The Analysis of Running Distances in National Teams in 2010 and 2014 FIFA World Cup and Estimation of Oxygen Consumption Capacity Based on These Distances

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Abstract

This study aims to analyze running distances in national teams during 2010 and 2014 FIFA World Cup and to propose a new program which estimates oxygen consumption capacity based on running distances. The data were evaluated by SPSS 22.0 statistical package program. The findings demonstrate that among teams participating in 2010 and 2014 FIFA World Cup, the lowest average running distance and estimated VO_2max values belong to Brazil with 7398.77 meters and 43.84 ml/kg/m, respectively. On the other hand, the highest average running distance and estimated VO_2max values belong to Australia with 10598 meters and 67.69 ml/kg/m, respectively. The average running distance and estimated VO_2max value in national teams participating in 2010 FIFA World Cup was 9635.54 meters and 60.52 ml/kg/m, while they were 9095.82 meters and 52 ml/kg/m in 2014 FIFA World Cup, respectively.

Keywords: FIFA World Cup 2010-2014, running distances, VO_2max

1. Introduction

Historical developments and natural conditions (pitch conditions, cultural values and physical features) lead to the emergence of different playing styles in different regions and countries of the world. There are different schools in various countries of the world, and each school brings a new taste to football. For instance, English football attaches importance to running, physical tackling, long passes and a high tempo until the end of 90 minutes. Brazilian football seems to have reached the highest elegance on the pitch. On the other hand, German and Dutch football is based on a more detailed technical game plan, and requires long running distances (Wahl, 2005).

The energy spent during a football game requires players to possess some physiological capacities, which are directly associated with player's physical condition and training methods. Football requires different approaches depending on the playing style, position on the pitch and difficulty level of the match. All players need to possess the ball during the game, and become fast and active in order to support their teammates for defensing and attacking. They are often expected to run for 90 minutes and support the teammate possessing the ball in a suitable position on the pitch (Reilly, 2003).

2. Methods

The average running distances during the tournament were used to estimate running distance in these national teams. (M-0.3138)/0.0.278 formula, which was developed by Cooper (Cooper, 1968) was used to estimate approximate VO2max values of the teams. The numbers in this formula (1), which enables to estimate VO2max values during 12 minutes, were multiplied by 3 in order to estimate VO2max values for 36 minutes. In a football match, during a half of 45 minutes, nearly 9 minutes are spent passively (penalty kick, free kick, goal kick, fouls etc.). Thanks to our modified formula, a new VO2max formula was developed in order to approximately estimate running distances in a football match. As a result, oxygen consumption of the players in a team was estimated based on their running distances.

$$VO_2max = \text{Running Distance} - 0.9414/0.0834 \qquad (1)$$

[Running Distance/1 mile (1.609m)]

Direct VO_2max estimation may pose threats to a player's life because it needs to be measured on his respiratory, circulatory and heart system. In fact, it is compulsory to maintain a medical staff during a VO_2max measurement. Nevertheless, as mentioned above, methods for VO_2max measurement have not been developed yet. These estimations usually yield results similar to direct VO_2max measurements. However, these methods are called "sub-maximal

measurements" because circulatory and respiratory systems are not fully activated.

2.1 VO$_2$max Test

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2.2 Statistical Analyses

After the data were analyzed through the SPSS 22 software program, descriptives statictics analysis was used to the analysis of running distances in national teams in 2010 and 2014 FIFA World Cup and estimation of oxygen consumption capacity based on these distances.

3. Findings

Table 1. Average running distances and VO$_2$max values in national teams participating in 2010 and 2014 FIFA World Cup

