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Does basketball training increase balance scores in children?

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Abstract

Background and Study Aim Balance is a motor skill that enables children to perform physical activities fluently and regular physical activity is needed for the development of balance skills. In this context, the problem of which physical activity should be directed to the balance development of children arises. The study is aimed to determine the effect of basketball training on balance skills in children aged 7-10 years.

Material and Methods The participant group of the study consisted of 24 children aged 7-10 years with a mean age of 9.25±0.94 who did not regularly perform physical activity and lived in rural or non-rural areas. Participants living in non-rural areas were included in the exercise group (n=12) and participants living in rural areas were included in the control group (n=12). The exercise group received basketball training for 8 weeks, two days a week, while the control group did not receive any intervention. Before and after the training process, all participants were tested at Level 1 in TOGU Challenge Disc and software to determine static and dynamic balance levels. As a result of the balance test, participants' static balance score (SBS), dynamic balance score (DBS), general balance score (GBS) and dynamic balance sub-parameter scores as right and left dynamic balance score (RL-DBS), superior inferior dynamic balance score (SI-DBS), horizontal plane dynamic balance score (HP-DBS), vertical plane dynamic balance score (VP-DBS), clockwise (C-DBS) and opposite clockwise dynamic balance score (OC-DBS) were taken as percentage. Descriptive statistics, Skewness, Kurtosis and Kolmogorov-Smirnov values, paired sample t-test and independent sample t-test were used to analyse the data. Statistical significance level was determined as p<0.05.

Results In the study, no difference was found between the exercise group and the control group in terms of pre-test results, which indicated that the participant groups showed homogeneous characteristics. In the exercise group, a significant increase was found in DBS, RL-DBS, SI-DBS, C-DBS, GBS levels after 8 weeks of basketball training. In the control group, there was a significant decrease in SBS and a significant increase in DBS, RL-DBS, SI-DBS, C-DBS and OC-DBS levels at the end of 8 weeks.

Conclusions As a result, regular basketball training provided an increase in dynamic balance level and general balance scores. Moreover, basketball training can slow the decrease in static balance that may occur as a result of growth spurts in children aged 7-10 years. Children targeted to develop balance skills can be directed to basketball training.

Keywords: basketball training, static balance, dinamic balance, balance score, child

Introduction

The World Health Organisation recommends that children and adolescents aged 5-17 years should engage in moderate to intense physical activity for at least one hour a day for optimal health [1]. However, studies have emphasised that the motor skill development of children who are more active in terms of physical activity is supported by physical activity [2, 3, 4]. Moreover, starting from childhood, it is assumed that high motor skill proficiency levels are an important factor that directs individuals to physical activity participation. Therefore, childhood is considered a critical period for the development of motor skills [5, 6].

Proficiency in basic motor skills such as locomotor, manipulative skills and balance is essential for the development of physical activity and sport-specific movement skills [7, 8]. In addition to the fact that balance and motor skills are considered prerequisites for physical competence and sportive performance [9], studies emphasise that they also form an important basis for children's physical development [10, 11, 12]. Therefore, a good physical condition is needed for children and one of them is balance [13].

The balance system of humans matures with age and the balance adjustment mechanism of 7-year-old children is similar to adults [14]. A good balance enables a person to perform movement effectively and efficiently with minimal risk of falling. Balance is analysed in two ways as static and dynamic [13]. Static balance is the body's ability to maintain its balance in a stationary position by standing on one leg or standing on a balance board [15], while dynamic balance is defined as the ability to maintain and regain a fixed position on moving or flat surfaces [16, 17, 18]. When body balance is not given the necessary importance, serious problems such as lack of development of sportive performance may occur.

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While the necessity of balance training for basketball has been accepted by studies [19, 20], the effect of basketball training on balance has not been revealed in the literature. Basketball, which is a sport that exercises the whole body, requires a combination of both static and dynamic balance as it includes a series of movements such as running, jumping, dribbling, passing and shooting in its dynamics. For example, while shooting the ball in basketball, static balance is needed for the ability to complete the movement correctly by maintaining the position of the body, while dynamic balance is needed during movements such as running or dribbling. However, there is no study on the effect of basketball training on the development of balance skills in children.

In this context, considering that balance skill is a basic motor skill that is necessary for children in the process of growth and development [21], this study aimed to reveal whether children who were directed to physical activity for balance development should be directed to basketball exercises or not. Besides, since the participants were selected from rural and non-rural areas and it was known that the movement diagrams of children living in rural areas were more active according to their living conditions, it was aimed to reveal to what extent this situation differentiated their balance skills according to regular basketball exercises.

