Journal of Sport and Health Research 2020, 12(3):420-429

Sentone, R. G.; Caetano, C. I.; López-Gil, J. F.; Cavichiolli, F. R. (2020). Relatioship between the population size of cities and the sports performance of brazilian swimmers. *Journal of Sport and Health Research. 12*(3):420-429.

Original

RELACIÓN ENTRE EL TAMAÑO DE POBLACIÓN DE LAS CIUDADES Y EL DESEMPEÑO DEPORTIVO DE LOS NADADORES BRASILEÑOS

RELATIOSHIP BETWEEN THE POPULATION SIZE OF CITIES AND THE SPORTS PERFORMANCE OF BRAZILIAN SWIMMERS

Sentone, R. G.[1]; Caetano, C. I. [1]; López-Gil, J. F. [2]; Cavichiolli, F. R. [1].

[1]Federal Unversity of Paraná State – Curitiiba/Paraná/Brazil

[2]Murcia Unversity – Murcia/ Spain

Correspondence to:
Sentone, Rafael Gomes
Federal University of Paraná State
Rua Tenente Djalma Dutra, 1257, apto 901, Centro, São José dos Pinhais/Paraná/Brazil
Tel.+55 41 984640986

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

editor@journalshr.com

Received: 02/08/2019
Accepted: 20/01/2020

Journal of Sport and Health Research 2020, 12(3):420-429

RESUMEN

Objetivo: analizar la influencia del tamaño poblacional en relación con el número de atletas de natación brasileños, así como las posibilidades de tener mejores resultados deportivos. **Métodos**: la muestra fue compuesta por atletas de natación masculinos y femeninos brasileños, incluidos en el ránking de la Confederación Brasileña de Deportes Acuáticos (CBDA) entre los años 2013 y 2017. Se categorizaron las ciudades por tamaño de población, de acuerdo con el Instituto Brasileño de Geografía y Estadística: categoría 1 (> 500,000), categoría 2 (100,001 – 500,000), categoría 3 (50,001 – 100,000), categoría 4 (20,001 – 50,000), categoría 5 (<20,001). **Resultados**: para las ciudades con más de 500,000 habitantes (categoría 1) se encontró una mayor probabilidad de que un atleta de natación pueda tener un alto rendimiento en esta modalidad (OR = 5.53; $IC_{95\%}$ = 5.32-5.75). **Conclusión**: los resultados del presente estudio demonstró que existe una relación entre el tamaño de la población de las ciudades brasileñas, especialmente para las ciudades más pobladas. Sugerimos que las políticas públicas para el deporte en las ciudades menos pobladas podrían aumentar las posibilidades de tener alto rendimiento en natación.

Palabras clave: Nadar; Prueba de rendimiento; Censo; Densidad poblacional; Rendimiento deportivo.

ABSTRACT

Objective: analyse the influence of population size in relation to the number of Brazilian swimming athletes, as well as the chances of having better results,. **Methods:** the sample was composed of Brazilian male and female swimming athletes, included in the ranking of the Brazilian Confederation of Aquatic Sports (CBDA) between 2013 and 2017. Categorization of cities by population was used, according to the Brazilian Institute of Geography and Statistics: category 1 (> 500,000), category 2 (100,001 – 500,000), category 3 (50,001 – 100,000), category 4 (20,001 – 50,000), category 5 (<20,001). **Results:** for cities with more than 500,000 inhabitants (category 1) a higher probability was found for a swimming athlete could have high-performance results (OR = 5.53; $CI_{95\%}$ = 5.32-5.75). **Conclusion:** the results of this study demontrated that there is a relationship between population size of Brazilian cities especilly for more populous cities. We suggest that public policies for sport in less populated cities could increase the chances of having high performance in swimming.

Keywords: Swimming; Performance Tests; Censuses; Population Density; Sports Performance.

Journal of Sport and Health Research 2020, 12(3):420-429

INTRODUCTION

Researches on predictors of sports talent are currently in vogue in the scientific community. Faber et al. (2016), on the subject of racquet sports, have identified that most of the studies rely on physical, social and psychological measuring instruments, and not on necessary instruments that measure multidimensional characteristics for talent development.

