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Comparison of Selected Physical Fitness Parameters Between Prepubertal Soccer and Basketball Players: The Case of Summer Sports Schools

Ergenlik Öncesi Futbolcu ve Basketbolcuların Seçilmiş Fiziksel Uygunluk Parametrelerinin Karşılaştırılması: Yaz Spor Okulları Örneği

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Abstract

The aim of this study was to compare selected physical fitness parameters between prepubertal soccer and basketball players attending structured summer sports school programs. A total of 85 prepubertal children participating in organized summer sports schools were included in the study, consisting of 57 soccer players and 28 basketball players. All participants were enrolled in short-term, structured summer sports school programs focused on sport-specific basic training. Physical fitness was assessed using vertical jump, flexibility, flamingo balance test, handgrip strength, back–leg strength, and 20-m sprint performance. The normality of the data was examined using the Kolmogorov–Smirnov and Shapiro–Wilk tests, and all variables showed normal distribution ($p>0.05$). Therefore, Independent Samples t-tests were used to compare physical fitness parameters between soccer and basketball players. No significant differences were observed between soccer and basketball players in vertical jump performance, flexibility, back–leg strength, or 20-m sprint time ($p>0.05$). However, basketball players demonstrated significantly better performance in balance as assessed by the flamingo balance test ($p<0.01$) and higher handgrip strength compared to soccer players ($p<0.05$). The findings indicate that most physical fitness parameters are similar between prepubertal soccer and basketball players attending summer sports schools, whereas balance and handgrip strength favour basketball players, possibly reflecting early sport-specific demands.

Keywords: Basketball, Physical Fitness, Prepubertal, Soccer.

Öz

Bu çalışmanın amacı, yapılandırılmış yaz spor okulu programlarına katılan ergenlik öncesi futbolcu ve basketbolcuların seçilmiş fiziksel uygunluk parametrelerini karşılaştırmaktır. Çalışmaya, düzenli yaz spor okulu programlarına katılan toplam 85 ergenlik öncesi çocuk dahil edilmiştir. Katılımcıların 57'si futbolcu, 28'i basketbolcudur. Tüm katılımcılar, branşa özgü temel antrenmanları içeren kısa süreli ve yapılandırılmış yaz spor okulu programlarına katılmıştır. Fiziksel uygunluk; dikey sıçrama, esneklik, flamingo denge testi, el pençe kuvveti, sırt–bacak kuvveti ve 20 m sprint performansı kullanılarak değerlendirilmiştir. Verilerin normal dağılıma uygunluğu Kolmogorov–Smirnov ve Shapiro–Wilk testleri ile incelenmiş ve tüm değişkenlerin normal dağılım gösterdiği belirlenmiştir ($p>0,05$). Bu nedenle gruplar arası karşılaştırmalarda bağımsız örneklemler t-testi kullanılmıştır. Futbolcu ve basketbolcular arasında dikey sıçrama performansı, esneklik, sırt–bacak kuvveti ve 20 m sprint süresi açısından istatistiksel olarak anlamlı bir fark bulunmamıştır ($p>0,05$). Buna karşın, flamingo denge testi ile değerlendirilen denge performansının basketbolcular lehine anlamlı düzeyde daha iyi olduğu ($p<0,01$) ve el pençe kuvvetinin basketbolcularda futbolculara kıyasla daha yüksek olduğu tespit edilmiştir ($p<0,05$). Elde edilen bulgular, yaz spor okullarına katılan ergenlik öncesi futbolcu ve basketbolcuların fiziksel uygunluk parametrelerinin büyük ölçüde benzer olduğunu; ancak denge ve el pençe kuvveti açısından basketbolcular lehine farklılıklar bulunduğunu göstermektedir. Bu farklılıkların, kısa süreli eğitim programlarında dahi ortaya çıkabilen erken dönem branşa özgü taleplerden kaynaklanabileceği düşünülmektedir.

Anahtar Kelimeler: Basketbol, Ergenlik Öncesi, Fiziksel Uygunluk, Futbol.

