

2019

## Relative age effect in Polish National Football teams

Andrzej Szwarc

*Department of Football, Gdansk University of Physical Education and Sport in Gdansk, Poland,  
andrzej.szwarc@awf.gda.pl*

Bartosz Dolanski

*Chair of Sport, Gdansk University of Physical Education and Sport in Gdansk, Poland*

Pawel Rompa

*Department of Football, Gdansk University of Physical Education and Sport in Gdansk, Poland*

Mateusz Sitek

*Department of Football, Gdansk University of Physical Education and Sport in Gdansk, Poland,  
mateusz.sitek16@gmail.com*

Follow this and additional works at: <https://www.balticsportscience.com/journal>



Part of the [Health and Physical Education Commons](#), [Sports Medicine Commons](#), [Sports Sciences Commons](#), and the [Sports Studies Commons](#)

---

### Recommended Citation

Szwarc A, Dolanski B, Rompa P, Sitek M. Relative age effect in Polish National Football teams. *Balt J Health Phys Act.* 2019;11(3):19-26. doi: 10.29359/BJHPA.11.3.03

This Article is brought to you for free and open access by Baltic Journal of Health and Physical Activity. It has been accepted for inclusion in Baltic Journal of Health and Physical Activity by an authorized editor of Baltic Journal of Health and Physical Activity.

---

## Relative age effect in Polish National Football teams

### Abstract

**Background:** The aim of this study was to determine if a Relative Age Effect (RAE) is present in Polish National Football Teams. **Material and methods:** Birth date distributions of football players from youth Polish National Teams (Under 15 – Under 19) and the senior Polish National Team were compared. The sample (a total of 1801 players) included 909 youth players – U-15 (n=290), U-16 (n=221), U-17 (n=153), U-18 (n=157), and U-19 (n=88) – and 892 professional players who played in at least one official game for the senior Polish National Team. **Results:** An over-representation of players born in the first quarter of each selection year was identified on all youth teams. Anova Friedman test confirmed that the number of players on youth National Teams is dependent on the month of birth. Anova Kruskala-Wallis test demonstrated a statistically significant difference in the number of players born in January, March, and May. The Relative Age Effect fades with increasing age, and vanishes in full, when players reach the senior Polish National Team level. **Conclusions:** The bias in selection of youth players may lead to poor talent identification and discrimination in the recruitment of professional football players.

### Keywords

player selection, relative age quarter distribution, football, talent identification

### Creative Commons License



This work is licensed under a [Creative Commons Attribution-Noncommercial-No Derivative Works 4.0 License](https://creativecommons.org/licenses/by-nc-nd/4.0/).

# Relative age effect in Polish National Football teams

## Authors' Contribution:

- A Study Design
- B Data Collection
- C Statistical Analysis
- D Data Interpretation
- E Manuscript Preparation
- F Literature Search
- G Funds Collection

Andrzej Szwarc<sup>1 ABDEF</sup>, Bartosz Dolański<sup>2 ABDF</sup>, Paweł Rompa<sup>1 BCDE</sup>,  
Mateusz Sitek<sup>1 CDEF</sup>

<sup>1</sup> Department of Football, Gdansk University of Physical Education and Sport, Poland

<sup>2</sup> Chair of Sport, Gdansk University of Physical Education and Sport, Poland

## abstract

**Background:** The aim of this study was to determine if a Relative Age Effect (RAE) is present in Polish National Football Teams.

**Material and methods:** Birth date distributions of football players from youth Polish National Teams (Under 15 – Under 19) and the senior Polish National Team were compared. The sample (a total of 1801 players) included 909 youth players – U-15 (n=290), U-16 (n=221), U-17 (n=153), U-18 (n=157), and U-19 (n=88) – and 892 professional players who played in at least one official game for the senior Polish National Team.

**Results:** An over-representation of players born in the first quarter of each selection year was identified on all youth teams. Anova Friedman test confirmed that the number of players on youth National Teams is dependent on the month of birth. Anova Kruskal-Wallis test demonstrated a statistically significant difference in the number of players born in January, March, and May. The Relative Age Effect fades with increasing age, and vanishes in full, when players reach the senior Polish National Team level.

**Conclusions:** The bias in selection of youth players may lead to poor talent identification and discrimination in the recruitment of professional football players.

