Journal of Sport and Health Research 2025, 17(3):395-407

Akinci, Yasin (2025). The Effect of Relative Age on Anthropometric and Physical Performance Characteristics Of 8-Year-Old Girls. *Journal of Sport and Health Research. 17*(3):395-407. https://doi.org/10.58727/jshr.112994

Original

Efectos De La Edad Relativa En Las Características Antropométricas y De Rendimiento Físico De Niñas De 8 Años

The Effect of Relative Age on Anthropometric and Physical Performance Characteristics Of 8-Year-Old Girls)

Yasin Akinci[1]

[1]*IDepartment of coaching education, University of Usak, Turkey*

yasin.akinci@usak.edu.tr

Correspondence to:
Yasin Akinci
Usak University
Kasbelen Mucavir, Ataturk Blv. 8.Km,
64000, Usak, Turkey
yasin.akinci@usak.edu.tr
+90 533 429 35 52

Edited by: D.A.A. Scientific Section Martos (Spain)

editor@journalshr.com

Received: 16/01/2025
Accepted: 03/03/2025

Journal of Sport and Health Research 2025, 17(3):395-407

EFECTOS DE LA EDAD RELATIVA EN LAS CARACTERÍSTICAS ANTROPOMÉTRICAS Y DE RENDIMIENTO FÍSICO DE NIÑAS DE 8 AÑOS.

RESUMEN

Este estudio investiga el efecto de la edad relativa en las características antropométricas y de rendimiento físico de niñas de 8 años que participan en pruebas de baloncesto en Uşak (Turquía). Un total de 73 participantes, agrupadas en cuartiles de nacimiento (Q1-Q4), se sometieron a mediciones antropométricas (altura, peso, envergadura de brazos, altura sentada) y pruebas de rendimiento físico (sprint de 20 m, salto de longitud de pie, lanzamiento de balón medicinal y prueba de agilidad T-HALF). Los resultados no mostraron diferencias significativas entre cuartiles en las características antropométricas, incluida la altura (media: 140,45 cm, F(3,69) = 0,53, p = 0,66) y el peso corporal (media: 31,98 kg, F(3,69) = 1,55, p = 0,21). Del mismo modo, los resultados del rendimiento físico no se vieron influidos significativamente por la edad relativa: sprint de 20 m (media: 5,32 s, F(3,69) = 1,88, p = 0,14), salto de longitud de pie (media: 92,77 cm, F(3,69) = 1,04, p = 0,38), lanzamiento de balón medicinal (media: 3,88 m, F(3,69) = 1,50, p = 0,22), y prueba de agilidad T-media (media: 9,65 s, F(3,69) = 1,40, p = 0,52). Estos resultados sugieren que la RAE no influye significativamente en las características físicas o antropométricas a esta edad, lo que pone de relieve el predominio de los factores genéticos sobre las ventajas relativas de la edad en la primera infancia. El estudio subraya la necesidad de investigación longitudinal para explorar cómo evoluciona la RAE con el tiempo, en particular durante la adolescencia, cuando los estirones pueden amplificar las disparidades físicas. Estas ideas contribuyen a optimizar la identificación de talentos y a fomentar la participación equitativa en los programas de baloncesto juvenil.

Palabras clave: Deportes femeninos, Efecto relativo de la edad, Baloncesto, Antropometría, Rendimiento.

THE EFFECT OF RELATIVE AGE ON ANTHROPOMETRIC AND PHYSICAL PERFORMANCE CHARACTERISTICS OF 8-YEAR-OLD GIRLS.