Materials and Methods

Participants

The study included 24 participants aged 7-10 years. Participants were included in the study on a voluntary basis and the content of the study was explained to the participants and their parents and an informed consent form was signed. The exercise group (n=12) of the study was selected among children residing in a non-rural settlement and not regularly participating in any physical activity, while the control group (n=12) was composed of village children not regularly participating in any physical activity. Exclusion criteria included failure to meet inclusion criteria, failure to comply with study procedures, and desire to leave the study.

Research Design

The study aimed to determine the effect of 8-week basketball training on the changes of balance, which was one of the biomotor abilities of children aged 7-10 years, in static and dynamic states. In the study, age, gender, height and weight values of the participants were recorded in the personal information form. Then, the balance test was performed with the TOGU Challenge disc balance machine. Afterwards, the basketball training specified in Table 1 was applied to the exercise group for 8 weeks. At the end of the eighth week, the balance test was retaken with the same equipment.

Table 1. Weekly Basketball Training Plan

Week	Training Plan
1	Ball handling exercises Ball handling Basketball basic posture Stop exercises with and without ball (single and double time)
2	Ball handling Stop exercises with and without ball (single and double time) Passing exercises (chest pass, floor pass, overhead pass)
3	Ball handling Fundamental studies (Drippling) Passing exercises (chest pass, floor pass, overhead pass)
4	Fundamental studies (Drippling) Right-Left lay up
5	Fundamental studies (Drippling) Left Lay Up Right Lay Up Shot practices
6	Fundamental studies Direction change studies -Crossover -Reverse
7	Fundamental studies Direction change studies -Crossover -Reverse Shot and lay-up exercises after changing direction
8	Fundamental studies Direction change studies -Speed deception -Reverse Shooting and lay-up exercises after changing direction

Ethics committee permission for the research was obtained from Yalova University Human Research Ethics Committee on 2023 with protocol number 2023/77. Participants were included in the study on a voluntary basis. During the current research, the “Higher Education Institutions Scientific Research and Publication Ethics Directive” was followed.

-Basketball Training Programme

The participants in the exercise group were given weekly basketball training sessions determined in Table 1 for 8 weeks, two days a week. Before the training, warm-up exercises including educational games (15 minutes) and cool-down exercises including educational games (15 minutes) were performed. Total training time was limited to 60 minutes. No intervention was made in the control group. At the end of eight weeks, the training and control groups were given a balance test again and their second measurements were taken.

-Data Collection and Instrument

In the study, the level 1 balance test in the "Training" mode of the TOGU Challenge Disc was applied to make static and dynamic evaluations of the participants (Figure 1). This test was applied before and after the 8-week basketball training sessions and balance data were collected. The pre and post test balance data were statistically analysed.

The Togu Challenge Disc is a device produced by MFT Body teamwork that uses games and visual targets to train balance and track the user's movements. The device consists of a balance disc and software with a gamified exercise interface [22]. Within the device, there are games that require balance with increasing difficulty from level one to level five. In balance games, static and dynamic balance levels of individuals are given from the system as a percentage at the end of the game. As the percentage of the score obtained at the end of the game increases, the balance level of the person increases. The device provides static balance score (SBS), dynamic balance score (DBS), dynamic balance sub-parameter scores and general balance score (GBS) results. Dynamic balance sub-parameter scores include right and left dynamic balance score (RL-DBS), superior inferior dynamic balance score (SI-DBS), horizontal dynamic balance score (HP-DBS), vertical plane dynamic balance score (VP-DBS), clockwise dynamic balance score (C-DBS) and opposite clockwise balance score (OC-DBS).

Within the scope of the test, the device and computer connection was provided and then the participant information was entered into the device software. The balance test to be performed was explained to the children in advance, and a 20-second balance test in the device was applied to the participants for practice before the main test. Then the 1st level training mode was selected from the software. Then the participants stood on the balance disc. In Level 1 of the training mode, there are 9 exercises that evaluate dynamic and static balance in a mixed way. Between the exercises, a 10-second waiting time is given for rest and preparation for the next exercise. The exercise ends with the completion of each step by moving the disc so that the small green circle follows the large blue circle. The aim is to keep the green circle in the centre of the large blue circle, which is in motion or in a stationary position. In the application, static balance and sub-parameter scores are given together with the total score for each participant who completes the 9-step Training Level 1 mode (Figure 1). Level training mode takes a total of 3.26 minutes. At the end of the test, SBS, DBS, RL-DBS, SI-DBS, HP-DBS, VP-DBS, C-DBS, OC-DBS, and GBS data were obtained and evaluated.

