Relative age effect in Greek female young volleyball players: data from the national talent identification program

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Published online: July 31, 2021

(Accepted for publication July 15, 2021)

DOI:10.7752/jpes.2021.s3250

Abstract

Relative age effects are developmental advantages that children born in the months following a particular cut-off date have over their younger counterparts. Evidence of relative age effect is well demonstrated in a variety of team sports, however, only few studies have examined the presence of relative age effects in young female volleyball players. The purpose of this study was to determine the prevalence of relative age effect, and the quarterly differences on anthropometric and physiological characteristics in a group of young female volleyball players 13-14 years old. In total, 389 female high-level volleyball players (age = 14.18±5.45 years, height = 167±0.07 cm, weight = 57.05±9.48 kg, and BMI = 20.28±2.76), participated in a national age-group selection training camp and were divided into two age groups (AG13, n =127) and (AG14, n = 262). To define the distribution in the birth quarter, volleyball players were separated into 4 groups according to the date of birth: T1 (January–March), T2 (April–June), T3 (July–September) and T4 (October–December). The relative age effect was not proven to be present between the first and the last age groups. For the AG13, 52.63% of the volleyball players were born in the first quarter, while 15.61% were born in the fourth quarter. The relative values for AG14 were 65.9% and 15.65% ($\chi^2 = 12.486$, $p = 0.187$) respectively. The findings of this study demonstrate that RAE has little effect on physiological markers in this female age group, with the development of strong functional drills in the sport being the top focus. Future studies are needed to identify not only the causes but also the consequences of the RAE in female volleyball players.

Key words: birth trimester, anthropometry, physiological tests, youth sports

Introduction

Volleyball is a popular, high-intensity, intermittent, non-contact team sport in which advanced height and jumping performances are critical factors for success and discriminate elite from sub-elite players (Tsoukos, Drikos, Brown, Sotiropoulos, Veligeas, & Bogdanis, 2019). Although the identification of elite athletes is a multifactorial phenomenon, the talent detection process should be simple and focused on the excess physical and motor abilities of the monitored players (Nikolaidis, Afonso, & Busko, 2015, Papadopoulou, Papadopoulou, Rosemann, Knechtel, & Nikolaidis, 2019).

Trainers tend to select the most mature and developed athletes that have the same chronological age because they fulfill the requirements of high performance. Consequently, young athletes of both genders born earlier with advanced linear development and increased maturity status are expected to perform better than those born in the last quarter of the year and are normally over-represented in the selection process in sports where performance is influenced by height, body weight, and physical qualities (Cobley, Baker, Wattie, & McKenna, 2009). Moreover, older and more talented athletes are exposed to more training experiences (skills, tactics, and training loads) as well as to advanced cognitive environments, having thus opportunities for better results (Baker and Logan, 2007, Baker, Janning, Wong, Cobley, & Schorer, 2014).

Thus, the influence of maturation in talent selection highlights the concept of the larger prevalence of early-born compared to late-born athletes during the same year and is called “Relative Age Effect” (RAE) (Baker et al., 2014, Boccia, Rainoldi, & Brustio, 2017). This momentary phenomenon is also observed in education (Dixon, Horton, & Weir, 2011), is most prominent (noticeable) mainly in team sports during the early pubertal years, and is gradually diminished after puberty (Burgess and Naughton, 2010, Sierra-Diaz, Gonzalez-Villora, Pastor-Vicedo, & Serra-Olivares, 2017). However, the RAE is also associated with the disadvantage of excluding late-born athletes from the selection process, which is accompanied by all negative psychosocial pubertal results (Strauss, Rodzilsky, Burack, & Colin, 2001, Thompson, Barnsley, & Battle, 2004, Cobley et al., 2009, Okazaki, Keller, Fontana, & Gallagher, 2011).

