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WORLD RANKING OF COUNTRIES IN ELITE SPORT

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ABSTRACT: Researchers, media, and sports leaders use the Olympic medal table at the end of each edition of the Winter or Summer Games as a benchmark for measuring the success of countries in elite sport. This ranking, however, has several limitations, such as: i) the absolute superiority of a gold medal over any number of silver and bronze creates the false inference that a country with one outstanding athlete capable of winning a gold medal is superior to another in events where several athletes finish second and third; ii) by not considering the number of countries participating in each event, the medal table does not consider the competition level of each sport; iii) only 87 of the 206 National Olympic Committees won medals when the 2016 Summer and 2018 Winter Olympic medal tables are combined. This statistical feature prevents an adequate comparative analysis of the success of countries in elite sport, considering that 58% of participants are absent. To overcome this lack, Nassif (2017) proposed a methodology with the following characteristics: a) a computation model that gives each country its share of points in at least one sport and, consequently, its world ranking based on the total number of points that particular country has obtained in all the sports in which it participates; b) the introduction of coefficients of universality and media popularity for each sport.
Apart from accurately assessing the performance of all countries in international competitions, this study in the future aims to undertake in-depth studies of the factors that determine the success or failure of nations in elite sport.

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1. Introduction

Although, according to the Olympic Charter, the International Olympic Committee (IOC) and the local organizing committees of the Olympic Games shall not draw up any global ranking per country,[1] scholars mainly refer to the Olympic medal table when they want to measure the performance of a country in sport. Indeed, economists use it when they aim to identify the impact of macro-level factors (such as wealth and population) on countries performances in elite sport.[2] It also serves as a performance measurement by researchers in Political Sciences, which analyze national elite sport policies implemented by governments from different countries.[3] Experts in Sports Management refer to it to identify the meso-level factors of an elite sport policy leading to success in international competitions such as financial support, governance, participation, talent identification, athletic career support, training facilities, coaching development and scientific research.[4] In this paper, we start by discussing the non-correctness of the Olympic medal table and then propose a new model that comprises the following features:

a) A weighted points system that replaces in any event, discipline, or sport the three-medal Olympic system.
b) The introduction of universality and popularity coefficients for each sport.
c) A computation model that attributes to each country its share of points in at least one sport and consequently its ranking based on the total number of points that this country would have acquired in all sports.

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[1] See Olympic Charter, article 57.

[2] See among others W. Andreff, *Economic development as major determinant of Olympic medal wins: predicting performances of Russian and Chinese teams at Sochi Games*, in *Int. J. of Ec. Pol. in Em. Ec.,* vol.6, n.4, 2013, 314-340; A.B. Bernard, M.R. Busse, *Who wins the Olympic Games: Economic resources and medal totals*, in *Rev. of Ec. and Stat.*, vol.86, n.1, 2004, 413-417; F.A. Den Butter, C.M. Van Der Tak, *Olympic medals as an indicator of social welfare*, in *Soc. Ind. Res.*, vol.35, n.1, 1995, 27–37; H.K. Lui, W. Suen, *Men, money, and medals: An econometric analysis of the Olympic Games*, in *Pac. Ec. Rev.*, vol.13, n.1, 2008, 1-16; P. Kiviaho, P. Mäkelä, *Olympic success: a sum of non-material and material factors*, in *Int. Rev. of Sp. Soc.*, vol.13, n.2, 1978, 5-22; I.A. Moosa, L. Smith., *Economic development indicators as determinants of medal winning at the Sydney Olympics: an extreme bounds analysis*, in *Aus. Ec. Pap.*, vol.43, n.3, 2004, 288-301; A.D. Novikov, A.M. Maximenko, *The Influence of Selected Socio-economic Factors on the Level of Sports Achievements in the Various Countries (Using as an Example the 18th Olympic Games in Tokyo*, in *Int. Rev. for the Soc. of Sp.*, vol.7, n.1, 1972, 27-44; A. Rathke, U. Woitek., *Economics and the summer Olympics: an efficiency analysis*, in *J. of Sp. Ec.*, vol.9, n.5, 2008, 520-537; M. Tcha, V. Pershin. *Reconsidering performance at the Summer Olympics and revealed comparative advantage*, in *J. of Sp. Ec.,* vol.4, n.3, 2003, 216-239; C. Van Tuyckom, *Going for gold! welfare characteristics and Olympic success: a Lisrel-model*, 2010, Köln, Lambert Academic Publishing.

[3] D. Reiche, *Success and Failure of Countries at the Olympic Games*, London and New York, 2016, Routledge; B. Houlihan, J. Zheng, *Small states: sport and politics at the margin*, in *Int. J. of Sp. Pol. and Pol.*, vol.7, n.3, 2015, 329-344.

[4] V. De Bosscher, S. Shibli, H. Westerbeek, M. Van Bottenburg, *Successful elite sport policies: An international comparison of the Sportspolicy Factors Leading to International Sporting Success (SPLISS 2.0) in 15 nations*, Aachen, 2015, Meyer & Meyer Verlag.

By proposing an accurate measurement of the performance of all the countries in elite sport, we will be able to better identify the factors that explain their success or failure.