Statistical Analysis

The data was analyzed on SPSS 26 packet program [23]. Normal distribution of the data was showed by Shapiro-Wilk test results and the skewness and kurtosis values. Mean, standard deviation, and percentage changes were determined as descriptive statistics. Paired Samples T Test and intra-group pre-test and post-test comparisons were used to determine the difference between the pre-test and post-test values of the groups. Statistical significance level was set at $p \leq 0.05$. Effect size (Cohen's d) was analysed in the study. The effect size was calculated with the formula d = [(mean 1- mean 2) / common standard deviation] and defined as small (0.2- 0.49), medium (0.5-0.79), and large (>0.8) [24].

Results

The study included 24 participants, 12 girls and 12 boys with a mean age of 9.25±0.94 years, among children who did not regularly engage in physical activity. Participants living in non-rural areas were included in the exercise group (n=12) and participants living in rural areas were included in the control group (n=12). Demographic data of the participants presented in Table 2.

The normality distribution of the balance data of the participants was examined with Skewness and

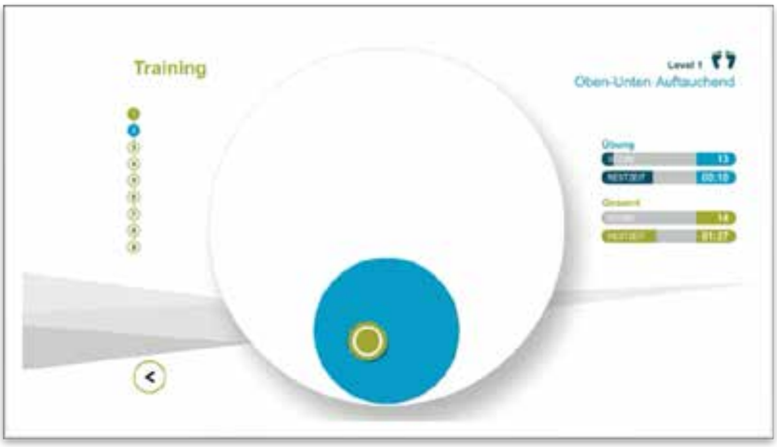

Figure 1. Togu Balance Disc Level 1 Balance test visualisation (produced from MFT Body teamwork device).

Table 2. Demographic data of the participants

Variables	n	Min	Max.	Mean ± sd.
Weight (kg)	24	19.20	46.70	29.50 ± 7.32
Height (cm)	24	116.20	157.00	129.94 ± 8.98
Years	24	7.00	10.00	9.25 ± 0.94

Values are expressed as means ± standard deviations. Min = minimum, Max = maximum

Table 3. Differences between the pre-tests of the exercise group and the control group

Variables	Group	n	Mean ± sd.	t	df	*p*-Value
SBS	Exercise	12	86.18 ± 12.10	-0.165	22	0.871
	Control	12	86.92 ± 10.14			
DBS	Exercise	12	51.25 ± 6.55	-0.362	22	0.721
	Control	12	52.50 ± 10.01			
RL-DBS	Exercise	12	33.33 ± 8.82	-0.128	22	0.899
	Control	12	33.92 ± 13.08			
SI-DBS	Exercise	12	38.83 ± 11.04	0.964	22	0.345
	Control	12	33.25 ± 16.74			
HP-DBS	Exercise	12	71.67 ± 13.50	-1.007	22	0.325
	Control	12	76.50 ± 9.71			
VP-DBS	Exercise	12	76.08 ± 15.75	0.653	22	0.520
	Control	12	71.92 ± 15.50			
C-DBS	Exercise	12	38.83 ± 8.35	-2.028	22	0.055
	Control	12	48.50 ± 14.24			
OC-DBS	Exercise	12	48.67 ± 12.55	0.262	22	0.796
	Control	12	47.25 ± 13.94			
GBS	Exercise	12	628.92 ± 77.83	-0.184	22	0.856
	Control	12	635.42 ± 94.28			

Values are expressed as means ± standard deviations. SBS = static balance score, DBS = dynamic balance score, RL-DBS = right-left dynamic balance score, SI-DBS = superior-inferior dynamic balance score, HP-DBS = horizontal plane dynamic balance score, VP-DBS = vertical plane dynamic balance score, C-DBS = clockwise dynamic balance score, OC-DBS = opposite clockwise dynamic balance score, GBS = general balance score

Kurtosis values and it was determined that the values were in the range of (+2)-(-2) and thus the data fit the normal distribution [25]. Therefore, parametric tests were preferred in statistical analysis.