ABSTRACT

This study investigates the Relative Age Effect (RAE) on the anthropometric and physical performance characteristics of 8-year-old girls participating in basketball try-outs in Uşak, Turkey. A total of 73 participants, grouped into birth quartiles (Q1-Q4), underwent anthropometric measurements (height, weight, arm span, sitting height) and physical performance tests (20m sprint, standing long jump, medicine ball throw, and T-HALF agility test). The results showed no significant differences across quartiles in anthropometric characteristics, including height (mean: 140.45 cm, F(3,69) = 0.53, p = 0.66) and body weight (mean: 31.98 kg, F(3,69) = 1.55, p = 0.21). Similarly, physical performance outcomes were not significantly influenced by relative age: 20m sprint (mean: 5.32 s, F(3,69) = 1.88, p = 0.14), standing long jump (mean: 92.77 cm, F(3,69) = 1.04, p = 0.38), medicine ball throw (mean: 3.88 m, F(3,69) = 1.50, p = 0.22), and T-HALF agility test (mean: 9.65 s, F(3,69) = 1.40, p = 0.52). These findings suggest that RAE does not significantly influence physical or anthropometric characteristics at this age, highlighting the predominance of genetic factors over relative age advantages in early childhood. The study underscores the need for longitudinal research to explore how RAE evolves over time, particularly during adolescence when growth spurts may amplify physical disparities. These insights contribute to optimizing talent identification and fostering equitable participation in youth basketball programs.

Keywords: Women sports, Relative age effect, Basketball, Anthropometrics, Performance.

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INTRODUCTION

Relative age effect (RAE) is an important phenomenon in sport sciences that refers to an advantage of chronological age-based grouping systems. The RAE is caused by differences in the physical, cognitive, and psychological development of individuals born in different months in the same year (Cobley et al., 2009; Kearney et al., 2018). This may lead to relatively older athletes being in a more advantageous position, especially in youth sports. For example, an 11-month difference between two children in the same age group can lead to significant differences in height, weight, muscle development and anthropometric characteristics (Alonso-Aubin et al., 2022; Helsen et al., 2005; Saç, A., & Çolak, 2019). Within the context of a sporting environment, In a sporting environment, it is assumed that the number of players represented in each quarter is equal. This is due to the fact that children of the same age exhibit similar developmental traits (Payne & Isaacs, 2017). By testing whether there is a difference between the expected number of players and the observed number of players, the RAE phenomenon is determined (Delorme & Raspaud, 2009; Musch & Grondin, 2001).

The relative age effect is also explained by the Maturation-Selection Theory (Malina, 2001). According to this theory proposed by Malina (1994), individuals with older chronological age exhibit increased anthropometric characteristics and physical fitness parameters with a developmental advantage. These advantages are particularly evident in performance characteristics such as aerobic capacity, muscular strength, endurance and speed. On the other hand, recent studies show that the relative age effect (RAE) in youth sports occurs most prominently during adolescence and its effect decreases with increasing age (de La Rubia Riaza et al., 2020). Gibbs et al. (2012) explain this situation with the ‘underdog effect’ hypothesis. According to this hypothesis, it suggests that relatively young athletes may gain a developmental advantage by reversing the negative effects of RAE over time. In this context, the ‘underdog effect’ is considered as a process that contributes to the development of individuals who are disadvantaged at an early age into more resilient, determined and successful individuals who develop perseverance by making more effort in the long run (Güllich & Emrich, 2014).

In sports such as basketball, where physical parameters such as height, agility, and strength are important, RAE is particularly noteworthy (Sampaio et al., 2006). Research has shown that relatively older athletes are the majority in youth basketball teams compared to their peers born in the first months of the year, and this is explained as a result of age-based grouping (Delorme & Raspaud, 2009; Torres-Unda et al., 2013). In the field of basketball studies, it has been established that older children tend to demonstrate superior proficiency in fundamental basketball skills, such as shooting, rebounding and defence. This phenomenon can be attributed to the physical advantages provided by increased height and strength (Arede et al., 2019). This effect is increasingly driven by advantages such as quality education, equipment and early access to elite programmes, in addition to the advantages of age-related maturity (Alonso-Aubin et al., 2022). In addition to its impact on physical development, BMI also plays an important role on the psychological and social status of the athlete. While relatively older athletes have more positive feedback and the opportunity to develop leadership skills, relatively younger athletes may face low self-esteem and higher dropout rates (Hancock et al., 2013). These differences highlight the importance of strategies aimed at reducing disadvantages based on date of birth.