2. What are the limits of the Olympic medal table?

The Olympic medal table is a ranking model that computes the gold, silver, and bronze medals obtained by the different countries in the different sport events, in every edition of the Summer and Winter Olympic Games. A gold medal has superior value over any number of silver medals, and a silver medal has superior value over any number of bronze medals. In the event where two countries obtain the same number of gold, the country with more silver medals is better ranked. Likewise, in the case where two countries obtain the same number of gold and silver medals, the country with more bronze medals will be better ranked. Despite its popularity, the Olympic medal ranking has some limitations, which prevent it from being a precise measurement tool for countries performances in international sport:[5]

i) The superiority of a gold medal over any number of silver and of a sliver over any number of bronze will create situations where a country with only one exceptional athlete capable of winning a gold medal is placed in front of another one endowed with several athletes who were placed second and third.

ii) The number of medals awarded per event does not take into account neither the level of competition of the sport to which it belongs nor the number of countries and athletes that it involves. For example, a sport, such as sailing that has 10 events and played in 115 countries, awards 10 gold medals, whereas a sport, such as basketball, that has only two events played in 215 countries, awards only two gold medals.

iii) An individual sport, such as sailing, can award medals to several athletes of the same country, whereas as a team sport, basketball awards one medal per country.

iv) Although the largest multidisciplinary competition in the world, the Olympics are not the pinnacle competition of several mainstream sports. In men's boxing for example, the professionals were allowed to compete in the 2016 Rio de Janeiro Games after 112 years of amateur competitions. The lack of financial rewards in Olympic boxing did not encourage the best professionals, considering that only three of them participated (1.2% of the total number of male boxers were professionals).[6] In men's football, teams are restricted to under-23 players with a maximum of three overage players allowed.[7] In tennis, men and women

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[5] N. Nassif, *Elite Sport Ranking of the "International Society of Sports Sciences in the Arab World": An accurate Evaluation of all Nations' Performances International Sports Competitions,* in *Ath. J. of Sp.*, vol.4, n.1, 2017, 53-64.

[6] www.sbnation.com/2016/8/10/12424182/2016-olympics-rio-boxing-pro-amateur.

[7] http://resources.fifa.com/mm/document/tournament/competition/02/54/40/46/oftsregulationsrio 2016-e_neutral.pdf.

players do not get points for the Professional Tennis Association (ATP) and Women Tennis Association (WTA) rankings.[8] In men's road cycling, the Olympic Games give fewer points in the UCI ranking than the Tour de France, Giro d'Italia, and La Vuelta.[9] In the 2016 professional golf season, more than 20 competitions gave more points than the Olympic golf tournament.[10]

v) Only 87 countries won medals when the 2016 and 2018 Olympic medal tables are combined.[11] That means 119 countries with national Olympic committees were, therefore, not ranked. This fact will prevent a proper comparative analysis of the success of countries in elite sport considering that almost 58% of the participants are absent.

Those factors make the Olympic medal table misleading in the case where a proper comparison of national elite sport policies needs to be drawn. To better address this issue, Nassif (2017) proposed a new ranking methodology,[12] which aims to measure annually the performance of the 206 countries that have National Olympic Committees in all the sports recognized by the Global Association of International Sports Federations (GAISF) plus other sports not yet recognized but enjoying a high degree of popularity (such as Mixed Martial Arts and esports). The GAISF is the international organization sanctioned by the International Olympic Committee (IOC) to "serve and represent the common interests of all International Federations and coordinate the efforts of all those that aspire to become IOC recognized and eventually, wish to enter the Olympic Program".[13] The GAISF international sport federations members are therefore:[14]

- Those that are part of the Winter and Summer Olympic programs;
- Those that are not yet part of the Olympic programs but are recognized by the IOC;
- Those that are not yet recognized by the IOC but are applying to be.

3. The methodology of the World Ranking of Countries in Elite Sport

Nassif (2017) presented this methodology in the first International Society for Sports Sciences in the Arab World (I3SAW) congress organized in Oran, Algeria. The I3SAW adopted this methodology and for the first three editions of this ranking (2014, 2015, and 2016), this ranking was called the I3SAW Ranking for Countries

[8] www.nytimes.com/2016/05/30/sports/tennis/points-and-prize-money-mean-more-to-olympic-tennis-holdouts.html .

[9] www.cyclingnews.com/news/uci-to-launch-new-rolling-world-ranking-system-in-2016/.

[10] www.owgr.com/about.

[11] www.Olympics.org: Medal tables 2016-2018.

[12] N. Nassif, *Elite Sport Ranking of the "International Society of Sports Sciences in the Arab World": An accurate Evaluation of all Nations' Performances International Sports Competitions,* cit., 53-64.

[13] https://gaisf.org/mission-and-vision/.

[14] https://gaisf.org/mission-and-vision/.

in Elite Sport.[15] In 2017, this ranking was named the World Ranking of Countries in Elite Sport (WRCES), a title that was trademarked and copyrighted[16] in 173 countries. The starting point of this methodology is a pointing system in any event, discipline, or sport (see glossary in Table 1).