The influence of different factors oin the performance of athletes (Kalani, Elahi, Nasrollah-Sajjadi & Zareian, 2019), such as the relationship between parents and they children is one of the study perspectives for undertending sports performance. Deepening in thes field, studies were developed seeking globally established indexes.

In the social field, progress has been achieved on demographic indexes that relate sports performance to athletes relative age, birthdate, and birthdate quartile (Arrieta, Torres-Unda, Gil & Irazusta, 2016; Brazo-Sayavera, Martínez-Valencia, Müller, Andronikos & Martindale, 2017; Ishigami, 2015; Knechtle et al., 2017; Júnior, Alves, Galatti & Marques, 2017; Jones, Lawrence & Hardy, 2018; Reid, Morgan, Churchill & Bane, 2014; Romann, Rössler, Javet & Faude, 2018; Teixeira et al., 2018; Sentone, López-Gil, Caetano & Cavichiolli, 2019; Caetano, Sentone, López-Gil, Caetano & Cavichiolli, 2020), concerning the reality of several sports modalities such as baseball, soccer, athletics, tennis and cricket, in various countries in Asia, Europe and North America.

Although the effects of age and date of birth have been widely studied, Ishigami (2016) evaluates that studies comparing the size of the population are better suited to indicate the chances of becoming a high-end athlete. Knechtle et al. (2017) also considered that such studies need to explore the place and country of birth. Population size is a relevant association variable and it is also studied in several fields such economy (Tran, Kortt & Dollery, 2018), biology (Yu & Lu, 2019), politics (van Houwelingen, 2017), medicine (Datta et al., 2019) and sports (Côté, Macdonald, Baker & Abernethy, 2006; da Costa, da Silva & Garganta, 2013; Hancock, Coutinho, Côté & Mesquita, 2018; MacDonald et al., 2009; Turnnidge, Hancock & Côté, 2014).

Côté et al. (2006) identified that, in Canada, cities from 50,000 to 100,000 inhabitants raised better hockey, basketball, baseball and golf athletes, arguing that smaller cities have better conditions to their development. MacDonald et al. (2009) described eight contextual factors that promote the development of young talents in sport: physical and psychological security, appropriate structure, good relationships, sense of belonging, positive social norms, efficient support, opportunity for skill building and family, school and community integration. These factors are commonly found in smaller cities (Bale, 2003; Côté et al., 2007; Hancock & Côté, 2014; Kyttä, 2002).

MacDonald et al. (2009) researched about golf and soccer athletes in the United States, finding out that the best athletes in these sports are in cities smaller than 1,000,000 and 250,000 inhabitants respectively. In Brazil (Costa, Cardoso & Garganta, 2013) the best soccer players are born in cities with a population of less than 200,000 inhabitants; and in Portugal, Hancock et al. (2018) found out that cities ranging from 200,000 to 4000,000 stand with 2.4 times more chances of having professional volleyball players.

Baker et al. (2009) found that the ideal size of cities to raise Olympic athletes ranges from 10,000 to 29,999 in the United Kingdom, from 250,000 to 499,999 in the USA, from 1,000,000 to 2,499,999 in Canada and from 2,500,000 to 4,999,999 in Germany, suggesting that the effects of the country are influenced by factors such as the specificity of each sport, and sociocultural and geographic variables. Hence, different sports in different countries may depend on specific population sizes, allowing or not the raise of better athletes.

Considering the sociodemographic researches that are being carried out, aiming to relate the detection of athletes with sports results and the recent findings about the population size, the objective of this study was to analyse the influence of population size in relation to the number of Brazilian swimming athletes, as well as the chances of having better results, to improve the understanding of researches that sustain the effects of population size in Brazil.

Journal of Sport and Health Research 2020, 12(3):420-429

METHODS

Participants

The present research was submitted and approved by the Ethics Committee of the Health Sciences Sector of the Federal University of Paraná (nº 2405344).

