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TOURISM OF FIGHTING ARTS

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Geography of Olympic Combat Sports. Part three: dominance

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Abstract
Background. This article continues a new interdisciplinary line of research into the geography of Olympic combat sports.
Problem and aim. A precise assessment of the point value of medals won at modern Olympic championships was assumed to be relative to the population of the countries concerned. The overarching aim of the article was to construct a new indicator that is a relative measure of medal points related to the population of a country. It also allows comparison of countries that differ in population. The theoretical aim was to construct and validate this indicator, and the practical aim was to apply the indicator to comparisons between different countries, considering the different Olympic combat sports disciplines.
Material and methods. The method of secondary source analysis was used. The results of combat sports competitions at the modern Olympic Games (1896-2021) made available by the International Olympic Committee were used, as well as data on the population number by the United Nations and data from individual country websites. Two indices were constructed to address the problem: the Olympic Games medal winning index (SM); and the Olympic Games points winning index (SP). Descriptive statistics were performed, distributions were examined, and rho Spearman correlations were calculated.
Results. As a result, four perspectives were documented: 1. Countries with a large number of medal points and several dominating combat sports: Hungary, Cuba, Bulgaria, and Sweden; 2. Countries with a large number of medal points and one or two leading combat sports: Georgia and Finland; 3. Countries with a small number of medal points and a small population: Estonia and Armenia; 4. Countries with a small number of medal points and a very small population: San Marino and Tonga.
Conclusions. It was concluded that only the first and second perspective were applicable, as it showed countries relevant in the classification of the number of medal points from previous studies. Therefore, the results of six countries: Hungary (in fencing and modern pentathlon), Cuba (in boxing), Sweden (in modern pentathlon) and Bulgaria (in wrestling, *judo* and boxing), as well as Georgia (*judo* and wrestling), and Finland (wrestling and modern pentathlon) are more relevant than those of other countries.

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Introduction

Modern sport is constantly evolving by adding new disciplines, ensuring that it does not lose its popularity [Varmus *et al.* 2022]. Interest in sporting competition, especially at the highest level, has also gone beyond the physical sciences [Woods *et al.* 2023]. One such interdisciplinary approach is the geography of sport [Bale 2003], which is an outgrowth of geography (from the earth and environmental sciences) [Jedrusik *et al.* 2010] and sport (from the physical culture sciences) [Pawlucki 2015] and is positioned at the interface between the two disciplines. In this area of science, a new direction of research on the geography of Olympic combat sports has been defined [Baginska *et al.* 2022a; 2022b]. It includes the combat sports played at the modern Olympic Games: boxing [Bingul *et al.* 2017], fencing [Borysiuk *et al.* 2022], *judo* [Prokopczyk, Sokolowski 2021], *karate* [Kusnierz et al. 2023], modern pentathlon [Jagiełło M., Jagiełło W. 2014], *taekwondo* [Jeon *et al.* 2023] and wrestling [Sokolowski, Prokopczyk 2022]. In this sense, aspects of geography and fighting arts overlap with martial arts tourism, which is understood as travel for practical study or research of martial arts [Cynarski 2020].

The present studies found that in boxing, in terms of the sum of all medals won by a country at the modern Olympic Games and in terms of medal points (converted as follows: 5 points for a gold medal; 3 points for a silver medal; 1 point for a bronze medal) the United States of America leads the way. Cuba came second and Russia third. In fencing, on the other hand, in terms of the number of medals won at the Olympic Games, the powerhouses are France, Italy and Hungary, respectively. In terms of medal points, Italy is the best, followed by France and then Hungary. In *judo*, on the other hand, Japan, France, and South Korea dominate the medal and points standings. Interestingly, in the youngest Olympic combat sport, *karate*, in terms of the number of medals won at the Olympic Games, Turkey is in first place, followed by Japan in second place and Azerbaijan in third place. But in terms of medal value points, it is Japan in first place, Spain in second and Turkey in third. In modern pentathlon, on the other hand, Hungary, Sweden, and Russia dominate the medal and point standings. Similarly, in *taekwondo*, in terms of medals won at the Olympic Games and in terms of points, three countries significantly dominate: South Korea, China and the USA. Finally, dominance in wrestling in both classifications belongs to the United States, Russia, and Japan [Baginska *et al.* 2022a; 2022b].