**Key words:** player selection, relative age quarter distribution, football, talent identification.

## article details

**Article statistics:** Word count: 3,035; Tables: 2; Figures: 0; References: 32

**Received:** April 2019; **Accepted:** September 2019; **Published:** September 2019

**Full-text PDF:** <http://www.balticsportscience.com>

**Copyright** © Gdansk University of Physical Education and Sport, Poland

**Indexation:** Celdes, Clarivate Analytics Emerging Sources Citation Index (ESCI), CNKI Scholar (China National Knowledge Infrastructure), CNPIEC, De Gruyter - IBR (International Bibliography of Reviews of Scholarly Literature in the Humanities and Social Sciences), De Gruyter - IBZ (International Bibliography of Periodical Literature in the Humanities and Social Sciences), DOAJ, EBSCO - Central & Eastern European Academic Source, EBSCO - SPORTDiscus, EBSCO Discovery Service, Google Scholar, Index Copernicus, J-Gate, Naviga (Softweco, Primo Central (ExLibris), ProQuest - Family Health, ProQuest - Health & Medical Complete, ProQuest - Illustrata: Health Sciences, ProQuest - Nursing & Allied Health Source, Summon (Serials Solutions/ProQuest, TDone (TDNet), Ulrich's Periodicals Directory/ulrichsweb, WorldCat (OCLC)

**Funding:** This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

**Conflict of interests:** Authors have declared that no competing interest exists.

**Corresponding author:** Corresponding author: Mateusz Sitek, Gdansk University of Physical Education and Sport, Kazimierza Górskiego Str. 1, 80-336 Gdansk, Poland; email: [mateusz.sitek16@gmail.com](mailto:mateusz.sitek16@gmail.com)

**Open Access License:** This is an open access article distributed under the terms of the Creative Commons Attribution-Non-commercial 4.0 International (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits use, distribution, and reproduction in any medium, provided the original work is properly cited, the use is non-commercial and is otherwise in compliance with the license.

## INTRODUCTION

Many educational systems and regulations that guide the participation of children and youth in science and sport divide candidates based on participants' chronological ages. This fact may cause significant discrimination in terms of participation in sport and lead to incorrect assessment of the potential or skills of candidates born in the final part of the selection year. In many countries, at the level of youth sports, the players are assigned to individual categories based on their birth date. Therefore, in extreme cases, the age difference between players competing in the same category can equal almost one year. Despite this age difference, these children compete in the same games [1]. It is believed that the acceptance of this criterion ensures fair competition and gives equal opportunities for the competitors. As a result, according to many studies conducted on athletes [2-10], players born at the beginning of a given selection year are more often identified as talented. This overidentification of talent in the older subgroup translates into greater opportunities to participate in competitions and more opportunities to represent the overall age groups. However, this talent identification may be more accurately attributed to earlier achieved biological maturity, having been born in the period close to the starting date of a given selection year [7, 8, 11]. In addition, as shown by research carried out by Malina et al. [12] on players aged 13-15 years who practice soccer, the players who qualified for higher skills groups are, in most cases, at the final stage of the maturation process when compared to their peers with lower skills. Furthermore, these studies have shown biological maturity, aerobic endurance, and body height to have a significant impact on the level of football skills.

The phenomenon of asymmetry in the distribution of birth dates, promoting players born at the beginning of the selection period and discriminating participants born in the later stages of the same period, is referred to as the Relative Age Effect (RAE) [13] and has been subjected to scientific research for many years [2, 3, 6, 8, 9, 10, 14-17]. Mikulic et al. [6] suggests that RAE may have a significant impact on the value of players selected for a representation and may be a reason for the low efficiency of the selection process for professional clubs. Furthermore, Thompson et al. [17] emphasize that RAE's influence is significantly higher in direct competition-based activities, in which the results significantly correlate with age and the level of maturity.

The aim of this study was to identify the occurrence of RAE among football players appointed to individual representations in the U-15...U-19 age categories and the senior Polish National Team. It was predicted that the surveyed youth representation teams would mostly consist of players born in the first quarter of a given selection year, while the influence of RAE would decrease with an increase in the calendar age of the players.

## MATERIAL AND METHODS

### DATA COLLECTIONS

The study involved 1,801 participants divided into two groups. The first group consisted of 909 players appointed to the youth National Teams in age categories from U-15 to U-19 in 2013-2016 (290 players of the U-15 team, 221 players of the U-16 team, 153 players of the U-17 team, 157 players of the U-18 team, and 88 players of the U-19 team). The comparison group was comprised 892 players who played in at least one official match on the first

Polish National Team between 1921 and 2016. The data concerning the birth dates of the players covered by the study were collected using the official representations of Poland posted on the official website of the Polish Soccer Association as well as Gudebski's [19] and Gowarzewski's [20] publications.