The data refer to Brazilian male and female swimming athletes in the Brazilian Confederation of Aquatic Sports (CBDA) ranking between 2013 and 2017. The database included 113,820 competition results, with 12,271 swimmers, 7,039 (57.3%) male and 5,232 (42.6%) female, ranged from 9 to 63 years old divided in 11 age categories (Mirin1 - 9 years, Mirin 2 – 10 years, Petiz 1 – 11 years, Petiz 2 – 12 years, Infantil 1 – 13 years, Infantil 2 – 14 anos, Juvenil 1 – 15 anos, Juvenil 2 – 16 anos, Júnior 1 – 17 years, Júnior 2 – 18/19 years, Sênior – 20 years or more). We selected all athletes who had enough performance to be classified in the Brazilian ranking, which is unique from 1 to 100. We assume that the place where athletes live is the same where they train - a standard practice in the literature that studies the effects of the place of birth (for example Côtè et al., 2006). Due to the large number of athletes and the variety of ages and rankings, we disregarded whether the athlete had a high or low competitive level because there was no tool that could neither categorize nor prove it.

Measures

We used the 2015 Brazilian census information, the most updated one, once Brazil is a country with great territorial extension and population size. The 2015 census provided the figures of people living in each of the 5,570 Brazilian cities, and in each of the 27 states, all legally registered as independent entities. The smallest city in this study has 2,707 inhabitants and the largest has 11,253,503 inhabitants.

In addition, the last methodology of categorization of cities by population was used, according to the Brazilian Institute of Geography and Statistics (IBGE): category 1 (> 500,000), category 2 (100,001 – 500,000), category 3 (50,001 – 100,000), category 4 (20,001 – 50,000), category 5 (<20,001). In category 5, we incorporated the categories (< 5,000) and (5,001 - 10,000) inhabitants. In the present study, the categories absorbed represent 3 athletes, 0.4% of the universe of athletes. The population considered for the study (IBGE, 2015) estimated the Brazilian population in 204,5 million inhabitants.

Analysis

To verify the normality between the number of athletes and the different categories, the Kolmogorov-Smirnov test was used, showing absence of normality in all categories (p<.05). In this line, the Kruskal-Wallis H test was used for the different population categories, as well as the size of the effect on the sample, using epsilon squared (Kelley, 1935; Tomczak & Tomczak, 2014; Rosenthal, 1991); according to Cohen (1988) interpretation (0-0.01 = no effect, 0.01-0.09 = small; 0.09 – 0.25 = intermediate; > 0.25 = large).

On the other hand, post-hoc tests were performed by the Mann–Whitney U test in the groups where p <0.05 was obtained. Significance values were adjusted by Bonferroni correction for several tests. Also, Rosenthal's r (1991) was used to calculate the effect size on the sample and to find out whether these differences are large according to Cohen's (1977) interpretation (0-0.1 = no effect, 0.1-0.3 = small; 0.3-0.5 = intermediate; >0.5 = large).

In addition, odds ratios (OR) were calculated to determine the probability of participants being present in the database. According to the preliminary result, OR greater than 1.0 ($CI_{95\%}$) indicated that a given category would provide greater conditions for high swimming performance. On the other hand, ORs less than 1.0 ($CI_{95\%}$) showed that a given category implies less chances of having a higher swimming performance. When the OR ($CI_{95\%}$) approach 1.0, it indicates a lack of association between the variables.

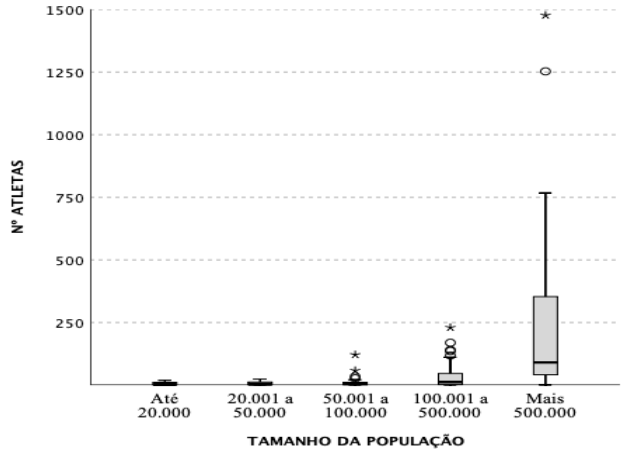
All analyses were performed using software SPSS version 21 and Microsoft Excel 2010, maintaining the level of significance at 5%.