Studies focusing on RAE in youth sports have predominantly examined male athletes, and research involving female athletes is limited (de La Rubia Riaza et al., 2020). A small number of studies on female basketball players suggest that the effects of the RAE are less pronounced compared to male athletes (Arrieta et al., 2016; Oliveira et al., 2017; Rubajczyk et al., 2017). In the study by Arrieta et al. (2016), which has an important place in the literature, analysed the relative age effect in 2,395 young elite basketball players from the U16, U18 and U20 European Championships and found that male players born in the first months of the year performed better and played more minutes. They reported that this effect, which was strongly observed in the U16 and U18 groups in males, was not observed in females. In another study, Oliveira et al. (2017)

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investigated the impact of the relative age effect (RAE) in relation to gender, competitive level, and team performance in their study involving 530 athletes from the 2015 Brazilian U15 Basketball Championship. They concluded that a dominant RAE was not observed in the U15 women's category, but that the medal-winning teams included female athletes born earlier in the year. In an extensive investigation, Rubajczyk et al. (2017) eamined the relative age effect (RAE) among young Polish male (n = 3849) and female (n = 3419) basketball players aged 14 to 22 years. The study identified the presence of RAE across all male and female cohorts. However, a statistically significant disparity in body height was observed exclusively within the U14 girls' category. The findings further indicated that female basketball players from the top three teams exhibited the greatest average body height. Moreover, athletes born in the first half of the year demonstrated significantly superior match outcomes and performance index ratings (PIR). The relative age effect (RAE) is less prevalent in women's sports due to reduced competitive intensity, a smaller participant pool, and distinct selection criteria. Variability in developmental trajectories among female athletes diminishes early physical advantages. Additionally, social and psychological influences, including motivational factors and participation incentives, contribute. Moreover, the emphasis on technical proficiency over physical superiority further mitigates the impact of RAE in women's sports (Smith et al., 2018).

However, the literature includes studies demonstrating that the relative age effect (RAE) manifests with varying intensities across different age categories (Delorme & Raspaud, 2009; García et al., 2014; Smith et al., 2018). A study investigating RAE among all French youth basketball players aimed to assess its presence and examine height differences within a general population of male (n=151,259) and female (n=107,101) players aged 7–18 years. The findings indicate a statistically significant RAE across all age categories for both genders, with a more pronounced effect during adolescence. Regarding height, players born in the first and second quartiles are consistently taller than those born in the fourth quartile, except for 17-year-old female players. In another study, García et al. (2014) analysed 954 players from the U17, U19 and U21 World Championships between 2005 and 2010 and found that the relative age effect was strong in the U17, decreased but significant effect in the U19 and no significant effect in the U21; no height differences were observed in the female category. Smith et al. (2018), in their meta-analysis, found that subgroup analyses indicated a greater relative age effect (RAE) in pre-adolescent (≤11 years) and adolescent (12–14 years) age groups, particularly at higher competition levels. Among children under 11, observed disparities suggest that those born earlier in the year may experience advanced developmental progress, leading to differences in coordination abilities.

The studies focusing on RAE in the world and in Turkey have revealed the existence of this phenomenon in different sports branches and levels (Calistoet al., 2020; Ntozis et al., 2011; Smith & Weir, 2020). Studies conducted in international basketball leagues (Arrieta et al., 2016; García et al., 2014; Tascioglu et al., 2023) in Europe's leading youth leagues (Torres-Unda et al., 2013), and in Turkey (Kılıç & Yılmaz, 2022; Yapar, 2020) have shown that athletes born in the first quarter are predominant in the selections. In these studies, it was reported that athletes born in the last quarter of the year were underrepresented and this could increase the dropout rates. These studies provide an important basis for understanding the long-term effects of RAE on sporting careers.

Even though the RAE in basketball is a frequently studied subject, the fact that the results demonstrate differences according to age groups and performance level indicates that there is a need for novel studies on this subject. The limited number of studies focusing specifically on girls and examining their initial selection process in basketball suggests that there is a substantial demand for new investigations in this subject. In this context, this study aims to examine the effects of RAE on anthropometric characteristics and physical performance in 8-year-old girls who want to start structured basketball training. Therefore, the following hypotheses were tested in this study.

1. There is a RAE among 8-year-old girls who want to participate in structured basketball training.

2. There is an effect of relative age on the anthropometric and physical performance

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characteristics of 8-year-old girls participating in basketball try-outs.

The characteristics considered in this study include height, weight, leg height, arm span, 20-metre sprint, standing long jump, medicine ball throw and T-HALF agility test. These parameters are important indicators of basketball potential and can provide important information to shape talent identification and development processes (Sampaio et al., 2006). Moreover, the homogeneous distribution of birth dates throughout the year in Turkey and the fact that birth dates are officially recorded daily minimise the limitations of the study (Tuik, 2024).