When the pre-test scores of the control and exercise groups were analysed for each balance parameter, no significant difference was found between the two groups (Table 3) ($p>0.05$). This situation showed that the two groups included in the study were not statistically significantly different from each other in terms of balance parameters and supported that the two groups were similar to each other.

When the difference between the pre and post test values of the exercise group was examined, a significant difference was found in dynamic balance scores, right and left movement, up and down movement, clockwise movement, dynamic balance scores and general balance scores ($p<0.05$). It was determined that the post-test values were higher in these parameters (Table 4). The effect of basketball training on balance scores was calculated using Cohen's d. It was found that basketball training had a significant effect on DBS, RL-DBS, C-DBS. Cohen's d values were found to be 1.00, 1.52, 1.44, respectively. When the effect of basketball training on SI-DBS and GBS values was analysed, Cohen's d values were found to be 0.75 and 0.56, respectively, and the effect level was found to be moderate.

The pre-test and post-test values of the exercise group did not differ significantly ($p>0.05$) in terms of static balance and dynamic balance scores obtained in horizontal, vertical and opposite clockwise movements.

When the pre-test and post-test measurements of the control group were compared, it was determined that the scores of static balance, dynamic balance, dynamic balance in right and left movement, dynamic balance in up and down movement, dynamic balance in clockwise and

Table 4. Comparison of mean scores of pre-post test measurements in the exercise group

Variables	n	Mean ± sd.	t	df	*p*-Value
Pre test SBS	12	86.17 ± 12.10	0.418	11	0.648
Post test SBS	12	84.92 ± 8.70			
Pre test DBS	12	51.25 ± 6.55	-5.141	11	0.000*
Post test DBS	12	58.17 ± 7.27			
Pre test RL-DBS	12	33.33 ± 8.82	-4.578	11	0.001*
Post test RL-DBS	12	44.83 ± 6.12			
Pre test SI-DBS	12	38.83 ± 11.04	-2.251	11	0.046*
Post test SI-DBS	12	46.17 ± 8.46			
Pre test HP-DBS	12	71.68 ± 13.50	-1.458	11	0.173
Post test HP-DBS	12	76.58 ± 11.34			
Pre test VP-DBS	12	76.08 ± 15.75	0.173	11	0.866
Post test VP-DBS	12	75.50 ± 11.61			
Pre test C-DBS	12	38.83 ± 8.35	-7.046	11	0.000*
Post test C-DBS	12	52.50 ± 10.50			
Pre test OC-DBS	12	48.67 ± 12.55	-1.105	11	0.293
Post test OC-DBS	12	52.92 ± 15.58			
Pre test GBS	12	628.92 ± 77.83	-2.587	11	0.025*
Post test GBS	12	670.17 ± 68.39			

Values are expressed as means ± standard deviations. SBS = static balance score, DBS = dynamic balance score, RL-DBS = right-left dynamic balance score, SI-DBS = superior-inferior dynamic balance score, HP-DBS = horizontal plane dynamic balance score, VP-DBS = vertical plane dynamic balance score, C-DBS = clockwise dynamic balance score, OC-DBS = opposite clockwise dynamic balance score, GBS = general balance score,* p <0.05

opposite clockwise movements differed significantly (p<0.05). It was determined that this difference occurred with a decrease in the static balance score and an increase in the scores of other parameters in the post-tests (Table 5). In the control group, no difference was found between the pre-test and post-test values of dynamic balance scores in horizontal and vertical movements and general balance scores (p>0.05) (Table 5).

Discussion

The study was aimed to determine the effect of 8-week balance exercises on static and dynamic balance scores in children aged 7-10 years. Static and dynamic balance scores were evaluated with Level 1 training mode on TOGU Balance Disc device. As a result of the evaluation, in addition to static balance (SBS), dynamic balance (DBS), general balance score (GBS), dynamic balance scores were obtained in right left movement (RL-DBS), superior inferior movement (SI-DBS), vertical plane movement (VP-DBS), horizontal plane movement (HP-DBS), clockwise movement (C-DBS), opposite clockwise movement (OC-DBS) as sub-parameters of dynamic balance.

