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Original Article

The frequency and performance trends of European countries in the U18 and U20 rankings for 1 500 m and 3 000 m between 2009–2020

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ABSTRACT

We purpose to determine the nationality of the European middle-distance athletes under 18 years (U18) and under 20 years (U20) during the last decade, to verify the participation trend for each country, and to assess whether the place of competition can be associated with the athletes ranking position. The sample comprised 902 European male runners, ranked among the best finishers from 2009 to 2020. The athletes were divided into two categories ($n_{U18} = 266$; and $n_{U20} = 636$) of two distances ($n_{1\ 500\ m} = 397$; $n_{3\ 000\ m} = 505$). The Mantel test was used for participation trend and the Chi-square test (χ^2) was used to verify differences between the ranking position and the place of competition. For both distances, the highest number of athletes were from Spain ($n = 127$), followed by Turkey ($n = 62$) and Great Britain ($n = 50$). No significant trends were shown for most of the countries, in both distances. A positive trend was shown for Slovenia (i.e., 3 000 m) over the years. A non-significant association was verified between the countries and the ranking position, as non-significant differences were proved for the place of competition. This information may be useful to guide athlete development programs in each country.

Introduction

Athletes' performance is influenced by several aspects, including the subject and the environment.[1,2] Endurance athletes' performance is strongly associated with physiological variables, such as aerobic capacity, running economy and lactate threshold.[3,4] Besides these individual characteristics, the context in which athletes are inserted,[5] including training facilities, social, economic, and cultural aspects related to the athlete's place of living were previously considered as important factors associated with their performance.[5,6] For example, among long-distance runners, the best athletes are from Kenya, namely from the Kalenjin tribe.[10] This success is associated with physiological characteristics and psychological advantages, which may be genetically conferred or environmentally influenced.[7]

Because African athletes are successful in long-distance running events, several studies have been conducted to understand this phenomenon.[8] However, few studies have been carried out to examine performance trends in athletes out of the African continent,[9] even if some studies have shown that African over-representativeness is followed by European.[10,11] Considering the number of medallists in the World Athletics ranking from 2006 to 2016, athletes from Great Britain, Spain, and Australia composed the top 3 for 10 000 m among senior runners.[12] A similar trend – representativeness of African runners, followed by European countries – was shown for half-marathoners and marathoners between 1997 – 2020,[10] similar as showed by Nikolaidis et al.,[11] whose results revealed that 16 European countries had at least one athlete among the best runners worldwide competing at 10-km, half-marathon, marathon, and 100-km ultramarathon.[11]

Considering that the European continent comprises countries with different cultural, regional, economic, and natural aspects, deeply understanding where the best athletes are from is relevant. Previous studies highlighted that the atmosphere created in countries can be linked to sports success,[13,14] that is, hosting sports events, providing training

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Abbreviation list

Under 18 years U18
Under 20 years U20
Chi-square test χ^2
1 500 meters 1 500 m
3 000 meters 3 000 m

facilities, and building a pro-community environment are positively related to sports participation and performance.[15] Besides the available evidence regarding the role of social and economic support in young athletes' development, among runners, most of the studies are centred on an adult or elite runners,[16–18] as well as no information is available about the effect of competing at home.[17,19]

Given that social and economic support is important to the athlete's long-term development process,[20] understanding where the best young athletes come from can provide important information to stakeholders, as well as to planning the development or update of national governments,[21] and information about funding and environmental characteristics that can be modified to support athletes' development. The purposes of this study were 1) to determine the nationality of the best European runners competing in 1 500 m and 3 000 m for U18 and U20 categories between 2009 and 2020, 2) to verify the countries' participation trend over time, and 3) to verify whether the place of competition can be associated with classification in ranking position. Based on studies performed with senior athletes, we hypothesized that Great Britain, Germany, and Spain were the countries where most athletes come from.[22]

Methods

Ethical aspects

The institutional review board of St Gallen, Switzerland, approved this study (EKSG 01/06/2010). Since the study involved the analysis of publicly available data, the requirement for informed consent was waived.

