Baltic Journal of Health and Physical Activity

Volume 16 | Issue 2 Article 9

2024

Relative age effect at men's volleyball world championships over time

Marcin Śliwa
Józef Piłsudski University of Physical Education in Warsaw, Poland, marcin.sliwa@awf.edu.pl

Mariusz Buszta
Józef Piłsudski University of Physical Education in Warsaw, Poland

Jerzy Sadowski
Józef Piłsudski University of Physical Education in Warsaw, Poland

Recommended Citation

Sliwa M, Buszta M, Sadowski J. Relative age effect at men's volleyball world championships over time. Balt J Health Phys Act. 2024;16(2):Article9. DOI: 10.29359/BJHPA.16.2.09

Relative age effect at men's volleyball world championships over time

Abstract

Introduction: Relative age effect (RAE) in sport is extensively described in the literature. However, there is scarcity of data on how to avoid problems in the talent identification process and, consequently, how to avoid dropping out or losing a potential volleyball talent. The aim of the study was to carry out a retrospective analysis of RAE at Men's U-19 and U-21 World Championships as well as Men's World Championships over the last 12 years and to investigate possible differences in quarterly age distribution depending on anthropometric features, geographical regions the teams under study came from as well as their performance (results) at the championships. Material and Methods: The analysis was based on volleyball players (n = 3,887) participating in Men's U-19 and U-21 World Championships as well as Men's World Championships over the last 12 years (2010–2022). Results: It was noted that RAE differed depending on age category, body height, geographical region of origin as well as the place taken during the championships. Conclusions: The findings indicate that there is a need to better understand RAE in order to avoid losing young volleyball players, which could contribute to the development of volleyball in the world.

Keywords

relative age effect, talent identification, birth quarter, championship players

Baltic Journal
of Health and Physical Activity
e-ISSN 2080-9999

Article

Relative age effect at men's volleyball world championships over time

Marcin ŚLIWA[1]*, Mariusz BUSZTA[2], Jerzy SADOWSKI[3]

[1] Faculty of Physical Education and Health in Biala Podlaska, Jozef Piłsudski University of Physical Education in Warsaw, Poland; ORCID 0009-0007-8883-1544
[2] Faculty of Physical Education and Health in Biala Podlaska, Jozef Piłsudski University of Physical Education in Warsaw, Poland; ORCID 0000-0002-1784-6868
[3] Faculty of Physical Education and Health in Biala Podlaska, Jozef Piłsudski University of Physical Education in Warsaw, Poland; ORCID 0000-0002-1751-9613

* Correspondence: Dr. Marcin Śliwa; e-mail: marcin.sliwa@awf.edu.pl

Abstract: Introduction: Relative age effect (RAE) in sport is extensively described in the literature. However, there is scarcity of data on how to avoid problems in the talent identification process and, consequently, how to avoid dropping out or losing a potential volleyball talent. The aim of the study was to carry out a retrospective analysis of RAE at Men's U-19 and U-21 World Championships as well as Men's World Championships over the last 12 years and to investigate possible differences in quarterly age distribution depending on anthropometric features, geographical regions the teams under study came from as well as their performance (results) at the championships. Material and Methods: The analysis was based on volleyball players (n = 3,887) participating in Men's U-19 and U-21 World Championships as well as Men's World Championships over the last 12 years (2010–2022). Results: It was noted that RAE differed depending on age category, body height, geographical region of origin as well as the place taken during the championships. Conclusions: The findings indicate that there is a need to better understand RAE in order to avoid losing young volleyball players, which could contribute to the development of volleyball in the world.

Keywords: relative age effect, talent identification, birth quarter, championship players.

Citation: Sliwa M, Buszta M, Sadowski J. Relative age effect at men's volleyball world championships over time. Balt J Health Phys Act. 2024;16(2):Article9. DOI: 10.29359/BJHPA.16.2.09

Academic Editor: Aleksandra Bojarczuk

Received: February 2024
Accepted: March 2024
Published: June 2024

Publisher's Note: BJHPA stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

1. Introduction

All over the world, sports competitions are held taking account of age categories. It stems from the fact that young athletes should be given a chance to develop their technical and perceptual-cognitive skills as well as motor and mental abilities, which are indispensable success factors, on equal terms [1, 2, 3]. However, a difference of almost 12 months in cognitive and physical development may occur between the youngest and the oldest athlete born within the same year [4]. World federations of team sports (volleyball, basketball, handball, football) organise youth world championships in a two-year system, with the cut-off date of January 1st. Therefore, within a given category, there may be a difference of up to 23 months between a child born in the first month of the year and a child born in December of the next year. For instance, during growth spurt, boys may grow 8 to 12 cm within a year [4]. Furthermore, young boys manifest considerable improvements in such motor abilities as speed, endurance, agility, strength [5] or jumping ability [6, 7]. Owing to a rapid improvement in these abilities, relatively older athletes (born in the first quarter of the year) may be more effective than their younger peers (born in the fourth quarter of the year). Consequently, we may observe the overrepresentation of older players rather than the expected normal distribution in particular quarters of the year. This is known as the relative age effect (RAE) [8, 9, 10]. As a result, younger players who may be

