Dynamics of Medal Shares at the IAAF World Championships Athletics - A Statistical Analysis

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ABSTRACT

Sport is a social phenomenon in which performances and high achievement reflect the overall achievements of a society. The aim of this study was to make a longitudinal analysis of high achievement in athletics, expressed in medals won at the IAAF World Championships in Athletics, in order to provide a basis for future work to better understand the factors that contribute to national sporting success and to help develop elite sport training and support systems. The medals won by all countries that participated in the championships from 1983 to 2011 were grouped by continent, gender and type of medal (gold, silver, bronze) and descriptive statistics was conducted. These are detailed in individual sections for each continent. Among the findings are that the combined men's and women's shares of the total medals won by continent are: Europe 50.85%, the Americas 29%, Africa 13.57%, Asia 4.71% and Oceania to 1.87%. However, between the 1983 and 2011 editions of the championships there was a significant decline in Europe's share, which is offset by increases mainly from the America's and Africa. The authors conclude with a recommendation for deeper and multidisciplinary analysis of all the trends identified.

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Introduction



chievement in high-performance sport is a multi-factorial phenomenon that is connected with the cumulative effects

of socio-economic, technological and scientific (biomechanical, biochemical, exercise-physiological, sport-psychological) factors, accompanied by the most effective elite sport training and support systems. Expression of high achievement, especially in athletics, can be in world records or in the medals won at the Olympic Games and IAAF World Championships in Athletics.

In the literature there are some studies examining the development of world records in particular sports and disciplines^{1, 2, 3, 5} or the medal achievements at a local level⁴. However, to date there are no studies dealing with dynamic evolution of performances in athletics as a whole, by continent or otherwise. Such information would provide a valuable basis for future work to better understand the factors that contribute to national sporting success and for developing the requisite systems. For this reason, the aim of the present study was to make a longitudinal analysis of medal achievements at the biennial IAAF World Championships in Athletics.

Methods

The medals won by all countries that have participated in the 13 IAAF World Championships in Athletics from 1983 (the first edition of the event) through 2011 were used as material for the study. This data was obtained from the official website of the International Association of Athletics Federations (IAAF)⁶. Additional information obtained from Wikipedia⁷ was also used. The medals were grouped by continent, by gender and by type of medal (gold, silver, bronze). Descriptive statistical analysis was conducted using the SPSS 15 program.

For the purposes of the analysis we made the following methodological compromises:

 the medals of the former Soviet Union were included in the total of Russia.

- medals of the former East and West Germany were included in the total of Germany.
- the medals of the former Czechoslovakia were included in the total of the Czech Republic.
- the medals of North America, Central America, South America and the Caribbean are combined into one group - the Americas (this grouping is consistent with that used by the International Olympic Committee).

Results and Discussion

Europe - Overview

From 1983 to 2011, Europe won a total of 896 medals at the IAAF World Championships in Athletics. The distribution of medals per championship, per medal category (gold, silver, bronze), per men and women, as well as the combined total for men and women, is shown in Table 1.

Figure 1 shows the general trend of all Europe's medals (men and women together) from 1983 to 2011. There is a downward trend from 88 medals in 1983 and 92 medals (maximum) in 1987 to 52 medals (minimum) in 2011. The same downward trend is noticed for gold medals (from 30 in 1983 to 16 in 2011), for silver medals (from 29 in 1983 to 18 in 2011, but with more variations in the declining line) and for bronze medals (from 29 in 1983 to 18 in 2011).

On average (all championships included) Europe's medal total consists of 29.80% gold, 35.04% silver and 35.16% bronze. Variability exists in relation to time in all three categories of medals: gold (23.68 to 36.23 %), silver (29.69 to 39.68%) and bronze (31.88 to 42.19%). The percentage contribution of each category to the total number of medals is 34.09% for the gold in 1983 vs. 30.77% in 2011, for the silver 32.95 vs. 34.62% and for the bronze 32.95 vs. 34.62% respectively.

