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Original Investigation

The prevalence of Constituent Year effect in Youth Olympic Games: implications for talent identification and development in basketball

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Purpose: The Relative Age Effect (RAE) and Constituent Year Effect (CYE) is increasingly recognized as a significant concern in youth sports, especially in basketball where physical traits such as height, arm span, and leg length are emphasized. This focus often eclipses the critical role of age-related variations in talent scouting processes. This study aims to explore the presence and impact of CYE in basketball, with a specific focus on the Youth Olympic Games (YOG).
Methods: Utilizing statistical analysis, primarily the Chi-square test and Cramer's V, this research examines the occurrence of CYE among basketball players at the YOG.
Results: The findings decisively confirm the existence of CYE in youth basketball (P= .000, $\chi 2$= 51.593, df= 2, Cramer's V= .403). Results of male ($\chi 2$ = 29.342, Cramer's V: .431) and female $\chi 2$ =23.43, Cramer's V: .383) also subsample suggest a significant skew in player selection based on birth year, with a large effect size in both cases. A notable discovery is the disproportionate number of athletes born in 2000, who are 19 times more common than those born in 2002, indicating a significant age-related skew in player selection. This indicates a strong association between birth year and player selection in the context of the YOG for both genders.
Conclusions: CYE's prevalence in youth basketball could detrimentally impact athletes' development and teams' overall performance. The research emphasizes the need for a more equitable and balanced approach in athlete selection. The paper proposes practical steps to reduce CYE in basketball, such as narrowing age categories or establishing smaller, more precise age groups to ensure fairer competition and more accurate talent identification.

Key words: talent identification, talent development, talent selection, YOG, RAE, CYE

Introduction

Nowadays, youth sports are gaining increased public attention as children's lifestyles have become more sedentary due to the fourth industrial revolution. The benefits of sustained physical activity on individual health, regardless of age, have long been recognized and promoted [1,2]. With heightened public interest, topics like talent identification, sporting careers, and fairness in youth sports have become important and interesting to coaches, parents, and scientists. Scientists have identified various effects that may influence the sports careers of children and youth. In 2013, authors[3] proposed a theoretical model explaining the impact of the Matthew, Pygmalion, and Galatea effects, and their interaction with the Relative Age Effect (RAE). The Relative Age Effect is a phenomenon that occurs in almost all sports competitions, giving an advantage to those born earlier in the same year within the same category[4]. While an age difference of less than 12 months may seem insignificant for adults, it can be substantial for children[5]. The majority of children experience a Relative Age Effect in sports during their pre-adolescent and adolescent years, which favors those who mature faster over their less developed peers. Talent identification systems often confuse maturation for talent[6]. The processes of initiation, identification, and selection are crucial yet risky, and if not conducted correctly, can lead to talent dispersion[7].

The term 'Relative Age' has been extensively investigated over the past two decades, with considerable evidence gathered about the influence of RAE in sports.
Previous research on the Relative Age Effect (RAE) in basketball has uncovered concerning trends[8,9]. Studies show that approximately 75% of male and 80% of female players who participated in championships were re-selected in the following year. Closer examination revealed that players born in the last quarter of the year were 20-25% more likely to be re-selected until the age of 20, compared to those born in the first quarter8. These findings highlight the inherent risks of RAE in basketball, particularly regarding flawed selection methods. Recent data indicates that players born in the earlier months of the year are overrepresented in national youth teams, despite no significant differences in performance compared to their later-born peers[9]. Although research specifically targeting RAE in youth national basketball teams is scarce, numerous studies have documented its significant presence at the national level in various countries[10,11,12]. Internationally, RAE has been observed in the U-17 and U-19 categories at the World Basketball Championship but is notably absent among Olympic athletes[13,14]. When athletes are allocated to age categories that contain several increments or years in the same age category, e.g., YOG sports, the age span varies from 3 years. In these age bands, the effects of the relative age work over a longer time span, leading to what is known as the

constituent year effect (CYE)[15,16]. Study[15] examines constituent year effect (CYE) and race performance among junior alpine skiers in the World Championships. In various junior age cohorts competing together, variation in sking performance can be expected not only due to practice load and experience but also due to inter-individual differences in physical and psychological maturation. In cohorts with multiple age bands, the effect is termed the constituent year effect (CYE). The CYE works in principle as the RAE but can function as a magnifying lens of the development within a larger multi-year cohort. This study aims to fill this research gap by examining the occurrence of CYE among basketball players at the Youth Olympic Games.