temporarily disadvantaged are omitted in the talent identification process because their performance is below expectations [11]. Therefore, it is important to optimise the talent identification process so that federations, clubs, coaches or managers can exert the best possible influence through providing all athletes (especially those with high performance potential) with equal development opportunities [1]. Research findings confirm the occurrence of RAE in the majority of team sports, particularly in those where there is a strong correlation between body height and mass and high performance [12], as is the case in volleyball [13].

The literature review reveals a bias in the process of talent identification in young athletes, where a larger proportion of chronologically older competitors in the same age category is noticeable, particularly at high levels of competition (e.g. in national teams). The occurrence of RAE was confirmed in young players and seniors in the majority of team sports, e.g. basketball [14, 15], handball [16] or football [17].

In volleyball, most studies also point to the occurrence of RAE. Śliwa et al. [18] reported that RAE occurred in young Polish volleyball players attending an elite sports school supervised by the Polish Volleyball Federation (PZPS). These players were the driving force of the national team during Youth World Championships (World Champions U-21 in 2017 as well as U-19 in 2015 and 2021) and Men's World Championships (World Champions in 2014 and 2018). Similar observations were made by Campos et al. [19] in four male categories of the World Championships (U-19, U-21, U-23 and the World Cup Men's). They noted a larger presence of players born in the first quarter of the year in all the categories (youth categories in particular).

Taking into account a wide scope of research into RAE in the last 20 years, it is worth checking whether the trend of selecting players born in the first quarter of the year continues. Volleyball is one of the most spectacular team sports in the world. As it generates great interest on the part of fans and sponsors, its sports level needs to be increased. Attempting to fully understand causes and effects of RAE in volleyball players may contribute to improving the level of the game in the world. Therefore, the aim of the study was to carry out a retrospective analysis of RAE at World Championships U-19 (WC U-19) and World Championships U-21 (WC U-21) World Championships as well as Men's (WC men) World Championships over the last 12 years and to investigate possible differences in quarterly age distribution depending on anthropometric features, geographical regions the teams under study came from as well as their performance in the World Championships.

2. Material and Methods

The study included volleyball players (n = 3,887) who competed in U-19 and U-21 World Championships in the years 2011–2021 (5 championships in each age category) and in Men's World Championships in the years 2010–2022 (4 championships). Information on dates of birth was taken on 1 October 2022 from the FIVB official website (https://en.volleyballworld.com).

In the FIVB system, January 1st is the cut-off date. Therefore, the players' birth dates were classified in four quarters: Q1 – players born between January 1st and March 31st, Q2 – players born between April 1st and June 30th, Q3 – players born between July 1st and September 30th, and Q4 – players born between October 1st and December 31st. They were also classified according to the semester of birth: the first semester (Q1–Q2) included players born between January 1st and June 30th, while the second semester (Q3–Q4) included players born between July 1st and December 31st.

To determine the differences between the actual and expected distributions of birth dates in each quarter, the chi-square test (χ^2) was applied [8]. The Odds Ratio (OR) was used to compare the distribution of birth dates between the first three quarters (Q1, Q2 and Q3) and the last quarter (Q4), as recommended by Cobley et al. [20]. OR was calculated with 95% confidence interval (CI) between the semesters. The effect size obtained for the chi-square test was interpreted as follows: OR < 1.23 (very small), OR between 1.23

and 1.85 (small), OR between 1.86 and 2.99 (medium) and OR > 2.99 (large) [21]. To analyse possible factors associated with RAE, the birth quarter (Q) was defined as an independent variable, whereas body height, geographical location of the team (America, Africa, Asia and Oceania as well as Europe), and results obtained by national teams during World Championships (medallists – players from teams that came 1st–3rd; participants of the knockout stage – players from teams that came 4th–8th; participants of the group stage – the remaining players from teams taking part in the championships) were defined as dependent variables. Moreover, two-way AVOVA was employed to study the differences in the players' body height taking account of birth quarters and results obtained during the championships. Statistical analysis was performed using STATISTICA 13.3 (StatSoft, Poland). The level of significance was set at $\alpha < 0.05$.

3. Results

In all age categories at the World Championships in volleyball, we noted the overrepresentation of players born in the first quarter of the year, with decreasing OR values when comparing Q4 with Q1, Q2 and Q3. The analysis of OR values Q1×Q4 revealed the largest effect in the youngest age category, i.e. U-19 (Table 1).

Table 1. Assessment of birth quarters in participants of FIVB Volleyball World Championships (U-19, U-21 and Men's World Championships) in the years 2010–2022.

