Investigation of the effect of isometric core strength training in addition to basic basketball trainings on explosive power in children aged 9-17

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Background and Study Aim With its dynamic and constantly changing characteristics, basketball, which requires more than one movement, is one of the most preferred and popular team sports in the world. It is important to know that basketball requires programs based on speed, agility and strength fitness components, in which endurance and strength parameters are predominant. In this context, resistance training, which provides skill excellence and increased muscle strength, is important for basketball players. The aim of this study is to examine the effects of 4-week specific core training applied to pre-adolescent and adolescent children who do basic basketball training on explosive strength.

Material and Methods A total of 16 [Control Group (CG): n=8; Experimental Group (EG): n=8] individuals (age 13.29 ± 1.96 years) who did not have any health problems from basketball school and continued basketball basic training were included in the study. The groups continued their usual basketball basic training program (2 days a week, 60 minutes a day). However, in addition to the basic training program, the experimental group was subjected to an isometric training program for 12-minute core strengthening. Training programs were made for a total of 4 weeks. We examined the effects of core training on speed, vertical jump and agility parameters. Statistical analyzes of the data obtained as a result of the research were obtained using the IBM SPSS 23.0 package program.

Results There was no difference between the groups for sprint and vertical jump parameters of core and basic basketball training ($p>0.05$). However, there was a significant difference in favor of EG in the agility test analysis results ($p<0.05$). As a result, we can say that 4-week core training applied in addition to the basic basketball training program in children improves agility characteristics.

Conclusions The findings showed that core training programs have positive effects on explosive strength parameters. In addition, strengthening the core area significantly improved the agility parameter, which is important in ground-direction changes. This, in parallel with the studies, supported that core training programs should be an integral part of other training programs. This study also showed that core stabilization training applied in a short time improves explosive strength parameters in children.

Keywords: basketball, core strength, children, biomotoric parameters.

Introduction

Basketball is one of the most popular team sports that has been accepted worldwide and is the most preferred [1, 2]. The basketball game, which offers different challenges in many time periods with its dynamic and constantly changing characteristics, is a sports activity that requires more than one movement [3, 4]. Considering the movements it contains due to its physical and physiological performance characteristics, it is a high-intensity and short-term anaerobic exercise that includes different sprint types, sudden accelerations/decelerations, jumps, flexibility, jumps, agility, upper and lower body strength or in low/moderate intensity and partially prolonged aerobic exercise activities such as standing and walking [2, 5, 6, 7, 8]. In addition to all these motoric skills, it is important to be able to dribble by filling positions, to be able to perform a good defense against the opponent and to apply technical and tactical elements in the best way in basketball, which includes many difficulties in a small area and requires more precision [4, 8].

The main factor for success for every sport branch is to develop good conditioning programs based on the specific physiological demands of that branch [9]. In this context, it is important to know that basketball specifically requires programs that focus on maximum aerobic/anaerobic endurance and power parameters on the basis of speed, agility and power fitness components [4, 6, 10]. In order to obtain the best efficiency for basketball, as a synthesis of all the above-mentioned features: morphological body type, genetic structure, functional and motor abilities, specific technical and tactical abilities, psychological and sociological characteristics constitute the complex skills of a basketball player [4]. Therefore, in basketball, where many player groups start at the age of 5-6, it is important that the age to start training is 7-8 in order to perform these skills in the best way [1, 4]. Because in studies, it has been stated that pre-adolescent and adolescent

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athletes or non-athletes have increased muscle strength, aerobic and anaerobic power, jumping ability and muscular endurance with short-term training [11]. In studies supporting these increases, they stated that coordination abilities improve with age and sports expertise, for example, adolescent basketball players exhibit much better vertical jump, complicated reaction, focused attention and speed of movement compared to their non-sport peers. Therefore, it is predicted that there will be a strong relationship between coordination and specific conditioning in all age groups of basketball players [10]. For example, it has been stated that male basketball players with higher skill levels have higher vertical jump, faster and more agility values than less talented players [2].

Especially resistance training, which is done in the early stages of life, prepares the necessary infrastructure for higher-level training to be done in the later periods, by increasing skill perfection and muscle strength. In recent years, research on the effects of strength exercises performed with appropriate techniques and continuous supervision on children and adolescents. It is known that strength training increases many biomotor abilities and performance by increasing muscle strength in pre-adolescent and adolescence periods. On the other hand, with the advancing time, the importance of individualization of programs is an undeniable fact due to innate genetic differences between individuals, differences in strength or/ and strength training and general fitness [12, 13, 14]. In the game of basketball, which is played at adolescent ages, which requires technical and physical ability and versatility, especially the players have a high rate of possession of the ball in the small playground. It requires many movements that include explosiveness in more than one direction, including acceleration, deceleration and jumping in various play styles. For this reason, it has been stated that power is important for changing direction performance in adolescent basketball players in various planes of motion [15].