Table 1. *Glossary*

Term	Definition	Examples
Sport	A group of disciplines or events that belong to the same international federation	Aquatics (FINA)
Discipline	A branch in a sport comprising one or more events	Swimming, water polo, diving and synchronized swimming are disciplines in the sport of Aquatics
Event	A competition in a sport or discipline that gives rise to a ranking	Men 50 M freestyle is an event of the discipline of swimming that belongs to the sport of aquatics

Since the number of National Olympic Committees that participated in the 2016 Olympics (last Summer Olympics to date) is 206, any winning team or athlete participating in an event whether it is in a team sport (basketball, football, handball …) or individual sport (i.e. athletics, swimming, wrestling …) gets a basic score of 206, the second getting 205, the third 204, and so on. To reward the top eight participants in every event, we introduced a weighting coefficient inspired by the formula 1 scores between 2003 and 2009.[17] So, the winner of the event will have his basic points multiplied by 10, the second by 8, the third by 6, the fourth by 5, the fifth by 4, the sixth by 3, the seventh by 2, and the eight by 1, as summarized in Table 2.

[15] www.aipsmedia.com/index.php?page=news&cod=17052; www.aipsmedia.com/index.php?page=news&cod=18503; www.aipsmedia.com/2017/01/18/20160/best-of-2016-world-sport-i3saw-rankings-usa-france.

[16] See registration certificate number 2553 signed on August 17th 2017 by the Lebanese Ministry of Economy and Commerce.

[17] Formula 1 2003 results archives website.

Table 2. *Points Classification within an event, discipline or sport*

Rank in an event	Basic Number Points granted on basis of number of Olympic committees	Weight (Formula 1 2003-2009 scale)	Weighted basic number of points:
1	206	10	2060
2	205	8	1640
3	204	6	1224
4	203	5	1015
5	202	4	808
6	201	3	603
7	200	2	400
8	199	1	199
9	198	1	198
10	197	1	197
11	196	1	196
……	……	……	……
……	……	……	……
206	1	1	1

As Table 3 shows, in the case where an individual sport with more than one competitor from each country, a total number of points per event for each country is obtained by summing up the points received by its athletes in that event.

Table 3. *Example of ranking and scaled points granting for a country in an event A*

Ranking of athletes in event A*	Points	Corresponding Ranking of countries in event A	Points
1. USA	2060	1. Brazil 2864 (1640+1224)	2060
2. Brazil	1640	2. USA 2060	1640
3. Brazil	1224	3. France 1209 (1010+199)	1224
4. France	1010	4. Italy 1003 (603+400)	1010
5. Spain	808	5. Spain 808	808
6. Italy	603		
7. Italy	400		
8. France	199		

* Note that the athletes are named here by their countries of origins

If a sport has several disciplines (such as aquatics, which includes the disciplines of swimming, water polo, synchronized swimming, and diving), the points won in every event are computed by discipline (see Table 4) and the points won in every discipline are computed by sport (see Table 5), following the same pointing system: 2060 for the first, 1640 for the second, 1224 for the third, 1010 for the fourth, 808 for the fifth, 603 for the sixth, 400 for the seventh and 199 for the eighth. Those who are ranked below will have points that decrease from 198 to 1. So, if we take as an example the sport of Aquatics, the points won by a country in every event (examples: Men 50 M freestyle, 100 M women backstroke, 200 M men Medley) are computed by discipline (swimming, water polo, synchronized swimming, and diving). The points by countries in each discipline are then computed to give the final ranking of the sport of Aquatics (see figure 1). If a sport does not have any discipline (such as athletics), the points won in every event will be computed by sport (see Table 6). This method was applied to avoid having a sport that has a multitude of events (athletics, aquatics, boxing) award more points than a team sport that has just two events (example of basketball: men/women).

Table 4. *Sample of disciplines in which the "summing-up rule" of events is being applied*

DISCIPLINES EXAMPLES	**POINTS**
Swimming	Sum of the points gained in the different men's and women's swimming events (100 M Freestyle men, 100 M Freestyle women, 200 M Butterfly men, 400 M Freestyle relay …) country rankings
Water Polo	Sum of the points gained in the men's and women's water polo events country rankings
Diving	Sum of the points gained in the different men's and women's diving events (Individual 3 M springboard men, Individual 10 M platform women, Synchronized 10 M platform, 400 M Freestyle relay …) country rankings

Table 5. *Sample of sports in which the "summing-up rule" of disciplines is being applied*

SPORTS EXAMPLES	**POINTS**
Aquatics	Sum of the points gained in the different aquatics disciplines: Diving, Swimming, Synchronized Swimming and Water Polo country rankings
Cycling	Sum of the points gained in the different cycling disciplines: BMX, Mountain Biking, Road and Track Cycling country rankings
Equestrian	Sum of the points gained in the different equestrian disciplines: Dressage, Eventing and Jumping country rankings

Figure 1. *Points computation by event, discipline, and event*

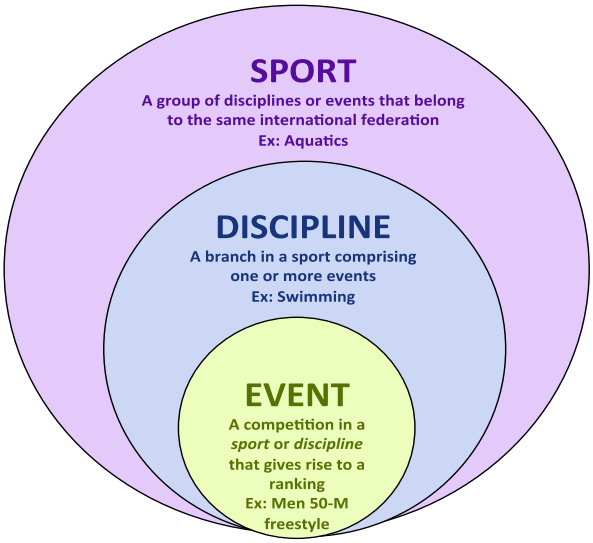

Table 6. *Sample of sports in which the "summing-up rule" of events in sports not having different disciplines is being applied*