Competition	Number (%) of athletes per quarter				Total	χ^2	p	OR (95% Confidence Interval)		
	Q1	Q2	Q3	Q4				Q1×Q4	Q2×Q4	Q3×Q4
	n(%)	n(%)	n(%)	n(%)						
WC U-19	468(33.6)	386(27.7)	322(23.2)	216(15.5)	1392	97.54	0.000*	2.16 (1.74–2.70)	1.79 (1.43–2.23)	1.49 (1.19–1.87)
WC U-21	364(30.8)	328(27.7)	280(23.7)	210(17.8)	1182	45.01	0.000*	1.73 (1.37–2.19)	1.56 (1.23–1.98)	1.33 (1.04–1.70)
WC men	354(27.0)	323(24.5)	370(28.2)	266(20.3)	1313	19.22	0.003*	1.33 (1.07–1.66)	1.21 (0.97–1.52)	1.39 (1.12–1.73)

χ^2: chi-square test; 1°quartile (Q1): Jan–Mar; 2° quartile (Q2): Apr–Jun; 3° quartile (Q3): Jul–Sep; 4° quartile (Q4): Oct–Dec; Effect size: OR < 1.23 (very small), OR 1.23 to 1.85 (small), OR 1.86 to 2.99 (medium), OR > 2.99 (large).*$p < 0.05$.

The analysis of quarterly age distribution for volleyball players in a period of 12 years revealed greater overrepresentation of players born in Q1–Q2 compared to those from Q3–Q4 for every age category (Figure 1). The largest difference was noted in the youngest players (U-19), where the number of births in Q1–Q2 in the years 2011 and 2015 was almost twice as high as in Q3–Q4. However, the difference grew smaller with the players' age, and there was no difference at all during Men's World Championships in 2022.

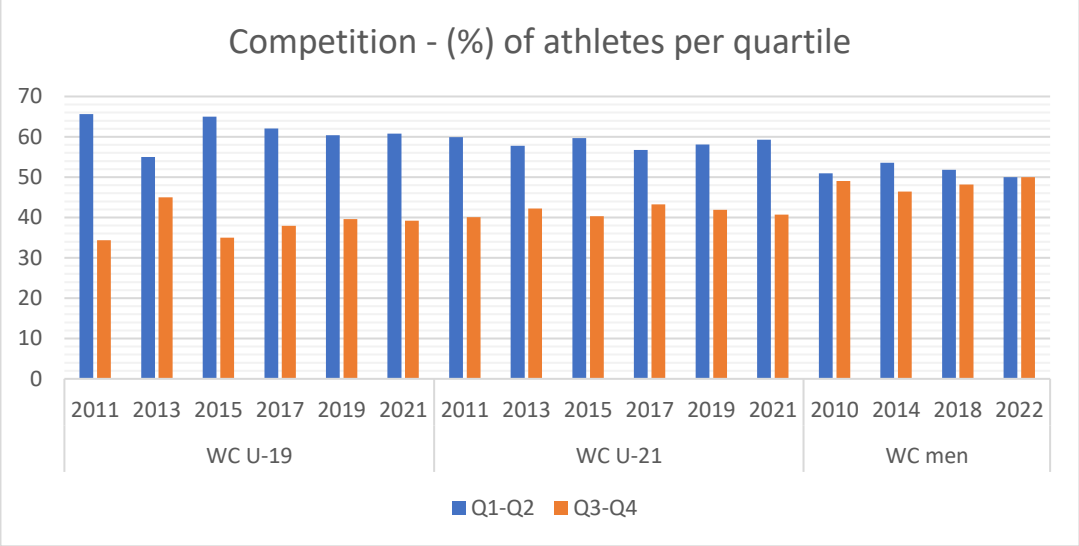

Figure 1. Distribution of birth semesters for all age categories at U-19, U-21 and Men's World Championships in the years 2010–2022.

The quarterly distributions of birth dates depending on the continents the teams under study came from were uniform in three cases only (U-19 Africa for $p < 0.07$ and U-21 as well as U-21 and Men's World Championships (WC Men) Asia and Oceania for $p < 0.45$ and $p < 0.61$). In the other cases, the distributions were significantly different from the expected ones ($p < 0.05$) (Table 2).

Table 2. Assessment of birth quarters and semesters in participants of FIVB Volleyball World Championships (U-19, U-21 and Men's World Championships) in the years 2010–2022 according to the geographical region the teams came from.