The data presented above refer to two indicators: the number of medals and the point value of medals. The countries dominating Olympic combat sports vary widely in terms of area, population, economic development, and political system, but are united by a long tradition of combat sports (native or foreign). Interestingly, these are countries located only in the northern hemisphere. However, to more accurately assess the value of medals won at the modern Olympics, it would be necessary to relate them to the population of the countries concerned. This would show the identification of sporting talents. Highly populated countries have large populations for sporting selection. In contrast, less populous countries have no such resources. Therefore, an Olympic medal won by a less populous country will theoretically have a higher value than a medal won by a more populous country. The aim of this study is therefore to verify the subjective point value of medals related to a country's population. This is a modern and interdisciplinary approach to the problems of sport in the 21st century. The assumption above indicates that the problem addressed is socially important since through the perspective of geography it is possible to verify the value of medals won in combat sports at the modern Olympics. Consequently, it refers to the dominance of the achievements of the countries concerned.

Methodology

Research material

First, the secondary source analysis method was utilized for obtaining boxing, fencing, *judo*, *karate*, modern pentathlon, *taekwondo*, and wrestling results from the Olympic Games that are available on the International Olympic Committee website [Olympic results 2024]. Moreover, the analysis included data concerning the number of a given country's citizens from the United Nations website [United Nations 2024], and in cases where no data was available (not all countries and territories are acknowledged by the United Nations, or data was not supplied to the UN, for instance Kosovo [Toponymic factfile 2024] and Ivory Coast [Worldometer 2024], the number of inhabitants was verified on individual country and territory websites. The geographical scope of the survey covered the territory of all countries worldwide while the general time span was the period 1896-2021, as the discussed sports were played at the Olympic Games in this period. Due to the COVID-19 pandemic, the Tokyo 2020 Olympics were held a year later [Klimczak *et al.* 2021; Fedyk *et al.* 2022a; 2022b]. Specifically, the time range for boxing was 1904-2021; for fencing 1896-2021; for *judo* 1964-2021 (excluding 1968, when not present in the programme); for *karate* 2021; for modern pentathlon 1912-2021; for *taekwondo* 2000-2021; and for wrestling 1896-2021 [Olympic results 2024].

Method

The original database of countries and territories comprised 258 units, while the authors included 98 for the analysis, as the remaining countries and territories did not have any medals in the seven sports analysed. A weighted points system was used to assess the total number of medals won by a given country: gold medal

means 5 points; silver means 3 points; bronze means 1 point. In order to relate to the current geopolitical world division, some corrections were made. Medals won by athletes from currently non-existent countries, such as Czechoslovakia, the CIS, the USSR, and Yugoslavia, were assigned to specific countries by considering the nationality of the medal winner, regardless of where they lived or trained. In team sports, the medals were allocated to specific countries, also due to the nationality of the players. By contrast, East Germany and West Germany medals were added up as medals for Germany, and Persia's medals were allocated for Iran.

Then, the following indicators were developed:

a) the Olympic Games medal winning index (SM) = number of gold + silver + bronze medals for analysed sports divided by the number of citizens of the examined country (in million).

b) the Olympic Games points winning index (SP) = number of gold medals x 5 points + number of silver medals x 3 points + number of bronze medals x 1 point for analysed sports divided by the number of citizens of the examined country (in million).

In the next step, to demonstrate the spatial distribution of the investigated phenomena, a proportional symbol map and choropleth map (two cartographic methods), were used [Piepiora 2019; Natural Earth data 2024]. The proportional symbol map was used to illustrate the total number as well as the individual colours of the medals, while the choropleth map was used for the points winning index at the Olympic Games (SP). The maps were generated in QGIS 3.28 GIS software.

For the Olympic Games points winning index (SP), five classes were determined for all disciplines. The natural interval method (Jenks' method) was employed to determine the class intervals for the choropleth map. This frequently used method involves clustering similar values together for optimisation, so that the largest possible gaps are discerned, and groups of values as close to each other as possible [Piepiora 2019; Natural Earth data 2024]. To generate the maps, the 'Cultural,' free, cartographic base map, scale 1:10 000 000, was used [Jasp stats 2024].