Table 1: Detail of Europe's medals at the IAAF World Championships in Athletics 1983 to 2011

	Europe's medals												
		-	Men				Women		Men & Women				
Year	gold	silver	bronze	men total	gold	silver	bronze	women total	gold	silver	bronze	total	
1983	15	14	14	43	15	15	15	45	30	29	29	88	
1987	11	19	15	45	16	16	15	47	27	35	30	92	
1991	8	10	11	29	14	12	11	37	22	22	22	66	
1993	11	16	16	43	7	14	12	33	18	30	28	70	
1995	8	9	10	27	11	12	14	37	19	21	24	6	
1997	9	12	11	32	13	14	12	39	22	26	23	7	
1999	11	11	11	33	14	11	11	36	25	22	22	69	
2001	10	10	12	32	11	16	10	37	21	26	22	6	
2003	7	11	13	31	12	13	14	39	19	24	27	78	
2005	8	8	11	27	10	11	16	37	18	19	27	6-	
2007	5	8	12	25	10	17	11	38	15	25	23	6	
2009	7	8	10	25	8	9	10	27	15	17	20	5	
2011	8	9	8	25	8	9	10	27	16	18	18	5.	

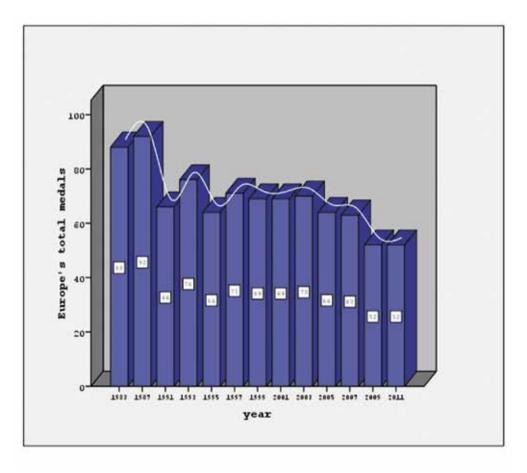


Figure 1: Distribution of Europe's IAAF World Championships in Athletics medals by year

Europe - Men's medals

Europe's men have won 417 medals, 46.54 % of all Europe's medals. This percentage was 48.86% in 1983 vs. 48.08% in 2011.

There is a downward trend from 43 men's medals in 1983 to 25 medals (minimum) in 2011. The same downward trend is noticed for the men's gold medals (from 15 in 1983 to 8 in 2011), for the men's silver medals (from 14 in 1983 to 9 in 2011) and for the men's bronze medals (from 14 in 1983 to 8 in 2011).

Europe - Women's medals

Europe's women have won 479 medals, 53.46% of the total of all Europe's medals. This percentage was 51.14% in 1983 vs. 51.92% in 2011.

There is a downward trend from 45 women's medals in 1983 to 27 (minimum) in 2011. The same downward trend is noticed for the women's gold medals (from 15 in 1983 to 8 in 2011), for the women's silver medals (from 15 in 1983 to 9 in 2011) and for the women's bronze medals (from 15 in 1983 to 10 in 2011).

Europe - Country shares

The countries that have taken the biggest shares of Europe's medal total are Russia (25.78%), Germany (17.41%), Great Britain & NI (8.48%), Italy (4.46%), France (4.35%), Spain (4.02%), Belarus (4.02%), Poland (3.57%), Ukraine (3.35%), Czech Republic (3.24%), Romania (2.34%) and Finland (2.12%). A rising trend can be seen for Russia, Great Britain and Poland.

The Americas

Americas - Overview

From 1983 to 2011, the Americas won a total of 511 medals at the IAAF World Championships in Athletics. The distribution of medals per championship, per medal category (gold, silver, bronze), per men and women as well as the combined total for men and women, is shown in Table 2.

Figure 2 shows the general trend of all of the Americas' medals (men and women together) from 1983 to 2011. There is an upward trend from 31 in 1983 and 27 (minimum) in 1987 to 51 (maximum) in 2009 and 48 in 2011. The same upward trend is noticed for gold medals (from 10 in 1983 to 18 in 2011), for silver medals (from 12 in 1983 to 19 in 2009 and 15 in 2011, but with more variations in the rising line) and for bronze medals (from 9 in 1983 to 15 in 2011).

