BIRTHPLACE OF BRAZILIAN ATHLETES WHO COMPETED IN TOKYO 2020 AND THE STATES VARIABLES RELATED TO THE CHANCES OF BEING A MEDALIST

Abstract - The purpose of this study was to describe the birthplace of Brazilian Tokyo 2020 Olympic athletes, and to investigate the states-related variables associated with winning an Olympic medal. Data were collected based on the Brazilian Olympic Committee official list of athletes competing at the Tokyo 2020 Olympic Games and from ESTADIC research (2016) and Brazilian Institute of Geography and Statistics (IBGE). Binary Logistic Regression was used with the purpose to estimate the chances of the states have athletes who won an Olympic medal. All the analysis was performed in JAMOVA, considering $p<0.05$. Sample comprised 303 athletes, from the five Brazilian regions. The model comparisons indicated that the second model was the best to explain the chances of the state have an athlete who won an Olympic medal (Model 2 versus Model 1: $\chi^2 = 21.41$; $p<0.001$; Model 3 versus Model 2: $\chi^2 = 2.77$; $p = 0.429$). So, age (OR= 0.91; CI95% = -0.15 – -0.2) and to be part in team sports (OR= 4.36; CI95% = 0.80 – 2.15) are associated with chances to winning an Olympic medal. The most of Brazilian Olympic athletes in Tokyo 2020 were born in Southeast region, especially in São Paulo and Rio de Janeiro states. The best model to explain associations with chances to winning a medal was composed to meso-level variables, and it was not found significant association between the macro-level characteristics investigated with the chances to be a medalist.

Keywords: athletes; Olympic Games; predictors of performance.

LOCAL DE NASCIMENTO DOS ATLETAS BRASILEIROS DE TÓQUIO 2020 E VARIÁVEIS DOS ESTADOS RELACIONADAS A CHANCE DE SER MEDALHISTA

Resumo - O objetivo deste estudo foi descrever o local de nascimento dos atletas olímpicos brasileiros de Tóquio 2020 e investigar as variáveis dos estados associadas à conquista de medalha olímpica. Os dados foram obtidos a partir da lista oficial do Comitê Olímpico Brasileiro de atletas selecionados para os Jogos Olímpicos de Tóquio 2020, através da pesquisa ESTADIC (2016) e Instituto Brasileiro de Geografia e Estatística (IBGE). Regressão Logística Binária foi utilizada para estimar as chances de os estados terem atletas que conquistaram medalha olímpica. As análises foram realizadas no Software JAMOVA, considerando $p<0,05$. A amostra foi composta por 303 atletas, das cinco regiões brasileiras. O segundo modelo foi o que melhor explicou as chances de o estado ter um atleta medalhista olímpico (Modelo 2 versus Modelo 1: $\chi^2 = 21,41$; $p <0,001$; Modelo 3 versus Modelo 2: $\chi^2 = 2,77$; $p = 0,429$). Assim, idade (OR = 0,91; IC95% = -0,15 - -0,2) e prática de esportes coletivos (OR = 4,36; IC95% = 0,80 – 2,15) foram associados às chances de conquista de medalha olímpica. A maioria dos atletas brasileiros em Tóquio 2020 nasceram na região Sudeste, principalmente nos estados de São Paulo e Rio de Janeiro. O melhor modelo para explicar as associações com chances de ser medalhista foi composto por variáveis de nível meso, e não foi encontrada associação significativa entre características de nível macro investigadas com chances de ser medalhista olímpico.

Palavras-chave: atletas; Jogos Olímpicos; preditores de performance.

LUGAR DE NACIMIENTO DE LOS DEPORTISTAS BRASILEÑOS EN TOKIO 2020 Y VARIABLES RELACIONADAS CON LA POSIBILIDAD DE SER MEDALLISTA

