Running Performance Variability

Subjects: Sport Sciences

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Sports performance is a multifactorial trait, expressed by the interaction of both individual and environmental characteristics. Taking this into account, it is of relevance consider the context where athletes are inserted to better understand variability in the performance, specially in practice mainly performed in outdoor environment, such as running.

running variability performance multilevel approach

1. Introduction

Sports performance is a multifactorial trait, determined by different predictors related to both the subject and the environment [1]. According to ecological model theory, human development (or a given behaviour) is the result of the interaction of variables derived from different levels, organized in a hierarchical structure, comprising variables directly related to the subjects as well as those related to social, physical, and natural environments[2][3][4]. In this context, athletes have different life stories, train with different coaches, and live in given neighbourhoods, which are located in cities/states/countries with distinct sports policies, different natural environments, and designs[5]. All of these aspects act together to produce the different athletes' profiles and performance[5][6].

At an international level, it has been proposed that a set of variables, such as individual- and training-related variables, economic, social, demographic, and climatic factors from the place where athletes live/train, as well as the so-called "macro-determinants" factors – human development index, per capita income, population size, population density, financial investments in sports, public policies for promotion of physical activity, and base sports – can be determinant for the sport development and to explain differences in performance of athletes from different nationalities[7][8][9]. Taking into account that road running is mainly performed in outdoor spaces, it means that beyond the biological, physiological, and biomechanical aspects, the natural and built environmental related factors can be of relevance to the engagement into the running training, leading to differences in the performance.

As the largest South American country, Brazil presents nearly continental dimensions and sociocultural contrasts[10], making such differences in runners' performances notable. There is also discrepancy regarding the distribution of the best Brazilian runners across the states, with a high concentration of them in the Southeastern region[11]. This fact can be related to the existence of local sports policies that promote sport participation among its residents, thereby allowing the development of elite athletes[12][13]. Moreover, each state has different characteristics, such as population size and density; public policies, design, and infrastructure; demographic rates; human development index (HDI)[14]; and violence rates, street safety and security policies[15]; as well as specific

geographic and weather characteristics[12][16]. So, it is possible to assume that these particularities can act together to express and explain the differences observed in runners' performance[17].

2. Running Performance Variability

In this sense, it was developed a research project (https://intrackproject.wixsite.com/website) aiming to identify *individual* and *environmental* factors associated with road running performance. Using data from this project, the manuscript "*Running performance variability among runners from different Brazilian states: a multilevel approach*", published in International Journal of Environmental Research and Public Health (doi: 10.3390/ijerph18073781), report a relevant between- and within-state variance in running performance (figure 1), ranging from 252 to 360 s/km, as well as relevant within-state differences.