The RAE has been studied in several different individual and team sports, such as tennis (Edgar and O'Donoghue, 2005), swimming (Costa, Marques, Louro, Ferreira, Marinho, 2013), combat sports (Albuquerque,

Franchini, Lage, Da Costa, Costa, & Malloy-Diniz, 2015), basketball (Arrieta, Torres-Unda, Gil, & Irazusta, 2015), baseball (Thompson, Barnsley, & Stebelsky, 1991) ice hockey (Barnsley and Thompson, 1988) and especially in soccer (Folgado, Caixinha, Sampaio, & Maçãs 2006, Fumarco and Rossi, 2015, Gonzalez-Villora, Pastor-Vicedo, & Cordente, 2015, Sierra-Diaz et al., 2017, Brustio, Lupo, Ungureanu, Frati, Rainoldi, & Boccia, 2018, Rada, Padulo, Jelaska, Ardigò, & Fumarco 2018, 2, Rubajczyk and Rokita, 2018, Subijana and Lorenzo, 2018). These studies revealed that there is enough evidence that children born in the first three months of the year are advantageously capable of excessive sport achievements in these sports (Cobley et al., 2009), but not in other sports, such as rugby (Jones, Lawrence, & Hardy, 2018) and water polo (Barrenetxea-Garcia, Torres-Unda, Esain, & Gil, 2018).

Regarding volleyball, the results of some studies conflict with some that have observed less RAE in older elite volleyball players (Campos Stanganelli, Rabelo, Campos, & Pellegrinotti, 2016) and more intense effects in younger (Campos et al., 2016, Reed, Parry & Sandercock, 2017), whereas others have not shown this (Van Rossum, 2006, Lidor, Arnon, Maayan, Gershon, & Côté, 2014, Parma and Penna, 2018, Papadopoulou et al., 2019). Female volleyball has been less investigated, and studies have shown controversial results. Nakata and Sakamoto (2012) in their study concerning elite Japanese volleyball players of both sexes reported that only in the females was the REA observed. In contrast, Parma and Pena (2018) observed an absence of RAE in elite adult female volleyball players.

Interestingly, only a few studies have investigated any possible over-representation of early-born young female volleyball players (RAE) in talent selection procedures or in participation at the highest competitive level with conflicting results (Okazaki et al. 2011, Campos et al. 2016, Akarcesme and Aytar. 2018, Papadopoulou et al. 2020). The occurrence of RAEs is less clear in the relative volleyball literature thus, more studies are needed in this sport and specifically to the linear anthropometric and sport-specific jumping performance variables that are of great interest in talent selection (Nikolaidis et al. 2015).

The aim of this study is the identification of RAE, and the determination of possible quarterly differences on anthropometric and physiological characteristics in a large group of young Greek female volleyball players 13-14 years old, who participated in the first phase of a national talent selection. It was expected that early-born players (first trimester) would have superior anthropometric traits and better jumping performance in comparison to their late counterparts (last trimester) of each relative year (Lovell, Towlson, Parkin, Portas, Vaeyens, & Cobley, 2014).

Methods

Participants

In total, 389 female high-level volleyball players born in 2006 (AG13) and 2005 (AG14), (age = 14.18 ± 5.45 years, height = 167 ± 0.07 cm, weight = 57.05 ± 9.48 kg, and BMI = 20.28 ± 2.76), which were preselected from 12 different regions all over Greece, volunteered to participate in the present study. All players were members of 108 sport clubs participating in the Greek national championship of these age groups. They had training experience for at least 5 years, and during the last two years, they were exposed to systematic volleyball training 3 times per week following a specifically designed program consisting of technical volleyball drills, physical conditioning, including plyometrics and coordination exercises, and tactical competitive bouts of 90 min each time under the supervision of national coaches. Participants were also divided into two age groups for year of birth (AG13, n=127 and AG14, n=262). To determine the distribution of the birth trimester, athletes were divided into 4 separate groups according to the date of birth as T1 (January–March), T2 (April–June), T3 (July–September), and T4 (October–December). Participants were informed about the purpose and the risks of the exercise protocol. Moreover, their parents signed informed consent form after taking detailed written information. All measurements of the protocol were conducted according to the Helsinki Declaration as revised in 2012 and was approved by the Ethical Review Board of the School of Sport Science and Physical Education, National and Kapodistrian University of Athens.

Experimental design

Anthropometric and physiological measurements were performed by experienced volleyball trainers after they were previously trained for this reason by University researchers. All measurements were performed during the first day of a region monitoring training camp organized by the Hellenic Volleyball Federation. By the end of this camp, 60 young females aged 13–14 years old who were selected were monitored through the national selectors to participate in selection of the final procedure for the cadet national team. After taking the anthropometric measures, the players in random order participated in a standardized 10-min warm-up, consisting of 5 min jogging at the player's own pace and 5 min of dynamic stretching preceded the tests under the supervision of the examiners. After warming up, all athletes were familiarized with the measurements and the testing procedures in detail. Two trials were performed for each test, and the best trial was kept for statistical analysis. Between trials, a 30 sec of rest was allowed and 5 min of rest between tests was allowed.