RESULTS

In the analysis of Brazilian cities, the Kruskal-Wallis H test showed statistically significant differences among population categories (H = 47.334, p <.001) (Graph 1); being 25% (ε^2 = 0.25) the proportion of variability in the number of athletes that can be attributed to the size of the population, and it is 25% (intermediate effect). The ORs had no significance

Journal of Sport and Health Research 2020, 12(3):420-429

when applied between male and female swimmers, indicating identical patterns. For this reason, a gender-stratified analysis is not shown



Graphic 1. Comparison between the number of swimming athletes and different categorized cities.

In this line, post-hoc tests were performed using Mann–Whitney *U* test with Bonferroni correction to adjust the significance values. The cities of categories 2, 3, 4 and 5 presented significant differences when compared with category 1. The size of the effect was considered intermediate for categories 2 and 5, and large for categories 3 and 4 according to Rosenthal's *r* (1991) (Table 1).

Table 1. Comparisons post-hoc and effect size in the population according to the number of swimming athletes in Brazil (n=12,271).

Population size	More than 500,000		
	U	*p*	*r*
100,001 - 500,000	50.78	<.001**	0.45
50,001 - 100,000	79.03	<.001**	0.63
20,001 - 50,000	80.41	<.001**	0.61
Up to 20,000	88.65	.023*	0.40

*$p \leq .050$; **$p \leq .001$.

In addition, ORs indicated similar patterns for categories 2, 3, 4 and 5 (cities up to 500,000 inhabitants), being higher in category 1 (Table 2). Category 2 indicated that in those cities there is no relation between the number of athletes and the sports performance (OR = 0.95, $CI_{95\%}$ = 0.92-0.99). In category 3 (OR = 0.26, $CI_{95\%}$ = 0.23-0.28), category 4 (OR = 0.05, $CI_{95\%}$ = 0.05-0.06) and category 5 (OR = 0.01, $CI_{95\%}$ = 0.01-0.02), there was a strong negative association between variables. Finally, for cities with more than 500,000 inhabitants (category 1) a strong association was indicated, with 5.53 times more chances of a swimming athlete having high performance results ($CI_{95\%}$ = 5.32-5.75) (Table 2).

Table 2. Odds ratios (OR) and the confidence interval (IC95%) of the different population categories.

Population size	Population		Athlete		OR	$IC_{95\%}$
	n	%	n	%		
More than 500,000	61,145,500	29.9	8,617	70.2	5.53	5.32-5.75
100,001 a 500,000	53,374,500	26.1	3,092	25.2	0.95	0.92-0.99
50,001 a 100,000	24,335,500	11.9	410	3.3	0.26	0.23-0.28
20,001 a 50,000	33,129,000	16.2	127	1.0	0.05	0.05-0.06
Até 20,000	32,515,500	15.9	25	0.2	0.01	0.01-002

DISCUSSION

Using the size of Brazilian cities in terms of number of inhabitants and the number of Brazilian swimming athletes, the objective of this study was to analyse the influence of population size in relation to the number of swimming athletes, as well as the chances of having higher sports performance. The data were compared among Brazilian swimmers of the national ranking in all age categories and swimming competitions, and the cities where they live, categorized by population size. The cities of categories 4 and 5 had proportionally less athletes than other categories, without equivalent results in scientific literature.

According to the results, Brazilian cities with more than 500,000 inhabitants (category 1) provide necessary infrastructure for sports success of swimming athletes, unlikely the findings of other authors, in smaller cities (Costa, Cardoso & Garganta, 2013).

We emphasize that the present study handled a more complex population in terms of age range, bigger number of cities and a longer time period of ranking. Because we studied an individual modality (swimming), it allowed the analysis of performance

Journal of Sport and Health Research 2020, 12(3):420-429

of each athlete, as demonstrated by statistical method. We re-adjusted the study to use the most recent demographic census since athletes developed along with the cities where they lived, unlike other studies that used the census of previous years.