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INTRODUCTION

Early childhood and the preadolescent period represent critical stages characterized by rapid physical, cognitive, and motor development. Physical activity participation during these developmental phases contributes significantly to the acquisition of fundamental motor skills and establishes the foundation for future athletic performance (Malina, Bouchard, & Bar-Or, 2004). Engaging in physical activity at an early age not only enhances motor competence but also promotes the development of bone mineral density, muscular strength, and cardiovascular endurance (Lloyd et al., 2015). Furthermore, the adoption of regular exercise habits during childhood is considered a key determinant in fostering positive attitudes toward lifelong physical activity.

Sports participation supports not only physical development but also the acquisition of psychosocial competencies, including self-confidence, discipline, self-regulation, and social adaptation (Côté & Hancock, 2016). Therefore, identifying the effects of participation in different sports disciplines on selected physical fitness parameters during the preadolescent period may provide valuable information for both training program design and talent identification processes.

Football and basketball are among the most popular team sports practiced by children and require a wide range of motor abilities, including agility, strength, endurance, balance, and coordination. However, the movement patterns, game characteristics, and physiological demands of these sports differ substantially (Stølen et al., 2005; Narazaki et al., 2009). Football predominantly involves lower-limb power, sprinting ability, agility, rapid changes of direction, and ball control skills, whereas basketball places greater emphasis on both upper- and lower-body strength, jumping performance, hand–eye coordination, and balance control (Drinkwater, Pyne, & McKenna, 2008).

These sport-specific differences suggest that the training stimuli associated with each discipline may produce distinct adaptations in muscular development, balance regulation, and motor coordination. Indeed, technical skills and training methodologies unique to each sport may influence the development of specific components of physical fitness in different ways. Previous research has demonstrated that regular sports participation during the preadolescent period contributes positively to biomotor abilities such as strength, flexibility, balance, and speed (Faigenbaum et al., 2009; Lloyd et al., 2015). Nevertheless, relatively few studies have directly compared the sport-specific effects of different athletic disciplines on these developmental outcomes.

In particular, the impact of early sport specialization on the physical fitness profile of children remains a topic of ongoing debate. While some researchers suggest that early specialization may enhance certain sport-specific physical attributes, others argue that it may limit the development of broader motor competencies (Côté & Hancock, 2016). Consequently, comparative investigations examining the effects of different sports on physical performance during the preadolescent period are needed to provide evidence-based guidance for coaches, practitioners, and youth sport development programs.

Accordingly, the present study aims to compare the physical performance characteristics of preadolescent football and basketball players attending sports schools

and to examine the influence of sport discipline on selected components of physical fitness.

MATERIAL AND METODS

Research Model

This study employed a cross-sectional, comparative, and between-subjects research design to compare selected physical fitness parameters of preadolescent football and basketball players participating in summer sports schools. Using a cross-sectional approach, the physical fitness characteristics of participants engaged in different sports disciplines were assessed at a single point in time. This research design was considered appropriate for the present study because it enables the comparison of existing physical fitness profiles among children participating in different sports and is widely used to identify inter-individual differences across groups.

The between-subjects design allowed football and basketball players to be treated as independent groups, facilitating the examination of potential sport-specific differences in physical fitness characteristics. The independent variable of the study was sport discipline (football or basketball). The dependent variables consisted of selected indicators of physical fitness, including vertical jump performance, flexibility, balance, handgrip strength, back and leg strength, and 20-meter sprint time.

Research Group

The study sample consisted of 85 prepubertal children enrolled in organized summer sports school programs, including 57 soccer players and 28 basketball players. All participants regularly attended structured summer sports school training sessions during the summer period. These programs were designed to provide sport-specific fundamental skill development through regular weekly training activities.

Summer Sports School Training Characteristics

All participants attended structured summer sports school programs conducted during the summer period. The programs lasted for 8 weeks and consisted of three training sessions per week. Each session lasted approximately 60–75 minutes and included age-appropriate warm-up activities, fundamental sport-specific skill training, general motor skill exercises, and game-based activities. Although the technical content differed according to sport discipline, the overall training frequency and duration were comparable between the soccer and basketball groups.

