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# Birthplace effect on Brazilian elite runners

# Efeito do local de nascimento em corredores de elite brasileiros

# Efecto lugar de nacimiento en los corredores de élite brasileños

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## Abstract

**Purpose**: The purpose of this study was to identify the birthplace effect on Brazilian elite runners. **Methods**: Information about Brazilian elite runners (5 km, 10 km, half-marathon, and marathon) competing between 2002 and 2022 was obtained using the official webpage of the Brazilian Track and Field federation. The downloaded information includes the athlete's name, date of birth, sex, race time, state of birth, date of the competition, and competition venue. To investigate the birthplace effect, we presented data considering Brazilian regions/states for both sexes and all race distances. **Results:** The sample was composed of 2,558 athletes (women: 47.1%; men: 52.9%). Most of the athletes were from the Southeast and South regions. The highest number of athletes in the Mid-west and Southeast participated in a half-marathon, while in the Northeast, North, and South, the majority of the athletes participated in full marathon race events. **Conclusion:** The Southeast region, especially the São Paulo state presented the highest frequency of Brazilian elite runners. Future studies should consider exploring the geographic and genetic factors that can be associated with this highest frequency of elite runners.
**Keywords:** Birthplace effect. Endurance. Athletes.

## Resumo

**Objetivo:** O objetivo deste estudo foi identificar o efeito do local de nascimento em corredores de elite brasileiros. **Métodos:** Informações sobre corredores de elite brasileiros (5 km, 10 km, meia maratona e maratona) competindo entre 2002 e 2022 foram obtidas usando a página oficial da Confederação Brasileira de Atletismo. As informações baixadas incluem o nome do atleta, data de nascimento, sexo, horário da corrida, estado de nascimento, data da competição e local da competição. Para investigar o efeito do local de nascimento, apresentamos dados considerando regiões/estados brasileiros para ambos os sexos e todas as distâncias da corrida. **Resultados:** A amostra foi composta por 2.558 atletas (mulheres: 47,1%; homens: 52,9%). A maioria dos atletas era das regiões Sudeste e Sul. O maior número de atletas no Centro-Oeste e Sudeste participou de uma meia maratona, enquanto no Nordeste, Norte e Sul, a maioria dos atletas participou de eventos de corrida de maratona completa. **Conclusão:** A região Sudeste, especialmente o estado de São Paulo, apresentou a maior frequência de corredores de elite

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brasileiros. Estudos futuros devem considerar explorar os fatores geográficos e genéticos que podem estar associados a essa maior frequência de corredores de elite.
**Palavras-chave:** Efeito local de nascimento. Resistência. Atletas.

## Resumen

**Objetivo:** El objetivo de este estudio fue identificar el efecto del lugar X'de nacimiento en los corredores de élite brasileños. **Métodos:** La información sobre los corredores de élite brasileños (5 km, 10 km, media maratón y maratón) que compitieron entre 2002 y 2022 se obtuvo utilizando la página web oficial de la Federación Brasileña de Atletismo. La información descargada incluye el nombre del atleta, la fecha de nacimiento, el sexo, el tiempo de la carrera, el estado de nacimiento, la fecha de la competencia y el lugar de la competencia. Para investigar el efecto del lugar de nacimiento, presentamos datos considerando regiones/estados brasileños para ambos sexos y todas las distancias de carrera. **Resultados:** La muestra estuvo compuesta por 2.558 atletas (mujeres: 47,1%; hombres: 52,9%). La mayoría de los atletas eran de las regiones Sudeste y Sur. El mayor número de atletas en el Centro-Oeste y Sudeste participó en una media maratón, mientras que en el Nordeste, Norte y Sur, la mayoría de los atletas participaron en eventos de carrera de maratón completos. **Conclusión:** La región Sudeste, especialmente el estado de São Paulo, presentó la mayor frecuencia de corredores de élite brasileños. Estudios futuros deberían considerar explorar los factores geográficos y genéticos que pueden estar asociados con esta mayor frecuencia de corredores de élite.
**Palabras-clave:** Efecto del lugar de nacimiento. Resistencia. Atletas.

## Introduction

The idea that the place of residence is related to sports success was investigated previously in a variety of domains, including soccer[1, 2], basketball [3, 4], volleyball [5], hockey[6], track and field[7] and swimming[8]. In summary, athletes born in small cities (i.e., populations below 500,000) tended to present the highest chance of being successful[9]. However, variations regarding countries and sports are expected, highlighting some talent development hotpots[10].