Approach to the problem

This is an exploratory study based on data from European Athletes (https://www.european-athletics.com/). The data were downloaded from the official results for European athletes listed for both 1 500 m and

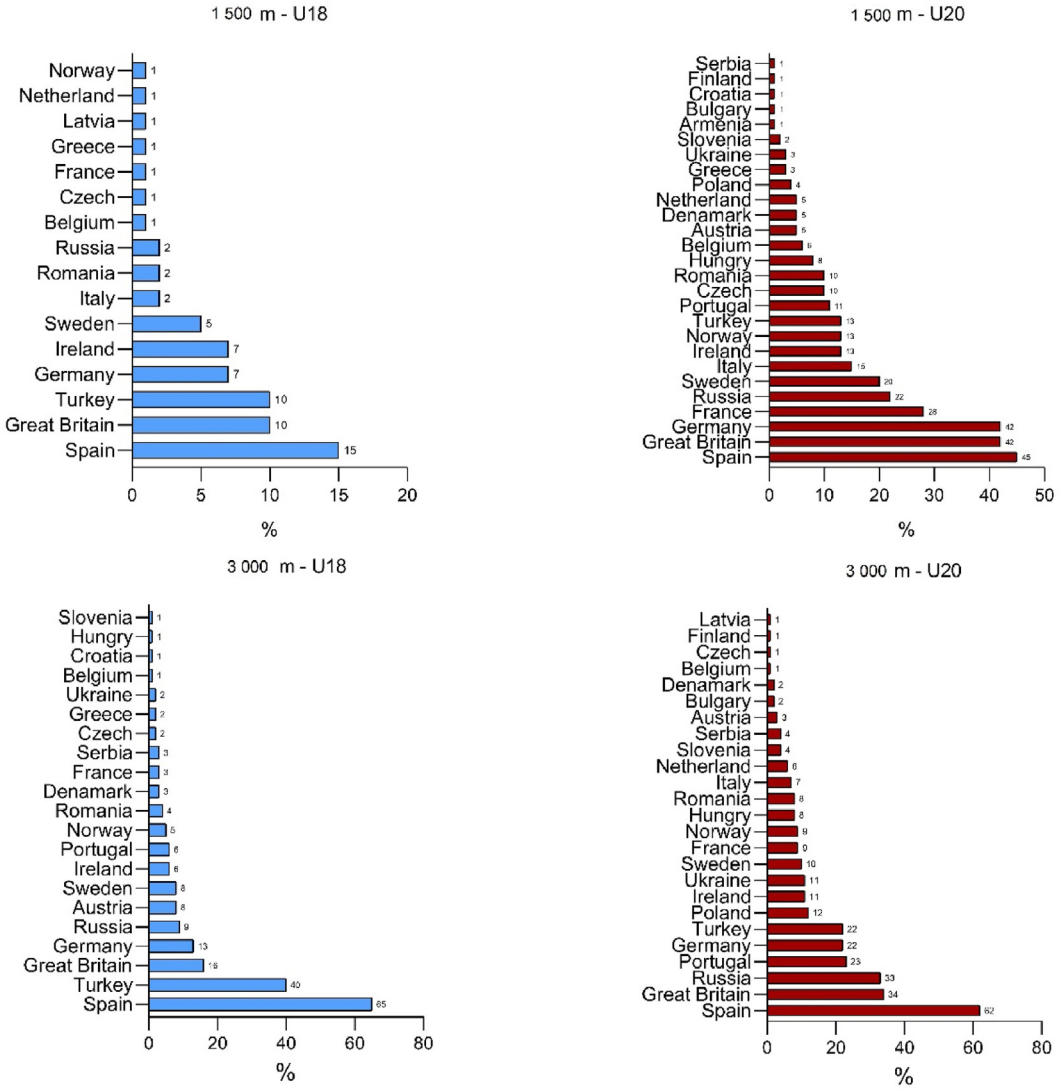

Fig. 1. Distribution of the best European athletes in 1 500 m and 3 000 m

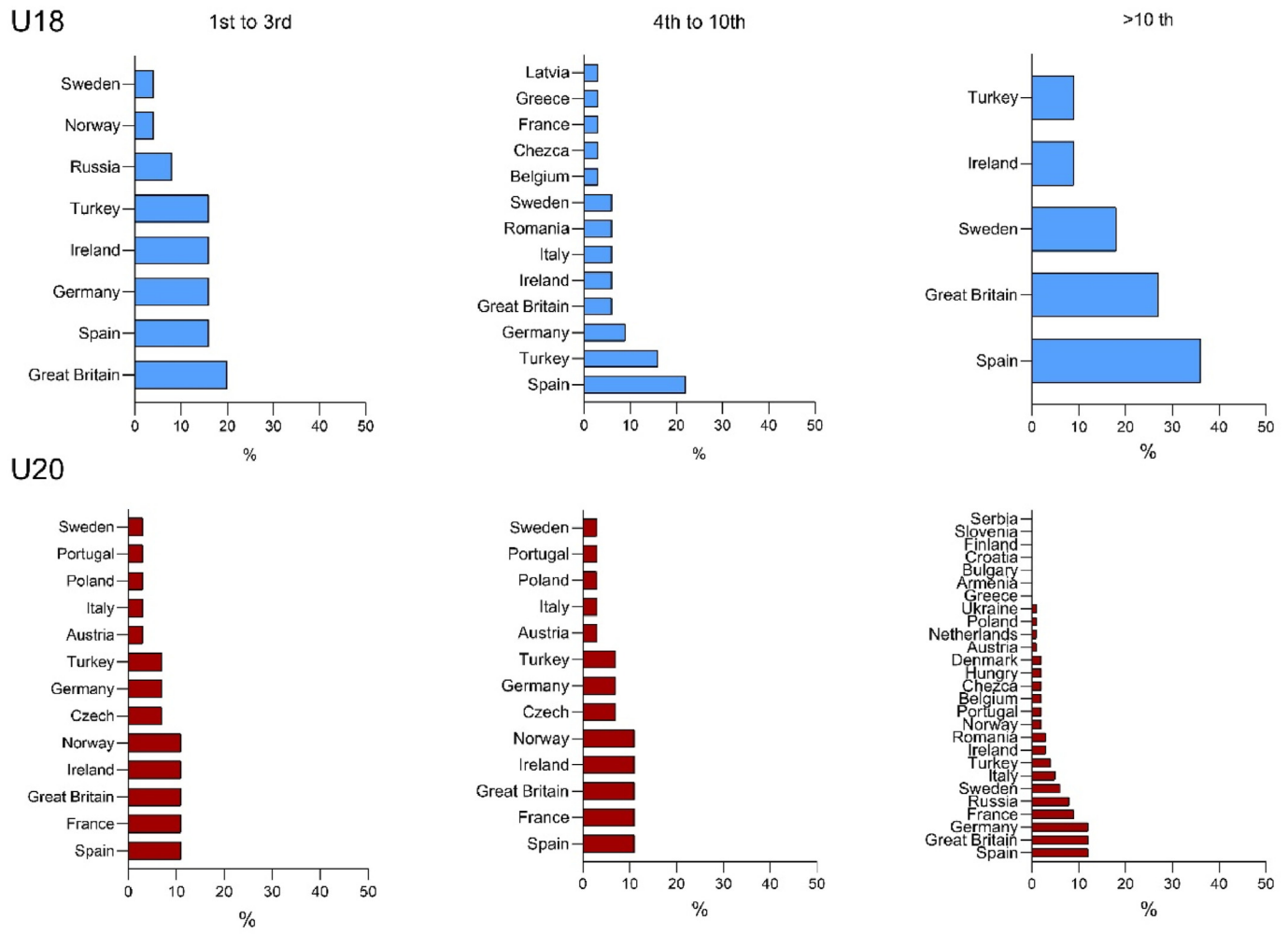

Fig. 2. Countries' distribution according to ranking position and age category, for athletes competing in 1 500 m.

3 000 m, between 2009 and 2020 (https://european-athletics.com/historical-data/top-list/season). The category of competition (U18; U20), race event distance (1 500 m; 3 000 m), race finish time (min:s), ranking position, nationality (country), and venue of competition (country) were downloaded, and proceed in an excel sheet. The ranking position was stratified into "1st to 3rd"; "4th to 10th" and "higher than 10th" considering previous studies.[10] Information about the venue of the competition was categorized as "competition at home" (when the nationality and the venue of the competition were the same) and "other" (when the nationality and the venue of the competition were different). A total of 902 male runners were sampled, considering both categories ($n_{U18} = 266$; $n_{U20} = 636$), and distance ($n_{1\ 500\ m} = 397$; $n_{3\ 000\ m} = 505$).

Statistical analysis

Descriptive statistics were presented using frequency (%). The frequency of athletes by country and position was computed and graphically presented. Following, the Chi-square test (χ^2) was used to verify the association between ranking position ("1st to 3rd"; "4th to 10th" and "higher than 10th") and place of competition ("at home"; "other country"). The effect size was presented using eta squared (η^2). The trend of the countries being ranked among the best athletes was tested using the Cochran-Armitage test and the Mantel test. WinPepi software was used for statistical analysis and all hypotheses were tested at $p < 0.05$ significance level.

Results

Fig. 1 presents the distribution for athletes in both distances and categories. For all groups (distance vs age categories), most of the athletes are from Spain ($n_{1\ 500\ m\ U18} = 15$; $n_{1\ 500\ m\ U20} = 45$; $n_{3\ 000\ m\ U18} = 65$; $n_{3\ 000\ m} = 62$). For athletes competing at 1 500 m, athletes from Great Britain present the second highest frequency ($n_{U18} = 10$; $n_{U20} = 42$), while for 3 000 m, those competing U18 are from Turkey ($n = 40$) and Great Britain ($n = 34$). Some countries presented a low frequency of athletes - with one athlete present in the ranking over time.