METHODS

This study used cross-sectional research design, one of quantitative research methods. Cross-sectional research is a study conducted with data obtained from a sample selected in a certain period of time (Büyüköztürk, 2018). In this study, the convenience sampling method was preferred because of the easy accessibility of girls' basketball group. Prior to the start of this study, approval was provided by the Non-Interventional Clinical Research Ethics Committee of Uşak University (542-542-04), and all procedures were meticulously carried out in accordance with the Declaration of Helsinki.

Participants

In this study, convenience sampling method from the purposive sampling method was used to provide speed and practicality to the study. In the study, 86 girls who wanted to take part in the basketball project to be carried out in Uşak province of Turkey 2023 participated voluntarily with the permission of their parents. However, statistical analyses were carried out with 73 girls because there was a deficiency in the recording of the data of 13 participants. The average age of the participants was $\bar{x}$=86.3 months. In order to investigate the RAE, the birth dates of the participants were distributed into birth quarters. The first quarter (Q1) included those born in January, February and March; the second quarter (Q2) included those born in April, May and June; the third quarter (Q3) included those born in July, August and September; and the fourth quarter (Q4) included those born in October, November and December.

Instruments

In this study, the parents of the participants were asked to complete and sign an informed consent form indicating that they gave permission for their children to participate in anthropometric and physical performance measurements. Dates of birth based on parental declaration were verified by comparing them with the children's identities. According to this information, they were divided into quartiles to evaluate the relative age effect. Anthropometric measurements of height, weight, sitting height for calculating leg height, and arm span length were performed. As physical performance tests, 20-meter sprint, long jump, medicine ball throwing and T agility test were used.

Anthropometric Measurements

Body weight measurements were performed with SECA digital weighing scale with a precision of 0.1 kg. Height and sitting height were measured with a Tanita Leicester portable stadiometer with an error of 0.1 cm (Parker et al., 2023). The leg length of girls was calculated by subtracting the sitting height from their height (Enqvist et al., 2024). Each measurement was performed twice, and the highest values were evaluated. In sitting height measurements, children were asked to sit on a chair in an upright position with no space behind their knees and the distance from the top of their heads to the seat of the chair was measured as sitting height. The measurement was performed twice and the highest value was evaluated (Pereira et al., 2021). For the arm span measurement, the longest distance between the fingertips of the right and left hands of the participants was measured. During the measurement, the athlete was asked to stand with his/her back against the wall, arms spread to the side at shoulder level parallel to the ground and palms facing forwards, and the measurement was recorded in centimetres (Cherif et al., 2022).

Physical performance measurements

20 m sprint (20 MS): The speed performance of the participants was determined by 20 m sprint test (Singh et al., 2024). Photocells were placed at the beginning and end of the 20m track. The participants started sprinting 50 cm behind the starting line. Two attempts were made, and the best time was evaluated.

Standing long jump (SLJ): Participants are positioned so that toes placed behind the line and stand at a normal distance. They stand parallel to the ground, arms in front and knees bent. With the swing of the arms, they jump forward as far as possible so that both feet touch the ground at the same time. The distance of the lagging foot from the starting line is recorded in centimetres. The test is repeated twice to record the athletes' best performance (Pérez-Castilla et al., 2021).

Medicine-ball throw (MBT): The participant was asked to stand at the starting point marked with tape and throw a 1-kilogram medicine ball backwards over his/her head with his/her back facing the direction of the throw. The point at which the medicine ball first contacted the ground was determined and the distance between the starting point and this contact point was measured and recorded in centimetres. The participant was given two attempts and the best performance was recorded as the test result (Beckham et al., 2023).

T-HALF agility test (T-HALF): T-HALF test was used to evaluate the agility performance of the participants. This test, which measures movement patterns commonly seen in basketball, consists of forward and backward sprinting and right and left displacement combinations. While the total running distance between the cones in the normal T-test was 36.56 meter, in this test the distance was reduced to 20 meter and the protocol was applied. The best time from the two trials of the participants was recorded in seconds (Hermassi et al., 2019).