The study was conducted with the principles in Declaration of Helsinki to ensure the rights, safety, and well-being of the participants.

The inclusion criteria for participation in the study were as follows:

(a) Regular attendance at summer sports school training sessions during the study period;

(b) Active participation in only one sport discipline, either soccer or basketball;

(c) Being in the prepubertal developmental stage;

(d) Being between 7 and 11 years of age;

The exclusion criteria were as follows:

(a) Failure to meet any of the established inclusion criteria;

(b) Presence of injury, pain, movement limitations, or chronic medical conditions that could affect performance during the testing procedures;

(c) Inability to safely or correctly perform the testing protocols;

Data Collection Tools

All measurements conducted within the scope of the study were performed by the same research team under standardized testing conditions and during the morning hours in order to minimize potential environmental and temporal influences on the assessment outcomes. Participants were instructed to refrain from engaging in any physical activity prior to testing, thereby reducing the potential effects of fatigue on performance measures. This approach is consistent with standard procedures commonly recommended in field-based research involving children and young athletes. Prior to data collection, both participants and their parents were informed about factors that could potentially influence test performance. Participants were instructed to wear comfortable sports clothing and athletic footwear on the day of testing, while clothing or accessories that could restrict movement or interfere with measurement accuracy were discouraged. In addition, participants were required to complete their last meal at least two hours before the testing session.

Anthropometric Measurements

To determine the descriptive characteristics of the participants, age, height (cm), body mass (kg), and body mass index (BMI) were assessed. Anthropometric measurements are widely used indicators for evaluating physical fitness and growth-related characteristics in children.

Height, Body Mass and Body Mass Index (BMI) Measurement Procedure

Height was measured using a stadiometer fixed to a flat surface. During the assessment, participants stood barefoot with their heels together and their bodies in an upright position. Care was taken to ensure that the head was aligned according to the Frankfurt plane. Measurements were recorded to the nearest 0.1 cm. This procedure is consistent with standard anthropometric measurement protocols (Lohman, Roche, & Martorell, 1988). Body mass was measured using a bioelectrical impedance analyzer (InBody 120) with a precision of 0.1 kg. Prior to measurement, participants were instructed to remove any metal objects, and all assessments were conducted under similar testing conditions to enhance measurement reliability (Heyward & Wagner, 2004). Body mass index was calculated using the formula: BMI = {Body Mass (kg)} / {Height^2\ (m)}. BMI is a commonly used anthropometric indicator for evaluating growth status and physical fitness characteristics in children and adolescents (Cole et al., 2000).

Physical Fitness Measurements

A field-based fitness test battery was administered to evaluate participants' physical fitness levels. The battery included assessments of explosive power, flexibility, balance,

upper- and lower-body strength, and speed performance. These tests are widely used and have demonstrated validity for assessing motor performance characteristics in children.

Vertical Jump Assessment

To assess lower-body explosive power, participants performed a vertical jump test. Participants were instructed to jump vertically as high as possible while keeping their hands on their hips. Jump height was recorded in centimetres using an electronic jump measurement system that automatically calculates jump height based on flight time. (Bosco, Luhtanen, & Komi, 1983).

Flexibility (Sit-and-Reach Test)

Flexibility was assessed using the sit-and-reach test. Participants sat on the floor with their bare feet placed against the testing box. They were instructed to reach forward as far as possible without bending their knees. The furthest distance reached was recorded in centimetres. This test is commonly used to evaluate hamstring and lower-back flexibility in children and adolescents (Wells & Dillon, 1952).

Flamingo Balance Test

Balance performance was assessed using the Flamingo Balance Test according to the Eurofit test battery protocol (Eurofit, 1988). Participants stood on their non-dominant foot on a wooden beam measuring 50 cm in length, 4 cm in height, and 3 cm in width. The total number of successful balance attempts completed within one minute was recorded. Higher scores indicated better balance performance.