Competition	Region	Number (%) of athletes per quarter				Total	χ^2	p	OR (95% Confidence Interval)		
		Q1	Q2	Q3	Q4				Q1×Q4	Q2×Q4	Q3×Q4
		n(%)	n(%)	n(%)	n(%)						
WC U-19	America	150(32.9)	121(26.5)	113(24.8)	72(15.8)	456	27.28	0.0001	2.08 (1.49–2.92)	1.68 (1.19–2.38)	1.57 (1.11–2.23)
	Europe	168(35.0)	140(29.2)	110(22.9)	62(12.9)	480	51.40	0.0000	2.70 (1.84–3.99)	2.25 (1.53–3.35)	1.77 (1.19–2.65)
	Africa	60(33.3)	41(22.8)	42(23.3)	37(20.6)	180	6.98	0.0726	1.62 (0.90–2.91)	1.11 (0.60–2.04)	1.13 (0.61–2.09)
	Asia and Oceania	90(32.6)	84(30.4)	57(20.6)	45(16.3)	276	20.09	0.0002	1.99 (1.22–3.27)	1.86 (1.14–3.06)	1.26 (0.76–2.12)
WC U-21	America	112(30.3)	112(30.3)	77(20.8)	69(18.6)	370	16.79	0.0008	1.62 (1.07–2.47)	1.62 (1.07–2.47)	1.12 (0.72–1.73)
	Europe	128(31.4)	113(27.7)	101(24.7)	66(16.2)	408	20.53	0.0001	1.93 (1.29–2.91)	1.71 (1.14–2.58)	1.53 (1.01–2.32)
	Africa	55(33.3)	48(29.1)	40(24.2)	22(13.3)	165	14.71	0.0021	2.48 (1.29–4.86)	2.17 (1.12–4.27)	1.81 (0.92–3.60)
	Asia and Oceania	69(28.9)	55(23.0)	62(25.9)	53(22.2)	239	2.66	0.4467	1.30 (0.78–2.16)	1.04 (0.61–1.75)	1.17 (0.70–1.96)

Competition	Region	Number (%) of athletes per quarter				Total	χ^2	p	OR (95% Confidence Interval)		
		Q1	Q2	Q3	Q4				Q1×Q4	Q2×Q4	Q3×Q4
		n(%)	n(%)	n(%)	n(%)						
WC Men	America	108(34.8)	115(37.1)	109(35.2)	76(24.5)	408	9.12	0.0278	1.42 (0.95–2.13)	1.52 (1.01–2.26)	1.43 (0.96–2.15)
	Europe	154(39.6)	112(28.8)	153(39.3)	110(28.3)	529	13.68	0.0034	1.40 (0.99–1.98)	1.02 (0.71–1.46)	1.39 (0.98–1.96)
	Africa	38(32.2)	50(42.4)	49(41.5)	23(19.5)	160	11.85	0.0079	1.64 (0.83–3.28)	2.16 (1.12–4.23)	2.11 (1.10–4.16)
	Asia and Oceania	54(33.7)	46(28.7)	59(36.9)	57(35.6)	216	1.81	0.6117	0.95 (0.56–1.61)	0.80 (0.47–1.39)	1.03 (0.61–1.75)

Table 3 shows quarterly distributions of volleyball players' birth dates (percentage) depending on the results they obtained during Volleyball World Championships (medallists, players from teams that came 4th–8th, the remaining players), the chi-square test results as well as the odds ratio. The quarterly distributions of birth dates were non-uniform in all the cases ($p < 0.05$).

Table 3. Assessment of birth quarters and semesters in participants of FIVB Volleyball World Championships (U-19, U-21 and Men's World Championships) in the years 2010–2022 according to the obtained results.

Classification	Number (%) of athletes per quarter				Total	χ^2	p	OR (95% Confidence Interval)		
	Q1	Q2	Q3	Q4				Q1×Q4	Q2×Q4	Q3×Q4
	n(%)	n(%)	n(%)	n(%)						
Medallists	181(30.7)	172(28.8)	150(25.1)	95(15.9)	598	29.89	0.00001	1.90 (1.36–2.67)	1.81 (1.29–2.54)	1.58 (1.12–2.23)
4th – 8th ranking	336(33.6)	263(26.3)	226(22.6)	174(17.4)	999	55.72	0.0000	1.93 (1.50–2.49)	1.51 (1.17–1.96)	1.30 (1.00–1.69)
Remaining players	669(29.2)	602(26.3)	596(26.0)	423(18.5)	2290	57.79	0.0000	1.58 (1.34–1.87)	1.42 (1.20–1.69)	1.41 (1.19–1.67)

The characteristics of volleyball players' body height depending on their birth quarter, age categories and geographical regions they came from are presented in Table 4.

Table 4. The characteristics of volleyball players' body height depending on their birth quarter, age categories and geographical regions they came from.