## DATA ANALYSIS

For each youth category as well for the players from the first Polish national team, birth dates were classified into four quarters: Q1 (January-March), Q2 (April – June), Q3 (July-September) and Q4 (October – December). To assess the distribution of birth dates, the percentage representation of each quarter was calculated from the total number of players appointed to the youth national teams in a given selection year. The same procedure was applied for the players from the first Polish national team. To compare the number of players appointed to the youth national teams according to the month of birth, the Anova Friedman test was conducted. The Anova Kruskal-Wallis test was carried out for comparison of the number of players appointed to first Polish national team and youth national teams according to the month of birth. The tests were conducted with the Statistica 12.1 software (StatSoft, Inc.) with statistical significance set at  $P < 0.05$ .

## RESULTS

Table 1. categorizes the players appointed to individual youth Polish national teams by birth month, displays the differences in the number of appointments between the age groups, and provides the level of statistical significance of these differences within each age category (U-15 through U-19).

Table 1. The number of players appointed to the first Polish representation in 1921–2016 and the youth representation of Poland in 2013–2016 together with the level of significance for the number of appointments depending on the month of birth in particular age categories

Birth month	1 <sup>st</sup> Polish repr.	Youth Polish National Teams					
		total U-15-U-19	U-15	U-16	U-17	U-18	U-19
January	87	150***	57	39	22	21	11
February	88	149***	52	41	22	20	14
March	73	128***	43	33	19	21	12
April	69	111	26	26	25	23	11
May	79	89***	25	26	16	14	8
June	71	64	16	13	13	16	6
July	52	49	20	7	7	9	6
August	65	68	21	16	10	11	10
September	72	46	14	9	8	12	3
October	77	21	7	4	3	4	3
November	77	17	6	3	4	2	2
December	82	17	3	4	4	4	2
minimum	52	17	3	3	3	2	2
maximum	88	150	57	41	25	23	14
sum	892	909	290	221	153	157	88
Anova Friedman Test (p)			0.0015***	0.0013***	0.0297***	0.0109	0.0865

\* $p < 0.05$  \*\* $p < 0.01$  \*\*\* $p < 0.001$

The Anova Friedman test reveals that the number of appointments for all national teams is strictly related to the players' birth months. This relation is outstanding

and very statistically significant in terms of U-15, U-16, U-18 (respectively:  $p < 0.001$  and  $p < 0.01$ ), significant in the U-17 category ( $p < 0.05$ ), and not statistically significant in the U-19 ( $p < 0.08$ ). These results confirm the occurrence of RAE during youth national team selections. In addition, the Anova Kruskal-Wallis test results from the analysis support that the number of appointments in all teams differs statistically significantly ( $p < 0.05$ ) in January, February, March and May.

The percentage of players' appointments to individual youth representations presented in Table 2 depending on the months and quarters of birth clearly indicates the preferred selection of players born in the first quarter of the year to all national teams. This tendency is particularly pronounced in the selection of players for U-15 and U-16 teams and disappears when appointing players to the U-19 team (the number of players born in the second and third quarter of the year clearly increases). However, no such trend exists in the senior national representation of Poland. In contrast, players born in all quarters of the year are similarly represented at the senior level.

Table 2. Percentage of players' appointments to the youth representation of Poland depending on the month and quarters of birth [%]

	U-15	U-16	U-17	U-18	U-19	Total	1 <sup>st</sup> Polish rep.
January	19.7	17.6	14.4	13.4	12.5	15.5	9.8
February	17.9	18.6	14.4	12.7	15.9	15.9	9.9
March	14.8	14.9	12.4	13.4	13.6	13.8	8.2
Q1	52.4	51.1	41.2	39.5	40.2	45.3	27.8
April	9.0	11.8	16.3	14.6	12.5	12.8	7.7
May	8.6	11.8	10.5	8.9	9.1	9.8	8.9
June	5.5	5.9	8.5	10.2	6.8	7.4	8.0
Q2	23.1	29.4	35.3	33.8	28.4	30.0	24.6
July	6.9	3.2	4.6	5.7	6.8	5.4	5.8
August	7.2	7.2	6.5	7.0	11.4	7.9	7.3
September	4.8	4.1	5.2	7.6	3.4	5.0	8.1
Q3	19.0	14.5	16.3	20.4	21.6	18.4	21.2
October	2.4	1.8	2.0	2.5	3.4	2.4	8.6
November	2.1	1.4	2.6	1.3	2.3	1.9	8.6
December	1.0	1.8	2.6	2.5	2.3	2.1	9.2
Q4	5.5	5.0	7.2	6.4	8.0	6.4	26.5