Handgrip Strength Assessment

Handgrip strength was measured using a digital hand dynamometer (Takei, Japan). Participants were instructed to exert maximal grip force while standing with the arm positioned alongside the body and the elbow fully extended. Grip strength was recorded in kilograms. Handgrip strength is widely accepted as an indirect indicator of overall muscular strength in children and adolescents (Wind et al., 2010).

Back–Leg Strength Assessment

Back and leg strength were assessed using a back–leg dynamometer (Takei, Japan). Participants performed a maximal pulling action while maintaining a slightly flexed knee position, straight arms, and an upright trunk posture. This test enables the combined assessment of lower-extremity and trunk strength (Johnson & Nelson, 1986).

20-m Sprint Test

To evaluate speed performance, participants were instructed to sprint 20 meters at maximal effort. Sprint time was recorded using a photocell timing system, and the fastest trial was included in the statistical analyses. The 20-m sprint test is a commonly used measure of short-distance speed performance in young athletes (Haugen & Buchheit, 2016).

Data Analysis

Statistical analyses were performed using IBM SPSS Statistics software (Version 24.0; IBM Corp., Armonk, NY, USA). Prior to the main analyses, the normality of the data was assessed by examining skewness and kurtosis values. All variables were found to fall within acceptable ranges, indicating that the assumption of normal distribution was satisfied (Tabachnick & Fidell, 2007). To determine whether the sample size was statistically adequate, an a priori power analysis was conducted using G*Power software (Version 3.1) before data analysis. The power analysis was based on a two-tailed Independent Samples t-test designed to compare two independent groups (soccer and basketball players). A medium effect size (Cohen's d = 0.50), an alpha level of 0.05, and a statistical power of 0.80 (1 – β) were assumed. The results indicated that the current sample size was sufficient to detect medium-to-large effect sizes. Descriptive statistics are presented as mean ± standard deviation (SD). Differences in physical fitness parameters between soccer and basketball players were examined using the Independent Samples t-test. Statistical significance was set at $p < .05$ for all analyses.

FINDINGS

Table 1: Descriptive statistics of the participants.

Variable	Group	n	$\bar{x}$	±	SD	Min	Max	t	P	Cohen's
Age (years)	Football	57	8.30	±	1.16	7	11	0.03	0.97	0.01
	Basketball	28	8.29	±	1.43	7	11			
Height (cm)	Football	57	129.29	±	8.06	111	144	-1.89	0.06	0.44
	Basketball	28	132.96	±	8.72	117	152			
Body weight (kg)	Football	57	28.77	±	7.24	18.30	46.20	-1.32	0.19	0.30
	Basketball	28	31.06	±	8.08	19.10	47.50			
BMI (kg/m2)	Football	57	16.98	±	2.80	13.01	24.31	-0.54	0.59	0.12
	Basketball	28	17.33	±	2.98	12.83	23.23			

**p<0.01 *p<0.05 Cohen's d: 0.20 = small effect, 0.50 = medium effect, and 0.80 = large effect.

According to the descriptive data presented in Table 1, a total of 85 prepubertal participants took part in the study, including 57 football players and 28 basketball players. The mean age of the football and basketball players was 8.30±1.16 years and 8.29±1.43 years, respectively. Mean height values were 129.29±8.06 cm for the football players and 132.96±8.72 cm for the basketball players. Mean body weight was 28.77±7.24 kg in the football group and 31.06±8.08 kg in the basketball group. The mean BMI values were 16.98±2.80 kg/m² and 17.33±2.98 kg/m² for the football and basketball groups, respectively. Independent Samples t-test analyses revealed no significant differences between football and basketball players in terms of age, height, body weight, or BMI ($p > .05$). These findings indicate that the two groups were comparable with respect to anthropometric characteristics prior to the analysis of physical fitness parameters. According to Cohen's *d* values, the effect size was negligible for age ($d = 0.01$), small-to-moderate for height ($d = 0.44$), small for body weight ($d = 0.30$), and small for BMI ($d =$

0.12). These findings further support the similarity of the two groups with respect to their baseline anthropometric characteristics.

Table 2: Comparison of the selected physical fitness parameters in terms of group variable.