SPORTS EXAMPLES	**POINTS**
Athletics	Sum of the points gained in the different men's and women's athletics events (pole vault, long jump, high jump, triple jump, 100M, Marathon …) country rankings
Boxing	Sum of the points gained in the men's and women's weight categories events country rankings
Rowing	Sum of the points gained in the different men's and women's rowing events (Single sculls men, Pair women, eight men..) country rankings

The points won in the ranking of aquatics are then multiplied by coefficients of universality and popularity. This same methodology will be used to calculate the points won by the countries in every sport.

3.1 Why the popularity and universality coefficients for each sport?

Universality takes into account the number of all countries participating in a given sport. For Nassif (2017), the more there are countries participating, the more difficult it is for them to win.[18] By taking into account the universality and popularity

[18] N. Nassif, *Elite Sport Ranking of the "International Society of Sports Sciences in the Arab World": An accurate Evaluation of all Nations' Performances International Sports Competitions,* cit. 53-64.

of each sport, the main goal is to give a differential weight for minor sports, such as curling or luge, and major sports, such as football and basketball. Popularity indicates the international media ratings for each sport. For Nassif (2017), popularity shows to which extent a sport is covered and therefore attracts private and public funding and raises competition's level by engaging the most talented athletes.

3.2 How are these coefficients calculated?

The universality coefficient is calculated based on the sport's number of national federations, its presence in the programs of the Olympics, the International School Sport federation, International University Sport Federation, International Sport Military Council, Paralympics, International Master Games Association, World Transplant Games Federation, Special Olympics, Deaflympics, Workers and Amateurs' International Federation, and the International Children's Games Association, all multisport organizations recognized by the IOC, as shown in Table 7.[19]

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[19] Remarks:

a. The coefficients were rescaled by 100 to achieve a total universality coefficient between 0 and 100. If the points won by the countries were multiplied by a coefficient number that was not rescaled by 100, the total number of points won by each country would be too high and would therefore not be easily readable and used by researchers, media, or sport organizations.

b. When a sport is part of the Olympic program, the total number of federation ratings would be multiplied by 2. I adopted this rule for two reasons. The first is because there are two calendars used for international competitions in an Olympic sport: one of world championships and the other for Olympic Games. These will, consequently, double the efforts of the national federations. The second reason is that an Olympic sport involves a competition between all the National Olympic Committees.

c. If a sport recognized by the ISF has less than 91 affiliated countries, the points of this sport would be the number of these countries divided by 100.

d. If a sport that is part of the FISU Compulsory Program has less than 173 affiliated countries, the points of this sport would be the number of these countries divided by 100. If it is an optional sport, two would divide this number.

e. If a sport recognized by the CISM has less than 136 affiliated countries, the points of this sport would be the number of these countries divided by 100.

f. If a sport recognized by the IMGA has less than 100 affiliated countries, the points of this sport would be the number of these countries divided by 100.

g. If a sport recognized by the WTGF has less than 52 countries, the points of this sport would be the number of these countries divided by 100.

h. If a sport recognized by the Special Olympics has less than 165 affiliated countries, the points of this sport would be the number of these countries divided by 100.

i. If a sport recognized by the Deaflympics has less than 125 affiliated countries, the points of this sport would be the number of these countries divided by 100.

j. If a sport recognized by the IPC has less than 182 affiliated countries, the points of this sport would be the number of these countries divided by 100.

k. If a sport recognized by the CICG has less than 29 affiliated countries, the points of this sport would be the number of these countries divided by 100.

l. If a sport recognized by the CSIT has less than 30 affiliated countries, the points of this sport would be the number of these countries divided by 100.

Table 7. *Example of the attribution of Universality coefficients in the 2018 WRCES*	
	Athletics
Number of federations / 100	2.06
Olympics program coeff. = 2*(Number of federations / 100)	4.12
ISF program coeff. = min (91, Number of national sport school federations) / 100 (91 being the max number of National schools sports federations)	0.91
FISU program coeff. compulsory = min (173, Number of national University sport federations) / 100. (173 being the max number of National University sports federations)	1.73
CISM program coeff = min (136, Number of national Military sport federations) / 100. (136 being the max number of National Military sports federations)	1.36
IMGA program coeff = min (100,Number of national master sport federations) / 100 (100 being the max number of National Master sports federations)	0
Transplant games program coeff = min (52, Number of national transplant games sport federations) / 100 (52 being the max number of National Transplant games sports federations)	0.52
Special Olympics program coeff = min (165, Number of national Special Olympics federations) / 100 (165 being the max number of National Special Olympics sports federations)	1.65
Deaflympics program coeff = min (125, Number of national Deaflympics sports federations) / 100 (125 being the max number of National Deaflympics sports federations)	1.25
Paralympics program coeff = min (182, Number of national Paralympics sport federations) / 100 (182 being the max number of National Paralympics sports federations)	1.82
Children games coeff = min (29, Number of national Children games sport federations) / 100 (29 being the max number of National Children games sports federations)	0.29
Workers and Amateurs coeff = min (30, Number of national workers and amateurs sport federations) / 100 (30 being the max number national workers and amateurs sport federations)	0.3
Total Universality	**16.3**