It is worth noting that the prevalence of appointments of players born in the first two quarters of the year (Q1 and Q2) over the selection of players born later (Q3 and Q4) was evident in all youth representations (U-15, U-16, U-17, U-18 and U-19) and was 75.5%, 80.5%, 76.5%, 73.3% and 70.4%, respectively. In the case of the two youngest divisions, U-15 and U-16, the number of players born in the first quarter accounted for over half of all appointments in each age category: 52.4% and 51.1%, respectively. The players least often chosen for appointment to all youth cadres were those born in the fourth quarter (Q4 – from 5% to 8%).

In addition, the comparative analysis between appointed youth and seniors shows the difference between the number of representatives from the month in which the most (February) and the least (November) players were born was 14% among youth players, and only 4.1% (July and February respectively) among seniors. An analysis of the total number of birth quarters revealed

that players born in the first half of the year (Q1 and Q2) constituted 75.3% of the youth national team appointments and only 52.4% of senior national team appointments. In turn, players born in the last quarter (Q4) constituted only 6.4% of players representing Poland in the youth categories and 26.5% representing at the senior national level.

Fig. 1. presents the comparison of the number of players born in individual months appointed between youth teams and senior professionals. The data illustration shows that players born in the first months of the year were preferred in the selection for youth national teams, while the number of players born in particular months was similar among the seniors, ranging from 52 to 88 players. This trend indicates the occurrence of RAE in the selection of players for the youth teams of Poland.

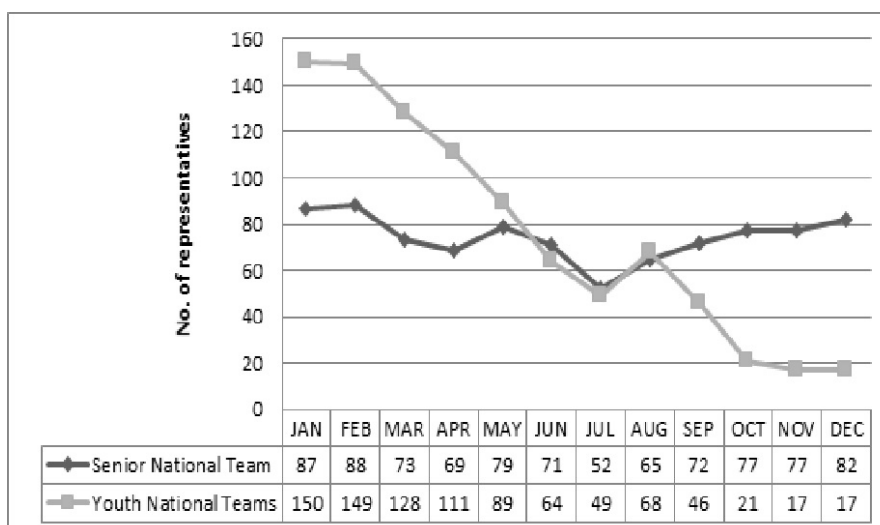


Fig. 1. Players born in individual months appointed between youth teams and senior professionals

## DISCUSSION

The aim of the conducted research was to analyze the birth dates of players appointed to the youth National Polish Teams and the first Polish representation, which were two comparative groups. In addition, the research aimed to determine whether the RAE was noticeable in the Polish national team and what differences occurred during the birth date of players appointed to individual national teams. The research goal was achieved on the basis of statistical analysis, made by Anova Friedman and Anova Kruskal-Wallis tests. They showed asymmetry in the distribution of birth dates in the youth National Teams of Poland from U-15 to U-19. It was confirmed that the majority of players appointed to the youth representation of Poland were born in the first half of the given selection period. However, the share of the RAE decreased along with the respondents' age. In the case of appointments to the first Polish representation, the research results were characterized by a smaller diversity in terms of the percentage of players born in particular months, quarters and half-years, which contradicts the occurrence of RAE in this group of respondents. These results coincide with other studies carried out on this subject. In studying the birth dates of players participating in the European Championships in various age categories in the period 2011–2012, Gonzalez-Villora et al. [10] observed that the RAE was visible in all age categories except senior teams. Studies show that the reason for the lack of a RAE among seniors is the loss of prevalence of traits associated with biological age after puberty in players born earlier. Players born later in the year "catch up" with their peers born in the early months of the same year [21,22].