Teams	N	2010 Distance (m)	2010 VO$_2$ (ml / kg / min)	2014 Distance (m)	2014 VO$_2$ (ml / kg / min)
Australia	2	10598	67.69	9775.3	61.56
Swiss	2	10342	65.78	9349.8	58.39
Portugal	2	10160	64.43	9103.3	56.55
Mexico	2	10093.75	63.93	9213.75	57.37
Germany	2	10061.86	63.69	9855.66	62.16
Serbia	1	10014	63.34	-	-
South Africa	1	9957.333	62.92	-	-
America	2	9946.18	62.83	9996	63.20
Italy	2	9926	62.68	8924.6	55.22
Japan	2	9887.06	62.39	9143	56.85
South Korea	2	9860.5	62.19	9404.6	58.80
Britain	2	9856.75	62.17	9076	56.35
Slovakia	1	9755.75	61.41	-	-
North Korea	1	9753.667	61.40	-	-
Slovenia	1	9707.667	61.05	-	-
Uruguay	2	9636.15	60.52	8848.25	54.65
Chile	2	9559.25	59.95	9439.7	59.06
Spain	2	9531.65	59.74	9212	57.36
Algeria	2	9519.667	59.65	9385,2	58.65
Denmark	1	9496.667	59.48	-	-
Paraguay	1	9483.11	59.38	-	-
Greece	2	9423.333	58.94	8462.1	51.77
Netherlands	2	9411.73	58.85	9360,96	58.47
France	2	9366.667	58.51	9091,8	56.47
New Zealand	1	9333	58.26	-	-
Cameroon	2	9321.333	58.18	8476.3	51.88
Ivory	2	9283.667	57.89	8271.6	50 ç35
Ghana	2	9268.37	57.78	9408.3	58 ç82
Brazil	2	9107	56.58	7398.77	43 ç85
Honduras	2	9092	56.47	8117.3	49 ç20
Argentina	2	8976.4	55.61	8818.64	54.43
Nigeria	2	8606.667	52.85	8862.5	54.76
Costa Rica	1	-	-	8920.3	55.19
Belgium	1	-	-	9205.2	57.31
Colombia	1	-	-	8851.6	54.68
Croatia	1	-	-	9097.3	56.51
Equator	1	-	-	8929.6	55.26
Iran	1	-	-	9497.6	59.49
Bosnia	1	-	-	9526	59.70
Russia	1	-	-	10043.3	63.56
Team averages and VO$_2$max values		9635.54	60.52	9095.82	56.50

* The lowest running distance among national teams participating in 2010 and 2014 FIFA World Cup (Brazil)

** The highest running distance among national teams participating in 2010 and 2014 FIFA World Cup (Australia)

Average Running Distances in National Teams Participating in 2010 FIFA World Cup 9635.54 meters.

Average Running Distances in National Teams Participating in 2014 FIFA World Cup 9095.82 meters
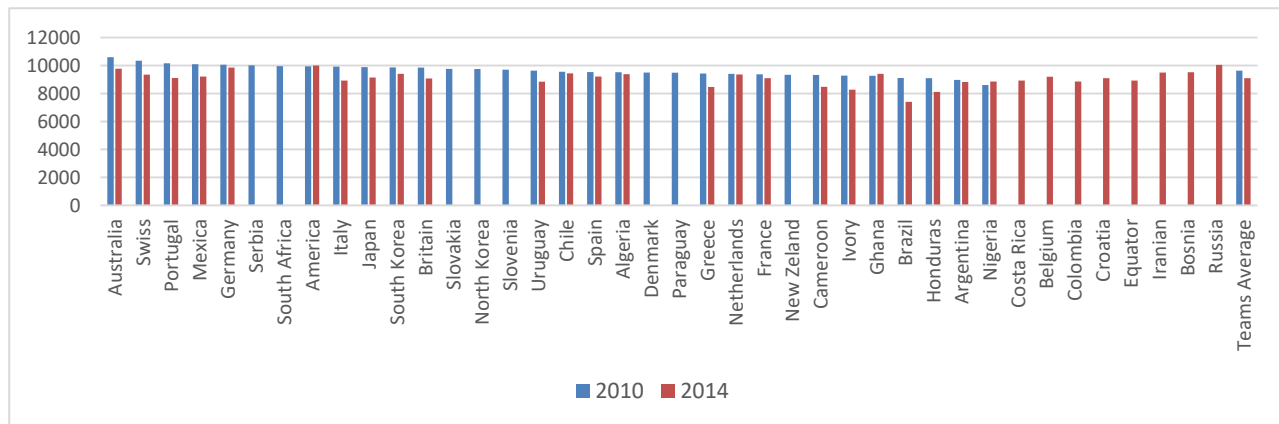
Graph 1. Average Running Distances in National Teams Participating in 2010 and 2014 FIFA World Cup

Table 2. Average running distances in national teams participating in 2010 and 2014 FIFA World Cup and standard deviation of their success