Statistic analyses were performed with the use of JASP 0.17.2 computer software [Storey 2011]. This study does not require the approval of the local ethics committee as it does not breach sensitive data.

Results

As a first step, descriptive statistics were calculated alongside a normality distribution test (Table 1).

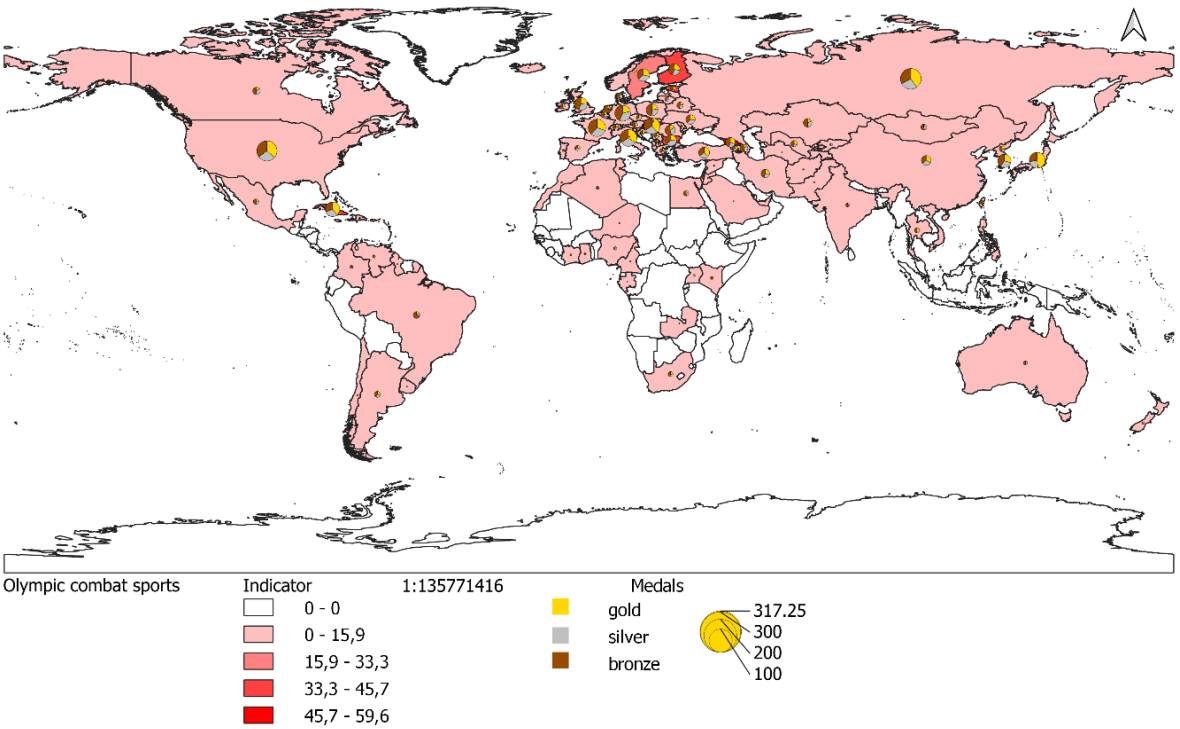
In the next step, Spearman's rho correlation between 2022 population mid-year estimates (millions) and a total sum of points was calculated for the 98 countries

Table 1. Descriptive statistics for analysed phenomena.

Statistics	Sum of gold medals	Sum of silver medals	Sum of bronze medals	Total sum of medals	Total sum of points	2022 Population mid-year estimates (millions)	Olympic Games medal winning index (SM)	Olympic Games points winning index (SP)
Valid	98	98	98	98	98	98	98	98
Median	2.000	3.000	6.500	12.000	27.000	12.010	0.951	2.162
Mean	11.327	11.418	16.000	38.765	106.927	65.242	2.941	6.971
Std. Deviation	23.520	19.008	22.935	64.235	194.323	204.524	5.234	12.017
Minimum	0.000	0.000	0.000	1.000	1.000	0.030	0.007	0.008
Maximum	127.000	87.000	107.000	317.250	998.270	1425.890	33.333	59.579
Skewness	3.087	2.375	2.205	2.542	2.749	6.165	3.285	2.683
Kurtosis	9.943	5.396	4.772	6.593	7.813	39.378	12.984	6.951
Shapiro-Wilk	0.534	0.634	0.687	0.624	0.586	0.284	0.570	0.597
P-value of Shapiro-Wilk	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Table 2. The Olympic Games points winning index (sum of points) – top 10 countries.