Resumen - El objetivo de este estudio fue describir el lugar de nacimiento de los atletas olímpicos brasileños en Tokio 2020 e investigar las variables de los estados asociados con la obtención de medalla olímpica. Los datos se recopilaron con base en la lista oficial del Comité Olímpico Brasileño, la encuesta ESTADIC (2016) y del Instituto Brasileño de Geografía y Estadística (IBGE). Regresión logística binaria fue utilizado para estimar las posibilidades de que los estados tengan atletas medallista olímpico. Los análisis se realizaron con el software JAMOVA, considerando $p<0.05$. La muestra estuvo compuesta por 303 deportistas, de las cinco regiones brasileñas, distribuidos en 21 estados y el Distrito Federal. El segundo modelo fue lo que mejor explicó las posibilidades de que el estado tenga medallista olímpico (Modelo 2 versus Modelo 1: $\chi^2=21,41$; $p<0,001$; Modelo 3 versus Modelo 2: $\chi^2=2,77$; $p=0,429$). Así, la edad (OR=0,91; IC del 95%=-0,15 - -0,2) y la práctica de deportes de equipo (OR=4,36; IC del 95%=0,80 - 2,15) se asocian con las posibilidades de ganar medalla olímpica. La mayoría de los deportistas brasileños en Tokio 2020 nacieron en la región Sudeste, principalmente en los estados de São Paulo y Río de Janeiro. El mejor modelo para explicar las asociaciones con las posibilidades de ser medallista se fue composto de variables de nivel meso, y no se encontró asociación significativa entre las características de nivel macro investigadas y las posibilidades de ser medallista.

Palabras-clave: deportistas; Juegos Olímpicos; predictores.

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Introduction

High-level sports performance is one of the main topics investigated in sports science. While most of the researches have adopted an athlete-centered approach, aiming to understand the individual-level factors associated with sports performance[1-3], in sports management field, few researches were conducted with the purpose to understand the role of contextual variables in the sport success[4]. These variables are hierarchically organized, comprising different levels, which should be considered to a better understanding of sports success[5, 6].

In an international approach, Bosscher et al.[7] proposed that the international high-level performance is influenced by variables organized into three different levels, which were called as micro-level (e.g., athletes and training characteristics), meso-level (e.g., sports policies), and macro-level (e.g., sports culture, socioeconomic and demographic). Further, the authors also indicated that macro-level factors (e.g., population, human development index, and political regime) explain half of the differences in the international sports performance between countries[8]. In addition, previous studies showed that birthplace is associated with the development of elite athlete[9-11]. In summary, these results are associated with the chances to be exposed to an enabling environment, i.e., sports development programs, coach qualification, and financial support to clubs and athletes training.

Brazil is one of the largest countries in the world. This dimension is expressed by the differences observed between its states regarding to population size and density, Human Development Index (HDI), violence rate, and natural and built environment characteristics. Moreover, differences regarding the existence of places to sports practice, talent development programs, and public sports polices[4,12,13] can play a relevant role in the development of an environment able to promote the athletes' development. A research conducted at a national level, showed that Southeast and South regions are pointed as being those with the friendliest environment for physical activity practice[14], which can positively impact in the sport development. In addition, these regions concentrate the highest number of sports clubs' and host the most important sports events in the country. Thus, the purpose of this study was to describe the birthplace of Brazilian Tokyo 2020 Olympic athletes, and to investigate the states-related variables associated with winning an Olympic medal.

Methods

This is an exploratory study, whose data were collected based on the Brazilian Olympic Committee official list of athletes competing at the Tokyo 2020 Olympic Games. Sample comprised 303 athletes (men: 160; women: 143), who were born in 22 states and the Federal District, comprising the five Brazilian regions (Mid-west: 4.6%; Northeast: 17.8%; North: 1.0%; Southeast: 62.7%; South: 11.2%; foreign-born: 2.6%). From each state, information regarding demographic, economic, and also public policies/investments/facilities for sports development were obtained from the government official webpages/documents. Table 1 summarizes the set of variables used in the present study.

Table 1**.** Micro and macro-level variables used in the study.

	Definition/ variables	Webpage
	Micro-level	
Athletes' information	Age, sex, birthplace, number of medals conquered in the Tokyo2020, club of training (when available)	https://www.olimpiadatododia.com.br/toquio-2020/84789-brasileiros-lista-classificados-olimpiada-toquio-2020/
	Macro-level*	
Population size	Estimated total population size in 2020	https://cidades.ibge.gov.br/
Population density	Relationship between population size and the total area of the territory (hab/km²) in 2010.	https://cidades.ibge.gov.br/
Gross Domestic Product (GDP)	Expresses the sum of all final goods and services determined in	https://cidades.ibge.gov.br/

	the state, during a given period. Data derives from the year 2010	
Number of sports facilities	Information regarding the number of sports facilities in each Brazilian states in 2016. Variable was categorized based on the median value.	https://www.ibge.gov.br/estatisticas/sociais/saude/16770-pesquisa-de-informacoes-basicas-estaduais.html
International sports events	Information regarding the existence of international sports events in the state, supported by the government in 2016. Variable was categorized as either yes (there is) or no (there is not).	https://www.ibge.gov.br/estatisticas/sociais/saude/16770-pesquisa-de-informacoes-basicas-estaduais.html
Tokyo 2020 Olympic medals	Total number of Tokyo 2020 Olympic medals won by athletes born in the state. This was the outcome variable.	
Total athletes by state	The total number of athletes born in each state	
Sports category	The sports participation was categorized as individual sports, team sports, mix	

	sports (i.e., Gymnastic).