Brazil is an epicenter for soccer[11]. Previous studies were developed to understand the environmental factors related to the development of soccer skills in the Brazilian context[12]. Soccer is part of the Brazilian culture[13] and one of the main leisure sports practices reported by the population, especially men and young people[14]. The importance of soccer for Brazilians was shown in adopting different behaviors, including the running boom in the country[15]. In 1970, the Mexico World Cup championship, influenced by the Cooper methods, was associated with the increase of runners in Brazil[15].

Like soccer, running is a relatively cheap sport, where training can be performed in non-structured spaces and does not demand expensive equipment[16, 17]. Notwithstanding, Brazil is not a strong nation in an international running context[18, 19]. The five Brazilian macro-regions (i.e., Southeast, South, Northeast, North, and Midwest) and the 26

federative units show cultural, social, economic, climatic, and geographic differences[20, 21]. These differences were related to access and maintenance of public policy programs[22], the number of Olympic athletes[23], physical activities/sports practice in the country[14], and soccer players' development[24].

However, no information is available regarding the place of residence associated with running performance. Previous research showed a relationship between a state's population size and gross domestic product, with the number of runners ranked among the 20 best athletes in 2020[25]. Therefore, the study was limited to one year of exploration, which impairs the generalization. Considering that people are not randomly distributed around the country and that individual and environmental characteristics are related to the "hotspots", the purpose of this study was to identify the birthplace effect on Brazilian elite runners. We hypothesized that the highest frequency of athletes is from the São Paulo state.

## Methods

*Sample and Design*

This is an exploratory study whose information was obtained from official publications. Data were collected from the results section of the Brazilian Track and Field Federation – *Confederação Brasileira de Atletismo* website (https://www.cbat.org.br/novo/?pagina=ranking_quadro&t=tta&a=2022) during April 2022. The information refers to results available for the best Brazilian runners between 2002 and 2022, competing in 5km, 10km, half-marathon, and marathon marks in outdoors official events. Available information included the athlete's name, date of birth, sex, race time, state of birth, date of the competition, and competition venue. Information about the state and region of birth was used for information regarding the birthplace effect.

Athletes' age was computed by taking into account the date of birth and the date of the competition. Data regarding the total economically active population was downloaded from the *National Observatory of Solidarity Economy and Cooperativism* (https://ecosol.dieese.org.br/ws2/tabela/economia-solidaria/estimativa-da-populacao-economicamente-ativa-por-cor-ou-raca), for 2010. The sample was composed of 2,558 athletes (women: 47.1%; men: 52.9%) aged between 18 – 52 years, who were ranked among the TOP20 Brazilian runners.

*Statistical Analysis*

Descriptive information was expressed as mean (and standard deviation) and median (and interquartile range), or frequency (%). Data normality distribution was tested by the Kolmogorov-Smirnov test, split by sex. We calculated the rate between the total of athletes (by state, of both sexes) and the total economic active population. SPSS 26.0 software was used in all analyses, and the significance level was set at 0.05.

**Table 1.** Athletes' descriptive information, considering Brazilian regions.

| | Mid-west (n = 239) | Northeast (n = 298) | North (n = 25) | Southeast (n = 1670) | South (n = 326) |
|---|---|---|---|---|---|
| ***Sex*** | | | | | |
| Female | 139 (58.2%) | 155 (52.0%) | 10 (40.0%) | 717 (42.9%) | 184 (56.4%) |
| Men | 100 (41.8%) | 143 (48.0%) | 15 (60.0%) | 953 (57.1%) | 142 (43.6%) |
| ***Race event*** | | | | | |
| 5 km | 7 (2.9%) | 10 (3.4%) | | 59 (3.5%) | 7 (2.1%) |
| 10 km | 79 (33.1%) | 60 (20.1%) | 14 (56.0%) | 559 (33.5%) | 101 (31.0%) |
| Half-marathon | 95 (39.7%) | 87 (29.2%) | 3 (12.0%) | 597 (35.7%) | 77 (23.6%) |
| Marathon | 58 (24.3%) | 141 (47.3%) | 8 (32.0%) | 455 (27.2%) | 141 (43.3%) |

Source: the authors.