On average (all championships included) the America's medal total consists of 37.77% gold, 32.48% silver and 29.75% bronze. Variability exists in relation to time in all three categories of medals: gold (30.56 to 47.06%), silver (18.52 to 41.30%) and bronze (17.39 to 44.44%). The percentage contribution of each category to the total number of medals is for the gold 32.26% in 1983 vs. 37.50% in 2011, for the silver 38.71 vs. 31.25 % and for the bronze 29.03 vs. 31.25 % respectively.

The Americas - Men's medals

The Americas' men have won 300 medals, 58.71% of all the Americas' medals. This percentage was 67.74% in 1983 vs. 56.25% in 2011.

There is an upward trend from 21 men's medals in 1983 to 27 in 2011. The same upward trend is noticed for the men's gold medals (from 8 in 1983 to 10 in 2011) and for the men's bronze medals (from 5 in 1983 to 9 in 2011). The same number (8) of men's silver medals appears in both 1983 and 2011.

The Americas – Women's medals

The Americas' women have won 211 medals, 41.29% of all the America's medals. This percentage was 32.26% in 1983 vs. 43.75% in 2011.

There is an upward trend from 10 women's medals in 1983 to 21 medals in 2011. The same upward trend is noticed for the women's gold medals (from 2 in 1983 to 8 in 2011), for the women's silver medals (from 4 in 1983 to 7 in 2011) and for the women's bronze medals (from 4 in 1983 to 6 in 2011).

Table 2: Detail of the America's medals at the IAAF World Championships in Athletics 1983 to 2011

			Men				Women		Men & Women			
Year	gold	silver	bronze	men total	gold	silver	bronze	women total	gold	silver	bronze	total
1983	8	8	5	21	2	4	4	10	10	12	9	31
1987	7	4	7	18	3	1	5	9	10	5	12	27
1991	9	8	9	26	2	5	3	10	11	13	12	36
1993	9	3	4	16	7	6	5	18	16	9	9	34
1995	11	7	9	27	7	6	2	15	18	13	11	42
1997	10	4	9	23	3	5	6	14	13	9	15	37
1999	8	6	6	20	5	6	6	17	13	12	12	37
2001	6	7	6	19	7	2	10	19	13	9	16	38
2003	11	7	5	23	3	6	4	13	14	13	9	36
2005	10	9	4	23	9	10	4	23	19	19	8	46
2007	12	11	7	30	7	7	4	18	19	18	11	48
2009	10	9	8	27	9	10	5	24	19	19	13	51
2011	10	Ř	9	27	8	7	6	21	18	15	15	48

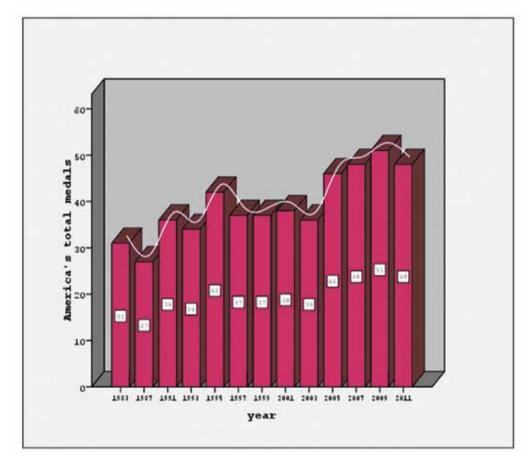


Figure 2: Distribution of the America's IAAF World Championships in Athletics medals by year

The Americas - Country shares

The countries that have taken the biggest shares of the America's medal total are the United States of America (53.82%), Jamaica (17.42%), Cuba (9.78%), the Bahamas (3.72%) and Canada (3.52%). A rising trend can be seen for the United States and Jamaica.

Africa

Africa - Overview

From 1983 to 2011, Africa won a total of 239 medals at the IAAF World Championships in Athletics. The distribution of medals per championship, per medal category (gold, silver, bronze), per men and women as well as the combined total for men and women, is shown in Table 3.