Data Collection Process

The data collection process was carried out on a standard basketball court with a parquet floor. Firstly, anthropometric measurements such as height, weight, stroke length and sitting height were taken. The measurements were made barefoot, and the participants were wearing shorts and t-shirts. After the measurements, the participants performed a light-paced jog for 5 minutes and then completed the warm-up process with dynamic stretching movements.

After the warm-up protocol, a 3-minute rest period was given and the tests were administered in the following order: standing long jump, medicine ball throw test, 20-meter run test and finally the T-Ha agility test. The accuracy of the performance measurements was ensured by providing a minimum of 3 minutes of complete rest between each test.

Data Analysis

In this study, Pearson chi-square goodness-of-fit tests were conducted to examine the relative age effect (RAE) on the anthropometric and physical performance characteristics of girls participating in basketball team try-outs. For the chi-square test, the assumption of expected frequencies exceeding 5 and the assumption of multiple correspondence analysis requiring positive frequencies in the contingency table were both met (Field, 2024). To assess distributional differences between subgroups, odds ratios were calculated using Q4 (fourth quarter) as the reference group in all quarters. A higher odds ratio indicates that group members are more likely to exhibit the trait in question compared to the reference group (Q4).

The distribution of the dependent variables in the study is given in Table 1. One-way ANOVA was used to analyse the anthropometric and physical performance differences of girls according to their birth quartiles (BQ). Before the comparison between variables, normality and homogeneity tests were performed. The normality of the data was determined by looking at the skewness and kurtosis values, while their homogeneous distribution was examined by Levene's test. In the findings, it was determined that the skewness and kurtosis values of the variables showed normal distribution since they were in the range of ±2 and the 'Levene Test' results met the homogeneity assumption since $p<0,05$ (Field, 2024). SPSS 25 package programme was used to analyse the data.

Table 1. The Distribution of the Dependent Variables of the Study

Dependent Variables	N	Min	Max.	Mean	Sd	Skewness	Kurtosis
Height	73	130	151	140,45	4,3	0,12	-0,27

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Body weight	73	21,9	55,3	31,98	7,02	1,14	1,08
Leg height	73	53,5	81	67,95	3,61	-0,42	0,48
Arm span	73	118	141	131,36	4,48	-0,28	0,31
20 M sprint	73	3,94	8,56	5,32	0,79	1,72	1,49
Standing long jump	73	51	128,5	92,77	18,91	-0,41	-0,33
Medicine-ball throw	73	2	6,3	3,88	0,84	0,18	0,24
T-HALF agility Test	73	7,96	13,16	9,65	1,15	0,85	0,44

RESULTS

Table 2 shows the distribution of girls' birth dates according to quartiles. Although a skewed distribution is observed towards Q1, it is determined that there is no statistically significant difference according to the findings of the Chi-square goodness of fit test ($\chi^2(3) = 2,67$, $p = 0,45$).

Table 2. Chi-square goodness of fit test results

									Odds ratio (CI 95%)		
	Q1	Q2	Q3	Q4	Total	χ2	p	df	Q1-Q4	Q2-Q4	Q3-Q4
Subjects	24	18	15	16	73	2,67	0,45	3	1,74 (0,83-3,65)	1,17 (0,54-2,51)	0,92 (0,42-2,04)

In Table 3, the anthropometric characteristics of 8-year-old girls who wanted to participate in structured basketball training were compared by one-way analysis of variance according to birth quartiles. Accordingly, birth quartiles had no statistically significant effect on height ($F(3, 69) = 0,53$, $p = 0.66$), body weight ($F(3, 69) = 1,55$, $p = 0,21$), leg length ($F(3, 69) = 1,83$, $p = 0,15$) and arm span ($F(3, 69) = 1,76$, $p = 0,16$).