## Results

The sample was composed of 2,558 athletes (women: 47.1%; men: 52.9%), age mean of 31.7±4.2 years, who competed between 2002 and 2022 in short (5 km, 10 km) and long-distance events (half-marathon and marathon). For Mid-west, Northeast, and South most of the athletes were female, while, for the North and Southeast, the highest frequency of the athletes was composed of men. Most of the athletes were from the Southeast, and South regions. The highest number of athletes in the Mid-west and Southeast were participants in half-marathon, while in the Northeast, North, and South, most of the athletes were participants in marathon race events (table 1).

For the total sample and running events, most of the athletes were from the Southeast and South regions, especially São Paulo (39.6%), Minas Gerais (13.4%), Rio de Janeiro (11.3%), and Paraná (5.5%). Lower participation was found for Roraima, Acre, Piauí, Sergipe, and Pará (North and Northeast regions). Figure 1 and figure 2 present the birthplace according to the race event, for both sexes, respectively. Women competing in 5 km were from eight different Brazilian states, most of them from the Southeast (São Paulo, Rio de Janeiro, and Minas Gerais) and the South region (the Rio Grande do Sul, and Paraná). No athletes from North or Mid-west were listed. For the 10 km and half-

marathon, approximately one in every two athletes were from the São Paulo state. Few athletes were from the North and Mid-west regions of the country. Compared to other distances such as the marathon, a higher distribution between birthplaces around the country was

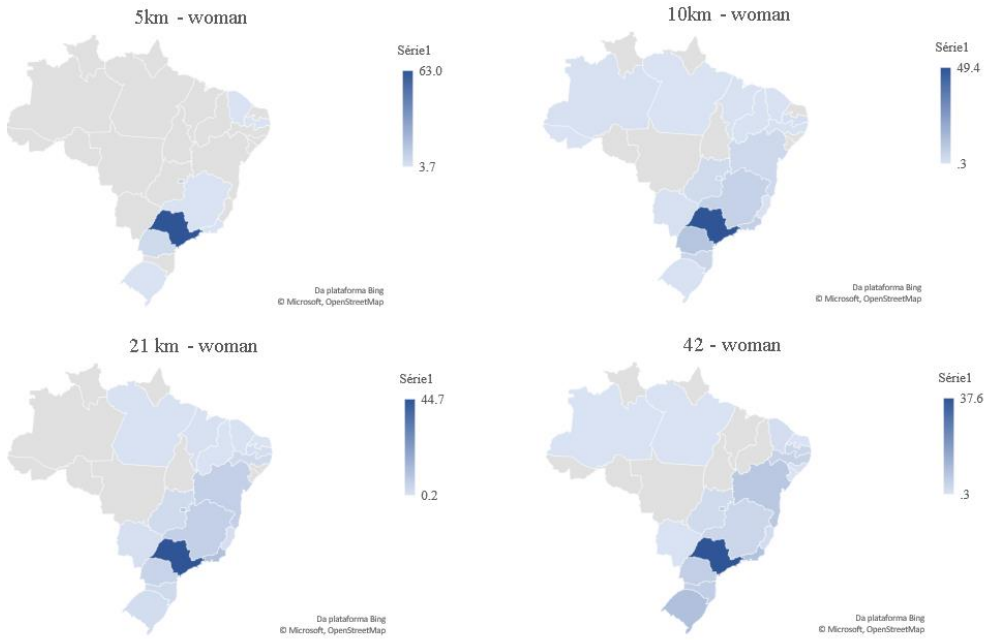


**Figure 1.** Birthplace results for women of different race events.

shown, but most of them were from São Paulo and the Rio Grande do Sul. Birthplace results for men are presented in figure 2. Most of the athletes were from the Southeast region, especially São Paulo, with 55%, 34.2%, 35.1%, and 34.3% for 5,10-km, half-marathon, and marathon, respectively. Few athletes were from the North and Mid-west regions.

Results for the place which record was obtained show that for both sexes, most of the athletes achieved the best performance competing at home (women: 85.2%; men: 76.7%). When results are shown considering the race event, most athletes competing in 5 km achieved the best performance competing abroad (women: 70.4%; men: 32.6%).

Table 2 shows the ratio between the total of athletes by state and the economically active population of each state. When data were controlled, Distrito Federal present the highest rate of athletes by economically active population for both sexes.