Figure 3 shows the general trend of all Africa's medals (men and women together) from 1983 to 2011. There is an upward trend from 3 medals in 1983 (minimum) to 30 medals (maximum) in 2011. An upward trend is also noticed for gold medals (from 0 in 1983 to 9 in 2011, but with more variations in the rising line), for silver medals (from 1 in 1983 to 10 in 2011, but with more variations in the rising line) and for bronze medals (from 2 in 1983 to 11 in 2011).

On average (all championships included) Africa's medal total consists of 35.98% gold, 35.57% silver and 28.45% bronze. Variability exists in relation to time in all three categories of medals: gold (0 to 71.43%), silver (25 to 45.45%) and bronze (0 to 66.67%). The percentage contribution of each category to the total number of medals is 0% for the gold in 1983 vs. 30% in 2011, for the silver 33.33% vs. 33.33% and for the bronze 66.67 vs. 36.67% respectively.

Africa - Men's medals

Africa's men have won 159 medals, 66.53% of all Africa's medals. This percentage was 100% in 1983 vs. 50% in 2011.

There is an upward trend from 3 men's medals in 1983 to 15 medals in 2011. An ward

trend is also noticed for the men's gold medals (from 0 in 1983 to 5 in 2011), for the men's silver medals (from 1 in 1983 to 5 in 2011) and for the men's bronze medals (from 2 in 1983 to 5 in 2011).

Africa - Women's medals

Africa's women have won 80 medals, 33.47% of the total of all Africa's medals. This percentage was 0% in 1983 vs. 50% in 2011.

There is an absolute upward trend from 0 women's medals in 1983 to 15 medals in 2011. An upward trend is also noticed for the women's gold medals (from 0 in 1983 to 4 in 2011), for the women's silver medals (from 0 in 1983 to 5 in 2011) and for the women's bronze medals (from 0 in 1983 to 6 in 2011).

Africa - Country shares

The countries that have taken the biggest shares of Africa's medal total are Kenya (33.47%), Ethiopia (22.59%), Morocco (11.30%) and South Africa (7.11%). A rising trend can be seen for Ethiopia and Kenya.

ASIA

Asia - Overview

From 1983 to 2011, Asia won a total of 83 medals at the IAAF World Championships in Athletics. The distribution of medals per championship, per medal category (gold, silver, bronze), per men and women, as well as the combined total for men and women, is shown in Table 4 (see next page).

Figure 4 shows the general trend of all Asia's medals (men and women together) from 1983 to 2011. There is an upward trend from 1 medal in 1983 to 7 medals in 2011, with three maxima (12 in 1993, 9 in 2003 and 11 in 2009). There are two maxima in the upward line of evolution for gold medals (6 in 1993 and 3 in 2005, 2007 and 2009), an upward trend for silver medals (from 0 in 1983 to 3 in 2011) and a bell-shaped curve describing the dynamics of the bronze medals (maximum of 7 in 2003).

Table 3: Detail of Africa's medals at the IAAF World Championships in Athletics 1983 to 2011

			Men				Women		Men & Women			
Kear	gold	silver	bronze	men total	gold	silver	bronze	women total	gold	silver	bronze	total
1983	0	1	2	3	0	0	0	0	0	1	2	3
1987	5	2	0	7	0	0	0	0	5	2	0	7
1991	6	6	3	15	1	0	1	2	7	6	4	1
1993	3	3	2	8	1	0	1	2	4	3	3	1
1995	4	7	4	15	1	1	2	4	5	8	6	1
1997	4	6	3	13	3	0	2	5	7	6	5	1
1999	4	6	4	14	1	4	3	8	5	10	7	2
2001	8	6	3	17	3	2	2	7	11	8	5	2
2003	7	4	4	15	4	3	1	8	11	7	5	2
2005	3	6	3	12	3	4	4	11	6	10	7	2
2007	5	2	5	12	3	3	2	8	8	5	7	2
2009	5	6	2	13	3	3	4	10	8	9	6	2.
2011	5	5	5	15	4	5	6	15	9	10	11	3