*The last Brazilian census dates from 2010, and some official information was not updated since then.
Source: authors.

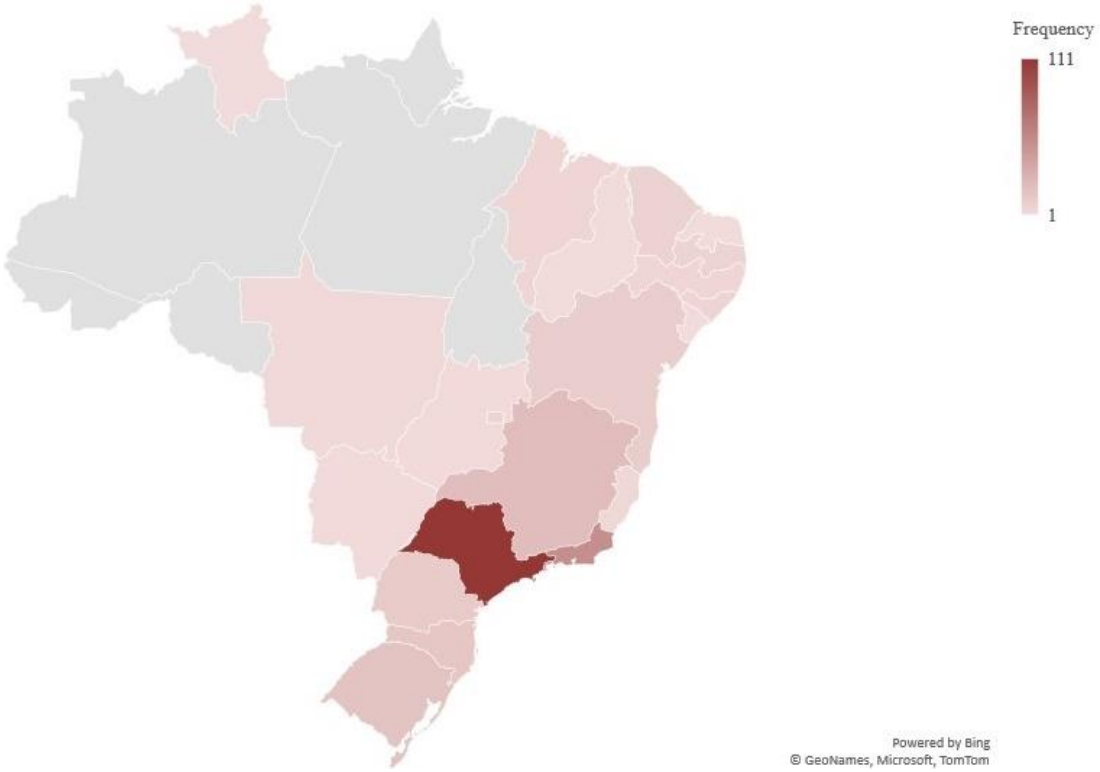
Data analysis

Descriptive statistics is presented in mean (standard deviation) or frequency (%). The Binary Logistic Regression was used with the purpose to estimate the chances of the states have athletes who won an Olympic medal. Three models were built: the model 1 included individual characteristics – sex (male; female) and age (continuous); the model 2 included the model 1 adding the meso-level characteristics - sports category (individual, team, mix), sports facilities (median), and international sports events in the state (yes; no); the model 3 included the model 2 and the macro-level characteristics - population size (median), GDP (median), and population density (median). All the analysis was performed in JAMOVA, considering 95% confidence interval.

Results

Most of athletes are male (52.8%), with a mean age of 27.5±5.75 years. Regarding the region where they were born, the majority was born in the Southeast region (62.7%), followed by the Northeast (17.8%), the South (11.2%), the Mid-West (4.6%), and the North (1%) (2.6% were foreign-born). When information regarding place of training was available, we verified that most athletes train in São Paulo (27.7%), followed by those who train in other country (15.2%). Further, most athletes are participants in individual modalities (60.4%), followed by team modalities (35.6%), and mix modalities (4.0%). The birthplaces of athletes are presented in Figure 1. As abovementioned, the majority of athletes were born in the Southeast region, especially in the states of São Paulo (36.6%), Rio de Janeiro (17.5%), and Minas Gerais (6.9%).