Measurements

Anthropometrics

A Seca stadiometer was used to measure stature height (HT) and arm height (AH) to the nearest 0.5 cm. The SECA 770 was used to measure body mass (BM) to the nearest 0.1 kg. A flexible tape was placed at the

level of the participants' extended hands to measure arm span. The following formula was used to measure the participants' BMI based on their height and weight: BMI (kilograms per meter squared) = Body mass/Stature height² (kg/m²).

Exercise Performance Test / Trials

Medicine Ball Throw Seated (1 kg)

A 1-kg overhead medicine ball throw was used to test upper-body muscle strength and explosive ability. The children had to pull the medicine ball behind their heads with both hands and violently throw it forward over the greatest distance possible while sitting. From the seated position to the landing point, the distance was measured to the nearest 0.1 m. The coefficient of interclass correlation (ICC) for test-retest reliability for the medicine ball throw was 0.91 ($p < 0.001$).

Jumping Performance

Three separate jump tests were used to measure lower body muscle strength and explosive force: a) standing long jump (LJ), b) countermovement jump (CMJ), and c) spike jump (SJ). In the standing long jump, players were told to jump as far as they could and land with both feet while swinging their hands and bending their knees to a self-selected degree.

For statistical analysis, the distance from the starting point to the landing point at heel touch was used. All of the trials were taken to the nearest 0.01 m. A countermovement jump (CMJ) from a standing posture with a preliminary countermovement and hands akimbo was used. A medium, long, short step approach followed a vertical jump performed in the spike jump. A medium, long, short phase approach preceded a vertical jump performed in competitive conditions for the spike jump. A Vertec Device was used to determine the height of the spiking. It was calculated by subtracting the jumping height from the height of the extended dominant arm in standing position. All jump trials were repeated two times with a 30-s rest period between each attempt, with the highest value being recorded for analysis. The ICCs for the standing long jump test, countermovement jump, and spike jump, respectively, were 0.94, 0.92, and 0.93 ($p < 0.001$).

Sit and reach test (SRT)

The hamstring muscles and lower back flexibility were assessed using the sit and reach test. After being seated with their legs extended against the YMCA sit and reach box (foot-line at 22 cm), players reached forward for at least 2 s without making any ballistic movements, $p = 0.001$, and the ICC was 0.91.

Agility T-test (AT)

The T-Test was used to evaluate the multi direction ability. Players were told to sprint forward as quickly as possible along the 10-yard distance (9.14 m), shuffle sideways (a total distance of 10 yards), and then run backward (10 yards) to the starting spot, covering a total T-shape distance of 40 yards. The time of the participants was kept track of using a manual stopwatch. The ICC was 0.94 ($p < 0.001$).

Sit-Ups Test (SU)

To test the abdominal and hip flexor muscle endurance, participants had to do as many sit-ups as they could in 30 s. They lied on the floor with knees slightly bent. Participants had to then raise their chest to a vertical position before returning to this position and touching the floor with their backs. The 30-s sit-up task was completed once with the intensity of the test taken into account.

Statistics

Data are presented as means $\pm$ standard deviations. For the statistical analysis, the SPSS v.23 was used. Shapiro-Wilks and Kolmogorov-Smirnov tests were used for assessing data normality. Mann-Whitney U and Kruskal-Wallis tests for independent samples were used to evaluate differences between age groups (13 and 14 years) and RAE groups (first -fourth trimester) for their exercise performance in the physical fitness tests. A pairwise comparison was made to examine the within-group differences. For the anthropometric characteristics, a 2-way ANOVA was used to evaluate between age group and birth quarter differences. Spearman's correlation coefficients were calculated for the assessment of the relationship between variables. A Chi square test (χ^2) examined whether the observed distribution per quarter significantly differed from the expected theoretical distribution. The calculation of the ICC with a 2-way mixed model was used to test-retest the reliability for all the dependent variables. For each analysis, the level of significance was set at $p \leq 0.05$.