Row	Teams	N	2010 Average Running Distance	2010 Success	2014 Average Running Distance	2014 Success	2010-2014 x ±sd
1	Spain	2	9531,65	Winner	9212	Group Stage	9371,83 ±226,03
2	Netherlands	2	9411,73	Runner-up	9360,96	Third Place	9386,35 ±35,90
3	Germany	2	10061,86	Third Place	9855,66	Winner	9958,76 ±145,81
4	Uruguay	2	9636,15	Fourth Place	8848,25	Round of 16	9242,20 ±557,13
5	Argentina	2	8976,4	Quarter Final	8818,64	Runner-up	8897,52 ±111,55
6	Ghana	2	9268,37	Quarter Final	9408,3	Group Stage	9338,34 ±98,95
7	Paraguay	1	9483,11	Quarter Final	-	-	9483,11
8	Brazil	2	9107	Quarter Final	7398,77	Fourth Place	8252,89 ±1207,90
9	America	2	9946,18	Round of 16	9996	Round of 16	9971,09 ±35,23
10	Japan	2	9887,06	Round of 16	9143	Group Stage	9515,03 ±526,13
11	South Korea	2	9860,5	Round of 16	9404,6	Group Stage	9632,55 ±322,37
12	Mexico	2	10093,75	Round of 16	9213,75	Round of 16	9653,75 ±622,25
13	Chile	2	9559,25	Round of 16	9439,7	Round of 16	9499,48 ±84,53
14	Slovakia	1	9755,75	Round of 16	-	-	9755,75
15	Portugal	2	10160	Round of 16	9103,3	Group Stage	9631,65 ±747,20
16	Britain	2	9856,75	Round of 16	9076	Group Stage	9466,38 ±552,07
17	France	2	9366,667	Group Stage	9091,8	Quarter Final	9229,23 ±194,36
18	South Africa	1	9957,333	Group Stage	-	-	9957,33
19	Nigeria	2	8606,667	Group Stage	8862,5	Round of 16	8734,58 ±180,90
20	Greece	2	9423,333	Group Stage	8462,1	Round of 16	8942,72 ±679,69
21	Slovenia	1	9707,667	Group Stage	-	-	9707,67
22	Algeria	2	9519,667	Group Stage	9385,2	Round of 16	9452,43 ±95,08
23	Australia	2	10598	Group Stage	9775,3	Group Stage	10186,65 ±581,74
24	Serbia	1	10014	Group Stage	-	-	10014,00
25	Denmark	1	9496,667	Group Stage	-	-	9496,67
26	Cameroon	2	9321,333	Group Stage	8476,3	Group Stage	8898,82 ±597,53
27	Italy	2	9926	Group Stage	8924,6	Group Stage	9425,30 ±708,10
28	New Zealand	1	9333	Group Stage	-	-	9333,00
29	Ivory	2	9283,667	Group Stage	8271,6	Group Stage	8777,63 ±715,64
30	North Korea	1	9753,667	Group Stage	-	-	9753,67
31	Honduras	2	9092	Group Stage	8117,3	Group Stage	8604,65 ±689,22
32	Swiss	2	10342	Group Stage	9349,8	Round of 16	9845,90 ±701,59
33	Costa Rica	1	-		8920,3	Quarter Final	8920,30
34	Belgium	1	-		9205,2	Quarter Final	9205,20
35	Colombia	1	-		8851,6	Quarter Final	8851,60
36	Croatia	1	-		9097,3	Group Stage	9097,30
37	Equator	1	-		8929,6	Group Stage	8929,60
38	Iran	1	-		9497,6	Group Stage	9497,60
39	Bosnia	1	-		9526	Group Stage	9526,00
40	Russia	1	-		10043,3	Group Stage	10043,30

Table 3. Minimal and maximal running distances in national teams participating in 2010 and 2014 FIFA World Cup

Teams	N	Minimum	Maximum	x	±sd
Australia	2	9775,30	10598,00	10186,65	581,74
Russia	1	10043,30	10043,30	10043,30	
Serbia	1	10014,00	10014,00	10014,00	
America	2	9946,18	9996,00	9971,09	35,23
Germany	2	9855,66	10061,86	9958,76	145,81
South Africa	1	9957,33	9957,33	9957,33	
Swiss	2	9349,80	10342,00	9845,90	701,59
Slovakia	1	9755,75	9755,75	9755,75	
North Korea	1	9753,67	9753,67	9753,67	
Slovenia	1	9707,67	9707,67	9707,67	
Mexico	2	9213,75	10093,75	9653,75	622,25
South Korea	2	9404,60	9860,50	9632,55	322,37
Portugal	2	9103,30	10160,00	9631,65	747,20
Bosnia	1	9526,00	9526,00	9526,00	
Japan	2	9143,00	9887,06	9515,03	526,13
Chile	2	9439,70	9559,25	9499,48	84,53
Iran	1	9497,60	9497,60	9497,60	
Denmark	1	9496,67	9496,67	9496,67	
Paraguay	1	9483,11	9483,11	9483,11	
Britain	2	9076,00	9856,75	9466,38	552,07
Algeria	2	9385,20	9519,67	9452,43	95,08
Italy	2	8924,60	9926,00	9425,30	708,10
Netherlands	2	9360,96	9411,73	9386,35	35,90
Spain	2	9212,00	9531,65	9371,83	226,03
Ghana	2	9268,37	9408,30	9338,34	98,95
New Zealand	1	9333,00	9333,00	9333,00	
Uruguay	2	8848,25	9636,15	9242,20	557,13
France	2	9091,80	9366,67	9229,23	194,36
Belgium	1	9205,20	9205,20	9205,20	
Croatia	1	9097,30	9097,30	9097,30	
Greece	2	8462,10	9423,33	8942,72	679,69
Equator	1	8929,60	8929,60	8929,60	
Costa Rica	1	8920,30	8920,30	8920,30	
Cameroon	2	8476,30	9321,33	8898,82	597,53
Argentina	2	8818,64	8976,40	8897,52	111,55
Colombia	1	8851,60	8851,60	8851,60	
Ivory	2	8271,60	9283,67	8777,63	715,64
Nigeria	2	8606,67	8862,50	8734,58	180,90
Honduras	2	8117,30	9092,00	8604,65	689,22
Brazil	2	7398,77	9107,00	8252,89	1207,90

