THE EVALUATION OF ATHLETIC ORGANIZATIONS OF INTERNATIONAL ASSOCIATION OF ATHLETIC FEDERATIONS AND OLYMPIC GAMES ACCORDING TO CRITICAL VELOCITY CONCEPT

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ABSTRACT

The purpose of this study was to compare Critical Velocity (CV) and Anaerobic Distance Capacity (ADC) values of international athletic organizations were determined as The International Association of Athletics Federations World Championship (IAAF-WC), IAAF World Junior Championship (WJC), IAAF Continental Cup (CC) and Olympic Games (OG). The CV and ADC values of international athletic organizations were estimated with linear regression analyze between times to exhaustion and total covered distances. This regression method was defined as linear total distance (Lin-TD) model. International athletic organizations were determined as IAAF World Championship (IAAF-WC), IAAF World Junior Championship (IAAF-WJC), IAAF Continental Cup (IAAF-CC) and Olympic Games (OG) organizations were involved in 800, 1500 and 5000 m. running events. Critical velocity (CV) and anaerobic distance capacity (ADC) values of thirteen IAAF-WC, eight IAAF-WJC, eleven IAAF-CC and twenty-two OG organizations were estimated with Lin-TD model using 800, 1500 and 5000 m. running events. It was determined that there was not any significiant difference among CV and ADC values of four organizations except significiant difference among CV values of IAAF-WC and OG organizations.

Key words: Critical Velocity, Critical Power, Athletic Organizations, Aerobic Fitness

1. INTRODUCTION

Critical velocity (CV) is the performance parameter which is used to assess aerobic performance. Critical power (CP) is determined with tests which is performed at cycle ergometry but CV is determined with tests which is performed at treadmill. It can be said that CV is the treadmill version of CP concept. CV is defined as the highest exercise intensity which can be sustained without fatigue during prolonged exercise (1-2). CV concept was based on linear relationship between covered distance and times to exhaustion. This linear relationship was determined with linear regression analyze. Second parameter is provided by CV concept is anaerobic distance capacity (ADC). ADC is distance which is run with energy sources stored in muscles.

Physiologically, CV was defined as a boundary between steady state and non-steady state exercise intensity and was an indicator aerobic fitness as lactate threshold and maximal oxygen uptake (VO²max) (3). CV concept was a practical method for aerobic fitness measurement and didn't need expensive and time consuming measurement. In running events, CV was simple and useful tool which indicated athletes' energetic profiles (4). CV concept could be performed using different running distance as well treadmill. Denadai et al. (2005) determined CV values of soccer players using 1500 and 3000 m. running time. This situation was an advantage for running events and athletes' aerobic fitness levels were determined with CV determination. The researches which was realized for adults demonstrated that CV wasn't significiantly different from velocity corresponding to lactate threshold (6) and maximal lactate steady state (7). Also ADC value was correlated with maximal lactate concentration which was measured after exercise and maximal accumulated oxygen deficit (8). These values demonstrated that CV values was aerobic fitness indicator which was determined practically. Therefore CV tests were performed practically by coaches.

In this study, international organizations which are organized by International Association of Athletic Federations (IAAF) were analyzed according to CV values which were determined with Lin-TD model which had two parameters as CV and ADC. Ettema (1966) wanted to develop model of human performance and used Lin-TD model (two parameter model) which was proposed by Monod & Scherrer (1965). Most studies evaluated time and velocity values of specific running events throughout chronological years in international organizations as olympic

games but few studies researched CV concept at international organizations as world championship, olympic games. Only Dekerle et al. (2006) researched CV values (distance-time relationship) of olympic games (from 1920 to 2004). In international organizations of IAAF, performance profiles of athletes which were represented by CV and ADC values were not researched. If these values which indicated energetic profiles of athletes were known, it would be possible to evaluate the performance levels of international organizations. The aim of this study was to compare CV and ADC values of international organizations of IAAF (IAAF World Championship (IAAF-WC), IAAF World Junior Championship (IAAF-WJC), IAAF Continental Cup (IAAF-CC)) and Olympic Games (OG) and evaluate performance levels of international organizations according to CV and ADC values.