Methods

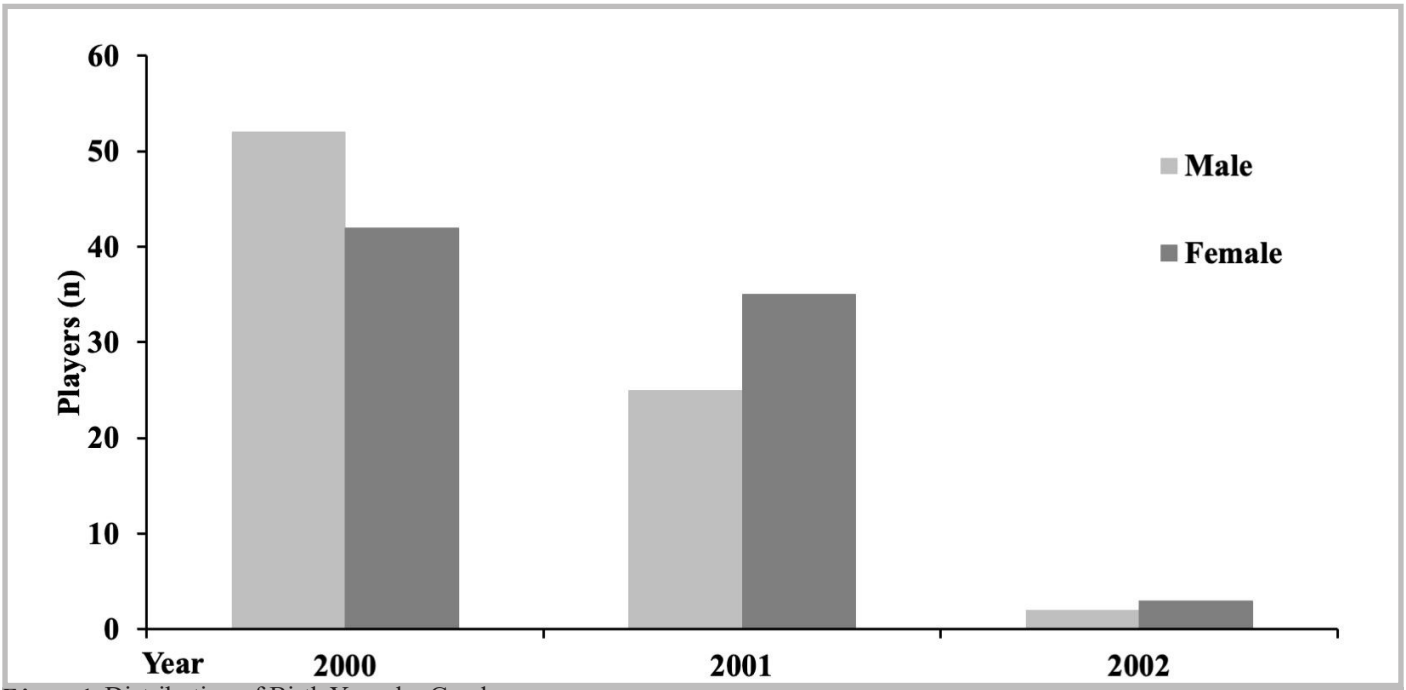
This study involved a sample of n= 159 basketball players, both male (n=79) and female (n=80), who participated in the 2018 Youth Olympic Games in 3 × 3 competition format.

The sample was further categorized by gender (Male & Female) based on their birth years into three subgroups: a) born in 2000, b) born in 2001, and c) born in 2002. The birth dates of all participants were carefully analyzed to assess the prevalence of RAE in youth basketball. Data for this study was obtained from the official Olympic World Library website[17] and was analyzed using Statistica 13.0 software (TIBCO Software Inc., Palo Alto, USA). A non-parametric Chi-square test (Pearson's $\chi 2$ test) was used to identify differences between observed and expected frequencies, with a 95% level of statistical significance ($P< .05$). Effect size measure (as Cramer's V (ϕ)) was used for interpretation according to Cohen as small < .05, medium .06 to < .24, and large 0.25).

Results

The anticipated distribution of birth years in this study would ideally be an equal representation across all four years, as is commonly observed in natural, spontaneous distributions. However, this specific investigation revealed a different outcome, with an unequal distribution of birth years for total sample and gender subsamples of participants of YOG (Figure 1).