No.	Country	Sum of gold medals	Sum of silver medals	Sum of bronze medals	Total sum of medals	Total sum of points	2022 Population mid-year estimates (million)	Olympic Games medal winning index (SM)	Olympic Games points winning index (SP)
1	Hungary	75	51	66	192	594	9.97	19.26	59.58
2	Georgia	21	18	32	71.60	193.20	3.74	19.14	51.66
3	Finland	26	27	42	95	253	5.54	17.15	45.67
4	Cuba	62	47	49	157.66	498.30	11.21	14.06	44.45
5	Estonia	7	3	8	18.33	52.99	1.33	13.78	39.84
6	Bulgaria	22	38	34	94	258	6.78	13.86	38.05
7	San Marino	0	0	1	1	1	0.03	33.33	33.33
8	Sweden	33	41	41	115	329	10.55	10.90	31.18
9	Tonga	0	1	0	1	3	0.11	9.09	27.27
10	Armenia	7	6	6	19.20	59.60	2.78	6.91	21.44



Map 1. The Olympic Games points winning index (SP).

analysed that have won medals in the modern Olympic Games in combat sports. Assuming $p < 0.001$, the correlation is 0.372, i.e. a weak positive correlation, but the relationship is clear. It is noted that the population of a country has little effect on total medal points. Olympic Games points total indices were compiled for the top 10 countries (Table 2 / Map 1); results were sorted by Olympic Games points winning index (SP).

The countries with the highest SP (between 59.58 and 21.44) were included in the first 3 classes according to the Jenks method. The top 10 countries are diverse: Hungary, Georgia, Finland, Cuba, Estonia, Bulgaria, San Marino, Sweden, Tonga, and Armenia. These are not the countries with the largest populations in the world. In fact, none of the 10 most populous countries in the world (China, India, United States, Indonesia, Pakistan, Nigeria, Brazil, Bangladesh, Russia, Mexico, and Japan) made it into the top 10 of the Olympic Games points winning index (SP). Moreover, only three countries with the highest number of medal points were among those with the highest value of the SP index (Hungary, Cuba, Sweden). However, it is worth noting that 8 of the 10 countries with the highest SP value are European or located on the European-Asian border.

Hungary, according to the Olympic Games points winning index (SP), is ranked number 1. The most important medal-earning sport for the country is a modern pentathlon, followed by fencing, wrestling, and boxing. Next is Georgia, which according to the Olympic Games points winning index (SP) boasts a large number of medal points for *judo*, and wrestling. Finland, which according to the Olympic Games points winning index (SP) is in third place, has earned the most points in wrestling and modern pentathlon. Cuba, which according to the Olympic Games points winning index (SP) is in 4th place, represents the widest range of sports that have earned it medal points, as it has earned the most medal points through boxing, *judo*, wrestling, fencing and *taekwondo*, respectively.

Estonia, which is ranked 5th according to the Olympic Games points winning index (SP), has few medal points, but has ranked highly according to this index due to its small population. It is not in the top 10 in any medal points ranking. The situation is similar with Armenia, which is ranked 10th according to the Olympic Games points winning index (SP) but does not have a dominant sport. Bulgaria, which according to the Olympic Games points winning index (SP) is 6th, has plenty of points won for wrestling, *judo*, and boxing. Tiny San Marino, which according to the Olympic Games points winning index (SP) is in 7th place and has only 1 medal for wrestling, thus owes its high ranking to a very small population. The same situation is true for tiny Tonga, which according to the Olympic Games points winning index (SP) is in 9th place and has a medal in only one competition - for boxing. Finally, Sweden, which according to the Olympic Games points winning index (SP) is in 8th place, owes many of its medal points to modern pentathlon, wrestling, and fencing.