Figs. 2 and 3 show countries' distribution according to ranking position, for 1 500 m and 3 000 m, respectively. For athletes ranked between "1st and 3rd" position, competing in 1 500 m (U18), 20% are from Great Britain, while 16% are from Spain, Germany, Ireland, and Turkey. Lower frequencies were shown for Russia (8%), Norway (4%), and Sweden (4%). Similarly, for those ranked between "4th and 10th" and "> 10th" most of the athletes are from Spain, Turkey, Germany, and Great Britain. For athletes competing at U20, Spain and France presented the highest frequency of athletes classified in the first positions (1st to 3rd). A similar pattern was shown for those ranked between "4th and 10th" (Spain, Germany, Great Britain), and "> 10th" (Spain, Great Britain, Germany), changing the order between Germany and Great Britain.

For runners competing in 3 000 m (U18), more than half of the athletes ranked between 1st and 3rd positions were Spanish or Turkish. Similar frequencies were observed for Great Britain, Germany, Norway,

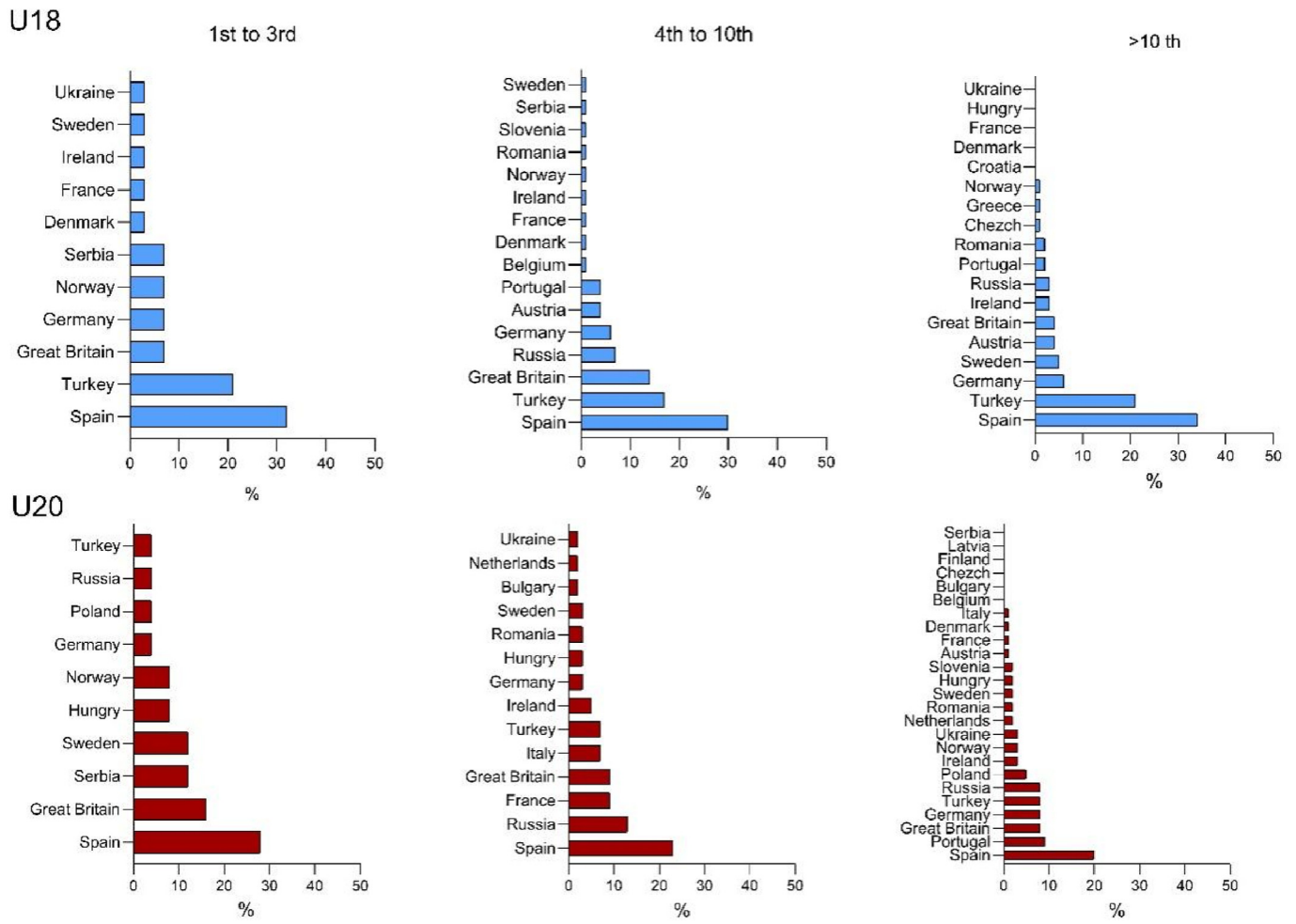

Fig. 3. Countries' distribution according to ranking position and age category, for athletes competing in 3 000 m.