Competition		Volleyball players' body height (n)							
		Q1		Q2		Q3		Q4	
	Classification	[cm]	n	[cm]	n	[cm]	n	[cm]	n
U-19	medallists	196.5±8.7	74	196.6±7.2	68	194.8±7.7	41	196.9±8.3	33
	4–8 ranking	194.1±8.4	133	195.2±8.5	102	194.6±8.1	74	197.4±7.2	51
	lowest ranking	193.5±11.8	261	192.4±7.8	216	193.1±7.7	207	192.2±8.0	132
U-21	medallists	197.1±8.4	63	197.5±8.4	61	197.9±7.7	55	196.6±8.8	37
	4–8 ranking	194.4±8.2	109	195.6±8.0	94	193.3±7.4	92	195.5±7.8	64
	lowest ranking	194.6±7.8	192	194.5±7.8	173	194.1±8.4	133	195.5±7.8	109

Competition		Volleyball players' body height (n)							
		Q1		Q2		Q3		Q4	
	Classification	[cm]	n	[cm]	n	[cm]	n	[cm]	n
WC Men	medallists	199.1±7.4	44	197.0±8.8	43	197.7±7.2	54	197.6±9.2	25
	4–8 ranking	196.8±8.3	94	198.3±7.4	67	197.8±7.9	60	198.2±9.5	59
	lowest ranking	194.4±7.8	216	196.3±8.1	213	196.2±7.5	256	195.2±9.5	182
	Region								
	America	194.7±8.1	370	195.0±7.8	348	193.7±7.5	299	194.2±8.6	217
	Europe	196.1±7.9	450	196.7±7.9	365	197.3±6.7	364	197.6±8.6	238
	Africa	192.5±6.9	153	193.2±6.9	139	194.9±9.0	131	191.9±7.3	82
	Asia and Oceania	193.9±13.2	213	194.5±8.9	185	193.0±8.8	178	195.1±15.6	155

Figure 2 shows the results of the analysis of variance for body height (a dependent variable). The differences between estimated marginal means for Region (upper left), Classification (upper right), Competition (lower left) as well as quarter*region interactions (lower right) proved to be statistically significant.