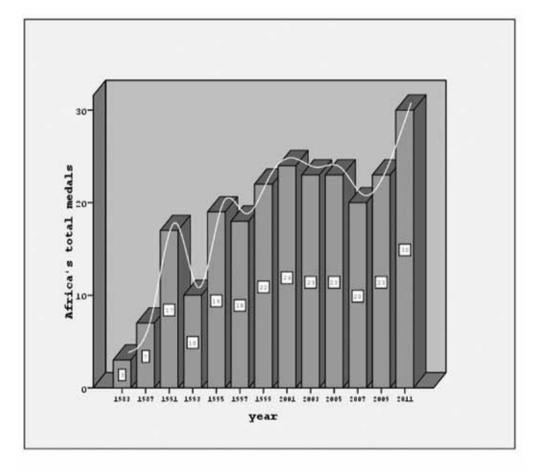


Figure 3: Distribution of Africa's IAAF World Championships in Athletics medals by year

On the average (all championships included) Asia's medal total consist of 31.33% gold, 28.92% silver and 39.75 % bronze. The percentage contribution of each category to the total number of medals is 0% for the gold in 1983 vs. 28.57% in 2011, for the silver 0% vs. 42.86% and for the bronze 100% vs. 28.57% respectively.

Asia - Men's medals

Asia's men have won 35 medals, 42.17 % of all Asia's medals. This percentage was 100% in 1983 vs. 42.86% in 2011.

There is an upward trend from 1 men's medal in 1983 to 5 medals in 2009 and 3 medals in 2011.

Asia - Women's medals

Asia's women have won 48 medals, 57.83% of all Asia's medals. This percentage was 0% in 1983 vs. 57.14% in 2011.

There is an upward trend from 0 women's medals in 1983 to 10 in 1993, followed by a decline until 2011 (4 medals).

Asia - Country shares

The countries that have taken the biggest shares of Asia's medal total are China (37.35%), Japan (25.30%), Bahrain (8.43) and Kazakhstan (7.23%).

Oceania

Oceania - Overview

From 1983 to 2011, Oceania won a total of 33 medals at the IAAF World Championships in Athletics. The distribution of medals per championship, per medal category (gold, silver, bronze), per men and women, as well as the combined total for men and women, is shown in Table 5.

Figure 5 shows the general trend of all Oceania's medals (men and women together) from 1983 to 2011. There is an upward trend from 1 medal in 1983 to 5 medals in 1997, followed by a decline until 2003 (1 medal) and then by a rise until 2011 (4 medals).

On average (all championships included) the Oceania medal total consists of 45.46% gold, 21.21% silver and 33.33 % bronze.

Oceania - Men's medals

Oceania's men have won 16 medals, 48,48 % of all Oceania's medals. This percentage was 100% in 1983 vs. 50% in 2011.

The highest number of men's medals, three, were won in 2001 and 2009.

Oceania - Women's medals

Oceania's women have won 17 medals, 51.52 % of all Oceania's medals. This percentage was 0% in 1983 vs. 50% in 2011.

The highest number of women's medals, three, were won in 1997 and 1999.

Oceania - Country shares

The countries that have taken the biggest shares of Oceania's medal total are Australia (84.85%) and New Zealand (15.15%).

Interaction Among Continents

The total number of medals won by athletes from all continents, in all editions of the IAAF World Championships in Athletics from 1983 to 2011, amounts to 1,762 (587 gold, 596 silver and 579 bronze).

Europe's share is 50.85%, the Americas' 29%, Africa's 13.57%, Asia's 4.71% and finally Oceania's is 1.87% (Figure 6a). Of course, there is variability in each continent's share depending on time. A comparison between the 1983 and 2011 championships (Figures 6b, Figure 6c) reveals that Europe's shares are, respectively, 70.96% vs. 36.88%, Americas' shares are 25% vs. 34.04%, Africa's shares are 2.42% vs. 21.28%, Asia's shares are 0.81% vs. 4.96% and Oceania's shares are 0.81% vs. 2.84%.

Clearly, there is a regressive trend for Europe and a progressive trend for all the other continents, especially the Americas and Africa.