and Serbia (7.1%). Spain, Turkey, and the Great Britain also presented high frequencies for athletes ranked between the "4th and 10th" positions, while Spain, Turkey, and Germany presented the highest frequencies for those classified "> 10th" positions. For the U20 category, the first positions were occupied by Spain (28%), Great Britain (16%), Serbia (12%), and Sweden (12%). A different pattern was found for athletes ranked between the "4th and 10th" and "> 10th", where most of the athletes are from Spain, Russia, and France, and Spain, Portugal, and Great Britain, respectively.

Table 1 and Table 2 present the frequency of athletes by country in each year, and the trend results test for both 1 500 m and 3 000 m. We used conditional formatting to show trends over time. For athletes competing in 1 500 m, a significant and positive trend was shown for Denmark and Spain, while Germany and Sweden showed a negative trend. For those competing in 3 000 m, Great Britain, Germany, Russia, and Ukraine presented a negative trend, while Turkey and Slovenia showed a positive trend.

Of the total athletes, almost 90% competed at home. The frequency of runners competing at home was higher among those in 3 000 m (94.3%) compared to those in 1 500 m (85.4%). Considering the age categories, the U18 presented a higher frequency of competition at home (94.4%), compared to those in U20 (85.6%). Most of the athletes ranked among the first positions competed at home (85.2%), however, no significant differences were observed among distributions ($\chi^2 = 3.96$; $p = 0.138$).

Discussion

The purposes of this study were to investigate the nationality of the best European young runners competing in 1 500 m and 3 000 m during the last decade (2010–2020); to verify participation trends for each country; and whether the place of competition can be associated with classification in ranking position. Based on a previous finding, we hypothesized that Great Britain, Germany, and Spain present the highest number of athletes ranked. Preliminary findings partially confirmed the hypothesis, since Spain, Great Britain, Turkey, Germany, and Russia had the highest number of athletes ranked in the U18 and U20.

The first important finding was that most of the ranking is composed of athletes from Spain, Turkey, and Great Britain. The pyramid effect metaphor can be partially linked to these findings, as previously demonstrated in Spain,[23] since it refers to the relationship between elite athletes and sports mass participation.[24] Although the present study was not developed with amateur runners, historically, the elite and mass participation are intrinsically related.[24] Data covering a big portion of North America, Asia, Africa and South America showed that athletes from Spain are the fastest in the marathon distance.[25] For participation surveys conducted in Spain and Germany revealed an increase in the number of runners.[26] For senior runners, data from events across the world indicated that Great Britain and Germany were the countries with the highest number of marathoners in the world.[27] The mechanisms by which events organization influence mass participation and young athletes' performance is beyond the scope of our purpose, and should be considered in future investigations.

Table 1
Frequency of athletes by country competing in 1 500 m between 2009 and 2020.

Country	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	Total	*p*-value Mantel test
Armenia	0	0	0	0	0	1	0	0	0	0	0	1	0.550
Austria	0	0	0	1	2	0	0	1	1	0	0	5	0.958
Belgium	0	1	1	0	0	0	1	3	0	1	0	7	0.684
Bulgaria	0	0	0	0	0	0	0	0	1	0	0	1	
Croatia	0	0	0	0	0	0	0	0	1	0	0	1	
Czech	0	0	2	2	3	1	0	0	1	1	1	11	0.835
Denmark	0	0	0	0	0	0	0	1	1	2	1	5	0.011
Spain	4	2	3	2	3	11	8	8	8	3	8	60	0.024
Finland	0	0	0	0	0	0	0	1	0	0	0	1	0.538
France	3	2	5	4	2	0	3	2	3	3	2	29	0.420
Great Britain	2	7	5	6	4	6	2	7	1	5	7	52	0.991
Germany	7	5	6	5	7	5	3	2	2	5	2	49	0.010
Greece	0	0	0	0	0	1	1	2	0	0	0	4	0.455
Hungary	1	0	0	3	1	0	0	0	0	2	1	8	0.982
Ireland	3	2	1	2	1	2	4	0	1	2	2	20	0.552
Italy	1	3	2	0	1	3	3	1	2	0	1	17	0.436
Lithuania	0	0	0	0	0	0	0	1	0	0	0	1	0.538
Netherland	0	0	0	0	1	0	1	1	2	0	1	6	0.099
Norway	1	3	1	1	0	1	0	3	1	2	1	14	0.901
Poland	0	0	1	1	0	0	1	0	1	0	0	4	0.820
Portugal	1	1	1	2	0	0	0	0	1	2	3	11	0.379
Romania	2	0	2	1	0	2	1	3	1	0	0	12	0.382
Russia	1	3	2	1	4	2	2	0	4	4	1	24	0.807
Slovenia	0	0	0	1	1	0	0	0	0	0	0	2	0.463
Serbia	0	0	0	0	0	0	0	0	1	0	0	1	0.348
Sweden	6	4	1	1	3	6	2	0	0	0	2	25	0.003
Turkey	0	0	0	2	2	4	5	3	4	2	1	23	0.054
Ukraine	1	0	0	0	0	0	0	0	0	1	1	3	0.488
Total	33	33	33	35	35	45	37	39	37	35	35	397	