The data on birth dates were collected among 909 players appointed to the youth Polish National Team in 2013–2016 and 892 players who played at least one official match in the first Polish national team in the period 1921–2016. Before the start of the work, a hypothesis and one research question were put forward. Referring to the hypothesis, its assumption has been confirmed in all age categories which were subjected to this research. Both in youth and the first Polish national teams, the players born in the first quarter made up the largest group for the appropriate selection period. In addition, the share of players born in the first quarter decreased with the increase in the respondents' age, apart from the U-19 age group, in which players from the first quarter accounted for 42%, 2.5 percentage points higher than the younger U-18 age category. Similar results were achieved by Mikulic et al. [6], who confirmed a gradual decline in the share of players born in the first quarter with the increase in the age of Slovak football representatives.

Statistical analysis has shown that in the youth representations of Poland from U-15 to U-18 the number of appointments depends on a player's month of birth. Additionally, based on data from all youth representations, it appears that the number of players born in January, March and May is significantly different from the others. This result is a confirmation of greater chances of appointments of players born in the first half of the year. A similar pattern was observed in a study conducted by Barnett & Dobson [22], which showed that in the Australian Football League 33% more players than the statistician would predict were born in January.

Similar results were obtained by Gonzalez-Villora et al. [10] in a study conducted on participants of Euro 2012, which found that approximately 55% of players who took part in this tournament were born in the first and the second quarter. In addition, the difference between January-June and July-December was 10%, which translated into about 90 more players born in the first period. The occurrence of the RAE phenomenon was also confirmed among players appearing in the Norwegian league in 2007. Only the Norwegian players were analyzed, of whom 130 were born in the first half of the year and only 87 in the second half [23]. The differences in appointments for individual age categories may depend on the players' biological. Children born in January are almost one year older than their peers born in December, which gives them an advantage in terms of physical conditions and acquired experience. One theory explaining the occurrence of the RAE among youth practicing sport is the maturation theory [24–29] which suggests that in the process of selection of players for youth representation players with higher parameters in the field of intellectual, mental and physical development more often receive appointments for national teams. The effect of this selection process is the asymmetry in the distribution of birth dates resulting from the preponderance in the maturation of players born in the initial months of a given year. However, as Musch and Grondin [11] demonstrated, RAE occurs only in conditions of high demand for a given sport. RAE occurs in the most popular sports and in countries or regions characterized by a large population. Such conditions mean that many people compete for one place on the team, so only the players with high skills and an advantage in terms of somatic parameters pass through the selection.

However, this effect is noticeable not only in soccer. Similar tendencies were also observed in ice hockey, volleyball [16], basketball [30], baseball [31] and tennis [2]. This phenomenon is directly related to the school sports elimination system, where, despite significant differences in biological development, all children



born in the same year are subject to the same fitness tests. The prevalence of children born in the early months of a given year is evident in fitness levels, morphological parameters, mental abilities, and experience not only within the sport, but also in life [21]. Additionally, Barnett and Dobson [22] noted that in the UK, people born at the beginning of the school year are better at learning and are more confident. Barnett also believes that schooling experiences with sport affect not only the chances of running a professional sports career, but also the desire to engage in amateur sport. Children born at the end of the year can easily be discouraged from a physical activity, which may result in more negative experiences than those positive results experienced by their more mature classmates. Specifically, the correlation of the RAE with suicide among school youth has been proven [32].

The results of this research were limited by the inability to compare the subjects' biological development. The data allowing comparison of these parameters, such as biological age, anthropometric dimensions, or motor skills would complement the collected data. The possibility of asymmetry in the distribution of birth dates among football players to the results of fitness tests would give a broader picture of the phenomenon of RAE. In addition, the identification of the most important factors that affect the advantage of players born earlier than their peers would significantly add to the value of research trials. Finally, a comparison of the RAE among Polish youth representatives with players from football academies, representing a high level of sports, would provide information on the extent and intensity of the RAE in Poland.

