followed a training regimen without using resistance bands. The same warm-up and the same technical and tactical drills were applied to both groups throughout the study period. The independent variable in this study was mini-band resistance training, while the dependent variables were linear speed and coordination ability.

Assessment

Assessment of anthropometric variables

Prior to the intervention, the anthropometric variables, including body height, body mass, and body mass index, were assessed using a Keito machine (Staal et al., 2004).

Assessment of linear speed

Assess linear speed, the 30-meter test was used. In this test, players have to run as fast as possible from the starting line to the finish line. This test is valid, reliable, and widely used to assess linear speed in soccer (Altmann et al., 2019). Two maximum attempts were allowed for each player, and the best attempt was considered for analysis.

Assessment of coordination ability

The Akramov test was selected to assess coordination ability (Akramov, 1990). This test aims to evaluate coordination and change-of-direction speed in soccer players. In the test, four cones are placed in a square formation, with a distance of 10 meters between each cone, and an additional cone is placed in the center of the square. The player must run as fast as possible from the starting line to the finish line, as shown in Figure 1. The test includes two variations: with and without the ball. In this study, the author used the test without the ball to eliminate the influence of technical skill. Each player was allowed two maximum attempts, and the best attempt was considered for analysis.

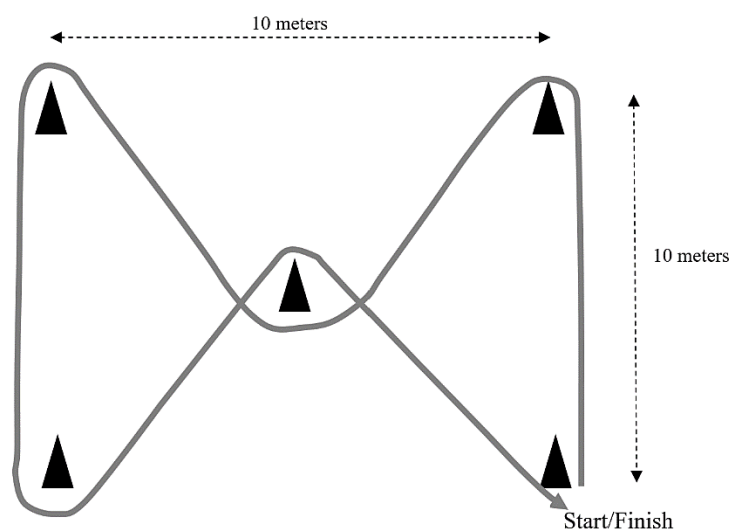


Figure 1. Akramov test for coordination ability.

Training program

Table 2. Training program content.

Week	Session	Elastic type	Exercises
1	1	Green	Leg extension
	2		Standing hip abduction
2	3		Lateral walks, steps each direction
	4		Hip flexor raises
3	5	Blue	Knee drives, each leg
	6		Single leg in & out
4	7		Scissors
	8		Back-front wards walk
5	9	Yellow	Quick thigh switch
	10		Rapid response lateral scissors
6	11		Hamstring curl right- left
	12		High knees fast
7	13	Red	Foot exchange, in – out
	14		Glute kickbacks for each leg
8	15		Rapid response scissors
	16		Half- round right & left

Both groups trained simultaneously, with the experimental group using mini-bands and the control group following the regular training program designed by the coach. The training lasted for eight weeks, with two sessions per week, each lasting 30 minutes. The work time was 20 seconds, the rest time was 10 seconds, and each leg performed 3 sets throughout the entire training period.

Various types of resistance bands differ in elasticity and resistance levels, each identified by a specific color. In this study, we used color-coded resistance bands indicating different resistance levels: green (very light), blue (light), yellow (medium), red (heavy), and black (very heavy). Table 2 presents the exercises performed using mini-bands. Figure 2 shows the application of the program.



Figure 2. Application the training program in the field.

Statistical analysis

Data in this study were presented as mean and standard deviation (SD). The Shapiro-Wilk test was used to assess the normal distribution of the data. An independent t-test was conducted to compare the experimental and control groups in the pre-test. A paired t-test was used to compare pre- and post-test results within each group. Hedges' g effect size was calculated to determine the magnitude of the difference between pre- and post-test results, with values categorized as small (0.20), medium (0.50), or large (0.80). A two-way ANOVA was performed, considering time (pre- and post-test) and group (experimental and control) as factors. If a significant group $\times$ time interaction was observed, a Bonferroni post hoc test was applied to aid in interpreting the interactions. Partial eta-squared (η^2) was used to assess the effect size of group differences, with η^2 values classified as small (0.01), moderate (0.06), and large (0.14). Statistical significance was set at $p < .05$.

RESULTS

Table 3 shows that linear speed and coordination ability significantly improved in both the experimental and control groups ($p < .05$; ES ranging from 0.568 to 3.531). The main time effects were also significant for both linear speed and coordination ability ($p < .05$), with large effect sizes (η^2 ranging from 0.385 to 0.935). However, the time $\times$ group interaction was not significant for linear speed ($p > .05$; $\eta^2 = 0.025$). In contrast, coordination ability showed a significantly greater improvement in the experimental group compared to the control group ($p < .05$; $\eta^2 = 0.693$).

Table 3. Comparison of Changes in Linear Speed and Coordination between experimental group and control group.