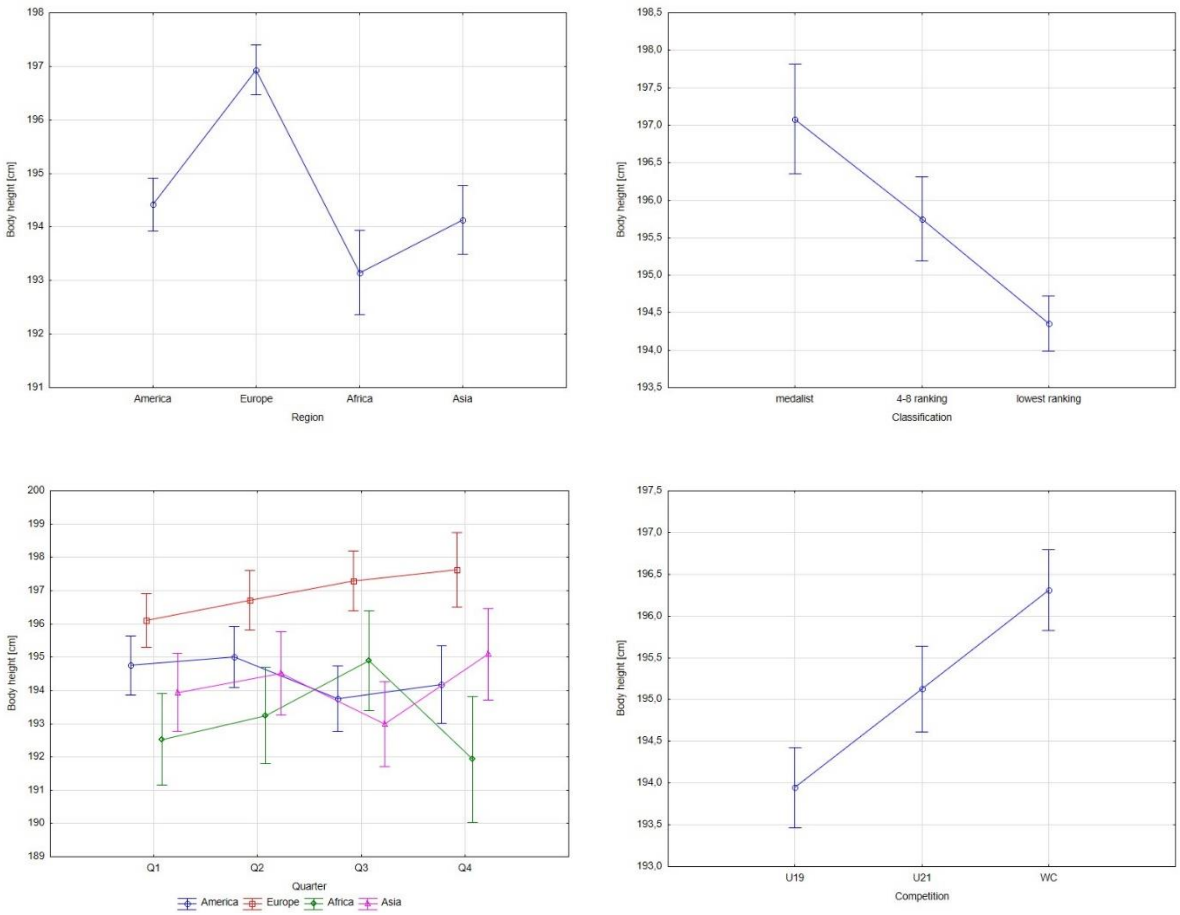

Figure 2. Results of the analysis of variance for body height for Region (upper left, F(3, 3871) = 32.980, p = 0.000), Classification (upper right, F(2, 3875) = 24.829, p = 0.000), Competition (lower right, F(2, 3875) = 23.231, p = 0.000) as well as Quarter*Classification (lower left, F(6, 3875) = 1.2844, p = 0.26071), Quarter*Category (upper left, F(6, 3875) = 0.89225, p = 0.49946) and Quarter*Region interactions (lower, F(6, 3875) = 2.2529, p = 0.01648). Vertical bars indicate 95% confidence intervals.

4. Discussion

The aim of the study was to retrospectively analyse the RAE at World Championships in volleyball in a period of 12 years taking into account anthropometric features, age categories, geographical regions the teams under study came from as well as their performance (results) in the championships.

The observation of the distribution of birth dates shows significant differences between the actual and expected distribution of the number of births in quarters and semesters in U-19 players. RAE is also noted in U-21 players; however, it starts to decrease gradually. It stems from the fact that older players (born in the same year) are more mature when it comes to biological development than their peers born in the last quarter of the year. As a consequence, in the process of talent identification, older players are selected to youth national teams since they manifest better parameters of body height and mass, strength, jumping abilities or speed [5, 18, 22, 23]. RAE also occurs in senior players participating in the World Championships; however, the difference is not statistically significant. A similar correlation was found in the study on Polish volleyball players from an elite sports school supervised by the Polish Volleyball Federation, who were the core of U-17, U-19, U-21 and senior national teams during World Championships [18].

The results show that the overrepresentation of births in the first months of the year decreases with the participants' age. These changes in RAE over the years result from smaller differences in biological age and greater homogeneity of the group. It indicates that other values begin to gain significance (e.g. longer training experience) [20, 24].

No consideration of RAE by sports officials, managers or coaches who look for talented youth and usually focus on such success factors as weight-height parameters or jumping abilities [25, 26] may lead to overlooking young talents due to their unfavourable age-related situation [8, 18]. Our analysis confirmed this correlation, as early exclusion is noticeable in players born in the second semester of the year (Q3–Q4).

It should be noted that our research group consisted of the best volleyball players in youth categories (U-19, U-21) as well as professional players who were the best in their countries at the last stage of transition from youth to senior volleyball. It means our group can be treated as elite (world top level).

As for the correlation of RAE with the region the national teams came from, the largest effect of statistical significance of x2 test was found in all categories (U-19, U-21 and Men's WC) in players coming from Europe. Most probably, it stems from the fact that in Europe, volleyball is a popular sport, and a lot of players take part in volleyball league matches. Thus, the correlation between the teams' region (Europe) and RAE may indicate that competition is positive in terms of RAE occurrence. Therefore, coaches, federations, clubs and sports organisations in Europe should be more careful so as not to choose players who have a temporary advantage in physical development over younger players born in the same year.

Despite the fact that in all age categories at World Championships there occurred an overrepresentation of players born in the first quarter of the year in terms of their performance, medallists manifested the greatest differences in OR values when comparing Q4 with the other quarters. It shows that the selection of talented players is mainly based on RAE. As a consequence, players born in the first months of the year are selected to teams and participate in national youth leagues more often. We ought to bear in mind that European and American countries are in the lead when it comes to winning medals. As a result, there are more children who do this sport, and the process of talent identification is oriented at achieving sports success. This fact was observed in other studies that focused on countries with fewer inhabitants and fewer volleyball players [27]. In such cases, coaches need to adopt a different approach when selecting children, as they may not necessarily be advanced in their physical development because few children compete for places available in sports clubs. As it has already been suggested, the lack of competition may act as a moderator for RAE [28].

Statistical analysis of the players' body height revealed significant differences between age categories, sports results achieved by the team during the championships as well as the region that the team came from. It shows that body height is a variable that influences coaches' decisions when selecting players to the national team. Achievements of men's U-19, U-21 and senior national teams indicate that the height parameter characterises the best players and is an important factor when it comes to achieving success at the highest level [29, 30]. This correlation was also found in the study which pointed to body height and jumping abilities as decisive factors for the selection of female national team players [31].

The current study is of significance in terms of both theory and practice. From a practical standpoint, it is suggested that if RAE were noted, coaches should act accordingly (e.g. by setting players individual goals) to prevent the loss of talents. From a theoretical point of view, RAE observed in young volleyball players may mean that the birth quarter may affect performance in young individuals, as their achievements depend on physical parameters. It indicates that the month of birth may be a decisive factor for talent identification in volleyball. The process of selection in volleyball aims at achieving immediate success, which does not always go hand in hand with young players' development.