Table 4: Detail of Asia's medals at the IAAF World Championships in Athletics 1983 to 2011

	Asia's medals												
			Men				Women		Men & Women				
Year	gold	silver	bronze	men total	gold	silver	bronze	women total	gold	silver	bronze	total	
1983	0	0	1	1	0	0	0	0	0	0	1	1	
1987	0	0	0	0	0	0	1	1	0	0	1	1	
1991	1	0	0	1	2	2	1	5	3	2	1	6	
1993	1	1	0	2	5	2	3	10	6	3	3	12	
1995	1	0	1	2	1	2	0	3	2	2	1	5	
1997	1	0	1	2	0	1	0	1	1	1	1	3	
1999	1	0	2	3	1	2	1	4	2	2	3	7	
2001	0	2	1	3	0	1	1	2	0	3	2	5	
2003	1	0	4	5	0	1	3	4	1	1	7	9	
2005	3	1	1	5	0	0	1	1	3	1	2	6	
2007	1	2	0	3	2	2	3	7	3	4	3	10	
2009	i	1	3	5	2	1	3	6	3	2	6	11	
2011	1	1	1	3	1	2	1	4	2	3	2	7	

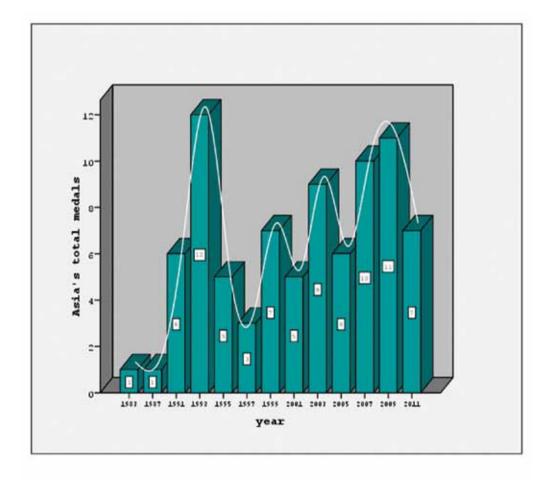


Figure 4: Distribution of Asia's IAAF World Championships in Athletics medals by year

Table 5: Detail of Oceania's medals at the IAAF World Championships in Athletics 1983 to 2011

Oceania's medals												
			Men				Women		Men & Women			
Year	gold	silver	bronze	men total	gold	silver	bronze	women total	gold	silver	bronze	total
1983	1	0	0	1	0	0	0	0	1	0	0	1
1987	0	0	0	0	0	2	0	2	0	2	0	2
1991	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	1	0	1	0	1	0	1
1995	0	1	0	1	0	0	1	1	0	1	1	2
1997	1	0	1	2	2	1	0	3	3	1	1	5
1999	0	1	0	1	1	0	2	3	1	1	2	4
2001	1	0	2	3	0	0	0	0	1	0	2	3
2003	1	0	0	1	0	0	0	0	1	0	0	1
2005	0	0	1	1	0	0	1	1	0	0	2	2
2007	1	0	0	1	2	0	0	2	3	0	0	3
2009	1	0	2	3	2	0	0	2	3	0	2	5
2009	0	1	1	2	2	0	0	2	2	1	1	4

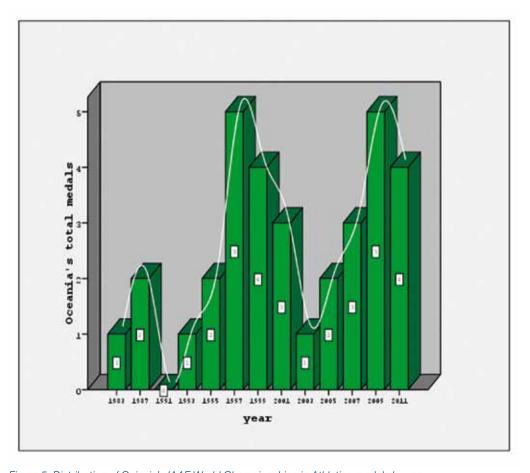


Figure 5: Distribution of Ociania's IAAF World Championships in Athletics medals by year

The share taken by European athletes in 2011 was just over half what it was in 1983 (36.88 vs. 70.96%). This loss is covered mainly by the gains of the America's and Africa.