Results

A total of 389 female volleyball players were divided into four groups according to the trimester birth quarter. Specifically, the number of participants in each birth quarter was 54, 24, 24 and 17 for the 1st (T1), 2nd (T2), 3rd (T3), and 4th (T4) trimester, respectively, in 13-year-old group and 65, 50, 43, and 30, respectively, for the 14-year-old group. Moreover, 52.63% of the participants were born in the 1st, whereas 15.61% were born in the 4th trimester for AG13. The relative percent values for these in the AG14 were 65.9% and 15.65%, respectively. There was not an observed association between age groups and birth quarter ($\chi^2 = 12.486$, $p = 0.187$).

No significant main effect of age ($p > 0.05$) was found in stature height, body mass, body mass index, or arm height between the two age groups (Table 1). However, the main effect of age was significant ($p < 0.01$) for arm span. In particular, arm span was greater in the older compared to the younger group.

Table 1. Anthropometric and physiological characteristics of female volleyball players regarding the age group.

	AG13		AG14		p
	n	Mean±SD	n	Mean±SD	
AGE(yrs)	124	13.53±0.29	264	14.54±0.31*	0.001
HT (cm)	125	1.66±0.07	264	1.67±0.08	0.310
BM (kg)	124	56.74±10.18	251	57.21±9.1	0.520
BMI	124	20.40±2.94	251	20.34±2.5	0.900
AH (m)	125	2.15±0.10	264	2.15±0.1	0.750
AS (m)	125	1.68±0.09	264	1.69±0.08*	0.001
SPJ (m)	125	0.37±0.09	264	0.41±0.08*	0.001
CMJ (m)	119	0.35±0.23	200	0.38±0.09*	0.001
LJ (m)	125	1.64±0.28	264	1.69±0.24*	0.044
SRT (cm)	125	14.20±12.06	227	14.04±12.03	0.480
SU (No)	125	36.74±10.88	264	32.48±10.07*	0.001
MBT (m)	125	3.58±1.09	263	3.96±1.1*	0.001
AG (sec)	118	12.36±0.93	200	12.06±1.05*	0.001

Values are means ± SD from 389 females. HT: stature height; BM: body mass; BMI: body mass index; AHT: arm height; AS: arm span; SPJ: spike jump; CMJ: countermovement jump; LJ: standing long jump; STR: sit and reach; SU: sit-ups test; MBT: medicine ball throw; AG: agility T-test. *Significant differences between the two age groups (AG13 and AG14; $p < 0.05$).

Regarding physiological characteristics, there was a significant main effect of age in SPJ, CMJ, LJ, SU, MBT, and AG between the two age groups (Table 1). Specifically, exercise performance in SPJ, CMJ, LJ, MBT, and AT was greater in the older compared to the younger group, whereas the number of repetitions during the sit-up test was higher in the younger vs. older group.

Table 2. Anthropometric and physiological characteristics of female volleyball players regarding the relative age effect

	AG13				AG14			
	1 st trimester		4 th trimester		1 st trimester		4 th trimester	
	n	Mean±SD	n	Mean±SD	n	Mean±SD	n	Mean±SD
AGE (yrs)	54	13.72±0.16	15	13.05±0.12	66	14.76±0.08	33	14.00±0.07
HT (m)	54	1.67±0.07	15	1.64±0.05	66	1.70±0.06	33	1.67±0.08
BM (kg)	54	57.96±11	15	55.35±7.84	66	58.58±7.62	33	56.75±9.59
BMI	54	20.75±3.45	15	20.52±2.28	66	20.31±2.13	33	20.38±2.82
AH (m)	54	2.16±0.09	15	2.10±0.08	66	2.18±0.07	33	2.16±0.11
AS (m)	54	1.69±0.09	15	1.64±0.04	66	1.71±0.06	33	1.68±0.09
SPJ (m)	54	0.38±0.09	15	0.33±0.11	66	0.42±0.08	33	0.40±0.09
CMJ (m)	49	0.35±0.09	15	0.27±0.12	66	0.38±0.10	33	0.36±0.11
LJ (m)	54	1.64±0.32	15	1.66±0.16	66	1.78±0.21	33	1.69±0.27
SRT (cm)	54	14.37±13.3	15	16.53±13.3	66	11.52±9.54	33	17.94±16.66
SU (No)	54	37.48±11.42		37.73±8.86		34.65±10.06		36.30±9.77
			15		66		33	
MBT (m)	54	3.64±1.01		3.41±1.01		4.18±1.17		3.95±1.27
			15		66		33	
AG (sec)	48	12.37±1.08		12.43±0.93		11.91±0.88		
			15		66		33	12.57±1.29