2. METHODS

Athletic running events of international organizations which are organized by IAAF and Olympic Games (OG) were taken for determining CV and ADC values. The athletic organizations were IAAF-WC, IAAF-WJC, IAAF-CC organizations. 800, 1500 and 5000 m. running events of all organizations were selected for determining CV and ADC values by Lin-TD model (4). Because of 1-15 minutes range of elite athletes VO²max attaining (10), 800, 1500 and 5000 m. running events of all organizations were selected for CV and ADC determination. Performance times of these running events were between 1 and 15 minutes. Last thirteen organizations from IAAF-WC organizations, last eight organizations from IAAF-WJC organizations, last eleven organizations from IAAF-CC organizations and last twenty-two organizations from OG were selected for analyze. Times of male athletes have gold, silver and bronze medal at 800, 1500 and 5000 m. running events were downloaded from www.iaaf.org and www.olympic.org. The mean of gold, silver and bronze medallists' times of per running events was determined as performance time of related running event (11). This performance time determination method was used for limit of high level performance of superior talented athletes (12). Performance times of male athletes were determined for per running events of all organizations. Performance times and distance of running events was fitted to Lin-TD model for determination of CV and ADC values (Equation 1). Lin-TD model which was used for determination of CV and ADC values was based on linear regression analyze between distance and performance time. For all organizations, distances and performance time data of running events were suitable to Lin-TD model to estimate CV and ADC values. CV and ADC values were estimated by using SPSS statistical package programme (SPSS Version 16.0, SPSS, Chicago, USA). According to distance - time relationship of running events for all organizations, the slope of linear regression line was determined as CV value and y-intercept of linear regression line was dtermined as ADC value (Figure 1).

$D = CV \times t + ADC$ (1)
D = Covered Distance
t = Performance Time
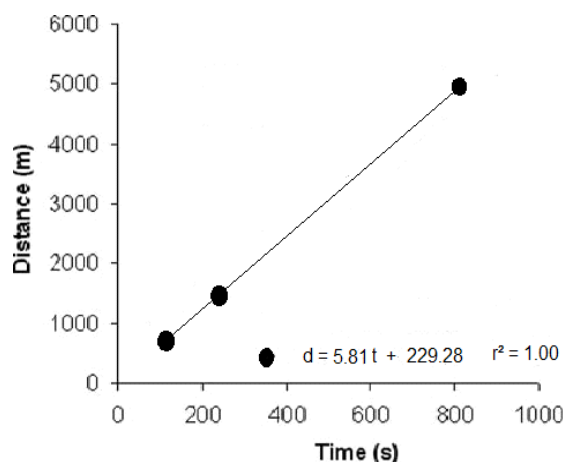CV = Critical Velocity
ADC = Anaerobic Distance Capacity

Fig. 1. *The Distance – Time Relationship of 2012 Olympic Games*

Data was given as mean ± standart deviation (SD). The determination coefficient (r^2) and standart error (SE) of CV estimation were calculated with Lin-TD model. One-way analysis of varience with Scheffe' post-hoc comparisons was used in order to signify the difference among four organizations (SPSS Version 16.0, SPSS, Chicago, USA). Significiance level of analyze was set up at $p < 0.05$.

3. RESULTS

Table 1 provides CV estimations of four organizations. There were no significant differences among CV values of IAFF-WC, IAAF-WJC and IAAF-CC organizations (6.05 ± 0.13 m/sec., 5.93 ± 0.11 m/sec., 5.84 ± 0.15 m/sec., p > 0.05, respectively) but the significant difference was found between IAAF-WC and OG organizations

(6.05 ± 0.13 m/sec., 5.81 ± 0.26 m/sec., $p < 0.05$, respectively). Also there were not significant differences among CV values of IAAF-WJC, IAAF-CC and OG organizations (5.93 ± 0.11 m/sec., 5.84 ± 0.15 m/sec., 5.81 ± 0.26 m/sec., $p > 0.05$, respectively). The coefficients of determination (r^2) of all organizations were found high ($r^2 = 1.00$). The SE values of CV estimations of four organizations were found similar to each other (IAAF-WC = 0.04 ± 0.03 m/sec., IAAF-WJC = 0.05 ± 0.02 m/sec., IAAF-CC = 0.06 ± 0.03 m/sec., OG = 0.07 ± 0.10, respectively).