Note: We used conditional formatting considering each country individually: shades of orange - lower values; shades of yellow - higher values

The second important finding was that no significant trends were shown for most of the countries, in both distances. A negative trend was observed for Germany and Sweden in 1 500 m, and for Great Britain, Germany, Russia, and Ukraine competing in 3 000 m. These results are in accordance with previous findings in which a negative performance trend was reported for athletes competing in long-distance events.[28] Factors that explain these results are related to the increase in the number of athletes from different countries competing over years. For example, athletes from Slovenia presented a positive trend in 3 000 m. However, the country was only ranked among the two last sessions studied (2018/2019; 2019/2020). These results suggest the need to better understand countries' context, geographical conditions, as well as school curriculum, which requires students to actively participate in sports camps.[29]

No differences were found between the place of competition and the ranking position. This finding was in contrast to a previous study in which European runners had a higher chance of being classified among the ten best athletes in long-distance events when they competed "at home".[22] The "home advantage" competitions have already been very well documented. A meta-analysis conducted by Jamieson,[30] showed that approximately 60% of competitive sports games are won by the home team, regardless of the type of sport (i.e., individual or team) or level of competition (amateur, professional or elite). Some of these explanations were provided by Pollard,[31] and include factors such as crowd influence, less travel fatigue, familiarity, referee bias, territoriality, special tactics, psychological factors, and regulations. Although running competitions have particularities. The home advantage can exist mainly in critical moments of the competition, mainly for younger athletes.

This study is not without limitations. Taken from the retrospective nature of this study, it was impossible to obtain information regarding the training characteristics (e.g., training methods, load distribution) of all athletes over the years. When training elite athletes, training can differ between athletes, especially in their advanced stages. Training volume and periodization models affect long- and short-term training processes and therefore individual performance trajectories. Additionally, the lack of information regarding the personal and environmental characteristics associated with performance in young athletes suggests that the generalization of this information should be avoided. Secondly, the study did not take into account changes in athletes' national citizenship over time. To the best of our knowledge, this is the first study to investigate the nationality of the best young European athletes in 1 500 m and 3 000 m to U18 and U20. These data can be used to manage athlete development programs in each country. Future studies can focus on whether the countries are represented in older age categories, as a follow-up on young athletes who reach high-level performance.

Conclusions

The best young athletes in 1 500 m and 3 000 m track running in the European continent were from Spain, Turkey, and Great Britain. Analysis of the participation trend showed no significant change for most of the countries. However, the results obtained can be used to better understand the contextual and environmental influence on these young elite European athletes, thus providing valuable information to support their development and improve performance through young athlete development programs in each country.

Table 2
Frequency of athletes by country competing in 3 000 m between 2009 and 2020.

Country	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	Total	*p*-value Mantel test
Austria	0	0	3	0	1	1	0	2	0	1	3	11	0.639
Belgium	0	0	0	0	1	1	0	0	0	0	0	2	0.532
Bulgaria	0	0	1	0	0	1	0	0	0	0	0	2	0.266
Croatia	0	0	0	1	0	0	0	0	0	0	0	1	0.337
Czech	0	0	0	1	0	0	0	1	0	0	1	3	0.593
Denmark	0	0	0	0	1	2	1	0	0	1	0	5	0.985
Spain	4	1	5	13	12	25	16	12	8	14	17	127	0.298
Finland	0	0	0	0	0	0	1	0	0	0	0	1	0.938
France	0	1	3	0	1	1	0	0	0	4	2	12	0.787
Great Britain	5	3	4	9	7	1	4	6	3	4	4	50	0.008
Germany	2	0	9	4	9	2	1	2	1	3	2	35	0.002
Greece	0	0	0	0	0	0	0	0	1	1	0	2	0.183
Hungry	0	0	0	2	0	0	0	1	3	2	1	9	0.131
Ireland	0	1	0	0	2	3	2	3	3	1	2	17	0.315
Italy	0	1	0	0	3	1	0	0	0	1	1	7	0.652
Latvia	0	0	0	1	0	0	0	0	0	0	0	1	0.337
Netherland	0	0	1	0	0	0	0	0	1	2	2	6	0.704
Norway	0	1	0	0	2	2	3	2	1	2	1	14	0.566
Poland	0	0	2	1	1	2	1	3	2	0	0	12	0.592
Portugal	3	1	5	3	0	0	0	3	3	5	6	29	0.869
Romania	1	0	1	1	1	3	4	1	0	0	0	12	0.149
Russia	4	5	3	5	8	3	1	4	6	0	3	42	0.001
Slovenia	0	0	0	0	0	0	0	0	0	3	2	5	0.005
Serbia	0	0	0	0	0	1	4	1	1	0	0	7	0.639
Sweden	0	0	1	4	0	0	3	0	5	2	3	18	0.184
Turkey	0	0	0	1	4	7	5	8	21	6	10	62	0.000
Ukraine	2	2	4	2	0	1	0	0	1	1	0	13	0.000
Total	21	16	42	48	53	57	46	49	60	53	60	505	