Values are means ± SD from 389 females. HT: stature height; BM: body mass; BMI: body mass index; AHT: arm height; AS: arm span; SPJ: spike jump; CMJ: countermovement jump; LJ: standing long jump; STR: sit and reach; SU: sit-ups test; MBT: medicine ball throw; AG: agility T-test.

significant main RAE (birth trimester) was found in anthropometric and physiological characteristics across 1st–4th birth quarters (Figure 1, 2). Specifically, anthropometric characteristics (Figure 1) and exercise performance (Figure 2) were similar across the 1st–4th birth quarters within the age groups. However, the main effect of age was significant ($p < 0.01$) regarding spike jump, countermovement jump, long jump, and agility T-test between the two age groups (Figure 2). In particular, spike jump performance was greater in the older compared to the younger group for all trimesters of birth quarter (Figure 2A), whereas jumping ability of countermovement (Figure 2B) and long jump trials (Figure 2C) were higher in the older for the 2nd–4th trimester birth quarters and only at the 1st trimester birth quarter, respectively, than in younger groups. Furthermore, agility T-test performance was greater in the older group for the 1st and 3rd trimester birth quarter compared to the younger group. No significant main effect of age was found in anthropometric characteristics and exercise performance in the seat and reach, sit-ups, and medicine ball throw trials.

Exercise performance in spike jump ($r = 0.227$, $p = 0.000$), countermovement jump ($r = 0.240$, $p = 0.000$), sit-ups ($r = -0.246$, $p = 0.000$), medicine ball throw ($r = 0.135$, $p = 0.008$), and agility T-test ($r = -0.231$, $p = 0.000$) was significantly correlated with age.

Discussion

The RAE recently has become an interesting scientific issue, especially in team sports, and several studies have shown an over-representation of early-born athletes in soccer (Cobley et al. 2009), ice hockey (Hurley, Lior, & Tracze, 2001), handball (Schorer, Baker. Büsch, Wilhelm, & Pabst, 2009), basketball (Delorme and Raspaud, 2009), as well as in individual sports, such as swimming (Medic, Young, Starkes, Weir, & Grove, 2009), tennis (Edgar and O'Donoghue, 2005) and mountain skiing (Müller, Hildebrandt, Schnitzer, & Raschner, 2016a). The magnitude of RAE is remarkable in the younger age group and gradually decreases after adolescence (Sierra-Diaz et al., 2017).

This study aimed to determine RAE in anthropometric and physiological characteristics in a group of Greek female volleyball players who were 13 (AG13) and 14 (AG14) years old and who participated in a national age-group selection training camp. RAE was not proven to be present in both age groups. Specifically, almost 54% of AG13 and 65.9% of AG14 volleyball players were found to be born in the first trimester of each year. However, in contrast to our hypothesis, there was not any significant difference between the “early and late-born” female volleyball players in anthropometric and physiological characteristics. Moreover, a significance between age group differences was observed with the older (AG14) over-performing against the younger group (AG13) in the CMJ, spike jump, long jump, and agility t-test. There were no observed significant differences in anthropometrical measures.

The relative information in volleyball is conflicting some studies that have reported RAE (Okazaki et al., 2011, Nakata and Sakamoto, 2012, Reed et al., 2017, Rubajczyk and Rokita 2020), while in others, have not reported this (Van Rosum, 2006, Parma and Penna, 2018, Papadopoulou et al., 2019). However, less information exists on young female volleyball players (Papadopoulou et al., 2019, Rubajczyk and Rokita, 2020).

Similar results to those of the present study were reported recently by Papadopoulou et al. (2020). In that study, authors have not observed RAE among selected and non-selected Greek female volleyball players of a similar age. In that study, the anthropometric and the selected physiological characteristics, although different in comparison to our study, did not differ among the different birth quarter groups. Additionally, in a study consisting of young Turkish volleyball players with approximately three years of experience, the early-born female young volleyball players had a higher percentage of RAE in comparison to those who were born in the last trimester who presented lower RAE tendencies. The RAE effect was not observed in speed and jumping performance parameters (Akarcesme and Aytar, 2018).

However, Okazaki et al. (2011), with a group of international female volleyball players under 14 years old, found a significant RAE, although height and body composition were not confirmed to be RAE predictors. Additionally, Campos et al. (2016) reported RAE presence among under-18-year-old female volleyball players representing different continents in the World Junior Championship. The results of that study showed a higher RAE effect in female players born in the first six months of the competitive year and superior performance of the early-born players in comparison to others with lower RAE birth rates.