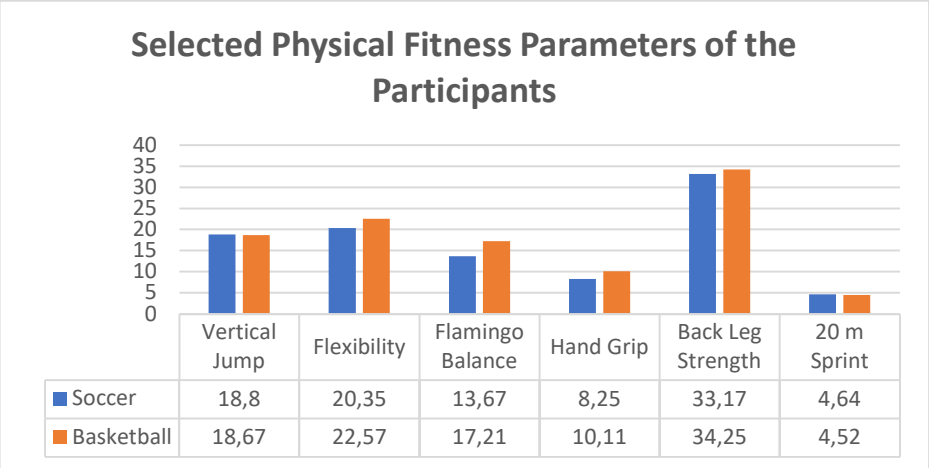
Variable	Group	n	$\bar{x}$	±	SD	t	P	Cohen's
Vertical Jump (cm)	Football	57	18.80	±	5.13	0.09	0.92	0.02
	Basketball	28	18.67	±	6.65			
Flexibility (cm)	Football	57	20.35	±	5.74	-1.76	0.08	0.40
	Basketball	28	22.57	±	5.31			
Flamingo Balance (sec)	Football	57	13.67	±	4.31	-2.91	0.00**	0.65
	Basketball	28	17.21	±	6.83			
Handgrip Strength (kg)	Football	57	8.25	±	2.68	-2.59	0.01*	0.63
	Basketball	28	10.11	±	3.29			
Back–Leg Strength (kg)	Football	57	33.17	±	10.80	-0.47	0.63	0.11
	Basketball	28	34.25	±	9.34			
20-m Sprint (sec)	Football	57	4.64	±	0.40	1.22	0.22	0.28
	Basketball	28	4.52	±	0.45			

**p<0.01 *p<0.05 Cohen's d: 0.20 = small effect, 0.50 = medium effect, and 0.80 = large effect.

According to the selected physical fitness parameters presented in Table 2, the mean vertical jump performance was 18.80 cm for the football players and 18.67 cm for the basketball players. No statistically significant difference was observed between the groups (p = .929). The calculated Cohen's d value was 0.02, indicating a negligible effect size. In the flexibility test, basketball players demonstrated a higher mean score (22.57 cm) than football players (20.35 cm); however, this difference did not reach statistical significance (p = .083). Nevertheless, the corresponding Cohen's d value was 0.40, suggesting a small-to-moderate effect size between the groups. For the Flamingo Balance Test, basketball players achieved a mean score of 17.21, whereas football players recorded a mean score of 13.67. The difference between groups was statistically significant (p = .005). The calculated Cohen's d value of 0.65 indicated a moderate effect size in favour of the basketball players. This finding suggests that balance performance was substantially better among basketball players compared with football players. Similarly, basketball players demonstrated significantly greater handgrip strength (10.11 kg) than football players (8.25 kg) (p = .013). The corresponding Cohen's d value was 0.63, indicating a moderate effect size. Therefore, the observed difference in handgrip strength may be considered practically meaningful. In the back–leg strength test, the mean values were 33.17 kg for football players and 34.25 kg for basketball players. No statistically significant difference was found between the groups (p = .639). The calculated Cohen's d value was 0.11, indicating a small effect size. For the 20-m sprint test, football players recorded a mean sprint time of 4.64 s, whereas basketball players achieved a mean time of 4.52 s. Although basketball players demonstrated slightly faster sprint performance, the difference was not statistically significant (p = .226). The corresponding Cohen's d value was 0.28, indicating a small effect size. Overall, significant differences between groups were observed only in balance performance and handgrip

strength, both favouring basketball players and demonstrating moderate effect sizes. No significant differences were found in vertical jump performance, flexibility, back–leg strength, or sprint performance.