Table 1 presents Birth year, expected frequencies, observed frequencies, $\chi 2$- Chi-square value, df- degrees of freedom, *P*-significance level, Cramer's V, Number of participants and Interpretation (Cohen) for male & female participants and for total sample of 159 players. The Chi-square test revealed significant disparities between observed and expected birth dates among the players of total sample, with a $\chi 2$ value of 51.593 and



F igure 1. Distribution of Birth Years by Gender

a significance level of $P= .000$. Specifically, players born in the year 2000 were 19 times more prevalent than those born in 2002. The year 2001 was the only year where observed frequencies closely matched expected frequencies[18].

Results of male ($\chi 2 = 29.342$, Cramer's V: .431) and female $\chi 2 =23.43$, Cramer's V: .383) subsample suggest a significant skew in player selection based on birth year, with a large effect size (table 1.) in both cases. This indicates a strong association between birth year and player selection in the context of the YOG for both genders. Additionally, certain studies[19] suggest that within each generation, talent is naturally and relatively equally distributed, theoretically leading to a consistent average talent level across generations. This implies that there shouldn't be any "talented" or "non-talented" generations. Therefore, the missed talents in the youngest generation can be quantified as the difference between the number of athletes in the underrepresented generation and the average. Conversely, the excess in the oldest generation, as determined by the difference between their athlete count and the average, represents those athletes who may have gained a competitive advantage due to earlier maturation rather than inherent talent. The representation from Table 1 of the data further underscores the significant presence of CYE in youth basketball within the Youth Olympic Games.

Discussion

Pino-Ortega at al.[20] suggests that the Relative Age Effect (RAE) occurs across different player positions and impacts overall kinematic performance parameters. Furthermore, Faber et al.[21] observed the existence of RAE both within and between years among elite competitors. In scientific work, biases exist regarding methods of determining RAE and in comparing different sports (individual and team) and age categories. Each sport has its chronological age boundaries within every age category, and these boundaries differ across sports. For instance, some sports have a three-year range in the Cadet age

Table 1. Observed vs. Expected Frequencies and Chi-square & Cramer'sV Results (n=159)

	No	By	Fo	Fe	χ 2	df	*P-value*	Cramer'sV	Interpretation
Male	79	2000	52	26	29.343	2	*<.000*	0.431	Large effect size (Cohen)
		2001	25						
		2002	2						
Female	80	2000	42	26	23.430	2	*<.000*	0.383	Large effect size (Cohen)
		2001	35						
		2002	3						
Total	159	2000	94	53	51.593	2	*<.000*	0.403	Large effect size (Cohen)
		2001	60						
		2002	5						

Legend: By – Birth year, Fe - expected frequencies, Fo - observed frequencies, χ2- Chi-square value, df- degrees of freedom, *P*- significance level, Cramer's V, No -Number of participants, Interpretation (Cohen)

category, while others span two or one year. Additionally, even within the same sport (e.g., taekwondo), the age range within the same categories varies between competition levels, with the cadet category spanning three years nationally but only two years at the international level (e.g., Youth Olympic Games). A focus on early success can eliminate potentially talented young athletes in both team and individual sports[18]. The RAE is a widespread issue that extends beyond basketball, affecting other sports like handball[22]. This study's findings support the notion that geographical and regional factors may also influence RAE in basketball at the Youth Olympic Games level. Research by Maciel et al.[23] revealed a similar RAE trend in the Santa Catarina State Basketball Championship, particularly affecting male players in the U13 category. The study[24] suggests that the training methodologies used in youth sports could further exacerbate RAE. Additionally, Generation Z's disengagement from the Olympic brand, as identified by Waseem et al.[25], could potentially impact RAE by reducing the pool of young athletes. Studies have shown that teams with a higher number of athletes born earlier in the year tend to perform better in tournaments[9]. Our findings unequivocally confirm the presence of RAE in youth basketball at the international Olympic level. Findings [26] in sample of master athlets suggest that the 5-year age categories may not provide an equal competitive opportunity especially for relatively older athletes as for those who are relatively younger, but may encour- age more strategic periodized training and participation. The overrepresentation of players born in the year 2000, which is 19 times greater than those born in 2003, leaves no doubt about of CYE existence. This age-related advantage in player selection could lead to significant disparities in various physical attributes, as seen in football and handball players[27,28]. These disparities can result in long-term negative consequences, including the loss of late-maturing talents and reduced team success. In studies by Medic et al.[29], the probability of participating in the US championships swimming and track and field was higher if the athletes were in the first and second year and lower if they were in their fourth or fifth year in the five-year age band category. This switch, in effect, can be explained by peak performance depending on the sport characteristics[30]. Therefore, addressing RAE & CYE issues proactively is crucial for participants in basketball, especially at the national team level.