Thus, the findings of this research are in line with the results of Baker et al. (2009) for athletes from the United States and Germany in cities with more than 500,000 inhabitants and for athletes of Brazilian artistic gymnastics (Caetano, Sentone, López-Gil, Caetano & Cavichiolli, 2020).

The findings os this study corroborate with Sentone *et al*. (2019) considering that swimming athletes are the most populous cities, as well as those in which the index of general human development, longevity, income and education are higher, especially the HDI income, six times more likely to have a swimming athlete in Brazil.

One of the shortcomings corrected in the present study was to consider athletes of all ages, unlike that performed by Hancock et al. (2018), analysing only adults. As a limiting factor, we found that previous researches were performed in countries smaller than Brazil, therefore our cities categories differ from those, which may compromise the comparison. However, starting from this first analysis, it is possible that researchers may apply different methods to expand understanding of presented results.

One limitation was the availability of data, ranging only from 2013 to 2017, due to a policy stablished by the research group. In this line, we recommend for future researches to look for up-to-date information or a longer period of time.

A further limitation of the research is the absence of relation between data and population density, since the last Brazilian census did not categorize cities according to their population density. However, this classification can be made with categories from 2010 census.

CONCLUSIONS

The findings of the present study demontrated that there is a relationship between population size of Brazilian cities especilly for more populous cities. We suggest that public policies for sport in less populous cities can have results on increasing the chances of high swimming performance.

The present study comprised an epidemiological research on the social structure of geographically distinct cities in Brazil. We consider the possibility that similar studies may be carried out for other sports, therefore we can confirm or dismiss the findings of this research, as well as results from other countries, given the peculiarity of Brazil as one of the biggest and most populous countries in the world.

Despite the result, the population size cannot be considered, itself, a prediction of athletes in Brazil. Therefore, we suggest that similar researches shall be carried out, in order to verify the relations with population density, date of birth and other geographic variables, extending the research to other sports modalities and comparative studies of Brazil with other countries.

ACKNOWLEDGEMENTS

Financing

This research was financed by the Brazilian Ministry of Sport (ME) through a project called Sport Intelligence, conducted by the Federal University of Paraná (UFPR). In addition, we had the collaboration of a researcher from University of Murcia (Spain), who was carrying out a dual doctoral degree, with international joint supervision between both universities (Extract of cooperation term 72/2018 – Case 23075.023034 \ 2018-31).

REFERENCES

1. Arrieta, H., Torres-Unda, J., Gil, S. M., & Irazusta, J. (2016). Relative age effect and performance in the U16, U18 and U20 European Basketball Championships. *Journal of Sports Sciences*, *34*(16), 1530–1534. https://doi.org/10.1080/02640414.2015.1122204

2. Baker, J., Schorer, J., Cobley, S., Schimmer, G., & Wattie, N. (2009). Circumstantial development and athletic excellence: The role of date of birth and birthplace. *European Journal of Sport Science*, *9*(6), 329–339. https://doi.org/10.1080/17461390902933812

3. Bale, J. (2003). *Sports geography* (2nd ed.).

New York, USA: Routledge.

4. Brazo-Sayavera, J., Martínez-Valencia, M. A., Müller, L., Andronikos, G., & Martindale, R. J. (2017). Identifying talented track and field athletes: The impact of relative age effect on selection to the Spanish National Athletics Federation training camps. *Journal of Sports Sciences*, *35*(22), 2172–2178. https://doi.org/10.1080/02640414.2016.1260151

5. Da Costa, I. T., da Silva, F., & Garganta, J. (2013). O Índice de Desenvolvimento Humano e a Data de Nascimento podem condicionar a ascensão de jogadores de Futebol ao alto nível de rendimento? Motriz: Journal of Physical Education, *19*(1), 34–45. https://doi.org/10.1590/S1980-65742013000100004

6. Caetano, C. I., Sentone, R. G., López-Gil, J. F., Caetano, H. B. S. & Cavichiolli, F. R. Influence of population size and density on sports performance of Brazilian artistic gymnastics. Retos, 38, 66-70.