Figure 1. Frequency of birthplace of Brazilian athletes in Tokyo 2020



Source: authors.

The highest number of medals was obtained by athletes born in São Paulo, Rio de Janeiro, and Bahia. São Paulo, Goiás and Bahia are the states with the highest number of sports facilities. Economic and demographic information are showed in table 2.

Table 2. Descriptive statistics of the state-level variables.

State	GDP (R$)	Population size	Population density (hab/km²)	Sports facilities	International sports events	Total number of medalist athletes
São Paulo	2,038,005.00	46,289,333	166.23	402	No	20
Rio de Janeiro	640,186.00	17,366,189	365.23	15	Yes	8
Minas Gerais	544,634.00	21,292,666	33.41	4	Yes	3
Rio Grande do Sul	408,645.00	11,422,973	37.96	7	No	4
Santa Catarina	256,661.00	7,252,502	65.27		Yes	3

Paraná	401,662.00	11,516,840	52.40	10	No	2
Bahia	258,649.00	14,930,634	24.82	105	Yes	5
Ceará	138,379.00	9,187,103	56.76	44	Yes	0
Paraíba	59,089.00	4,039,277	66.70	11	No	2
Alagoas	49,456.00	3,351,543	112.33	1	Yes	0
Distrito Federal	235,497.00	3,055,149	444.66	108	No	2
Maranhão	85,286.00	7,114,598	19.81	23	No	1
Pernambuco	167,290.00	9,616,621	89.62	4	Yes	0
Espírito Santo	109,227.00	4,064,052	76.25	8	Yes	1
Mato Grosso	123,834.00	3,526,220	3.36	3	Yes	0
Pará	138,068.00	8,690,745	6.07	3	Yes	0
Goiás	7.206.589	7,113,540	17.65	126	Yes	0
Mato Grosso do Sul	91,866.00	2,809,394	6.86	6	Yes	0
Roraima	11,011.00	631,18	2.01	15	No	0
Piauí	41,406.00	3,281,480	12.40	4	No	0
Rio Grande do Norte	59,661.00	3,534,165	59.99	3	Yes	1
Sergipe	38,867.00	2,318,822	94.36	43	No	0

Source: authors.

The regression analysis results are presented in table 3. The model comparisons indicated that the second model was the best one to explain the chances of the state have an athlete who won an Olympic medal (Model 2 versus Model 1: $\chi^2 = 21.41$; $p<0.001$; Model 3 versus Model 2: $\chi^2 = 2.77$; $p = 0.429$). So, younger athletes (OR= 0.91; 95%CI = -0.15 – -0.2) and those from team sports (OR= 4.36; 95%CI = 0.80 – 2.15) were more prone to win an Olympic medal. Model with macro level variables did not increase the explanatory power of the results.

Table 3. Binary Logistic Regression results for chances to winning an Olympic medal.

Predictor	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)
Intercept	0.944 (-1.68 - 1.56)	0.679 (-2.31 - 1.53)	0.865 (-2.14 - 1.85)
Sex (male)	1.544 (-0.19 - 1.06)	1.784 (-0.08 - 1.24)	1.9 (-0.04 - 1.32)
Age	0.937 (-0.13 - 0.00)*	0.92 (-0.15 - -0.02)*	0.918 (-0.15 - -0.02)*
Sports category			
Individual sports		Reference	Reference
Team sports		4.331 (0.79 - 2.14)*	4.368 (0.80 - 2.15)*
Mix sports		0.577 (-2.68 - 1.58)	0.659 (-2.57 - 1.73)

International events			
No		Reference	Reference
Yes		0.909 (-0.82 - 0.63)	0.559 (-1.52 - 0.35)
Sports facilities			
<10 facilities		Reference	Reference
≥10 facilities		1.319 (-0.45 - 1.00)	2.375 (-0.13 - 1.86)
Population size			
<173			Reference
≥173			1.327 (-1.08 - 1.64)
GDP (in millions R$)			
<640			Reference
≥640			0.281 (-3.18 - 0.64)
Population density			
<166hab/km²			Reference
≥166hab/km²			1.151 (-0.85 - 1.13)
Model Fit Measures			
AIC	0.270	0.281	0.024
BIC	0.256	0.282	0.103
R^2Mcf	0.259	0.296	0.114
Model Comparisons	χ^2	p-value	
Model 1 – Model 2	21.41	<0.001	
Model 2 – Model 3	2.77	0.429	

Source: authors.