Graph 1: The graph of selected physical fitness parameters of the participants



According to Graph 1, the mean vertical jump performance of the football and basketball players was 18.80 cm and 18.67 cm, respectively. The mean flexibility values were 20.35 cm for the football players and 22.57 cm for the basketball players. The mean Flamingo balance test scores were 13.67 and 17.21 for the football and basketball groups, respectively. Mean handgrip strength values were 8.25 kg for the football players and 10.11 kg for the basketball players. The mean back–leg strength values were 33.17 kg and 34.25 kg for the football and basketball players, respectively. Finally, the mean 20-m sprint times were 4.64 s for the football players and 4.52 s for the basketball players. Overall, Graph 1 shows that basketball players demonstrated higher mean values in flexibility, balance, handgrip strength, and back–leg strength, whereas vertical jump performance was similar between groups. In addition, basketball players recorded slightly faster sprint times than football players.

DISCUSSION AND CONCLUSION

Participation in regular physical activity during childhood plays a crucial role in growth and development processes (Dumlu, 2023). Sports schools provide an important educational environment in which children can develop motor skills, improve physical fitness, and establish long-term exercise habits (Apaydın & Bahadır, 2021). When directing children toward specific sports disciplines, not only individual interest but also physical fitness characteristics should be considered (Lloyd et al., 2015). In this context, team sports such as soccer and basketball, which support the development of fundamental motor skills, may influence biomotor abilities including strength, balance, speed, and flexibility in different ways.

Accordingly, the present study aimed to compare the physical fitness levels of prepubertal soccer and basketball players attending summer sports schools. The findings suggest that sport-specific physical differences may emerge even at an early age and contribute to the development of evidence-based approaches for youth sport participation and talent identification. The results revealed significant differences

between prepubertal soccer and basketball players in certain biomotor parameters, particularly balance and handgrip strength, whereas no statistically significant differences were observed in vertical jump performance, flexibility, back–leg strength, or sprint performance.

The significantly superior Flamingo balance performance observed in the basketball group suggests that participation in basketball at an early age may contribute to the development of postural control, particularly in static and single-leg balance tasks. Previous research has demonstrated a strong association between balance ability, lower-extremity strength, and body composition in young individuals. For example, Suzuki et al. (2024) reported a positive relationship between skeletal muscle mass and balance performance. Basketball requires frequent jumping, landing, and multidirectional movements, all of which stimulate proprioceptive adaptations and neuromuscular coordination that contribute to enhanced postural stability (Chaouachi et al., 2014). The superior balance performance of the basketball players observed in the present study may therefore be attributed to the sport's high demands for postural control, multidirectional movement patterns, and continuous changes in body position during offensive and defensive actions (Bhat & Moiz, 2013).

Similarly, the greater handgrip strength observed among basketball players likely reflects the sport-specific demands placed on the upper extremities through repetitive ball handling, passing, catching, and shooting activities, which contribute to the development of forearm and hand musculature (Holway & Spriet, 2013). This finding is consistent with previous studies demonstrating that young athletes participating in sports requiring substantial upper-body involvement generally exhibit greater handgrip strength than athletes involved primarily in lower-body dominant sports. Supporting the present findings, Abe et al. (2024) compared young kendo athletes, a sport characterized by intensive upper-body involvement, with young soccer players and reported significantly greater handgrip strength in the kendo group. These results suggest that the repeated technical movements and loading patterns associated with basketball may contribute to greater upper-body strength development compared with soccer players at the same developmental stage. Furthermore, Alotaibi et al. (2025) emphasized that handgrip strength can serve as a simple indicator of overall musculoskeletal performance. Therefore, the greater handgrip strength observed among basketball players in the current study may reflect superior upper-body strength development and neuromuscular coordination, which may also contribute to their enhanced balance performance.