Further research on RAE is needed to confirm the above-mentioned suggestions. The research should be more extensive and take into account biological maturation, progress regarding sports career development, position on the court or players' individual performance. As a result, it would help to avoid overestimating or underestimating potential volleyball talents. One of the practical solutions that could reduce RAE would be to change a two-year system into a one-year system in national competitions across all age categories. Another possible solution is to design a comprehensive system of talent identification and selection for a given sport which would include more frequent physical development assessment tests (every 3/6 months or more often). Finally, the most appropriate approach to the issue is to increase awareness of RAE among coaches, sports officials and managers. These people are responsible for sports organisation and development. Therefore, they should understand RAE and its influence on the development of sport and young athletes.

5. Conclusions

The findings of the current study revealed the occurrence of RAE at volleyball world championships (U-19, U-21 and seniors) in the last 12 years. However, the difference grew smaller with the players' age. An additional statistical analysis of RAE with respect to the players' body height showed significant differences between age categories, sports results achieved by the national team during the championships and the region the national team came from. It indicates that body height is a variable that exerts a considerable influence on coaches' decisions regarding the selection of players to national teams. The research results show that despite numerous scientific investigations on RAE, in volleyball the situation has not improved considerably over the last 12 years. As a consequence, we will still observe early exclusion and loss of talents in volleyball.

References

1. Tribolet R, Watsford ML, Coutts AJ, Smith C, Fransen J. From entry to elite: The relative age effect in the Australian football talent pathway. J Sport Sci Med. 2019; 22(6):741–745. DOI: 10.1016/j.jsams.2018.12.014
2. Ramos S, Volossovitch A, Paulo Ferreira A, Fragoso I, Massuça L. Differences in maturity, morphological and physical attributes between players selected to the primary and secondary teams of a Portuguese Basketball elite academy. J Sport Sci. 2019;37(15):1681–1689. DOI: 10.1080/02640414.2019.1585410
3. Hancock DJ, Adler AL, Côté J. A proposed theoretical model to explain relative age effects in sport. Eur J Sport Sci. 2013;13(6):630–637. DOI: 10.1080/17461391.2013.775352
4. Kalinski SD, Jelaska I, Knezević N. Age effects among elite male gymnasts. Acta Kines. 2017;2:84–89.