The study included 24 participants and the research population was selected from the age range of 7-10 years. The effect of basketball training on balance was examined in order to make the participants gain regular physical activity habits. The participants were divided into two groups as exercise group (n=12) and control group (n=12). The control group included village children living in rural areas and the exercise group included children living in non-rural areas. The children in the two groups were selected among those who did not regularly engage in physical activity. In addition to the effect of basketball on balance by selecting two different groups here, it will also be ensured to reveal whether the lack of regular physical activity of village children can be covered by higher movement capacities in living conditions and whether this situation supports the development of balance skills. Even if it was thought that the training and control groups in the study were in different populations, the pre-test results were analyzed with the Independent sample t-test to determine whether there was a difference between the two groups in terms of balance and to support the homogeneity of the two groups. As a result of the statistical analysis, the fact that no significant difference was found between the groups in the pre-test results (p>0.05) supports that the participant groups were similar in terms of the variables to be examined in the study.

Balance was considered to be the basic element

Table 5. Comparison of mean scores of pre-post test measurements in the control group

Variables	n	Mean	t	df	*p*-Value
Pre test SBS	12	86.92 ± 10.14	2.558	11	0.027*
Post test SBS	12	79.42 ± 12.00			
Pre test DBS	12	52.50 ± 10.01	-3.099	11	0.010*
Post test DBS	12	60.83 ± 9.45			
Pre test RL-DBS	12	33.92 ± 13.08	-2.766	11	0.018*
Post test RL-DBS	12	47.00 ± 12.02			
Pre test SI-DBS	12	33.25 ± 16.74	-2.307	11	0.042*
Post test SI-DBS	12	41.92 ± 12.26			
Pre test HP-DBS	12	76.50 ± 9.71	0.985	11	0.346
Post test HP-DBS	12	71.42 ± 15.02			
Pre test VP-DBS	12	71.92 ± 15.50	-0.592	11	0.566
Post test VP-DBS	12	74.50 ± 13.92			
Pre test C-DBS	12	48.50 ± 14.24	-3.561	11	0.004*
Post test C-DBS	12	63.00 ± 7.29			
Pre test OC-DBS	12	47.25 ± 13.94	-4.891	11	0.000*
Post test OC-DBS	12	61.67 ± 16.03			
Pre test GBS	12	635.42 ± 94.28	-1.377	11	0.196
Post test GBS	12	665.91 ± 97.44			

Values are expressed as means ± standard deviations. SBS = static balance score, DBS = dynamic balance score, RL-DBS = right-left dynamic balance score, SI-DBS = superior-inferior dynamic balance score, HP-DBS = horizontal plane dynamic balance score, VP-DBS = vertical plane dynamic balance score, C-DBS = clockwise dynamic balance score, OC-DBS = opposite clockwise dynamic balance score, GBS = general balance score, * $p < 0.05$

necessary for sustaining almost all movements [26]. In addition, balance skill was one of the necessary factors for correct posture through proprioceptors [27]. The ability to control posture and maintain balance during a movement forms the basis of physical activities [28]. Balance skill can be shaped according to the physical activity performed [29]. As can be seen, while balance skill affects performing physical activities, it can be said that physical activities have an effect on balance. In addition, it was an undeniable fact that balance was an important factor in the development of movement and the application of motor skills in children aged 7-10 years. For this reason, it was necessary to ensure the development of balance skills in children and to direct children to physical activity. It was important that the physical activities to be performed were activities that will support balance development. Especially the age group of 7-10 years was defined as the general transition phase in the period of sportive movements, in this phase, children should be directed to activities with rich content that will increase their motor skills [30]. When the literature studies were examined, it was determined that the implementation of the basic gymnastics program in preschool children positively affected balance development [31]. Tan and Çolak [32], determined that core exercises increased balance levels in children aged 8-10 years. In another study, the effect of swimming and theraband exercises on balance was examined and it was concluded that balance development was significantly increased in the group performing the two exercises [33]. In this study, the effect of regular basketball training on balance was examined. As a result of the study, after 8 weeks of basketball training, dynamic balance scores, dynamic balance scores in right and left movements, up and down movements, clockwise movements, and general balance scores increased in the exercise group. Since basketball training consists of movement patterns such as movement on one leg, shooting, sudden change of direction, etc., balance parameters may have improved positively [34, 35]. Erkmen et al. [36] examined the balance levels of athletes subjected to basketball, gymnastics, and soccer branches and found that the balance of basketball players was low compared to the other two branches. In future studies, we suggest that the effects of basketball training as well as other sportive branch training on balance should be examined.