Discussion

This study aimed to describe the birthplace of Brazilian Tokyo 2020 Olympic athletes, and to investigate the state-related variables associated with winning an Olympic medal. It was observed that i) the majority of Olympic athletes were born in the Southeast and Northeast regions; ii) age and be part of a team sports were significantly associated with winning an Olympic medal. Results related to birthplace are in accordance to previous results. In this context, Tozetto et al.[15] showed that Brazilian Olympic medalists were born in places with an average HDI and a population size higher than 100,000 inhabitants, and 58.6% of them were from the Southeast region. Similarly, data from the SPLISS project (Sports Policies Leading to Sport Success) revealed that 63% of the Brazilian athletes in Rio 2016 Olympic Games came from the southeast region, and this

is the region with the highest HDI value in the country (0.764), and also the most benefited region regarding the sports projects implementation[16].

However, differently to results observed in previous studies, the Northeast region was the second region with the highest number of athletes in the Tokyo 2020. The increment in number of elite athletes from the Northeast region, can be associated with the legacy of Rio 2016, where a Northeast Olympic Training Center (Centro de Formação Olímpica do Nordeste; Fortaleza – Ceará) was built to support 26 Olympics sports. This factor can explain the differences observed between results from this study when compared to previous ones that investigated association between Olympic success and macro-level indexes. For example, Gomes-Sentone et al.[17] found that among Brazilian swimming athletes, HDI, income, and education were important social indicators for sports performance, and similar results were reported by Costa et al.[18] among soccer players, and Santos[19], studying junior, elite professionals, and masters athletes in Athletics World Rankings.

Regarding age, it was found an inverse association with the chances to win an Olympic medal, meaning that younger athletes were more prone to win a medal. The age range of Brazilian athletes was between 13 – 51 years, similar to the results found by Longo et al.[20], when studied the best athletes at the 2012 Summer Olympics (age ranged between 14.0 to 52.8 years). The authors showed that in most of the sports, the athletes of both sexes presented an average age under 30 years, except for Beach Volleyball (30.5 years), Sailing (31.1 years), and Shooting (32.6 years) for male athletes, and Triathlon (30.2 years) for female athletes. Taking into account the Brazilian medalists in Tokyo 2020, the average, minimum and maximum age of athletes who won an Olympic medal were lower than those from the non-medalists. These results could be due to the medals won in female gymnastic, female skate, and male soccer, due to their young ages.

This study has some limitation. Differently from previous studies, the statistical analysis was not performed taking into account differences in medals (gold, silver, and bronze), and results could be different if this approach was used. The total medals was considered individually, meaning that in team sports, for example, each athlete counted as a medal, given that athletes are from different states. Another point to be mentioned, is the fact that it was not possible to explore the place where athletes train. Since some athletes do not train in the same state they were born, this information would be of

relevance to better understand the athletes' trajectories until the Olympic medal, and future studies should investigate it. The macro-level variables were limited to population size and density, and GDP; however, cultural, social and economic indicators can be associated with sports development in states. On the other hand, results provided information that can guide public polices makers regarding the strategies to promote high level sports performance. For example, in Tokyo 2020, the North and Mid-West regions had few athletes, in comparison with other Brazilian regions. For Paris 2024 and Los Angeles 2028, these regions can receive more attention and support to athletes, coaches and universities, which can reflect in an increase in the number of athlete's participation.

Conclusion

Most of Brazilian Olympic athletes in Tokyo 2020 were born in Southeast region, especially in São Paulo and Rio de Janeiro, followed by those who were born in Northeast, South, Midwest, and North regions. This distribution follows that observed by the Brazilian population, since both, Southeast and Northeast regions, are the most populated regions, comprising, respectively, about 42% and 27.1% of Brazilian residents. The best model to explain association with the chances to win a medal was composed to meso-level variables, and no significant association was found between macro-level characteristics and the chances of an athlete be a medalist.

Notwithstanding the sports practice, in theory, be accessible for everyone, some practices are not easily accessible for some minorities and/or economic groups, due to cost (and also cultural aspects) associated with the practice. Given that, and in association with the fact that there are some economic, social and cultural discrepancies between Brazilian regions (and also economic inequalities within Brazilian population), future studies could investigate the between-regions differences in the distribution of sports modalities, and its relationship with macro-level characteristics.

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