7. Cohen, J. (1977*). Statistical power analysis for the behavioral science*. New York, USA: Academic Press.

8. Côté, J., Baker, J., & Abernethy, B. (2007). Practice and play in the development of sportexpertise. In G. Tenenbaum & R. C. Eklund (Eds.), *Handbook of sport psychology* (3rd ed.) (pp. 184–202). Hoboken, New Jersey, USA: Wiley.

9. Côté, J., Macdonald, D. J., Baker, J., & Abernethy, B. (2006). When "where" is more important than "when": Birthplace and birthdate effects on the achievement of sporting expertise. *Journal of Sports Sciences*, *24*(10), 1065–1073. https://doi.org/10.1080/02640410500432490

10. Datta, A., Lin, W., Rao, A., Diouf, D., Kouame, A., Edwards, J. K., …, & Baral, S. (2019). Bayesian Estimation of MSM Population Size in Côte d'Ivoire. *Statistics and Public Policy*, *6*(1), 1–13. https://doi.org/10.1080/2330443X.2018.1546634

11. Faber, I. R., Bustin, P. M. J., Oosterveld, F. G. J., Elferink-Gemser, M. T., & Nijhuis-Van der Sanden, M. W. (2016). Assessing personal talent determinants in young racquet sport players: a systematic review. *Journal of Sports Sciences*, *34*(5), 395–410. https://doi.org/10.1080/02640414.2015.1061201

12. Hancock, D. J., Coutinho, P., Côté, J., & Mesquita, I. (2018). Influences of population size and density on birthplace effects. *Journal of Sports Sciences*, *36*(1), 33–38. https://doi.org/10.1080/02640414.2016.1276614

13. Hancock, D. J., & Côté, J. (2014). Birth advantages, social agents, and talent development in youth sport. Em A. R. Gomes, R. Resende, & A. Albuquerque (Eds.), *Positive human functioning from a multidimensional perspective: Promoting high performance* (pp. 15–32). New York, USA: New Publishers.

14. Júnior, V. R., Alves, I. V., Galatti, L. R., & Marques, R. F. (2017). The relative age effect on Brazilian elite futsal: men and women scenarios. Motriz: *Journal of Physical Education*, *23*(3), e101704. http://.doi.org/10.1590/S1980-6574201700030016

15. Instituto Brasileiro de Geografia e Estatística (2015). *Estimativa da população dos municípios e unidades da federação brasileiros*. Retrieved from: https://www.ibge.gov.br/estatisticas/sociais/populacao/9103-estimativas-de-populacao.html?=&t=o-que-e

16. Ishigami, H. (2016). Relative age and birthplace effect in Japanese professional sports: a quantitative evaluation using a

Bayesian hierarchical Poisson model. *Journal of Sports Sciences*, *34*(2), 143–154. https://doi.org/10.1080/02640414.2015.1039462

17. Jones, B. D., Lawrence, G. P., & Hardy, L. (2018). New evidence of relative age effects in "super-elite" sportsmen: a case for the survival and evolution of the fittest. *Journal of Sports Sciences*, *36*(6), 697–703. https://doi.org/10.1080/02640414.2017.1332420

18. Kalani, A., Elahi, A., Nasrollah-Sajjadi, S. & Zareian, H. Cuáles son los factores que influyen en el proceso de identificación de talentos deportivos de Irán? Hallazgos de un estudio cualitativo. (2019). *SPORT TK-Revista EuroAmericana De Ciencias Del Deporte*, *8*(2), 103-112. https://doi.org/10.6018/sportk.391831

19. Kelley, T. L. (1935). An Unbiased Correlation Ratio Measure. *Proceedings of the National Academy of Sciences of the United States of America*, *21*(9), 554–559. Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1076656/pdf/pnas01761-0040.pdf

20. Knechtle, B., Aschmann, A., Onywera, V., Nikolaidis, P. T., Rosemann, T., & Rüst, C. A. (2017). Performance and age of African and non-African runners in World Marathon Majors races 2000–2014. *Journal of Sports Sciences*, *35*(10), 1012–1024. https://doi.org/10.1080/02640414.2016.1209302