## CONCLUSIONS

Regarding the hypothesis and the research question guiding this investigation, the following conclusions were made:

1. The asymmetry in the distribution of birth dates among Polish youth football representatives is present in all age categories from U-15 to U-19, and the intensity of this phenomenon decreases with the players' age.
2. The RAE among youth Polish National Teams is manifested through increased participation in the appointments of players born in the first quarter of a given year.
3. The dependence of the number of appointments for the youth representation of Poland from the birth month of the players has been proved in the age categories from U-15 to U-18.
4. In all age categories from U-15 to U-19 and in the first Polish representation, the most players were born in the first quarter.
5. In all youth teams, players born in the first half of the year accounted for over 70% of all those appointed for representation in a given age category.

## REFERENCES

- [1] Gil SM, Badiola A, Bidaurrezaga-Letona I, et al. Relationship between the relative age effect and anthropometry, maturity and performance in young soccer players. *J Sports Sci.* 2014;32(5):479-486. <https://doi.org/10.1080/02640414.2013.832355>
- [2] Agricola A, Zhanel J, Hubacek O. Relative age effect in junior tennis (male). *Acta Gymnica.* 2015;43(1):27-33. <https://doi.org/10.5507/ag.2013.003>
- [3] Carling C, Le Gall F, Reilly T, A.M. W. Do anthropometric and fitness characteristics vary according to birth date distribution in elite youth academy soccer players? *Scand J Med Sci Sport.* 2009;19(1):3-9. <https://doi.org/10.1111/j.1600-0838.2008.00867.x>
- [4] Delorme N, Boiché J, Raspaud M. Relative age effect in elite sports: Methodological bias or real discrimination? *Eur J Sport Sci.* 2010;10(2):91-6. <https://doi.org/10.1080/17461390903271584>
- [5] Helsen WF, Van Winckel J, Williams AM. The relative age effect in youth soccer across Europe. *J Sports Sci.* 2005;23(6):629-36. <https://doi.org/10.1080/02640410400021310>