## Discussion

The purpose of this study was to identify the birthplace effect on Brazilian elite runners. The main findings showed that *(a)* most of the elite athletes were from the Southeast region, especially São Paulo state; when data were controlled by the total of economically active

population, Distrito Federal presented the highest ratio for both sexes *(b)* athletes reached the best performance competing at home (ie., where they live). These results are according to our hypothesis. The birthplace effect showed a higher frequency of athletes born in the

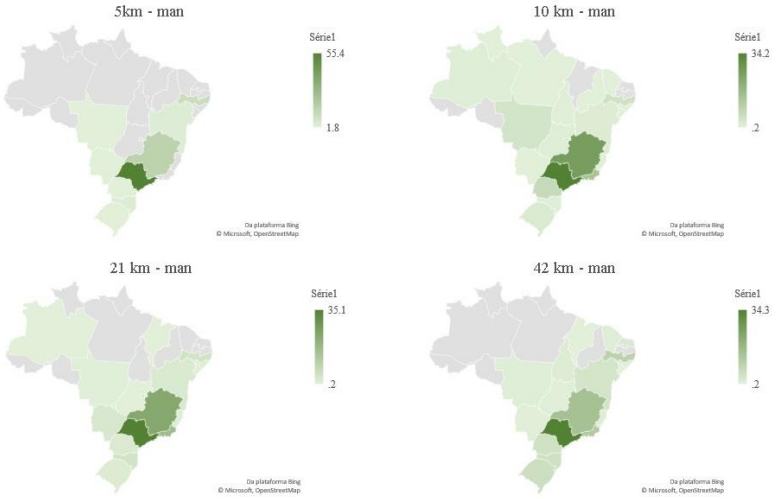


**Figure 2.** Birthplace results for men of different race events.

Southeast region, especially São Paulo and Rio de Janeiro states.

These results agree with previous findings showing that most of the Olympic athletes in Rio 2016 were born in this region[23], as well as soccer players[24], and high-elite athletes[26]. Based on previous research, and the characteristics of Brazilian macro-regions, these findings can be related to demographic[27], economic[2], and sports characteristics[14].

Demographic aspects that can be related to success among athletes include (i) population size, (ii) population density, and (iii) economic aspects. The Southeast region represents only 1/10 of the Brazilian territory but concentrates approximately half of the Brazilian population, presenting a higher

populational density. Previous studies investigating the pyramid effect in sports showed that for track and field, a higher number of practitioners was positively associated with athletes' success[28]. In addition, the Southeast is the economic center of the country, hosting major events performed in Brazil (e.g., World cup, Olympic Games). These compositional factors can be related to sports success in different aspects, such as

the legacy of sports participation between the population, training facilities, and the number of events.

In addition, aspects related to the infrastructure of the perceived environment may also be related to the greater presence of runners in the southeast region[29]. Comfortable surfaces

**Table 2.** Total of athletes by state and economically active population rate

| States | Total the economically active population | Women athletes | Men athletes | Rate women | Rate men |
|---|---|---|---|---|---|
| Acre | 303,666 | 1 | 0 | 3.29309E-06 | 0 |
| Alagoas | 1,256,920 | 3 | 7 | 2.38679E-06 | 5.57E-06 |
| Amapá | 295,957 | 0 | 0 | 0 | 0 |
| Amazonas | 1,465,913 | 5 | 5 | 3.41084E-06 | 3.41E-06 |
| Bahia | 6,555,394 | 67 | 33 | 1.02206E-05 | 5.03E-06 |
| Ceará | 3,642,508 | 12 | 4 | 3.29443E-06 | 1.1E-06 |
| Distrito Federal | 1,402,347 | 85 | 45 | 6.06127E-05 | 3.21E-05 |
| Espírito Santo | 1,827,434 | 16 | 8 | 8.75545E-06 | 4.38E-06 |
| Goiás | 3,158,265 | 32 | 15 | 1.01321E-05 | 4.75E-06 |
| Maranhão | 2,585,068 | 5 | 2 | 1.93419E-06 | 7.74E-07 |
| Mato Grosso | 1,545,517 | 12 | 24 | 7.76439E-06 | 1.55E-05 |
| Mato Grosso do Sul | 1,258,721 | 10 | 16 | 7.94457E-06 | 1.27E-05 |
| Minas Gerais | 9,939,712 | 63 | 281 | 6.33821E-06 | 2.83E-05 |
| Pará | 3,194,160 | 4 | 1 | 1.25229E-06 | 3.13E-07 |
| Paraíba | 1,617,724 | 28 | 0 | 1.73083E-05 | 0 |
| Paraná | 5,587,965 | 83 | 57 | 1.48534E-05 | 1.02E-05 |
| Pernambuco | 3,827,344 | 34 | 83 | 8.88345E-06 | 2.17E-05 |
| Piauí | 1,319,217 | 3 | 1 | 2.27408E-06 | 7.58E-07 |
| Rio de Janeiro | 7,814,732 | 104 | 185 | 1.33082E-05 | 2.37E-05 |
| Rio Grande do Norte | 1,375,046 | 2 | 9 | 1.4545E-06 | 6.55E-06 |
| Rio Grande do Sul | 5,818,591 | 49 | 0 | 8.42128E-06 | 0 |
| Rondônia | 774,823 | 0 | 0 | 0 | 0 |
| Roraima | 196,508 | 0 | 1 | 0 | 5.09E-06 |
| Santa Catarina | 3,543,218 | 52 | 45 | 1.46759E-05 | 1.27E-05 |
| São Paulo | 21,639,763 | 534 | 479 | 2.46768E-05 | 2.21E-05 |
| Sergipe | 927,795 | 1 | 4 | 1.07782E-06 | 4.31E-06 |
| Tocantins | 630,413 | 0 | 8 | 0 | 1.27E-05 |