Resistance training is important for basketball players. With the power obtained from basketball-specific resistance training programs, it causes changes in skeletal muscle, central and peripheral nervous system resulting in increased muscle strength output. Thus, athletes will be motivated to handle the high-stress workload that may occur during training or play more easily. On the other hand, strength training programs are important to prevent injuries that may occur with adequate strength, rehabilitate injuries and/or improve long-term health [3, 14]. Sports medicine specialists emphasized the importance of core strengthening techniques, which have become a fitness trend in the sports medicine world in recent years, in order to increase performance and prevent injury, and emphasized core strengthening, which is often called lumbar stabilization. The core can be described as a muscular box with the abdominals anteriorly, the paraspinals and gluteals posteriorly, the diaphragm as the roof, and the pelvic floor and hip girdle muscles [16, 17]. Core muscles, on the other hand, are defined as a structure that connects the lower extremities, pelvis, spinal cord, ribs and upper extremities with a kinetic chain [18]. It is advocated as an important prerequisite to prevent low back pain, increase athletic performance and protect musculoskeletal health, especially in performing some daily activities such as walking, climbing stairs, standing upright, as well as the implementation of many other sports such as trunk and core muscle development, football, basketball, athletics, and jumping disciplines [19, 20]. Athletes need sufficient balance, strong core stability and neuromuscular control to effectively perform the movements required by their sports [21]. Because the movements starting from the core muscle system always keep our kinetic response and readiness against the opponent alive in providing motor control, standing against gravity or torques [18].

It is stated that regularly followed and well-planned core training programs that emphasize the strengthening of the core region (for example, focusing on the abdominal, waist, trunk and hip muscles) are also suitable for children. In addition, it can be said that it provides postural benefit in gaining sports-specific skills and stabilizing the lumbosacral region, as well as the ability to perform challenging physical tasks that require core muscle strength, good condition and control [14, 18, 22]. In a study on the subject, it was seen that the 8-week core stability training program developed functional movement models and dynamic postural control in athletes, and it was more beneficial especially in athletes with weak movement skills [21]. From this point of view, the aim of our study is to examine the effects of specific core training applied to pre-adolescent and adolescent children who do basic basketball training in basketball school on explosive strength.

Material and Methods

Participants

A total of 16 [Control Group (CG), n=8; Experimental Group (EG), n=8] individuals (age 13.29 ± 1.96 years) who did not have any health problems from basketball school and continued basketball basic training were included in the study. If they had a history of health problems, a disease or physical condition that could affect physical activity, they were excluded from the study. All of the participants were previously informed about

the testing procedures and any known risks, and provided their own written informed consent. Participants were asked not to do any exercise 24 hours before the tests. All of the procedures were in accordance with the Helsinki Declaration of 2021. This study was approved by University of Inonu Ethics Committee for research on human participants.

Research Design

Individuals who regularly attend basketball school 2 days a week for 1 hour a day for basic basketball training were included in the study. Individuals were divided into two groups as CG and EG. The groups continued their usual basketball basic training program (2 days a week, 60 minutes a day) (table 1). However, in addition to the basic training program, the experimental group was subjected to an isometric training program for 12-minute core strengthening (table 2). After obtaining the demographic and biometric information of the individuals, the first performance tests (sprint, jump and agility) were measured before the training programming. After the measurements, the individuals started to work in order to apply the training protocol created specifically for the groups for a total of 4 weeks. After the training program was over, the tests applied before the training were also applied after the training. All tests were administered in the indoor gym of the basketball school. All the data obtained were recorded on the form created specifically for the study.

Height and Body Mass

All measurement procedures were performed without minimal clothing and shoes. The height measurements of the participants were measured with a 0.1 cm precision portable stadiometer (Seca Ltd., Bonn, Germany) with the head in the frankfort plane, while the body was upright and the weight was evenly distributed on both legs. Body weight (VA) and body fat ratio measurements were measured with a body analyzer with a capacity of 270 kg and a sensitivity of 100 g (Tanita SC-330S, Amsterdam, Netherlands).

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In addition to the regular basketball basic training program, the participants were included in the basic core strength training program. The core stability program was created from 4 different isometric positions, each lasting 30 seconds and performed in two repetitions.

Participants were required to maintain a static position with only their forearms and toes touching the ground. Subjects were asked to maintain hand-eye contact, a neutral spine, and a straight line from head to ankles. The coach demonstrated each of the 4 exercises with their proper techniques. Afterwards, the participants were given a trial for 5 seconds. The test started when the participant showed the correct position. Individuals were asked to keep the exercise as long as possible for the specified time. However, if they could not hold the position for the specified time, they were instructed to fall to the ground and then return to the exercise within 1-2 seconds. Rest periods of 30 seconds between repetitions and 120 seconds between each plank exercise were given [23, 24, 25].