Variables	Experimental group (n = 10)			Control group (n = 10)			Main time effect	Time x group
	Pre-test	Post-test	p-value [g] Magnitude	Pre-test	Post-test	p-value [g] Magnitude	p-value [η^2] Magnitude	p-value [η^2] Magnitude
	Mean $\pm$ SD			Mean $\pm$ SD				
30m sprint time (s)	5.42 $\pm$ 0.33	5.16 $\pm$ 0.20	.044* [0.952] Large	5.54 $\pm$ 0.23	5.37 $\pm$ 0.32	.026* [0.610] Moderate	.003‡ [0.385] Large	.502 [0.025] Small
Akramov coordination time (s)	13.67 $\pm$ 0.46	12.18 $\pm$ 0.38	.000*** [3.531] Large	14.26 $\pm$ 1.14	13.62 $\pm$ 1.11	.000*** [0.568] Moderate	.000‡ [0.935] Large	.000# [0.693] Large

Note. No statistically significant were observed in between groups pre-test comparison; EG: Experimental group; CG: Control group; g: Hedges' g effect size; η^2 : Partial eta-squared; *: significant difference between pre- and post-tests ($p < .05$); *** $p < .001$; ‡: significant main time effect; #: significant time x group.

DISCUSSION

The aim of this study is to determine the effects of an 8-week mini-band resistance training program on linear speed and coordination ability in U13 youth soccer players. The main findings of the present study indicate that eight weeks of resistance band training improve both linear speed and coordination ability in both the experimental and control groups. However, the experimental group outperformed the conventional training program in coordination ability. This could be attributed to the fact that children's linear speed can develop rapidly due to the growth spurt that accompanies this stage. The U13 age category is characterized by increased physical and morphological growth, which naturally contributes to speed enhancement. It is well known that speed is linked to morphological aspects. Some studies have shown that an increase in leg length due to growth positively influences stride length, thereby improving speed (Meyers et al., 2016). Additionally, during this phase, an increase in muscle mass is observed in young athletes, particularly in the quadriceps and hamstrings, which contributes to speed improvement (Kanehisa et al., 1995).

The results presented in the study by Papaiakevou, G., et al., 2009 indicate that age and gender are factors influencing 30-meter sprint speed during childhood and adolescence. Moreover, the study by Christou et al. (2006) found that combining soccer training with resistance training to develop overall physical abilities in young boys enhances maximal strength, natural lower-limb growth, vertical jump performance, 30-meter sprint speed, and agility.

In addition to the previously mentioned aspects of speed being influenced by physical and morphological growth, resistance band training may contribute to speed development through several mechanisms. One such mechanism is enhanced muscle activation, as resistance bands help activate and develop key muscle groups, such as the glutes, hips, and thigh muscles, which are crucial for explosive movements in sprinting (Gaamouri et al., 2023).

Moreover, strength development plays a role, as resistance band training is a form of resistance exercise that helps build lower-body strength (such as in the glutes, thighs, and hamstrings), which is essential for force generation and acceleration. It is well known that strength gains correlate with increased speed (Seitz et al., 2014). Studies have also shown that using elastic resistance in strength training with weights effectively enhances power in athletes (Stevenson et al., 2010). Resistance band training also improves stability and balance, helping young athletes maintain correct form and posture during fast movements, leading to greater efficiency in effort and time during performance (Özsu, 2018).

Additionally, resistance band training positively affects flexibility. As commonly recognized, increased joint flexibility and muscle elasticity enhance functional movement (range of motion). A five-week resistance band training program for rugby players demonstrated significant improvements in lower-limb flexibility (Guillot et al., 2019).

Regarding coordination ability, it involves the ability to coordinate movements efficiently and effectively. The results of this study indicate that coordination significantly improved in the U13 experimental group compared to the control group.

It is well known that children develop coordination ability through maturation (Goodway, et al., 2019). Several factors may influence coordination ability development, including age, gender, weight status (Battaglia et al., 2021), geographical region, and living environment (Gallotta et al., 2022). However, resistance band training may enhance coordination in young athletes through several mechanisms.

Elastic resistance training with bands requires athletes to control their movements, improving body awareness and proprioception. Motor coordination enhances the ability to regulate the excessive degrees of freedom in the motor system, transforming body segments into controllable units. This can be achieved through resistance band exercises targeting the lower body, which allow athletes to adapt movement patterns and adjust force application easily, thereby improving performance. Resistance band training helps activate stabilizing muscles and small muscle groups, which are essential for smooth and coordinated movements. Developing motor coordination should be a primary strategy in childhood to promote obesity prevention, reduce injury risks in the long term, and enhance physical activity levels (Lima et al., 2017).

It is also worth noting that some studies support the idea that motor coordination can be developed through varied sports participation. For example, practicing multiple sports such as swimming and soccer contributes to coordination enhancement (Stanković et al., 2023). Additionally, resistance bands provide elastic resistance without excessive joint stress, making them a safe training tool for young athletes (Huo et al., 2023).

The present study supports the integration of resistance bands into exercise routines that simulate dynamic movement patterns (such as squats, lunges, or lateral steps, which were used in our study). These exercises mimic sports-specific movements across different athletic activities and enhance overall motor coordination in young athletes.

This study has some limitations, as it relied on only two tests to measure linear speed and coordination ability. Future investigations should consider dividing the 30-meter sprint test into 10, 20, and 30 meters to determine whether it improves start speed and acceleration performance. Additionally, using other coordination tests that better represent actual ability would be beneficial. Future studies could also explore the effects of resistance bands on hip flexibility and mobility in young soccer players.

CONCLUSIONS

The current study demonstrated that mini-band resistance training can be a highly effective tool for developing linear speed and coordination ability in youth soccer players. It also showed that coordination ability improves more significantly compared to conventional training. Therefore, incorporating resistance bands into a well-structured training program can help young athletes build a strong foundation for sports performance, provided it is supervised by specialized experts. Additionally, resistance bands can contribute

to faster, more coordinated, and more efficient movements, paving the way for future performance improvements.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author.

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