In view of the above, four perspectives on the dominance of the countries concerned in the Olympic combat sports with the highest SP index were identified:

1. with a high number of medal points and several combat sports: Hungary, Cuba, Bulgaria, and Sweden.

2. with a high number of medal points and one or two combat sports: Georgia and Finland.

3. with a small number of medal points and a small population: Estonia and Armenia.

4. with a small number of medal points and a very small population: San Marino and Tonga.

Discussion

The results obtained provided cognitively interesting data. Depending on the adopted perspective of the importance of achievements, the dominance of Hungary, Cuba, Bulgaria, and Sweden (first perspective); Georgia, Finland (second perspective); Estonia, Armenia (third perspective); San Marino, Tonga (fourth perspective) was observed. There are noticeable differences here from previous studies relating strictly to the classification of the number of medal points, where, depending on the Olympic combat sport, the United States of America, Cuba, Russia (in boxing) lead the way; Italy, France, Hungary (in fencing); Japan, France, South Korea (in *judo*); Japan, Spain, Turkey (in *karate*); Hungary, Sweden, Russia (in modern pentathlon); South Korea, China, USA (in *taekwondo*); USA, Russia, Japan (in wrestling) [Baginska *et al.* 2022a; 2022b].

It should be noted that the significance of achievements in Olympic combat sports is similar only in the first and second perspectives to the number of medal points classification. It is true for Hungary (in fencing and modern pentathlon), Cuba (in boxing), Sweden (in modern pentathlon), Bulgaria (wrestling, *judo* and boxing), Georgia (*judo* and wrestling) and Finland (wrestling and modern pentathlon). Consequently, the third and fourth perspectives were rejected. In this sense, the medals won by these countries in combat sports at the modern Olympic Games are more significant than those won by populated countries such as China, the United States of America, Russia and Japan [Storey 2011]. Hungary, Cuba, Sweden, Bulgaria, Georgia, and Finland are not social, economic and territorial powers, therefore the results achieved by them in combat sports at the modern Olympic Games should be considered more significant in relation to the achievements of China, the United States of America, Russia, Japan, i.e. countries generally considered to be the most developed in the world [Wise, Kohe 2020].

On the other hand, an analysis of the results from all four perspectives shows that all the countries in the top ten Olympic Games points winning (SP) index (Hungary, Cuba, Sweden, Bulgaria, Georgia, Finland, Estonia, Armenia, San Marino, and Tonga) are a breeding ground for talents in Olympic combat sports. These less populous countries do not have the large population resources for a sport selection that more populous countries such as China, the United States of America, Russia, and Japan do [Hall, Lin 2024]. Therefore, the role of the importance of sporting talent is highlighted here and the subjective feeling remains that an Olympic medal won by a less populated country is of greater value than a more populated country [DeChano-Cook, Hallett 2024].

The present finding brings cognitive novelty to the physical culture sciences in the area of sports geography and to the earth sciences in the area of geography that in terms of Olympic Games points winning (SP) Hungary dominates fencing, Cuba dominates boxing, Hungary, Sweden, and Finland dominate modern pentathlon, Bulgaria dominates up to three sports: wrestling, *judo* and boxing, Finland and Georgia dominate wrestling, and finally Georgia dominates *judo*.

Research limitation

The research results obtained are time-limited to up until the Tokyo Olympic Games in 2021 [Vanoes *et al.* 2020]. After the Paris Olympics in 2024, the data will have to be updated and the results will have to be reviewed [Alberts 2014]. In addition, *karate* has dropped out of the 2024 Paris Olympics programme and the Olympic combat sports competition will be narrowed down to boxing, fencing, *judo*, modern pentathlon, *taekwondo*, and wrestling [Olympic Games Paris 2024]. However, this does not undermine the desirability of continuing research into the geography of Olympic combat sports but merely indicates that the direction set for research must be flexible and adapt to changes set by the International Olympic Committee [DeChano-Cook, Shelley 2017].