Note: We used a conditional formatting considering each country individually: shades of orange - lower values; shades of yellow - higher values

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Submission statement

Our work submitted has not been published previously, is not under consideration for publication elsewhere, its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and, if accepted, it will not be published elsewhere including electronically in the same form, in English or in any other language, without the written consent of the copyright holder.

Data availability

Datasets analyzed during the current study are available in the https://european-athletics.com/historical-data/top-list/season.

Authors' contribution

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Mabliny Thuany and Thayse Natacha Gomes. The first draft of the manuscript was written by Mabliny Thuany and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Ethical approval

The institutional review board of St Gallen, Switzerland, approved this study (EKSG 01/06/2010). Since the study involved the analysis of publicly available data, the requirement for informed consent was waived.

Conflict of interest

Beat Knechtle is an Editorial Board Member for Sports Medicine and Health Science and was not involved in the editorial review or the decision to publish this article. The authors have no relevant financial or non-financial interests to disclose.

References

1. Casado A, Hanley B, Ruiz-Perez LM. Deliberate practice in training differentiates the best Kenyan and Spanish long-distance runners. *Eur J Sport Sci.* 2020;20(7):887–895. https://doi.org/10.1080/17461391.2019.1694077.
2. Puthucheary Z, Skipworth JRA, Rawal J, Loosemore M, Someren KV, Montgomery HE. Genetic influences in sport and physical performance. *Sports Med.* 2011;41(10):845–859.
3. Degens H, Stasiulis A, Skurvydas A, Statkeviciene B, Venckunas T. Physiological comparison between non-athletes, endurance, power and team athletes. *Eur J Appl Physiol.* 2019;119(6):1377–1386. https://doi.org/10.1007/s00421-019-04128-3.
4. Joyner MJ. Physiological limits to endurance exercise performance: influence of sex. *J Physiol.* 2017;595(9):2949–2954. https://doi.org/10.1113/JP272268.
5. Cote J, Macdonald DJ, 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(10):1065–1073. https://doi.org/10.1080/02640410500432490.