Table 3. ANOVA test results and descriptive statistics for anthropometric characteristics

	Measure	BQ	n	X	SD	F	P
Anthropometric Characteristics	Height	Q1	24	140,79	3,53	0,53	0,66
		Q2	18	141,03	4,7		
		Q3	15	139,27	5,18		
		Q4	16	140,41	4,18		
	Body weight	Q1	24	31,35	6,19	1,55	0,21
		Q2	18	34,68	7,83		
		Q3	15	32,17	8,29		
		Q4	16	29,71	5,39		
	Leg height	Q1	24	69,08	2,64	1,83	0,15
		Q2	18	69,67	2,96		
		Q3	15	66,93	4,83		
		Q4	16	69,09	3,96		
	Arm Span	Q1	24	131,56	3,81	1,76	0,16

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	Q2	18	132,92	4,55
	Q3	15	129,4	5,26
	Q4	16	131,16	4,25

The physical performance characteristics of 8-year-old girls who wanted to participate in structured basketball training were compared by one-way analysis of variance according to birth quartiles (Table 4). Accordingly, birth quartiles did not have a statistically significant effect on the performances of 20m Sprint (F(3, 69) = 1,88, p = 0,14), Standing long jump (F(3, 69) = 1,04, p = 0,38), Medicine ball throw (F(3, 69) = 1,5, p = 0,22) and T-HALF agility test (F(3, 69) = 1,4, p = 0,52).

Table 4. The ANOVA results and descriptive statistical of physical performance measures

	Measures	BQ	n	X	SD	F	P
Physical Performance Measures	20 MS	Q1	24	5,06	0,83	1,88	0,14
		Q2	18	5,53	0,94		
		Q3	15	5,56	0,74		
		Q4	16	5,26	0,48		
	SLJ	Q1	24	96,77	19,04	1,04	0,38
		Q2	18	86,67	19,06		
		Q3	15	91,87	17,65		
		Q4	16	94,50	19,57		
	MBT	Q1	24	4,04	0,97	1,5	0,22
		Q2	18	4,01	0,77		
		Q3	15	3,49	0,81		
		Q4	16	3,86	0,69		
	T-HALF	Q1	24	9,60	1,13	1,4	0,52
		Q2	18	9,76	1,18		
		Q3	15	10,05	1,30		
		Q4	16	9,24	0,90		

DISCUSSION

This study contributes to the understanding of the Relative Age Effect (RAE) in young girls by analysing physical performance parameters such as explosive power, speed, and agility. The findings reveal critical insights into the role of genetic and anthropometric factors in shaping these abilities and offer suggestions for future research directions.

It is widely recognized that physical performance characteristics, including medicine ball throwing and standing long jump, are closely tied to anthropometric features such as height, leg length, and body composition (Gabbett, 2005; Garcia-Gil et al., 2018). In this study, the absence of significant RAE-related differences in performance metrics could be attributed to the minimal variations in anthropometric characteristics among 8-year-old girls. At this age, growth patterns are still relatively uniform, and the physical advantages that may emerge from being relatively older are not as pronounced. This aligns with research indicating that the influence of anthropometry becomes more evident during adolescence when growth spurts and hormonal changes lead to greater variability in physical traits (Malina, 2001).

Longitudinal studies have shown that as children enter puberty, the disparities in physical performance due to differences in height, weight, and body

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composition become more apparent (Ben Mansour et al., 2021). For example, medicine ball throwing performance is strongly influenced by upper body strength, which is directly correlated with height and arm length. Similarly, long jumping relies heavily on lower limb strength and leverage, both of which are influenced by leg length (Albaladejo-Saura et al., 2021). Therefore, it may be more insightful to assess RAE-related differences in physical performance during adolescence, when the interplay between growth and athletic performance becomes more pronounced.

The findings indicate that the explosive power, speed, and agility of 8-year-old girls appear to be primarily influenced by genetic factors rather than RAE. This conclusion is consistent with prior research that underscores the substantial role of genetic predispositions in determining physical abilities, especially during early childhood (Ginevičienė et al., 2022; Malina, 2001). Neuromuscular efficiency, muscle fiber composition, and metabolic processes—all of which are largely hereditary—play pivotal roles in developing traits such as explosive power and speed (Varillas-Delgado et al., 2022). Additionally, it is well-established that motor skill proficiency and coordination in young children are influenced more by innate abilities than by external factors such as age-related cohort advantages (Payne & Isaacs, 2017). This intrinsic predisposition may overshadow any potential benefits conferred by being relatively older within a cohort, which could explain the lack of significant RAE-related differences observed in this study.