If within a sport (such as cycling, for example), there is a difference in terms of universality between the different disciplines (road cycling, track cycling, mountain biking …) there would be a difference in the universality coefficient between them. Nevertheless, because the same international federation (International Cycling Union) runs them, the universality coefficient of cycling would be equal to the cycling discipline that has the highest universality coefficient (see Table 8).

Table 8. *Universality coefficients of the different disciplines within the sport of cycling*	
	Universality coefficient
Cycling	**14.4**
Road Cycling	14.4
Track cycling	8.44
Mountain biking	10.38
Cyclo-cross	3.72
BMX	5.58
Trials	1.86
Indoor	1.86

For the popularity coefficient, we will first measure in a one-year span, the frequent presence of the different sports in each country's major sport website.[20] Since there are many differences in popularity between events within a discipline (between men's football and women's football, for example) or between disciplines within a sport (between football and futsal, as examples), we will look to the most popular sport event. In every country, the most popular sport event would get a score of 100. If a country has more than 100 sports events, the most popular sport event in this country would still get a score of 100 and the other sport events that are ranked below would get points according to the rule of three.

As an example, if men's football is the most popular sport event in France, it would get 100. If there are 200 sports events in France, the second most popular event would get:

(Points for the 2nd most popular event * 100) / 200 = (199*100)/200 = 99.5.

These points will then be multiplied by a coefficient based on the Gross National Income (GNI) of each country. Every trillion of dollars gives one point for the GNI coefficient. Given that France's GNI is 2.59 trillion, France's GNI's coefficient will be of 2.59. Therefore, the most popular sport event in France would have 259 points (see Table 9). The multiplication of the points by a country's GNI coefficient was done because we consider that a sport that is popular in wealthy countries attracts more funding than a sport popular in developing countries and consequently, a "wealthy sport" will attract athletes that are more talented and thus have a higher level of competition.

Table 9. *Total popularity points for sports in France in the 2018 WRCES*

Sports events	**Popularity rank**	**Basic number of points**	**Total number of popularity points in France (Basic number of points * French GNI coefficient[21])**
Football (men)	1	100	259 = (100*2.59)
Tennis (no difference between men and women)	2	99	256.4 = (99*2.59)
Rugby Union (men)	3	98	253.8 = (98*2.59)
Basketball (men)	4	97	251.2 = (97*2.59)
Handball (men)	5	96	248.5 = (96*2.59)
….	…	…	…

[20] The identification of the most popular sport websites in each country was done through the website "alexa", which provides commercial web traffic data and analytics (https://www.alexa.com).
[21] GNI coefficient = GNI / 1 billion.

The popularity points won by a sport event in each country are then added to have their total number of points in the world (see Table 10).

Table 10. *Total number of popularity points for men football in the 2018 WRCES*

Countries	**Popularity points for men football**
France	259
Germany	360
Greece	20.5
Hungary	12.3
…	…
World	**7370**

The total number of points won by a sport event will be added to the total number of points won by the other sport events of the same discipline. In the case of the discipline of football, for example, we will add the points won by men's football and women's football (see Table 11).

Table 11. *Total number of popularity points for the discipline of football in the 2018 WRCES*

Men's football event popularity points	7370
Women's football event popularity points	999
Football popularity points Men's football event popularity pts + Women's football event popularity pts	**8369** 7370+999

The same calculus will be done with all the other disciplines. To align with the calculus of the universality coefficient and avoid having a popularity coefficient disproportionally higher than the universality coefficient, the popularity coefficient of a sport will be equal to the coefficient of its more popular discipline. Indeed, if we add the popularity coefficients of the different disciplines to have a total popularity coefficient of a sport, the popularity coefficient will be much higher than its universality coefficient. So, since there are 109 sports included in the 2018 WRCES, the most popular sport in the world will get a popularity coefficient of 109. This was done because we consider that the most popular sport will be the first among the 109 choices that present themselves to youth interested to make a career in professional sport. But because the popularity coefficient of a sport is equal to the popularity coefficient of its most popular discipline, the most popular discipline will get a popularity coefficient of 109. The other disciplines will get a popularity coefficient that will be calculated following the rule of three:

Discipline A popularity coefficient

(Discipline A total popularity points * 109) / Most popular discipline total popularity points.

For example, in 2018, being the most popular discipline in the world, football, will obtain a popularity coefficient of 109 points. To have the popularity coefficient of volleyball, we will multiply the popularity points of volleyball (2817) by 109 and then divide this product by the popularity points of football:

Volleyball popularity coefficient

(Volleyball total popularity points * 109) / Football total popularity points

(2817* 109) / 8369 = 36.7

The rule of three was implemented to create a more realistic gap between the popularity of each sport. Indeed, for the year 2018, football obtained almost three times more points than volleyball (2817 points), which is the 13th most popular sport. If we did not use the rule of three, volleyball popularity coefficient would have been 97, in other words, very close to football's, which does not reflect the real gap in terms of popularity between these two disciplines. As stated above, the popularity coefficient of a sport would be equal to the popularity coefficient of its most popular discipline. Table 12 will show the example of the popularity coefficient of the sport of football (the sport of football include the disciplines of football, futsal, beach soccer, and interactive football).