When the control group was considered, it was determined that there was a significant increase in dynamic balance scores in dynamic balance scores, right and left movements, up and down movements, clockwise movements and opposite clockwise movements. In addition, it was determined that there was a statistical decrease in the static balance score ($p<0.05$). It was seen that similar results were obtained in terms of dynamic balance level and development of dynamic balance parameters in the exercise group and control group, but the exercise group showed better development within the scope of general balance score. The fact that the general balance scores of the exercise group increased significantly clearly showed that basketball training provides balanced development in children of this age group. The increase in dynamic balance levels in the control group may be due to the fact that the children in this group were village children living in rural areas. It was an undeniable fact that village children living in rural areas have more active living conditions than children residing in non-rural areas. The fact that children in rural areas have more playgrounds, the level of danger in their living spaces was low, and they spend more time with their friends leads these children to a more physically active life level, although they have fewer opportunities to participate in regular physical activity. When the literature was examined, Liu et al. [37], reported that physical inactivity was higher in children living in urban areas compared to those living in rural areas. In another study, it was found that inactivity level was lower in children aged 2-11 years living in rural areas compared to those living in urban areas [38]. This may be due to the fact that television time and the use of video games are more common in children living in non-rural areas [39, 40]. This may have favorably supported the development of dynamic balance parameters in the control group of the study. However, the physical activity levels of the participants were not measured within the scope of the study. This constitutes the deficiency of the study. In order to obtain a more homogeneous participant group, we suggest that the physical activity levels of the participants should also be examined in similar studies held in future.

In terms of static balance score, there was a decrease in both groups, but a statistically significant decrease was observed in the control group. In children, muscles and tendons try to adapt to the bone with disproportionate growth in the body limbs that occur as a result of growth spurts, and this process may lead to a temporary decrease in motor skills such as balance [41]. This situation may have led to a decrease in static balance levels of the participant children with the increase in height and limb length with growth. With this result of the study, it can be said that basketball training slows down the decrease in static balance level that may occur with growth.

Conclusions

In conclusion, exercise was very important for children's overall health and development. It helps to promote a lifestyle that contributes to their physical, cognitive and emotional well-being. Therefore, parents and educators should encourage and provide opportunities for children to engage in regular physical activity. In this study, the effects of basketball training on static and dynamic balance, which were important for motor development in children, were investigated and the necessity of directing children aged 7-10 years to basketball in the field for balance development was discussed. In addition, children living in rural areas were included in the study as a control group. Within the scope of the study, it was determined that 8-week basketball training provided improvement in dynamic balance levels in children aged 7-10 years. As a result of the study, it was observed that there was an improvement in dynamic balance and its sub-parameters in the control group. This result may have emerged due to the selection of the control group among children living in rural areas. The fact that children living in rural areas have more playgrounds and non-hazardous areas, the current living and environmental conditions are active in rural areas, and at the same time, even if children growing up in these conditions do not have the opportunities to participate in a regular physical activity, the fact that they have more physical motivation reasons in these living conditions suggests that their movement capacity is higher. This situation leads to an increase in the physical activity levels of children living in rural areas and, accordingly, to the development of dynamic balance. However, the physical activity levels of the participants were not revealed within the scope of the study, which is among the limitations of this study. We recommend that the physical activity levels of the participant children should be determined in similar studies to be conducted in the future and examined with the results. In addition, it was concluded that static balance level tends to decrease in children aged 7-10 years and it was thought that this may be due to growth spurts in children. It was determined that basketball training slowed down the decrease in static balance. In conclusion, basketball training offers a versatile approach to balance training in children, targeting both static and dynamic balance. It supports the development of basic physical skills, promotes injury prevention and can lead to better performance in other aspects of life. Therefore, introducing children to basketball at a young age can be highly beneficial for their long-term physical development. We suggest that future studies should examine and compare the effects of basketball training as well as regular training in other sports for balance development. Thus, it can be determined which type of physical activity children should be directed to for balance development.

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