

What is behind the Olympic medal success of the sports nations?

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The Olympic Games are over and the sports teams have returned home with more or less proud medal tables. Two factors are of major importance for a country's Olympic medal success: gene pool and per capita income. Which countries were over- and underperformers at this year's games in this regard?

Actually, no medal tables should be published at the Olympics. They do not correspond to the idea of the founder of the modern Olympic Games, Baron de Coubertin, who dreamed of a "peaceful meeting of the youth of the world". A list of how many gold, silver and bronze medals a country's athletes have won tends to inspire national pride. However, it should be added right away: The origin of an athlete also played a major role in the ancient Olympics. It was not uncommon for winners to receive generous material rewards from their cities of origin because they basked in the splendor of their successful athletes. This phenomenon has persisted to this day, with Singapore topping the list of the most generous countries. There, a gold medal is rewarded with around 830,000 euros while Germany rewards such a medal with 20,000 euros.

Today the sporting success of a country is shown everywhere by means of a medal table. The population of a nation with many (gold) medals feel happy, which is of course welcomed by politicians and sporting interest groups. If a nation is doing badly, the highest possible financial support is required in order to improve its rank in the future. If a nation is particularly successful, the same thing happens so that this rank can be maintained.

The German athletes did well in Tokyo. They brought home 10 gold, 11 silver and 18 bronze medals. In the medal table, which is usually shown, they take ninth place.

Two key factors in medal success

The question arises as to what Olympic success can be traced back to. There are two main determinants. The first is the gene pool that can be accessed. Countries with a large population – e.g. China with 1.5 or India with 1.4 billion people – can find genetically particularly suitable people for each sport more easily than a country like Germany with around 84 million or Switzerland with around 8 million can.

The second important determinant is the extent to which the athletic gene pool is used. To this end, many factors have to be cited, in particular the suitable selection in early youth, the infrastructure to be able to practice a sport (e.g., the number of tennis courts), the promotion of the particularly gifted through financial support (e.g., through state employment in the military) and especially effective training methods. These various factors are closely related to a country's economic prosperity – per capita income. A poor country can afford the corresponding expenses less than a rich country.

We used a regression analysis to determine the connection between these two essential determinants. We have deliberately limited ourselves to two explanatory factors. The number of medals achieved by a nation

is explained on the basis of its logarithmic population size and its per capita income, which was standardized for purchasing power in US dollars. With this simple approach, 36 percent of the variation between countries is attributed to the two determiners. Both the logarithm of the population size and the per capita income turn out to be statistically significant determinants ($p < 0.01$).

Overperformers and underperformers among the sporting nations

According to our calculations, the German athletes “should” have won 30 medals, which is fewer than the 37 medals actually won. So they performed better than would have been expected based on our model. Germany’s neighbouring countries, Austria and Switzerland, should have won 18 and 23 medals, respectively, given their population size and income per capita; in reality it was only 7 and 13, i.e. only 39 percent and 57 percent of the potential we calculated.

The medal table used in the media is based exclusively on the number of gold medals won. This is lead by the United States, followed by China, Japan, and Great Britain and Russia at the top. The American participants won almost exactly a third of all medals, namely 113 of a total of 339 medals awarded. If population size and income per capita are taken into account, they would only have won 42 medals. This suggests that other important factors, especially sports management as a whole, play an important role. China, which is in second place in the usual medal table, won 88 medals, whereas according to the two most important determinants, population size and per capita income, it would only have been 35 medals.

In contrast, Argentina «should» have won 15 medals, but actually only achieved 3 medals. Even more extreme is India, which was awarded only 7 medals, according to population size (1.4 billion) and per capita income 31 would have been appropriate. Obviously, with better sports management, these countries would have the ability to win more medals.

Several countries are exactly reaching their potential. The Canadian athletes bring home 24 medals, exactly the number calculated according to the gene pool and economic prosperity. The same applies to Brazil and Kenya.

Of course, the medal wins can also be assigned to many other determinants, but it is still astonishing that the number of medals won can be easily understood with the population size and per capita income alone. It will be exciting to see whether the size of the population or the factors associated with a high per capita income such as the degree of utilization of talents and training methods will dominate in the future.

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