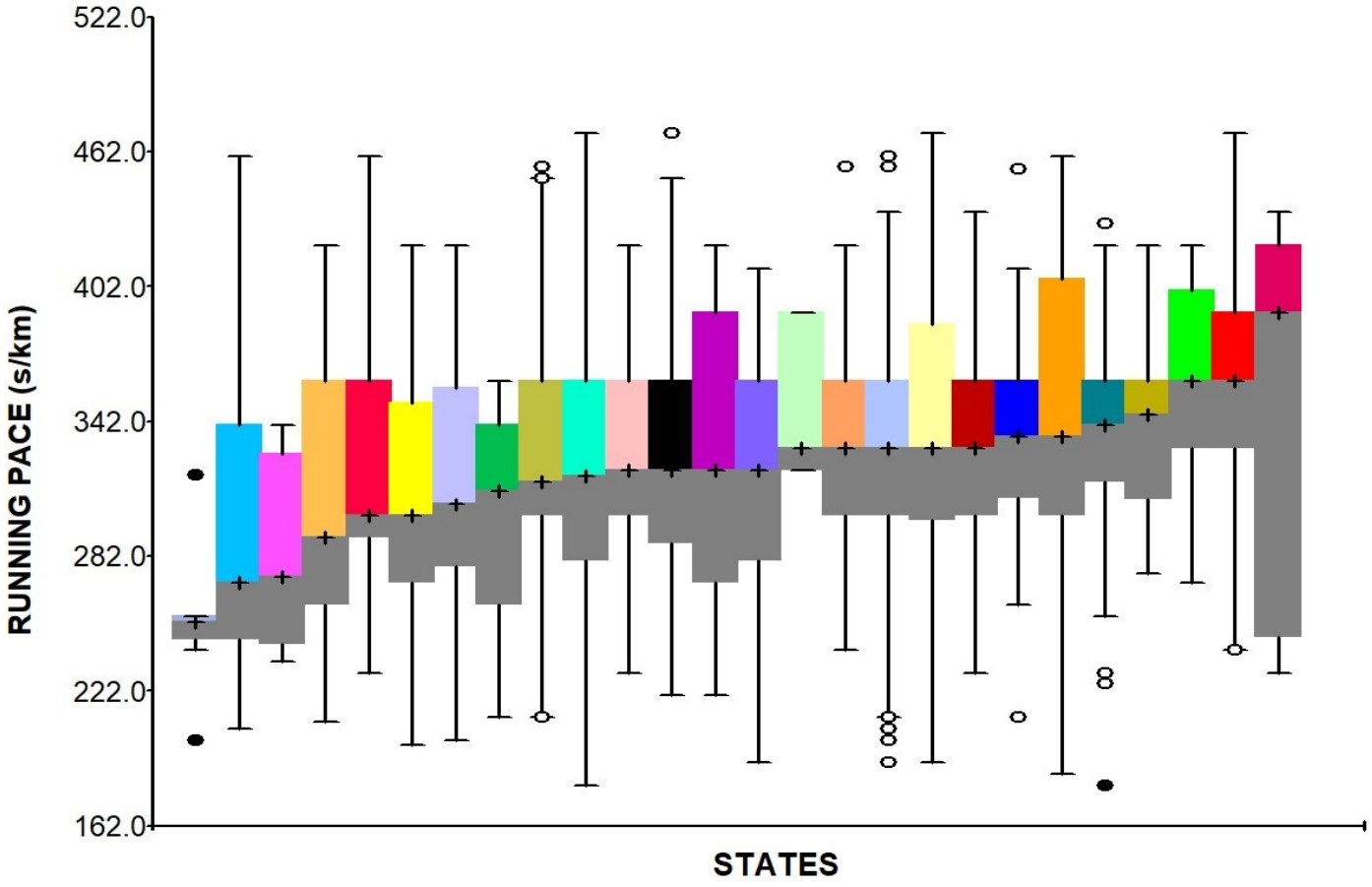

Figure 1. Running pace variance between Brazilian states, sorted by the median. Box-plot elements are as follow: cross, median; superior and inferior box limits, mean 75th and 25th percentiles, respectively; top and bottom bars, maximum and minimum normal values, respectively; circles indicate outliers.

In addition, it was also identified that state-level differences explained 3% of the total variance in Brazilian runners' performance, with 54.4% of this variance being explained by running events, Human Development Index, and violence index. At the individual level, biological (sex, age, and BMI), socio-demographic (SES), and training

(training frequency and volume/week) variables explained 56.4% of the 97% of the variance fraction associated with individual-level characteristics.

These results reinforce the significant role of the environment on the explanation of running performance variability; given the diversity across states, environmental variables should not be neglected, as they are relevant to the exploration of other variables possibly related to running performance.