In addition, our study includes results from 1896 to 2021 in relation to the current political division of the world and current population (as of 2022). It is virtually impossible to obtain data on the populations of the countries in question from past times because reliable and continuous databases do not exist. In addition, as a result of political changes in the world, some countries have ceased to exist (for instance, the USRR, Yugoslavia, Czechoslovakia) and others have come into being (for instance, Ukraine, Croatia, Bosnia and Herzegovina, Czech Republic, Slovakia). Therefore, it is not possible to reconstruct the population of these countries throughout the analyzed period. The above should be treated as a controlled confounding variable.

Further research

In further research work, we envisage studies on the number of medals and medal points according to the level of socio-economic development. These will be case studies of individual countries around the world.

Conclusions

The point values of medals related to a country's population indicate the dominance of several world countries: Hungary (in fencing and modern pentathlon), Cuba (in

boxing), Sweden (in modern pentathlon), Bulgaria (in wrestling, *judo* and boxing), Georgia (in *judo* and wrestling), and Finland (in wrestling and modern pentathlon), representing the first and second presented perspective. The aforementioned countries are not social, economic, and territorial powers, and therefore the results achieved by them in combat sports at the modern Olympic Games should be considered more relevant in relation to other countries considered to be the most developed in the world.

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Geografia olimpijskich sportów walki. Część trzecia: dominacja

Słowa kluczowe: sporty walki, geografia sportu, Międzynarodowy Komitet Olimpijski, Igrzyska Olimpijskie, Organizacja Narodów Zjednoczonych

Streszczenie

Tło. Niniejszy artykuł kontynuuje nową interdyscyplinarną linię badań nad geografią olimpijskich sportów walki.

Problem i cel. Założono, że precyzyjna ocena wartości punktowej medali zdobytych na nowożytnych mistrzostwach olimpijskich powinna być odniesiona do populacji danych krajów. Nadrzędnym celem artykułu było skonstruowanie nowego wskaźnika, który jest miarą względną i umożliwia pomiar liczby medali po przeliczeniu na punkty do populacji danego kraju. Pozwala on również na porównanie krajów różniących się liczbą ludności. Celem teoretycznym było skonstruowanie i walidacja tego wskaźnika, a celem praktycznym było zastosowanie wskaźnika do porównań między różnymi krajami, biorąc pod uwagę różne dyscypliny olimpijskich sportów walki.

Materiał i metody. Zastosowano metodę analizy źródeł wtórnych. Wykorzystano wyniki zawodów sportów walki na nowożytnych igrzyskach olimpijskich (1896-2021) udostępnione przez Międzynarodowy Komitet Olimpijski, a także dane dotyczące liczby ludności udostępnione przez Organizację Narodów Zjednoczonych oraz dane ze stron internetowych poszczególnych krajów. W celu rozwiązania problemu skonstruowano dwa wskaźniki: wskaźnik medalowy Igrzysk Olimpijskich (SM) oraz wskaźnik punktowy Igrzysk Olimpijskich (SP). Przeprowadzono statystyki opisowe, zbadano rozkłady i obliczono korelacje Spearmana.

Wyniki. W rezultacie udokumentowano cztery perspektywy: 1. Kraje z dużą liczbą punktów medalowych i kilkoma dominującymi sportami walki: Węgry, Kuba, Bułgaria, Szwecja; 2. Kraje z dużą liczbą punktów medalowych i jednym lub dwoma wiodącymi sportami walki: Gruzja i Finlandia; 3. Kraje z małą liczbą punktów medalowych i małą populacją: Estonia i Armenia; 4. Kraje z małą liczbą punktów medalowych i bardzo małą populacją: San Marino i Tonga.

Wnioski. Stwierdzono, że tylko pierwsza i druga perspektywa była uzasadniona, ponieważ pokazywała kraje istotne w klasyfikacji liczby punktów medalowych z poprzednich badań. W związku z tym wyniki sześciu krajów: Węgier (w szermierce i pięcioboju nowoczesnym), Kuby (w boksie), Szwecji (w pięcioboju nowoczesnym) i Bułgarii (w zapasach, judo i boksie), a także Gruzji (judo i zapasy) i Finlandii (zapasy i pięciobój nowoczesny) są bardziej miarodajne niż pozostałych krajów.