Test Protocols

Sprint Test

The 20 m sprint run was measured in an indoor

Table 1. Basketball basic training protocol

Groups	Weeks	Days	Tımes	Content of the training
Control Experimental	4	2	60 min.	Basketball specific warm-up Basic Ball handling skills Simple fundamental movement training Motoric feature development studies Stretch and cool down

Table 2. The EG core stability protocol

Group	Weeks	Days	Times	Content of the training
Experimental	4	2	12 min.	Plank (prone, supine, right and left side) 30 sec. x 2 rep.

environment using an infrared photocell device (Sport Expert, Tümer Engineering / Turkey), a two-door timing system placed at the start and finish lines. Subjects stood ready in a semi-crouched position with the tips of their toes 50 cm away from the starting line after they had done adequate warm-ups before the measurement. When they felt ready, they were asked to run at the maximum speed they could run. Each individual was given two attempts with a recovery period of approximately 3 minutes between them. Individuals were verbally motivated throughout all trials to achieve the best outcome. At the end of the run, the duration of the distance covered was recorded in 's' with an electronic stopwatch connected to the photocell mechanism. The best time obtained was used for analysis. Also, enough space was left for all participants to slow down after the run [10, 26, 27, 28, 29].

Vertical Jump

The vertical jump test is a standardized test for measuring explosive power, vertical jump and athletic performance. The vertical jump height indicator (Vertec/by Jump USA) was used for the measurement of this test. At the moment preceding the jump, the participants could freely flex the hip, knee, and ankle joints and prepare the upper limbs for a sudden upward thrust, in an effort to promote the highest vertical jump possible. The participants stands with feet apart below the height indicator. The feet are at shoulder-width. The participants swings his arms forward and up, jumps upward and tries to make contact with the rod of the indicator with his right hand at the position which indicates the highest possible value, lands in the starting position and repeats the jump, only now trying to make contact with the rod of the indicator using his left hand. The rest time between jumps was 20 s. The participant's vertical jump height was calculated as the difference between their maximum jump height and standing reach height. "Peak Power" was calculated from the maximal jump height of three trials [30, 31].

Modified T Agility Test

The modified agility t-test is a recently established contemporary protocol as a measure of defensive movements and speed in changes of direction that occur with forward-backward and right-left running. Participants waited for the exit in the ready position by placing their preferred front foot for running, not exceeding the marked line 50 cm behind the starting gate. Participants were instructed to touch the top of the cones (30 cm high) placed at all rotation points.

Each subject was required to sprint forward 5 m and touch the tip of the cone with the right hand. Then she performed a lateral shuffle to the left 2.5 m, and touched the tip of the cone with the left hand. Subject then changed direction and shuffled 5 m to the right to touch the tip of the cone with her right hand. She then shuffled 2.5 m to the left to touch the tip of the cone in the middle with her right hand. Finally, the subject back-peddled 5 m, passing through the finish point. Participants covered a sum total distance of 20m. 3 trial rights were given for each athlete. The subjects were allowed 3 minutes of rest between each run. By writing the measurement results in seconds, the best time obtained in three trials was recorded. Any subject who crossed one foot in front of the other, failed to touch the tip of the cone, and/or failed to face forward throughout had to repeat the test [15, 32, 33].

Statistical Analysis

Statistical analyzes of the data obtained as a result of the research were obtained using the "IBM SPSS 23.0 (IBM Corp., Armonk, NY, USA)" package program. After descriptive statistics of the data were made, normality analysis was performed for the data set.

For the homogeneity of the research data, the normal distribution of the data was tested with the "Skewness-Kurtosis" and "Shapiro Wilks" tests. As a result of this test, it was determined that the distributions were normal. For this reason, "Independent Samples T Test", which is one of the parametric tests, was used to analyze the difference between the groups. Effect size (ES) was also estimated for main effects and interaction by calculating partial eta squared values using the SPSS 23.0 statistical package. All tests taken were expressed as median (min-max), mean and standard deviation (SD) values. The degree of significance was determined as "$p < 0.05$" in the study.

Results

Table 3 shows that the average age of the athletes participating in the study was 13,29 ± 1,96 years, an average height of 159,38 ± 12,89 cm, and body weight 62,37 ± 20,55 kg.

The findings of the Independent Samples T-Test results regarding the analysis of the data in this study are as follows.