4. Discussion

It can be observed that a player's running distance has increased in the last ten years. For instance, average running distance is nearly 11.000 meters in 90 minutes. Because players playing in different positions on the pitch perform different duties, midfielders', defenders' and forwards' running distances are estimated to be 11.4, 10.1 and 10.5 kilometers, respectively. It can be stated that a player's running distance during a football match varies between 8 and 11 kilometers. A football player performs different activities during a match such as standing (17.01%), walking (40.4%), low tempo running (35.1%), high tempo running (8.1%), high tempo sprint (0.7), as well as other activities such as tackling, headers and shooting, dribbling, and jumping (Günay, & Yüce, 1996). The close proximity of football players with an average $MaxVO_2$ values of 55-65 ml/kg/min to long distance runners underlines the importance of the aerobic energy spent by these players (Marangoz, & Gençay, 2017).

When VO_2max measurements of football teams are analyzed, Yamaner (1987) reports that VO_2max of 15 players in Gençlerbirliği was measured as 54.58 ml/kg/min. İşlegen (1987) stated that VO_2max value of 19 players in Turkish First Football League, 12 players in Turkish Second Football League and 18 players in Turkish Third Football League as 51.55 ml/kg/min, 51.17 ml/kg/min and 48.09 ml/kg/min, respectively. Yamaner (1990) found out that VO_2max value of 17 players in Galatasaray was 59.35 ml/kg/min. Müniroğlu et al. (2000) reports that VO_2max value of 20 players in Turkish First Football League was measured as 59.48 ml/kg/min. Koç et al. (2000) observed that VO_2max value of 18 players in Kütahyaspor, a football team in Turkish Third Football League, was 54.71 ml/kg/min. In a study on 63 football players in Turkish First, Second and Third Football League, Kızılet et al. (2002) measured VO_2max as 54.34

ml/kg/min. Sınırkavak et al. (2004) reports that VO_2max value of 10 players in Sivasspor was calculated as 42.84 ml/kg/min. Marangoz & Gençay (2017) demonstrated that VO_2max values of two groups of 24 players in Kahramanmaraşspor and Siirtspor were measured as 57.62±3.25 ml/kg/min and 59.45±4.46ml/kg/min, respectively.

Reeves et al. (1999) measured VO_2max values of 18 players in English Premier League and 14 players in Hong Kong as 50.0 ml/kg/min and 59.1 ml/kg/min, respectively. Ostojic (2000) reports that VO_2max values of two groups of 16 players in Serbian First and Third Football League was measured as 53.5 ml/kg/min and 42.9 ml/kg/min, respectively. Edwards et al. (2003) found out that VO_2max value of 20 players in English Premier League was 62.1 ml/kg/min. In a study on 20 elite football players in Irish League, Mclntyre (2005) observed that VO_2max was calculated as 57.6 ml/kg/min. In a study on 72 footbal players in Japan, Tahara et al. (2006) reported VO_2max as 54.0 ml/kg/dk.

Although the highest VO_2max value measured in studies on football players is 80 ml/kg/min, this value is nearly 55-68 ml/kg/min for male football players except goalkeepers. It can be observed that VO_2max values measured in recent years have varied between 61.1 and 70.7 ml/kg/min in recent years (Aşçı, 2003).

5. Conclusion

In conclusion, the modified formula developed for this study to estimate oxygen consumption capacity measured VO_2max levels of national teams participating in 2010 and 2014 FIFA World Cup as 60.52 ml/kg/min and 56.50 ml/kg/min, respectively. It can be argued that these values are lower than VO_2max values measured in recent years. It was also demonstrated that average running distances of national teams participating in 2010 and 2014 FIFA World Cup were nearly 9500 meters, which is lower than the running distances measure in recent years. Finally, no significance or correlation was observed between running distance and success in the tournament.

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