6. Rossing NN, Stentoft D, Flattum A, Côté J, Karbing DS. 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(3):1304–1313. https://doi.org/10.1111/sms.13009.
7. Onywera V, Scott RA, Boit MK, Pitsiladis YP. Demographic characteristics of elite Kenyan endurance runners. *J Sports Sci*. 2006;24(4):415–422. https://doi.org/10.1080/02640410500189033.
8. Noble TJ, Chapman RF. Marathon specialization in elites: a head start for africans. *Int J Sports Physiol Perform*. 2020;13(1):102–106. https://doi.org/10.1123/ijspp.2017-0069.
9. Casado A, Hanley B, Santos-Concejero J, Ruiz-Perez LM. World-class long-distance running performances are best predicted by volume of easy runs and deliberate practice of short-interval and tempo runs. *J Strength Condit Res*. 2021;35(9):2525–2531. https://doi.org/10.1519/JSC.0000000000003176.
10. Thuany M, Gomes TN, Rosemann T, Knechtle B, de Souza RF. No trends in the age of peak performance among the best half-marathoners and marathoners in the world between 1997-2020. *Medicina*. 2021;57(5):409. https://doi.org/10.3390/medicina57050409.
11. Nikolaidis PT, Onywera V, Knechtle B. Running performance, nationality, sex, and age in the 10-km, half-marathon, marathon, and the 100-km ultramarathon IAAF 1999-2015. *J Strength Condit Res*. 2017;31(8):2189–2207. https://doi.org/10.1519/JSC.0000000000001687.
12. Santos PA, Sousa CV, da Silva Aguiar S, et al. Human development index and the frequency of nations in Athletics world rankings. Article. *Sport Sci Health*. 2019;15(2):393–398. https://doi.org/10.1007/s11332-019-00529-1.
13. Vella SA, Cliff DP, Okely AD. Socio-ecological predictors of participation and dropout in organised sports during childhood. *Int J Behav Nutr Phys Activ*. 2014;11:62. https://doi.org/10.1186/1479-5868-11-62.
14. Bale J, Sang J. *Kenyan Running: Movement Culture, Geography and Global Change*. Routledge; 1996.
15. Said E. Development, underdevelopment, resistance. In: Bale J, Sang J, eds. *Kenyan Running - Movement Culture, Geography and Global Change*. Routledge; 1997.
16. Thuany M, Gomes T, Villiger E, et al. Trends in participation, sex differences and age of peak performance in time-limited ultramarathon events: a secular analysis. *Medicina*. 2022;58(3):366. https://doi.org/10.3390/medicina58030366.
17. Scheer V, Sousa CV, Valero D, Knechtle B, Nikolaidis PT, Valero E. A descriptive study on health, training and social aspects of adults that participated in ultra endurance running as youth athletes. *J Sports Med Phys Fit*. 2020. https://doi.org/10.23736/S0022-4707.20.11198-8.
18. Knechtle B, Aschmann A, Onywera V, Nikolaidis PT, Rosemann T, Rüst CA. Performance and age of african and non-african runners in world marathon majors races 2000-2014. *J Sports Sci*. 2017;35(10):1012–1024. https://doi.org/10.1080/02640414.2016.1209302.
19. Weippert M, Petelczyc M, Thürkow C, Behrens M, Bruhn S. Individual performance progression of German elite female and male middle-distance runners. *Eur J Sport Sci*. 2021;21(3):293–299. https://doi.org/10.1080/17461391.2020.1736182.
20. Deelen I, Janssen M, Vos S, Kamphuis CBM, Ettema D. Attractive running environments for all? A cross-sectional study on physical environmental characteristics and runners' motives and attitudes, in relation to the experience of the running environment. *BMC Publ Health*. 2019;19(1):366. https://doi.org/10.1186/s12889-019-6676-6.
21. Tcymbal A, Gelius P, Abu-Omar K, et al. Development of national physical activity recommendations in 18 EU member states: a comparison of methodologies and the use of evidence. *BMJ Open*. 2021;11(4):e041710. https://doi.org/10.1136/bmjopen-2020-041710.
22. Thuany M, Pereira S, Hill L, et al. Where are the best European road runners and what are the country variables related to it? *Sustainability*. 2021;13(14):7781. https://doi.org/10.3390/su13147781.
23. Seguí-Urbaneja J, Inglés E, Alcaraz S, De Bosscher V. Sport pyramid metaphor: trickle down and up effect in Spain. *Rev Int Med Cienc Act Fís Deporte*. 2020;20(77):1–20. https://doi.org/10.15366/rimcafd2020.77.001.
24. De Bosscher V, Sotiriadou P, van Bottenburg M. Scrutinizing the sport pyramid metaphor: an examination of the relationship between elite success and mass participation in Flanders. *International Journal of Sport Policy and Politics*. 2013;5(3):319–339. https://doi.org/10.1080/19406940.2013.806340.
25. Andersen JJ. The state of running 2019. RunRepeat. 21 September, 2021. Accessed 10 October, 2022. https://runrepeat.com/state-of-running.
26. Scheerder J, Breedveld K, Borgers J. *Running across Europe - the Rise and Size of One of the Largest Sport Markets*. Palgrave Macmillan; 2015.
27. Andersen JJ. Marathon Statistics 2019 Worldwide (Research). RunRepeat. 6 August, 2021. Accessed 10 October, 2022. https://runrepeat.com/research-marathon-performance-across-nations.
28. Reusser M, Sousa CV, Villiger E, et al. Increased participation and decreased performance in recreational master athletes in "berlin marathon" 1974-2019. *Front Physiol*. 2021;12:631237. https://doi.org/10.3389/fphys.2021.631237.
29. Dobay Beáta, Banhidi M. Sport tourism development in Slovakia Dezvoltarea turismului sportiv în Slovacia. *Palestrica of the third millennium – Civilization and Sport*. 2012;13(1):19–22.
30. Jamieson JP. The home field advantage in Athletics: a meta-analysis. *J Appl Soc Psychol*. 2010;40(7):1819–1848. https://doi.org/10.1111/j.1559-1816.2010.00641.x.
31. Pollard R. Home advantage in football: a current review of an unsolved puzzle. *Open Sports Sci J*. 2008;1:12–14.