Practical Applications

To reduce the impact of the Relative Age Effect (RAE) & Constituent Year Effect (CYE) in team sports like basketball, we suggest the following approaches:

a) Re-evaluate Age Categorization: Tournament organizers in team sports such as basketball should reconsider and potentially adjust the age categorization for youth categories. This means ensuring age groups are narrowly defined, ideally covering as short a period as possible, except in senior categories. Such adjustments in age group definitions can help create a more level playing field and promote fair competition, which is crucial for the development of young athletes.

b) Implement Chronological Adjustments: Adapting the approach of chronological adjustments in a team sport like basketball involves using age-related data to inform player selection and game strategy. This could include adjusting player statistics or evaluations based on their relative age, to better understand and compare performances across different age groups. While this strategy doesn't eliminate CYE, it can assist coaches and scouts in identifying and nurturing talent more equitably, ensuring that younger or late-developing players in the same age group are not overlooked.

c) Incorporate Biological Age in Talent Identification: Shifting from solely chronological age-based categorization to incorporating biological age measurements can be particularly impactful in basketball. This method provides a more accurate assessment of a player's physical and developmental maturity, ensuring that selections and training are tailored to their actual growth stage. It could involve assessments like bone age, physical maturity, or other physiological metrics to offer a more comprehensive view of an athlete's development. This approach aims to minimize the disadvantages faced by younger or later-maturing athletes within the same age group, fostering a more inclusive and effective talent development environment.

These practical applications, when thoughtfully implemented, can help mitigate the impact of RAE in basketball and similar team sports, leading to a more equitable and effective system for identifying and developing young athletic talent.

Conclusions

The findings decisively confirm the existence of CYE in youth basketball (P= .000, $\chi 2$= 51.593, df= 2, Cramer's V= .403). Results of male ($\chi 2$ = 29.342, Cramer's V: 0.431) and female $\chi 2$ =23.43, Cramer's V: .383) also subsample suggest a significant skew in player selection based on birth year, with a large effect size (Table 1.) in both cases. A notable discovery is the disproportionate number of athletes born in 2000, who are 19 times more common than those born in 2002, indicating a significant age-related skew in player selection. This indicates a strong association between birth year and player selection in the context of the YOG for both genders.CYE's prevalence in youth basketball could detrimentally impact athletes' development and teams' overall performance. The research emphasizes the need for a more equitable and balanced approach in athlete selection. The paper proposes practical steps to reduce CYE in basketball, such as narrowing age categories or establishing smaller, more precise age groups to ensure fairer competition and more accurate talent identification. The overwhelming prevalence of players born in the year 2000 compared to those born in 2002 highlights the urgent need for reform in selection processes. Competitors in basketball can have as much as a three-year age difference between them. It's crucial for basketball coaches to be mindful of these age-related issues to minimize errors in selection and strategy that could result in the loss of talented players from a club or team standpoint. Additionally, such disparities could lead to athletes potentially leaving their clubs or abandoning the sport altogether. This study suggests that the RAE is primarily a concern at the national level and within national teams, warranting immediate attention from officials. Potential solutions include limiting the number of eligible age groups, subdividing existing age categories and Incorporating Biological Age in Talent Identification process. Future research should not only focus on the variations of RAE across different sports within the Youth Olympic Games and among different positions in basketball, analyzed by gender, but also benefit from determining whether the obtained results are general or specific to certain playing positions.

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Ethical Committee approval

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Informed Consent Statement

Not applicable.

Conflicts of interest

The authors confirm there is no conflict of interest.

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Declaration if used ChatGPT

We didn't used ChatGPT.

Author-s contribution

Conceptualization,M.B. and D.Č.; methodology, D.Č.; software, M.B. and I.G.; validation, M.B. and D.Č.; formal analysis, M.B.and A.M..; investigation, A.M.;resources, D.Č. and A.M.; data curation, D.Č. and A.M.; writing—original draft preparation, M.B.and A.M.; writing—review and editing, D.Č. and M.B.; visualization, M.B.and A.M.; supervision, D.Č.; project administration, M.B. All authors have read and agreed to the published version of the manuscript.

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