Table 12. *Popularity coefficients of the sport of football and its disciplines*

	Popularity coefficient
Football (the sport)	**109**
Football (the discipline)	109 (96 Men, 13 Women)
Futsal	9.7
Beach soccer	2.9
Interactive football	1.9

Since there is no indication that the universality and popularity of a discipline are correlated, the total coefficients of each discipline in the WRCES methodology will be the sum of its universality and popularity coefficients. The total coefficient of a sport will be also equal to the total coefficient of its most popular and universal discipline. Table 13 will show the example of the sport of handball. The sport of handball includes the disciplines of handball and beach handball.

Table 13. *Total coefficient for the sport of handball*

	Popularity Coefficient (PC)	**Universality Coefficient (UC)**	**Total coefficient (PC + UC)**
Handball (the sport)	21.4	10.41	**31.81**
Handball (the discipline)	21.4	10.41	**31.81**
Beach handball	0	1.97	**1.97**

This methodology has been used to calculate the total coefficient of 109 sports in 2018. As such, the points won in every event after the coefficient multiplications would be computed by discipline and the points won in every discipline after the coefficient multiplications would be computed by sport. For example, in the year 2018, in the sport of aquatics, the USA won first position in swimming, third position in diving, ninth position in synchronized swimming, and first position in water polo. Table 14 shows the number of points the USA won in the different disciplines of aquatics.

Table 14. *Points won by the USA in the different disciplines of Aquatics*

Disciplines	**USA rank in each of the discipline**	**Points won by the USA considering its rank (PW)**	**Coefficient of each discipline (CD)**	**Points won by the USA after the coefficient multiplication PW*CD**
Swimming	1st	2060	45.6	2060*45.6 = **94636**
Diving	3rd	1224	10.2	1224*10.2= **12497**
Synchronized swimming	9th	198	7.2	198*7.2 = **1421**
Water Polo	1st	2060	3.4	2060*3.4 = **28222**

To calculate the points won by the USA in aquatics, we will first do the sum of the points it won in each of the aquatics disciplines, as it is shown in Table 15.

Table 15. *Points won by the USA in Aquatics after summing up the points it won in the different aquatics disciplines*

	Points won by USA
Swimming	94636
Diving	12497
Synchronized swimming	1421
Water Polo	28222
Aquatics	**136776**

Given that the USA got the highest amount of points in aquatics, it will be ranked number one in this sport. So, the total points that the USA will get from aquatics would be the points won from being ranked number one (2060) times aquatics total coefficient (45.6) for a total of 94636**.**

The points won by each country in each of the sports after the coefficients multiplications were added to obtain their total amount of points (see Table 16[22] with the top three countries). The final ranking was done according to the "summed" total amount of each country.

Table 16. *Samples of total number of points of the top three countries in the 2017 Final WRCES*

	USA	Germany	France
Sum of the 103 sports*	**983220**	**524689**	**523440**
*103 sports were taken in consideration in 2017			

For the competitions chosen, the WRCES uses the official ranking prepared by the international federation of each sport. When a sport that does not have an official world ranking, the results of the last world championships and/or the Olympics[1] to date are used. This is why the aquatics ranking was already completed in 2018. Because there is not an official world ranking made by FINA (the International Aquatics Federation), the results of the last competitions (2017 World Championships and 2016 Olympics) were taken in consideration. Here again, coefficients were given to these two competitions based on their media popularity. To calculate the popularity of these competitions, we have proceeded in the same way we did when we calculated the popularity of the different disciplines. In the case of aquatics, we found that the Aquatics Olympics tournament is two times more popular than the Aquatics World Championship. So, the points won by the countries in the Aquatics Olympic tournament were multiplied by two. After this calculus, we did the sum of the points won by the countries in both competitions. The country that would have the highest amount of points would be ranked number one in the 2018 ranking. This country would get again 2060 points that would be multiplied by the aquatics total coefficient. So, a country that was ranked second in the Olympics Aquatic tournament and third in the Aquatics World Championship would be ahead of a country that was ranked third in the Olympics Aquatic tournament and second in the Aquatics World Championship.

3.3 What changes did the WRCES methodology bring?

In the 2017 WRCES edition (last edition completed to date), 206 countries were ranked instead of the 87 that were only ranked by the combined 2016-2018 Olympic medal table. The WRCES also proposes an annual evaluation of countries performances in more than 100 sports (103 in 2017 and 109 in 2018) instead of one done once every 4 years in only 35 by the combined Winter and Summer Olympic medal table. It also accounts countries performances in all the major

[22] The 2017 final WRCES was taken here because the 2018 WRCES is not completed yet.
[23] If it is an Olympic sport.

international competitions, such as the FIFA World Cup, Tennis Grand Slams, and the Rugby Union World Cup where the Olympic medal table does not record success. The WRCES also gives a more accurate measurement of countries performance in sport. According to Mostapha Khalil,[24] consultant to the Egyptian NOC, *"Ethiopia is not better than us in sports. We beat them in every sport except in long distance running."* The WRCES gave reason to Khalil's statement, as shown in Table 17. It, therefore, rewards countries that succeed in highly popular and universal sports that do not offer a lot of medals (Argentina in basketball and football), and scale appropriately those that win several medals in minor sports that have a multitude of events (Norway in winter sports and Hungary in canoe-kayak), as shown in Table 18.