In contrast, the absence of significant differences in vertical jump performance, back–leg strength, flexibility, and sprint performance may be explained by the overlap in training content during the early stages of athletic development (Malina et al., 2015). Before full biological maturation, training intensity and sport-specific specialization remain relatively limited, leading children to exhibit similar neuromuscular characteristics regardless of sport participation (Faigenbaum et al., 2009). The lack of differences in vertical jump height and back–leg strength may indicate that participants had not yet reached a stage of sport-specific specialization sufficient to produce distinct adaptations in lower-extremity explosive power. Research on youth training suggests

that younger children benefit primarily from the development of fundamental motor skills, movement competency, and coordination rather than maximal strength or anaerobic power development (Faigenbaum et al., 2009).

Although no statistically significant difference was observed in flexibility, basketball players demonstrated higher mean flexibility values than soccer players. Basketball involves movements requiring large ranges of motion, including reaching, overhead actions, and dynamic multidirectional movements, which may positively influence flexibility development. Consistent with this interpretation, Domínguez-Díez et al. (2021) reported significant associations between range of motion and performance among basketball players. Similarly, Genç and Demircioğlu (2024) found significant relationships between range of motion and performance variables in basketball athletes. In their study involving young and amateur basketball players, a significant association was observed between hamstring flexibility and both vertical jump and balance performance (Genç & Demircioğlu, 2024). These findings suggest that improvements in flexibility may contribute positively to overall athletic performance.

The absence of significant differences in sprint performance and the similarity of sprint times between groups may indicate that sprint ability, which is influenced by neuromuscular power, stride characteristics, and biological maturation, has not yet differentiated substantially according to sport discipline during the prepubertal period. Supporting this interpretation, Malina et al. (2015) emphasized that biological maturation remains a primary determinant of physical performance differences among young athletes. Although numerous studies involving older age groups have reported sport-specific differences in sprint performance, such distinctions may not yet be evident in younger children. Likewise, Lloyd et al. (2016) reported that children under the age of 11 demonstrate similar sprint performances across different team sports despite variations in training methodologies.

In conclusion, the present study demonstrated that children participating in summer sports school programs who played basketball exhibited significantly superior balance and handgrip strength compared with their soccer-playing peers. However, no significant differences were observed in vertical jump height, flexibility, back–leg strength, or sprint performance. These findings suggest that sport-specific demands may influence certain neuromuscular and postural capacities, whereas other performance characteristics remain largely determined by general growth, maturation, and motor learning processes during early development.

The findings have several practical implications for youth athlete development. First, sports programs for children should continue to emphasize the broad development of fundamental motor capacities rather than early specialization in strength or speed-related abilities. Second, coaches may consider monitoring balance and upper-extremity strength as potential early indicators of sport-specific adaptation. Finally, because no significant differences were observed in lower-body strength or sprint performance, diversified training approaches should be encouraged to support holistic athletic development and reduce the potential risks associated with early single-sport specialization.

Limitations

Several limitations of the present study should be acknowledged. First, the cross-sectional design prevents the establishment of causal relationships between sport participation and physical fitness outcomes. Longitudinal studies are needed to determine whether the observed differences are directly attributable to sport-specific training adaptations over time.

Second, the study sample was recruited using a convenience sampling method and consisted exclusively of children attending summer sports school programs. Therefore, the findings may not be generalizable to all youth athletes, particularly those participating in long-term club or academy training programs.

Third, participants were recruited from a limited geographical area, which may restrict the external validity of the findings. Future studies involving larger and more diverse samples from different regions would strengthen the generalizability of the results.

Fourth, biological maturation status was not directly assessed. Given that maturation can substantially influence physical fitness characteristics during childhood and adolescence, future research should incorporate measures of biological maturation to better distinguish training-related adaptations from developmental effects.

Finally, although several important components of physical fitness were evaluated, additional variables such as aerobic capacity, agility, coordination, and sport-specific technical skills were not assessed. Future investigations including a broader range of performance measures may provide a more comprehensive understanding of sport-specific adaptations in young athletes.