References

1. Yan, X.; Papadimitriou, I.; Lidor, R.; Eynon, N. Nature versus Nurture in Determining Athletic Ability. Med Sport Sci 2016, 61, 15-28, doi:10.1159/000445238.
2. Tehrani, H.; Majlessi, F.; Shojaeizadeh, D.; Sadeghi, R.; Hasani Kabootarkhani, M. Applying Socioecological Model to Improve Women's Physical Activity: A Randomized Control Trial. Iran Red Crescent Med J 2016, 18, e21072, doi:10.5812/ircmj.21072.
3. Vella, S.A.; Cliff, D.P.; Okely, A.D. Socio-ecological predictors of participation and dropout in organised sports during childhood. Int J Behav Nutr Phys Act 2014, 11, 1-10.
4. Bronfenbrenner, U. Bioecologia do desenvolvimento humano: tornando os seres humanos mais humanos; Artmed: Porto Alegre, 2011; pp. 310.
5. Maia, J.A.R.; Garganta, R.; Seabra, A.; Lopes, V.P.; Vinagre, J.; Freitas, D.L.; Prista, A.; Meira, C. Dados longitudinais e modelação hierárquica. Um tutorial para investigadores das ciências do desporto. Rev Bras Cineantropometria & Desempenho Hum 2005, 7, 94-108.
6. Rossing, N.N.; Stentoft, D.; Flattum, A.; Côté, J.; Karbing, D.S. Influence of population size, density, and proximity to talent clubs on the likelihood of becoming elite youth athlete. Scand J Med Sci Sports 2018, 28, 1304-1313, doi:10.1111/sms.13009.
7. Bosscher, V.D.; Shibli, S.; Westerbeek, H.; Bottenburg, M.v. Successful elite sport policies: an international comparison of the Sports Policy factors Leading to International Sporting Success (SPLISS 2.0) in 15 nations; 2015.
8. Meira, T.B.; Bastos, F.C.; Bohme, M.T.S. Análise da estrutura organizacional do esporte de rendimento no Brasil: um estudo preliminar. Rev Bras Educ Fís Esporte 2012, 26, 251-262.
9. Bohme, M.T.S.; Bastos, F.d.C. Esporte de alto rendimento: fatores críticos de sucesso - gestão - identificação de talentos, 1 ed.; Phorte: São Paulo, 2016; pp. 360.
10. Instituto Brasileiro de Geografia e Estatística (IBGE). I. Painel de Indicadores. Availabe online: https://www.ibge.gov.br/indicadores.html (accessed on 19 August 2020).

11. Confederação Brasileira de Atletismo (CBAt). Ranking Brasileiro 2020 Available online: (accessed on 07 March 2020).
12. Galatti, L.R. AFEs, Human Development and Sport High Performance. In R. N. d. D. H. d. Brasil (Ed.), Movement is life: physical and sports activities for all people. Brasília, DF: United Nations Development Program (UNDP). 2017.
13. Tozetto, A.V.B.; Rosa, R.S.d.; Mendes, F.G.; Galatti, L.R.; Souza, E.R.d.; Collet, C.; Moura, B.M.d.; Silva, W.R.d. Local de nascimento e data de nascimento de medalhistas olímpicos brasileiros. Rev Bras Cineantropometria & Desempenho Hum 2017, 19, doi:10.5007/1980-0037.2017v19n3p364.
14. Costa, I.T.; Cardoso, F.S.L.; Garganta, J. O Índice de Desenvolvimento Humano e a Data de Nascimento podem condicionar a ascensão de jogadores de Futebol ao alto nível de rendimento? Motriz, Rio Claro 2013, 19, 34-45.
15. Cerqueira, D.; Bueno, S.; Lima, R.S.; Neme, C.; Ferreira, H.; Alves, P.P.; Marques, D.; Reis, M.; Cypriano, O.; Sobral, I., et al. Atlas da violência. Availabe online: http://www.ipea.gov.br/atlasviolencia/arquivos/downloads/6537-atlas2019.pdf (accessed on 10 May 2020).
16. Instituo Brasileiro de Geografia e Estatística (IBGE). Clima. Availabe online: https://www.ibge.gov.br/geociencias/informacoes-ambientais/climatologia/15817-clima.html?=&t=acesso-ao-produto (accessed on 07 May 2020).
17. Cote, J.; Macdonald, D.J.; Baker, J.; Abernethy, B. When "where" is more important than "when": birthplace and birthdate effects on the achievement of sporting expertise. J Sports Sci 2006, 24, 1065-1073, doi:10.1080/02640410500432490.