5. Coelho Silva MJ, Figueiredo AJ, Simoes F, Seabra A, Natal A, Vaeyens R, Philippaerts R, Cumming SP, Malina RM. Discrimination of U-14 soccer players by level and position. Int J Sport Med. 2010;31(11):790–796. DOI: 10.1055/s-0030-1263139
6. Temfemo A, Hugues J, Chardon K, Mandengue S, Ahmaidi S. Relationship between vertical jumping performance and anthropometric characteristics during growth in boys and girls. Eur J Pediatr. 2009;168(4):457–464. DOI: 10.1007/s00431-008-0771-5
7. Śliwa M, Sacewicz T. Biomechanical assessment of the strength of volleyball players in different stages of the training macrocycle. Pol J Sport Tourism. 2015;22(3):148–152. DOI: 10.1515/pjst-2015-0022
8. Musch J, Grondin S. Unequal competition as an impediment to personal development: a review of the relative age effect in sport. Dev Rev. 2001;21(2):147–167. DOI: 10.1006/drev.2000.0516
9. Gil SM, Badiola A, Bidaurrazaga-Letona I, Zabala-Lili J, Gravina L, Santos-Concejero J, Lekue JA, Granados C. Relationship between the relative age effect and anthropometry, maturity and performance in young soccer players. J Sport Sci. 2014;32(5):479–486. DOI: 10.1080/02640414.2013.832355
10. Prieto-Ayuso A, Martínez-Gorroño M. Influence of relative age affect in basic Physical Abilities. Rev Int Med Cienc Act Fís Deporte. 2017;67:413–434. DOI: 10.15366/rimcafd2017.67.002
11. Delorme N, Chalabaev A, Raspaud M. Relative age is associated with sport dropout: evidence from youth categories of French basketball. Scand J Med Sci Sport. 2011;21(1):120–128. DOI: 10.1111/j.1600-0838.2009.01060.x
12. Furley P, Memmert D. Coaches' implicit associations between size and giftedness: Implications for the relative age effect. J Sport Sci. 2016;34(5):459–466. DOI: 10.1080/02640414.2015.1061198
13. Rubajczyk K, Rokita A. The relative age effect and talent identification factors in youth volleyball in Poland. Front Psychol. 2020;11:1445. DOI: 10.3389/fpsyg.2020.01445
14. Oliveira HZ, Ribeiro Júnior DB, Vianna JM, Werneck FW. Relative age effect in Brazilian Basketball Championship: Under 15 players. Rev Bras Cineantropom Desempenho Hum. 2017;17(5):526–534. DOI: 10.5007/1980-0037.2017v19n5p526
15. Subijana C L, Lorenzo J. Relative age effect and long-term success in the Spanish soccer and basketball national teams. J Hum Kinet. 2018;65:197–204. DOI: 10.2478/hukin-2018-0027
16. Gomez-Lopez M, Angosto Sanchez S, Granero-Gallegos A, Chirosa Ríos LJ. Relative age effect in handball players of Murcia: Influence of sex and category of game. J Hum Sport Exerc. 2017;12(3):565–573. DOI: 10.14198/jhse.2017.123.01
17. Rubajczyk K, Rokita A. The relative age effect in Poland's elite youth soccer players. J Hum Kinet. 2018;64(1):265–273. DOI: 10.1515/hukin-2017-0200
18. Śliwa M, Sadowski J, Buszta M. Relative age effect and talent identification in youth volleyball players from the Polish Volleyball Federation sports school. Pol J Sport Tourism. 2021;28(4):21–25. DOI: 10.2478/pjst-2021-0022
19. Campos F, Stanganelli L R, Rabelo F, Campos L, Pellegrinotti I. The relative age effect in male volleyball championships. Int J Sport Sci. 2016;6(3):116–120. DOI: 10.5923/j.sports.20160603.08
20. Cobley S, Baker J, Wattie N, McKenna J. Annual age-grouping, and athlete development. Sport Med. 2009;39(3):235–256. DOI: 10.2165/00007256-200939030-00005
21. Olivier J, Bell ML. Effect sizes for 2 × 2 contingency tables. PLoS One. 2013;8(3):e58777. DOI: 10.1371/journal.pone.0058777
22. Figueiredo AJ, Coelho-e-Silva MJ, Cumming SP, Malina RM. Relative age effect: Characteristics of youth soccer players by birth quarter and subsequent playing status. J Sport Sci. 2019;37(6):677–684. DOI: 10.1080/02640414.2018.1522703
23. Till K, Cobley S, O'Hara J, Cooke C, Chapman C. Considering maturation status and relative age in the longitudinal evaluation of junior rugby league players. Scand J Med Sci Sport. 2014;24(3):569–576. DOI: 10.1111/sms.12033
24. Rubia A, Lorenzo-Calvo J, Lorenzo A. Does the relative age effect influence short-term performance and sport career in team sports? A quantitative and qualitative systematic review. Front Psychol. 2020;11:1947. DOI: 10.3389/fpsyg.2020.01947
25. Petroski EL, Fraro JD, Fidelix YL, Silva DAS, Pires-Neto CS, Dourado AC, Viera FS. Anthropometric, morphological and somatotype characteristics of athletes of the Brazilian Men's volleyball team: An 11-year descriptive study. Rev Bras Cineantropom Desempenho Hum. 2013;15(2):184–192. DOI: 10.5007/1980-0037.2013v15n2p184

26. Tsoukos A, Drikos S, Brown LE, Sotiropoulos K, Veligekas P, Bogdanis GC. Anthropometric and motor performance variables are decisive factors for the selection of junior national female volleyball players. J Hum Kinet. 2019;67:163–173. DOI: 10.2478/hukin-2019-0012
27. Lidor R, Côté J, Arnon M, Zeev A, Cohen-Maoz S. Relative age and birthplace effects in division 1 players – Do they exist in a small country. Talent Dev Excell. 2010;2(2):181–192.
28. Schorer J, Cobley S, Büsch D, Bräutigam H, Baker J. Influences of competition level, gender, player nationality, career stage and playing position on relative age effects. Scand J Med Sci Sports. 2009;19(5):720–730. DOI: 10.1111/j.1600-0838.2008.00838.x
29. Sattler T, Hadzic V, Dervisevic E, Markovic G. Vertical jump performance of professional male and female volleyball players: effects of playing position and competition level. J Strength Cond Res. 2015;29(6):1486–1493. DOI: 10.1519/JSC.0000000000000781
30. Czaplicki A, Śliwa M, Szyszka P, Sadowski J. Biomechanical assessment of strength and jumping ability in male volleyball players during the annual training macrocycle. Pol J Sport Tourism. 2017;24(4):221–227. DOI: 10.1515/pjst-2017-0021

Author Contributions: Study Design, MS, MB, and JS; Data Collection, MS; Statistical Analysis, MS; Data Interpretation, MS, MB, and JS; Manuscript Preparation, MS, MB, and JS; Literature Search, MS. All authors have read and agreed to the published version of the manuscript.

Funding: The research obtained no external funding.

Institutional Review Board Statement: N/A

Informed Consent Statement: N/A

Data Availability Statement: Data available from the corresponding author on request.

Conflicts of Interest: The authors declare no conflict of interest.