21. Kyttä, M. (2002). Affordances of children's environments in the context of cities, small towns, suburbs, and rural villages in Finland and Belarus. *Journal of Environmental Psychology*, *22*(1–2), 109–123. https://doi.org/10.1006/jevp.2001.0249

22. MacDonald, D. J., Cheung, M., Côté, J., & Abernethy, B. (2009). Place but not Date of Birth Influences the Development and Emergence of Athletic Talent in American Football. *Journal of Applied Sport Psychology*, *21*(1), 80–90. https://doi.org/10.1080/10413200802541868

23. MacDonald, D. J., King, J., Côté, J., & Abernethy, B. (2009). Birthplace effects on the development of female athletic talent. *Journal of Science and Medicine in Sport*, *12*(1), 234–237. https://doi.org/10.1016/j.jsams.2007.05.015

24. Reid, M., Morgan, S., Churchill, T., & Bane, M. K. (2014). Rankings in professional men's tennis: a rich but underutilized source of information. *Journal of Sports Sciences*, *32*(10), 986–992. https://doi.org/10.1080/02640414.2013.876086

25. Revuelta, L., Garcia, N. A. & Rey-Baltar, A. Z. (2017). Apoyo parental para la práctica físico-deportiva. Diferencias en función del sexo y nível de práctica. *Sportis: Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad*, 3(2), 272-285. https://doi.org/10.17979/sportis.2017.3.2.1769

26. Romann, M., Rössler, R., Javet, M., & Faude, O. (2018). Relative age effects in Swiss talent development – a nationwide analysis of all sports. *Journal of Sports Sciences*, *36*(17), 2025–2031. https://doi.org/10.1080/02640414.2018.1432964

27. Rosenthal, R. (1991). *Meta-analytic procedures for social research* (Rev. ed). Newbury Park (California), USA: Sage Publications.

28. Sentone, R. G., López-Gil, J. F., Caetano, C. I., Cavichiolli, F. R. Relationship between human development index and the sport results of Brazilian swimming athletes. *Journal of Human Sport and Exercise*, v. 14, p. S2009-S2018, 2019. http:// doi:10.14198/jhse.2019.14.Proc5.22

29. Teixeira A. S. & Silva J. F. & Santos P. C. & Salvador P. C. & Campos F. S. & Lucas R. D. & Guglielmo L. G. (2018). Relative age effect,

skeletal maturation and aerobic running performance in youth soccer players. Motriz: Journal of Physical Education, *24*(4), e101864. *http://doi.org/10.1590/S1980-6574201800040018*

30. Tomczak, M., & Tomczak, E. (2014). The need to report effect size estimates revisited. An overview of some recommended measures of effect size. *TRENDS in Sport Sciences*, *1*(21), 19-25. Retrieved from : http://www.tss.awf.poznan.pl/files/3_Trends_Vol21_2014__no1_20.pdf

31. Tran, C., Kortt, M., & Dollery, B. (2018). Population size or population density? An empirical examination of scale economies in South Australian local government, 2015/16. *Local Government Studies*, *45*(5), 632–653. https://doi.org/10.1080/03003930.2018.1501364

32. Turnnidge, J., Hancock, D. J., & Côté, J. (2014). The influence of birth date and place of development on youth sport participation: Contextual factors and sport participation. *Scandinavian Journal of Medicine & Science in Sports*, *24*(2), 461–468. https://doi.org/10.1111/sms.12002

33. Van Houwelingen, P. (2017). Political participation and municipal population size: A meta-study. *Local Government Studies*, *43*(3), 408–428. https://doi.org/10.1080/03003930.2017.1300147

34. Ventura-León, J. L. (2017). Tamaño del efecto para Kruskal-Wallis: aportes al artículo de Domínguez-González et al. *Investigación en Educación Médica*. https://doi.org/10.1016/j.riem.2017.07.002

35. Yu, L., & Lu, J. (2019). Effects of population size and structure on reproductive success of a *Pistacia chinensis* population. *Plant Biosystems - An International Journal Dealing with All Aspects of Plant Biology*, 1–8. https://doi.org/10.1080/11263504.2019.1578280