Kısaltmalar / Abbreviations

SD	Standart sapma (Standard deviation)
X	Ortalama (Mean)
SPSS	Sosyal bilimler için istatistik paketi (Statistical package for the social sciences)
p value	Anlamlılık değeri (Significant value)
t value	T değeri (T value)
N	Katılımcı sayısı (Number of participant)
Min	Minimum (Minimum)
Max	Maksimum (Maximum)
BMI	Vüvut kütle indeksi (Body mass index)
Kg	Kilogram (Kilogram)
Cm	Santimetre (Cantimeter)
Sec	Seconds

Beyanlar / Declarations

Etik Onay ve Katılım Onayı / Ethics approval and consent to participate

Bu çalışmanın hazırlanma ve yazım sürecinde "Yükseköğretim Kurumları Bilimsel Araştırma ve Yayın Etiği Yönergesi" kapsamında bilimsel, etik ve alıntı kurallarına uyulmuş olup; toplanan veriler üzerinde herhangi bir tahrifat yapılmamış ve bu çalışma herhangi başka bir akademik yayın ortamına değerlendirme için gönderilmemiştir. Makale ile ilgili doğabilecek her türlü ihlallerde sorumluluk yazara aittir. Çalışma için etik onay, Kütahya Dumlupınar Üniversitesi Sosyal ve Beşeri Bilimler Fakültesi Bilimsel Araştırma ve Yayın Etik Kurulu tarafından verilmiştir (belge no. 29.12.2025 - 2025/12). Tüm katılımcılar bu çalışmaya gönüllü olarak katılmıştır. 18 yaş altı katılımcılardan veli onay belgesi alınmıştır.

During the preparation and writing of this study, scientific, ethical and citation rules were followed in accordance with the 'Higher Education Institutions Scientific Research and Publication Ethics Guidelines'; no alterations were made to the collected data, and this study has not been submitted for evaluation to any other academic publication

medium. The author is solely responsible for any violations that may arise in connection with this article. The Ethical approval for the study was granted by the Ethical approval for the study was granted by the Scientific Research and Publication Ethics Committee of Kütahya Dumlupınar University, Faculty of Social and Human Sciences (document no. 28/07/2025-2025/07). All participants voluntarily participated in this study.

Veri Ve Materyal Erişilebilirliği / Availability of data and material

Bu çalışmanın bulgularını destekleyen veriler, makul talepler üzerine sorumlu yazardan temin edilebilir. Veri seti yalnızca akademik amaçlar için erişilebilir olacak ve verilerin herhangi bir kullanımı, orijinal çalışmayı referans gösterecek ve katılımcıların gizliliğini koruyacaktır.

The data that support the findings of this study are available from the corresponding author upon reasonable request. The dataset will be accessible only for academic purposes, and any use of the data will recognize the original study and maintain the confdentiality of the participants.

Çıkar Çatışması / Competing interests

Yazarlar, bu makalede sunulan çalışmayı etkileyebilecek herhangi bir çıkar çatışması veya kişisel ilişkiye sahip olmadıklarını beyan etmektedirler.

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Yazar Katkıları / Authors' Contribution Statement

Çalışmanın tasarımı ve planlanması: S.Ö., S.A.; Veri toplama, analizi veya yorumlanması: S.Ö., S.A., E.K.; Makalenin yazımı: S.Ö., S.A., E.K; Veri düzenleme, yöntem belirleme, yazım – özgün taslak, yazım – gözden geçirme ve düzenleme: S.Ö., S.A., E.K.; Tüm yazarlar, makalenin önemli noktalarını eleştirel bir şekilde gözden geçirmiştir. Tüm yazarlar makalenin son halini onaylamıştır. /

Design and planning of the study: S.Ö., S.A.; Data collection, analysis or interpretation: S.Ö., S.A., E.K.; Manuscript preparation: S.Ö., S.A., E.K.; Data organization, methodology development, writing - original draft, writing – review and editing: S.Ö., S.A., E.K.; All authors critically reviewed the key points of the manuscript and approved the final version.

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