Table 17. *Comparison between Egypt and Ethiopia's results in the WRCES and the Olympic medal table*

Countries	2014-2016 Combined Olympic Medal Table	2016 WRCES[25]
Ethiopia	48th	144th
Egypt	77th	39th

Table 18. *Comparison between Argentina, Norway, and Hungary's results in the WRCES and the Olympic medal table*

Countries	2014-2016 Combined Olympic Medal Table	2016 WRCES[26]
Argentina	36th	11th
Norway	11th	22nd
Hungary	15th	28th

4. Future prospects for research

After going through the advantages that the WRCES offers in terms of sport performance measurements of countries, our future research will be related to the identification of the factors that can lead them to succeed. As it explained in the introduction, literature on this subject has shown that winning in sport is based on several factors:

[24] Mostapha Khalil, Consultant in the Egyptian Olympic Committee, in discussion with the author, June 2016.
[25] I did not take in consideration the 2017 WRCES, because it cannot be compared neither with the 2014-2016 combined medal table (where the year 2017 is missing) nor with the 2016-2018 combined Olympic medal, because the latter also concerns the results of 2018.
[26] Ibid.

- At a Macro-level, political (when succeeding in sport is in the national agenda of the government),[27] economic (size of the Gross Domestic Product),[28] demographic (size of the population),[29] and cultural (interest of the population to participate in sport competition and attend sport events);[30]
- At a Meso-level, related to all the strategies undertaken by the national sport governing bodies: Ministry of Youth and Sports, National Olympic Committees, National Federations;[31]
- At a Micro-level, related to all the strategies leading to performance put in place by the stakeholders that are "on the field": coaching staff, medical staff and athletes.[32]

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[27] See for example J. Grix, F. Carmichael, *Why do governments invest in elite sport? A polemic*, in *Int. J. of Sp. Pol. and Polit.*, vol.4, n.1, 2012, 73-90; J. Riordan, *Rewriting Soviet Sports History*, in *J. of Sp. Hist.*, vol.20, n. 3, 1993, 247-258; I.P. Henry, M. Amara, M. Al-Tauqui, *Sport, Arab Nationalism and the Pan-Arab Games*, in *Int. Rev. for the Soc. of Sp.*, vol.38, n.3, 2003, 295-310; H.E. Chehabi, *Sport and Politics in Iran: The Legend of Gholamreza Takhti*, in *The Int. J. of the Hist. of Sp.*, vol.12, n.3, 1995, 48-60.

[28] See among others A.D. Novikov, A.M. Maximenko, *The Influence of Selected Socio-economic Factors on the Level of Sports Achievements in the Various Countries (Using as an Example the 18th Olympic Games in Tokyo)*, cit., 27-44; P. Kiviaho, P. Mäkelä, *Olympic success: a sum of non-material and material factors*, cit., 5-22; A. Rathke, U. Woitek., *Economics and the summer Olympics: an efficiency analysis*, cit, 520-537; C.M. Van Der Tak, *Olympic medals as an indicator of social welfare*, cit., 27–37; D.K.N. Johnson, A. Ali, *Coming to Play or Coming to Win*, Wellesley College Department of Economics working paper, n.8, 2000; H.K. Lui, W. Suen, *Men, Money and Medals: An Econometric Analysis of the Olympic Games*, cit., 1-16; C. C. Van Tuyckom, *Going for gold! welfare characteristics and Olympic success: a Lisrel-model*, 2010, Köln, Lambert Academic Publishing.; W. Andreff, Economic Development as Major Determinant of Olympic Medal Wins: Predicting Performances of Russian and Chinese Teams at Sochi Games, cit., 314-340; G. Kuper, E. Sterken, *Olympic Participation and Performance since 1896*, in University of Groningen, Research Institute Systems, Organizations and Management working paper, 2001. I.A. Moosa, L. Smith, *Economic Development Indicators as Determinants of Medal Winning at the Sydney Olympics: An Extreme Bounds Analysis*, cit., 288-301; M. Tcha, V. Pershin. *Reconsidering performance at the Summer Olympics and revealed comparative advantage*, cit., 216-239.

[29] B. Houlihan, J. Zheng, *Small States: Sport and Politics at the Margin*, cit., 329-344.

[30] S.J. Overman, *The Protestant Ethic and the Spirit of Sport: How Calvinism and Capitalism Shaped America's Games*, Mercer University Press, 2011; N. Nassif, *Sport Policy in Lebanon, 1975 to 2004: Lebanese Geopolitical Background, Lebanese Sport Characteristics and Difficulties Plan for Development*, Saarbrucken, Germany, 2010, Lambert Academic Publishing GMBH & Co. KG.