Source: the authors.

for running and attractive environments, such as large parks, are among the main reasons presented by a previous study for the practice of running among experienced runners[30]. Due to geographic and economic factors, more developed regions tend to have more conditions to create and maintain spaces like these[31].

From a historical perspective, Brazil's Southeast region was the epicenter of running in the country[15]. The most traditional and important events were realized in São Paulo and Rio de

Janeiro, and this scenario remains today[15, 32]. In addition, this characteristic can be associated with the second finding, which athletes reach the best performance

competing at home. A recent study showed amateur runners who reside in the North, Northeast, and Mid-west travel to Southeast and South regions to participate in race events[32]. At the same time, those in the Southeast and South tend to travel among the regions to participate in events. Travelling longer distances to participate in race events generates more financial expenses. Recent research on Brazilian runners pointed out that economic factors greatly impact the practice of running, especially with the costs of travelling to participate in events in other states and expenses with registration fees[33].

Nevertheless, an origin with the most athletes would not imply that athletes of this origin would be the best. A paradigm supporting this idea was an analysis of half-marathoners and marathoners originating from 126 countries and competing between 1999 and 2014 in all road-based races held in Switzerland[34]. Particularly, Knechtle et al.[34] observed that runners from Ethiopia and Kenya, despite being <0.1 % of all finishers, achieved the fastest race times. Runners of varying origin might differ with regards to training practice[35] and motivation[36]. For instance, compared to Spanish long distance runners, Kenyans did not practice some training activities that Spanish runners did (e.g., weights and physical fitness training, running technique or alternative trainings); instead Kenyans focused on tempo runs more than Spanish[35]. Furthermore, compared to UK 5km, half- and full-marathoners, Indian runners scored higher in social motive using an adapted version of the Motivation of Marathons Scales[36]. Although it was acknowledged that the variation within a country might follow a different pattern from the variation between countries, the abovementioned differences between countries might provide some insights about the participation trends across Brazil.

Limitations of the present study include the lack of information regarding the early development years of the athletes, as well as environmental features that could be related to training, participation in competitions, and performance. A second point is the lack of trend information regarding genetic characteristics that could explain running predisposition in the Southeast region. Recent studies showed higher genetic variability between Brazilian regions, indicating strong European and African contributions to the Brazilian gene pool[37]. In addition, the information available was limited by the total number of athletes in ranking by years, which impairs the trend analysis. It should be highlighted that the origin of an athlete referred to the

available information provided by the website of the Brazilian Track and Field Federation; however, it was not known whether the athlete was a native of this area or was an offspring from immigrants from other areas. A similar limitation exists when examining the role of nationality in sports since it is not considered the ethnicity of the athlete, and the interaction of genetics and environment may vary accordingly.

## Conclusion

The Southeast region, especially the São Paulo state, presents the highest frequency of Brazilian elite runners. Future studies should consider understanding geographic and genetic factors associated with this highest frequency of athletes in elite runners.

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