Furthermore, recent investigations into genetic contributions to physical performance provide evidence that natural aptitude can mitigate the advantages gained from age-related disparities. For instance, muscle strength and explosive power are linked to the proportion of Type II muscle fibres, which are genetically determined (Ostrander et al., 2009). These factors may level the playing field among children, regardless of their relative age within the cohort.

Anthropometric, physical performance, and psychological differences in adolescence can be influenced by the month of birth due to the relative age effect (RAE). Adolescents born earlier in the selection year often exhibit advantages in height, weight, strength, and coordination compared to their younger peers, particularly in competitive sports and academic settings (Musch & Grondin, 2001). These differences emerge due to variations in biological maturation, with older adolescents within a cohort generally demonstrating superior physical and cognitive attributes (Cobley et al., 2009). However, these disparities may diminish over time as late-maturing individuals catch up in adulthood (Malina et al., 2004). Psychological factors, such as self-confidence and motivation, may also be shaped by relative age advantages or disadvantages.

Another critical aspect of this discussion is the methodological approach used to study RAE. This study's cross-sectional design provides a snapshot of a specific age group, but it may not fully capture the developmental trajectories influenced by RAE. Longitudinal studies, which follow individuals over time, are better suited to understanding the cumulative and dynamic effects of relative age on physical and athletic development (Cortes Morales, Oliveire, 2020; Hancock et al., 2013). Such studies would allow researchers to examine how relative age advantages evolve across different stages of growth and development.

For instance, early advantages associated with RAE, such as higher levels of maturity and coordination, may diminish over time as younger peers catch up in physical and cognitive development (Cobley et al., 2009). Conversely, RAE may become more pronounced in certain sports or activities that rely heavily on early specialization (Baker et al., 2017). A longitudinal approach could help identify these patterns and provide a more comprehensive understanding of how RAE interacts with other developmental factors over time.

Generalizability of Findings

A notable limitation of this study is its narrow sample size, which may restrict the generalizability of the findings. Previous literature has emphasized the importance of large and diverse participant groups to ensure robust and widely applicable conclusions (Cobley et al., 2009). Expanding the sample size to include participants from various geographical, socio-economic, and cultural backgrounds would enhance the reliability and validity of RAE-related results.

For example, cultural differences in sports participation and selection processes may influence

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the prevalence and magnitude of RAE. Studies have shown that RAE is more pronounced in sports with structured talent identification systems, such as soccer and basketball, compared to unstructured recreational activities (Musch & Grondin, 2001). Including a broader range of participants would allow researchers to explore these contextual factors and develop a more nuanced understanding of RAE across different settings. Additionally, larger sample sizes enable the use of more sophisticated statistical analyses, such as multilevel modelling, to account for individual variability and interactions between variables (Wattie et al., 2008). By addressing these limitations, future research could produce findings that are not only more generalizable but also more actionable for practitioners and policymakers.

CONCLUSIONS

In conclusion, the absence of significant RAE-related differences in explosive power, speed, and agility among 8-year-old girls suggests that these traits are predominantly influenced by genetic factors. The interplay between physical performance and anthropometric characteristics underscores the importance of observing these differences during adolescence, when growth and hormonal changes amplify disparities in physical traits. Furthermore, the limitations of cross-sectional designs highlight the need for longitudinal studies to capture the dynamic nature of RAE and its long-term impact on athletic development. Finally, expanding the sample size and diversity of participants in future research would enhance the generalizability and applicability of RAE findings.

Although the results of this study indicate that RAE does not significantly affect physical or anthropometric characteristics in this cohort, the author highlights the importance of adapting training approaches to account for RAE in youth sports. In addition, training programs for young athletes should priorities agility, reaction time and decision-making skills to help mitigate differences in strength and endurance. Coaches are also advised to implement rotational team selection policies to ensure equitable participation and development opportunities for players of different relative ages. In addition, managing teams of athletes born in different quarters of the year (e.g. Q1 to Q4) requires specific strategies. These include designing individualized training plans based on players' physical and cognitive maturation, adjusting competitive expectations according to RAE, and providing targeted support and mentoring to younger athletes who may experience developmental delays compared to their older teammates.

By addressing these considerations, researchers can develop a more comprehensive understanding of RAE and its implications for talent identification, coaching, and policy development. Such efforts would not only advance the field but also contribute to creating more equitable and inclusive systems for nurturing young talent in sports and other physical activities.

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