If we examine men's medals and women's medals separately, some differences are revealed in each continent's share of the medal total. Regarding men, each continent's percentage share of the total of the 927 medals won is as follows: Europe 44.98%, the Americas 32.36%, Africa 17.15%, Asia 3.78% and finally Oceania 1.73%. Of course there is variability in these shares depending on time. A comparison between the championships in 1983 and the championships in 2011 reveals that the share taken by Europe's men is 62.32 vs. 34.72%, by the Americas' men is 30.43 vs. 37.50%, by Africa's men 4.35 vs. 20.83%, by Asia's men 1.45 vs. 4.17% and by Oceania's men 1.45 vs. 2.78%. There is a clear regressive trend for Europe (a loss of 27.6% in the share) and a progressive trend for all the other continents, especially the Americas (a gain of 7.07%) and Africa (a gain of 16.48%).

Regarding women, each continent's percentage share of the total of the 835 medals won is as follows: Europe 57.36%, America 25.27%, Africa 9.58%, Asia 5.75% and finally Oceania 2.04%. Again, there is variability depending on time. A comparison between the championships in 1983 and 2011 reveals that the share taken by Europe's women is 81.82 vs. 39.13%, by the Americas' women 18.18 vs. 30.43%, by Africa's women 0 vs. 21.74%, by Asia's women 0 vs. 5.80% and by Oceania's women 0 vs. 2.90%. Here too, there is a clear regressive trend for Europe (a loss of 42.69% in the share) and a progressive trend for all the other continents, especially the America's (a gain of 12.25%) and Africa (a gain of 21.74%).

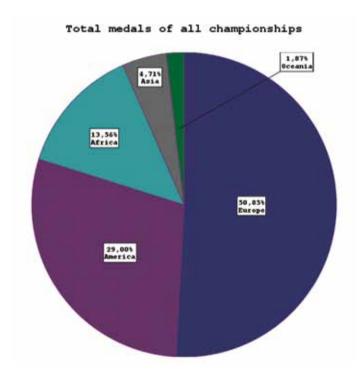


Figure 6a: Continental shares of the medals from all IAAF World Championships in Athletics

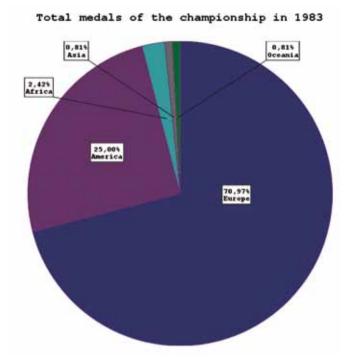


Figure 6b: Continental shares of the medals from the 1983 IAAF World Championships in Athletics

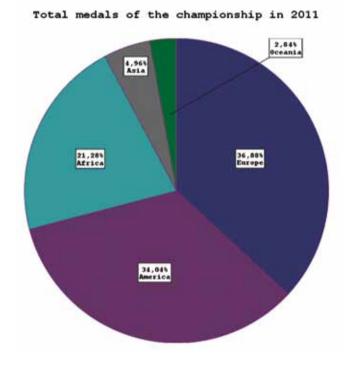


Figure 6c: Continental shares of the medals from the 2011 IAAF World Championships in Athletics

Conclusions

This study aimed to increase understanding of achievement in athletics, expressed in medals won, based on the analysis of the results of the IAAF World Championships. If we look at the five continents, Europe's share is 50.85%, the Americas' 29%, Africa's 13.57%, Asia's 4.71% and finally Oceania's 1.87%. However, from the first to the final Championship, there is a clear decline in the share taken by European athletes, which is compensated by corresponding increases in the shares taken by the athletes from the other continents, mainly the Americas and Africa.

Given that sport is a social phenomenon in which performances and high achievement reflect the overall achievements of a society, the interpretation of the above-mentioned trends in elite level athletics deserves deeper and multidisciplinary analysis.

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