Volleyball is a very popular sport among females in Greece, and the basic technical skills of the sport are taught by the physical education teachers in several classes of primary and high school as a part of the annual physical education program. Reed et al. (2017) found a strong indication of RAE in sports studied in school programs, an observation that was not confirmed in the present study. Additionally, volleyball is a late specialization sport, and the volleyball long-term athletic development guidelines for this age group suggest development with priority on the fundamental skills of the sport in favor of the overall progressive training of the relative physiological abilities (Coutinho et al., 2015). These training schedules that were recently adopted by a large number of volleyball trainers may be the reason for the absence of RAE and significant differences in the performance in selected physiological tests among the participants in the present study since it is well known that RAE is defined in sports with high demands for physiological characteristics (Hurley et al., 2001, Cobley et al., 2009, Medic et al., 2009, Shorer et al., 2009, Reed et al., 2017).

Only a few sports in Greece used talent identification programs at the national level to select athletes for elite performance. As a consequence, all trainers from the local clubs advised making the first identification mainly according to the advanced anthropometric traits, taking as a cut-off a height over 165 cm, the systematic access to training programs, and the overall competitive performance as the initial entry criteria, which are factors that increase the probability of elite future success (Hancock, Adler, & Cote 2013). Thus, a large number of volleyball players with different physiological abilities and technical qualities were presented, a fact that increased the variability on the examined parameters (Nikolaidis, Ziv, Arnon, & Lidor, 2012).

Athletes of similar age with early maturity status are preferably selected in different types of sports (Deprez, Coutts, Franssen, Deconinck, Lenoir, & Vaeyens, 2013, Torres-Unda, Zarrazquin, Gil, Ruiz, Irazusta, Kortajarena, Seco, Irazusta, 2013, Muller et al., 2016a, Steidl-Müller, Hildebrandt, Raschner, & Müller, 2019). A more advanced maturation status is associated with more developed stature and physiological capacities compared to their counterparts born some months later whose maturation will take place later (Malina 1994). Older athletes have a temporary exposure to a more advanced athletic environment (more competitions and specific attention from the trainers) that permits them to develop their experience in various physiological and sport skill abilities in comparison to the less mature that are often over-looked (Romann and Cobley, 2015). Unfortunately, the maturation status of the participants was not measured, and this was a limitation of the present

study. However, the age of the participants was correlated to spike jump, countermovement jump, and agility t-test and negatively correlated with abdominal strength. Moreover, body weight was also correlated to abdominal strength and medicine ball throwing. Taking into consideration social gender reasons that may appear as ethical obstacles in determining maturity status in young female athletes, the peak height velocity (PHV) estimated from anthropometric and body composition measures is an alternative measure that should be examined in future volleyball studies (Mirwald, Baxter-Jones, Bailey, & Beunen, 2002). Although, in some recent papers, the biological age was not confirmed to be a discriminant factor between the birth trimesters of the participants (Gil, Badiola, Bidaurreaga-Letona, Zabala-Lili, Gravina, Santos Concejero, Lekue, & Granados, 2014, Lovell et al. 2015, Müller, Müller, Hildebrandt, & Raschner 2016b).

Conclusion

In conclusion, RAE was not observed in young female Greek volleyball players, although large RAE percentages were reported in the literature, in early-born female volleyball players. Moreover, the female volleyball players had similar anthropometric and body composition traits besides the two-year chronological difference. Significant differences between age groups were observed for CMJ, spike jump, long jump, and agility t-test when participants were matched for birth trimesters. One of the strengths of this study was the large number of participants and the biannual chronological cut-off of the participants. These results confirm the literature-conflicting results on this issue and the need for more studies to identify not only the causes but also the consequences of the RAE in female volleyball players. Moreover, we point out the relative interventions from policymakers (Universities, Federations, clubs) to eliminate the risk of dropouts during the adolescent period to allow the further development of this sport in Greece. Practically, the results of the present study are important for volleyball practitioners, showing that RAE does not influence physiological parameters in this age group, the priority for which is the development of the fundamental technical drills of the sport. This observation should not mislead experts concerning the appropriate multidimensional physical training for these age groups.

Acknowledgements

The authors would like to thank Falcon Scientific Editing (<https://falconediting.com>) for proofreading the English language in this paper.

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