[31] M. Green, *Changing Policy Priorities for Sport in England: The Emergence of Elite Sport Development as a Key Policy Concern*, in *Leis. St.*, vol.23, n.4, 2004, 365-385; B. Houlihan, *Public Sector Sport Policy: Developing a Framework for Analysis*, in *Int. Rev. for the Soc. of Sp.*, vol.40, n.2, 2005: 163-185; V. De Bosscher, S. Shibli, H. Westerbeek, M. Van Bottenburg, *Successful elite sport policies: An international comparison of the Sportspolicy Factors Leading to International Sporting Success (SPLISS 2.0) in 15 nations*, cit.; D. Reiche, *Success and Failure of Countries at the Olympic Games*, cit.

[32] These references are numerous and concern several sub-disciplines of sports sciences: sport physiology, biomechanics, sport psychology and coaching.

All the above research has analyzed the factors behind countries success in elite sport based on the medals won in the Olympics. Moreover, they are all separated at the different levels. Economists and political scientists focus on the macro-level factors. Scholars in sports management look at the meso-level, and experts in sport physiology, biomechanics, sport psychology and coaching.

Our assumption is that these factors cannot be separated and a vertical chain that includes the different macro/meso/micro-factors achieves the success of countries in elite sport. By following the WRCES, our goal is to be able to measure accurately the performance of all countries participating in international competitions to give a more detailed comparative approach in order to identify a holistic framework which will include all the macro/meso/micro-factors determining countries results in sport. We have already started this research. We first did a correlation calculus of the 2014, 2015, and 2016 versions of this ranking[33] with the population, Gross Domestic Product (GDP), and scientific research output rankings of the same years were measured. This comparative study is undertaken for the following reasons:

- Population and GDP rankings will show the impact of demography and wealth, which were two of the macro-level factors identified by researchers in the field. Those two rankings have been taken from the *CIA World Factbook* ;[34]
- Research output ranking will be examined, because the establishment and optimization of meso and micro-factors cannot be achieved without an extensive knowledge in sports management, sports marketing, sports communication, sports law, sports physiology, sports psychology, and sports coaching. The research output ranking was taken from the website *Scimago Journal & Country Rank*[35] which is a publicly available portal that includes the journals and country scientific indicators developed from the information contained in the website *Scopus*, a database gathering all the papers that have been accepted for publication.

There will be no comparative study between sport performance and political power, because this factors is related to a will or decision taken to succeed in sport - not a tool, such as wealth and population, that have a direct impact on the countries performances. Table 19 shows the results of the correlations calculus between the WRCES and the ones of the population, GDP, and research output for the years 2014, 2015, and 2016:

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[33] *USA, Russia and Germany Ranked Top Three Countries in Elite Sport Ranking*, in *Association Internationale de la Presse Sportive*, July 21, 2015 (www.aipsmedia.com/index.php?page=news&cod=17052); *International Society of Sport Sciences in the Arab World Releases Elite Sport List*, in *Association Internationale de la Presse Sportive*, April 14, 2016, (www.aipsmedia.com/index.php?page=news&cod=18503); *USA and France Top I3SAW Ranking of Countries in Elite Sport*, in *Association Internationale de la Presse Sportive*, January 18, 2017, (www.aipsmedia.com/2017/01/18/20160/best-of-2016-world-sport-i3saw-rankings-usa-France).

[34] *The World Factbook*, in Central Intelligence Agency (www.cia.gov/library/publications/the-world-factbook).

[35] "Homepage," Scimago Journal & Country Rank, www.scimagojr.com.

Table 19. *Results of the correlations between the WRCES, population, GDP and research rankings for the years 2014, 2015 and 2016*	
Correlation WRCES 2014 /population ranking 2014	0.39
Correlation WRCES 2015 /population ranking 2015	0.35
Correlation WRCES 2016 /population ranking 2016	0.34
Correlation WRCES 2014 /GDP ranking 2014	0.78
Correlation WRCES 2015 /GDP ranking 2015	0.76
Correlation WRCES 2016 /GDP ranking 2016	0.76
Correlation WRCES 2014 /research output ranking 2014	0.82
Correlation WRCES 2015 /research output ranking 2015	0.81
Correlation WRCES 2016 /research output ranking 2016	0.81

By looking at the correlations calculus between the WRCES and the ones of the population, GDP, and research output for the years 2014, 2015, and 2016, we find that the correlation between a large population and good sports results is weak, the correlation between a high GDP and good sport results is strong, and the one between a high research output and good sport results is very strong. Following these calculations, we can conclude that having a large population is, therefore, not an asset.

Our future research is now to try to understand why population is not important. By finding out the reasons of the weak impact of population, we will open the door for the identification of the other factors determining countries success in sport.

5. *Conclusion*

The WRCES was created for two main objectives:

a) Rank annually and accurately the performance of all the countries in all the sports recognized and/or applying for GAISF membership.

b) Become an international reference to undertake research in the field of elite sport performance.

This ranking methodology will undergo annual amendments in the popularity and universality coefficients of the different sports, but its concept will remain the same. However, the vast domain to be explored is the one related to the study of the factors determining success of countries in elite sport. To be sustainable and coherent, this research project has to include the input of scholars from different fields, politicians, sport administrators, journalists, coaches, athletes, and other potential stakeholders of the sport movement.

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