- [6] Mikulič M, Gregora P, Benkovský L, Peráček P. The relative age effect on the selection in the Slovakia national football teams. *Acta Fac Educ Phys Univ Comenianae*. 2015;55(2):122–31. <https://doi.org/10.1515/afepuc-2015-0013>
- [7] Ribeiro Assis M, Marques Barbosa MA, Silva Junior CJ, Imbiriba LA, Palma A. Relationship between relative age effect and physical characteristics of young soccer players. *Cult Cienc y Deport*. 2015;10(30):227–33. <https://doi.org/10.12800/ccd.v10i30.591>
- [8] Vaeyens R, Philippaerts RM, Malina RM. The relative age effect in soccer: A match-related perspective. *J Sports Sci*. 2005;23(7):747–56. <https://doi.org/10.1080/02640410400022052>
- [9] Van den Honert R. Evidence of the relative age effect in football in Australia. *J Sports Sci*. 2012;30(13):1365–74. <https://doi.org/10.1080/02640414.2012.707329>
- [10] González-Víllora S, Pastor-Vicedo JC, Cordente D. Relative Age Effect in UEFA Championship Soccer Players. *J Hum Kinet*. 2015;47(1):237–48. <https://doi.org/10.1515/hukin-2015-0079>
- [11] 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):147–67. <https://doi.org/10.1006/drev.2000.0516>
- [12] Malina RM, Ribeiro B, Aroso J, Cumming SP. Characteristics of youth soccer players aged 13-15 years classified by skill level. *Br J Sports Med*. 2007;41(5):290–5. <https://doi.org/10.1136/bjsm.2006.031294>
- [13] Helsen WF, Baker J, Michiels S, Schorer J, van Winckel J, Williams AM. The relative age effect in European professional soccer: Did ten years of research make any difference? *J Sports Sci*. 2012;30(15):1665–71. <https://doi.org/10.1080/02640414.2012.721929>
- [14] Dudink A. Birth date and sporting success [12]. *Nature*. 1994;368(6472):592. <https://doi.org/10.1038/368592a0>
- [15] Gonaus C, Müller E. Using physiological data to predict future career progression in 14- to 17-year-old Austrian soccer academy players. *J Sports Sci*. 2012;30(15):1673–82. <https://doi.org/10.1080/02640414.2012.713980>
- [16] Grondin S, Deshaies P, Nault L. Trimestres de naissance et participation au hockey et au volleyball [Internet]. Vol. 2, *La Revue Québécoise de l'Activité Physique*. 1984: pp. 97–103. Available from: [http://www.cms.fss.ulaval.ca/upload/psy\\_nouveau/fichiers/grondin\\_et\\_al\\_1984\\_rq\\_de\\_p.pdf](http://www.cms.fss.ulaval.ca/upload/psy_nouveau/fichiers/grondin_et_al_1984_rq_de_p.pdf)
- [17] Thompson AH, Barnsley RH, Battle J. The relative age effect and the development of self-esteem. *Educ Res*. 2004; 46(3):313–20. <https://doi.org/10.1080/0013188042000277368>
- [18] Gudebski M. Z orłem na piersi. 90 lat biało-czerwonych [With the eagle on one's breast. 90 years of the Polish national team]. Bełchatów: Wydawnictwo Fenix; 2012. Polish.
- [19] Gowarzewski A. Biało-Czerwoni. 1921-2018 [The Polish national team. 1921-2018]. Katowice: Wydawnictwo GiA; 2017. Polish.
- [20] Del Campo DGD, Vicedo JCP, Villora SG, Jordan ORC. The relative age effect in youth soccer players from Spain. *J Sport Sci Med*. 2010;9(2):190–8.
- [21] Lames M, Auguste C, Dreckmann C, Görsdorf K, Schimanski M. Der 'Relative Age Effect' (RAE): neue Hausaufgaben für den Sport. *Leistungssport*. 2008;38(6):4–9.
- [22] Barnett AG, Dobson AJ. Analysing Seasonal Health Data. *openaccess Publ R*. 2010. <https://doi.org/10.1007/978-3-642-10748-1>
- [23] Wiium N, Ommundsen Y, Enksen HR, Lie SA. Does relative age effect exist among Norwegian professional soccer players? *IJASS(International J Appl Sport Sci)*. 2017;22(2):66–76. <https://doi.org/10.24985/ijass.2010.22.2.66>
- [24] Fenzel LM. The effect of relative age on self-esteem, role strain, GPA, and anxiety. *J Early Adolesc*. 1992;12(3):253–66. <https://doi.org/10.1177/0272431692012003002>
- [25] Helsen WF, Starkes JL, Van Winckel J. Effect of a change in selection year on success in malesoccer players. *Am J Hum Biol*. 2002;12(6):729–35. [https://doi.org/10.1002/1520-6300\(200011/12\)12:6<729::AID-AJHB2>3.0.CO;2-7](https://doi.org/10.1002/1520-6300(200011/12)12:6<729::AID-AJHB2>3.0.CO;2-7)
- [26] Malina RM, Bouchard C, Bar-Or O. Growth, maturation, and physical activity. *Growth, Matur Phys Perform*. 2004;
- [27] Philippaerts RM, Vaeyens R, Janssens M, et al. The relationship between peak height velocity and physical performance in youth soccer players. *J Sports Sci*. 2006;24(3):221–30. <https://doi.org/10.1080/02640410500189371>
- [28] Reilly T, Bangsbo J, Franks A. Anthropometric and physiological predispositions for elite soccer. *J Sports Sci*. 2000;18(9):669–83. <https://doi.org/10.1080/02640410050120050>
- [29] Simmons C, Paull GC. Season-of-birth bias in association football. *J Sport Sci*. 2001;19: 677–86. <https://doi.org/10.1080/02640410152475801>
- [30] González-Víllora S, Pastor-Viedo JC. Relative age effect in sport: Comment on Alburquerque, et al. (2012). *Percept Mot Skills*. 2012;115(3):891–4. <https://doi.org/10.2466/25.05.PMS.115.6.891-894>
- [31] Stanaway KB, Hines TM. Lack of a season of birth effect among American athletes. *Percept Mot Skills*. 2011;81(3):952–4. <https://doi.org/10.2466/pms.1995.81.3.952>
- [32] Thompson AH, Barnsley RH, Stebelsky G. "Born to play ball". The relative age effect and major league baseball. *Sociol Sport J*. 2016;8(2):146–51. <https://doi.org/10.1123/ssj.8.2.146>

Cite this article as:

Szwarc A, Dolański B, Rompa P, Sitek M.  
 Relative age effect in Polish National Football teams  
 Balt J Health Phys Act. 2019;11(3):19-26  
 doi: 10.29359/BJHPA.11.3.03