In table 4, according to the results we analyzed, the differences revealed by core and basketball training in independent sample groups; although there was a mathematical difference between the groups in the measurements of the sprint (EB=0.022; p=.585; 2.36%) and vertical jump (EB=0.172; p=.111; 21.23%) tests, this difference was not statistically significant ($p>0.05$). However, there was a statistically significant difference in favor of EG in the measurements of agility (EB=0.257; p=.045) test ($p<0.05$), this difference showed improvement by 10.33%.

Table 3. Descriptive data of all participants

Demographic features	n	X̄	SS
Age (years)	16	13.29	1.96
Height (cm)	16	159.38	12.89
Body weight (kg)	16	62.37	20.55

Table 4. Findings of difference between groups

		CG	EG	T test			
Biomotoric abilities	**N**	**X̄±SS**	**X̄±SS**	**t**	**p**	**ES**	**%Δ**
Sprint (20m)	16	4.06±.1253	3.96±.4704	.559	.585	0.022	2.36
Vertical Jump	16	28.25±4.528	34.25±8.876	-1.703	.111	0.172	21.23
Agility	16	14.292±.7475	12.815±1.7477	2.199	.045*	0.257	10.33

ES: Effect Size; * The difference is statistically significant at the p<0.05 level. %Δ: percentage of difference between measurements

Discussion

In the world of exercise and sports, the debate about the benefits of core strengthening for both athletes and sedentary individuals has continued from the past to the present and is still a current issue. In basketball, which is one of the performance sports, it is emphasized that endurance, muscle strength, sprint speed, agility and jumping ability are at the forefront in terms of game characteristics. Emphasizing the importance of core training for the improvement and development of these abilities, experts said that core programs are important especially for children in terms of gaining sports-specific skills and benefiting postural control. From this point of view, in this study, an answer was sought to the question of how the application of a core stability program in addition to the basic basketball training program would have an effect on explosive strength parameters.

Although there were improvements in the parameters of sprint (2.36%) and vertical jump (21.23%) from explosive strength according to the training pre-test and post-test results between the groups. These results were not significant as they did not differ between the groups (p>0.05). However, the improvement in the agility parameter (10.33%) represented a significant result in favor of EG (p<0.05). When the literature on the subject was reviewed, Doğan and Savaş [18] stated that their core training activities benefited the static-dynamic balance and basketball psychomotor development of basketball players aged 12-14. They also emphasized that core training should be an integral part of basic training programs for the continuity of development. In his study, Sannicandro [20] aimed to examine the effects of an integrative core stability training on jumping and sprint performance in young basketball players. He stated that the experimental group showed significant improvements in all parameters during the two time periods, but the control group showed significant improvement only in the 10m parameter. When we examined the core training studies in different performance sports, Hoshikawa et al. [34], according to the results of the study in which they looked at the effects of stabilization training on trunk muscle and physical performance in young male football players, reported that adding stabilization exercise to soccer training does not increase trunk muscle, but improves hip extensor strength and vertical jump performance in early adolescence soccer players. Ozmen and Aydogmus [35] stated that if we observe the changes brought about by core strength training in core endurance, dynamic balance and agility parameters in adolescent badminton players, significant gains were observed in Star Excursion Balance and core endurance aspects, but no change was observed in agility. Allen et al. [19], who examined the effect of core endurance interventions on trunk muscle endurance tests in school-aged children, except for performance sports, found that there were significant increases in muscular fitness test performance for each measured test result. Considering the risk of low back pain that starts in childhood, they stated that in terms of the results of the study, medium to high-intensity dynamic core exercises can be added for children and adolescents during their warm-up in physical education classes in order to improve trunk and core muscle endurance. Oliver et al. [23] stated that core muscle activations will help reduce injury rates, since young people are always at risk of musculoskeletal injuries while doing physical activity. In this context, in their study, they concluded that applying core stability programs to a basic physical education curriculum is beneficial for all children.

This study showed similar results with other

studies. We can say that well-planned, controllable and regular core stabilization training has a positive effect by improving biomotor skills. It can be said that it provides a positive benefit in the movement component that requires agility by providing trunk and spine balance, especially in children and young people.

Limitations of the study

Factors such as the difficult conditions caused by the covid-19 pandemic, the small age children in the study group, and the distance of the basketball school from the city center determine the limitations of the study.

Conclusions

As a result of all the results obtained it has been stated that core stabilization training programs are important for every age group and for any sport branch. It has been proven by the studies that core training has important effects on improving biomotor skills, physical fitness parameters, acquired postural posture, gaining a solid body and preventing injury risks.

This study also showed that core stabilization training applied in a short time improves explosive strength parameters in children. Therefore, it has been demonstrated that making these trainings a routine is especially important in terms of sportive performance, as stated in the literature. In future studies, long-term and different stabilization study models can be added at monthly intervals. You can also compare different genders with different age groups.

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