Table 1. Critical velocity (CV) values of organizations

Organization	CV (m/sec.)	SD (m/sec.)	r² (mean)	SE (mean)
IAAF-WC*	6.05	0.13	1.00	0.04
IAAF-WJ	5.93	0.11	1.00	0.04
IAAF-CC	5.84	0.15	1.00	0.05
OG*	5.81	0.26	1.00	0.06

Significiant difference between IAAF-CC and OG organizations, p< 0.05.

Table 2 provides ADC estimations of organizations. It was determined that there was no significant difference among ADC values of IAFF-WC, IAAF-WJC, IAAF-CC and OG organizations (180.84 ± 15.26 m., 177.12 ± 23.93 m., 196.90 ± 29.63 m., 194.49 ± 20.21 m., respectively). The SE values of ADC estimations of four organizations were found similar to each other (IAAF-WC = 20.04 ± 11.93 m., IAAF-WJC = 22.88 ± 9.01 m., IAAF-CC = 30.53 ± 15.23 m., OG = 22.19 ± 11.54 m., respectively).

Table 2. Anaerobic Distance Velocity (ADC) values of organizations

Organization	ADC (m.)	SD (m.)	SE (mean)
IAAF-WC	180.84	15.26	20.04
IAAF-WJ	177.12	23.93	22.88
IAAF-CC	196.90	29.63	30.53
OG	194.49	20.21	22.19

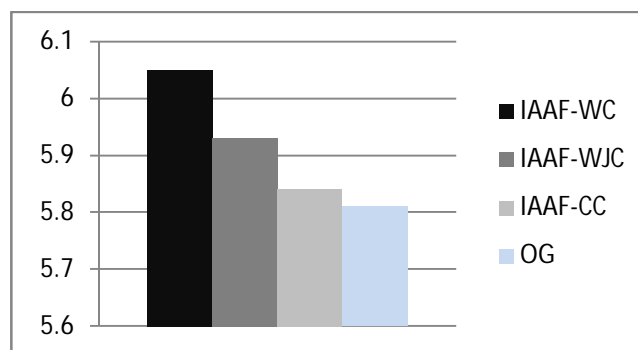*No significiant difference among ADC values of organizations, p>0.05.*

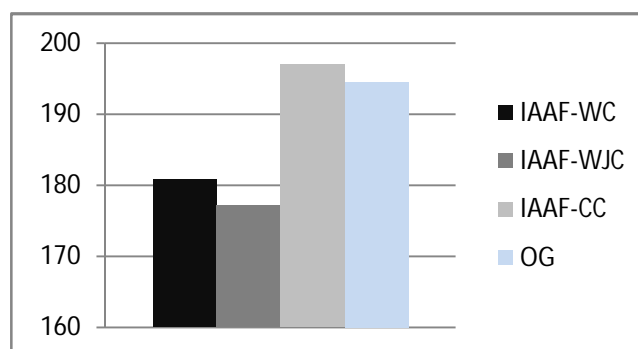**Fig. 2.** *Critical Velocity (CV) Values of International Organizations (m/sec.)*

Fig. 3. *Anaerobic Distance Capacity (ADC) Values of İnternational Organizations (m.)*

4. DISCUSSION

The present study intended to compare CV values of IAAF-WC, IAAF-WJC, IAAF-CC and OG organizations. The results of this study indicates that there were no significant difference among CV values of international organizations except for significant difference between CV values of IAAF-WC and OG organizations. Similarly, there were no significant differences among ADC values of all organizations.

SE values of CV estimations of all organizations were high (mean SE value = 1.00 ± 0.00). This indicated that Lin-TD model is suitable for CV estimations. CV and ADC values of fourteen elite male long-distance runners which were determined by Billat et al. (1995) (CV = 5.36 ± 0.22 m/sec., ADC = 252.50 ± 97.9 m.) were different from CV and ADC values of present study. It was seen that CV values of long-distance runners were lower than CV values of our study. On the other hand, their ADC values were higher than ADC values of our study. The cause of this difference could be investigation group of Billat et al. (1995). Aerobic fitness level of long-distance runners in the investigation of Billat et al. (1995) could be an effect on this situation.

CV values of IAAF-WC were higher than CV values of OG organization (p < 0.05) but no significant difference was found among ADC values of these organizations. Although CV values of IAAF-WC were higher than CV values of OG, it was seen that their ADC values were similar (p > 0.05).

CV values of IAAF-WJC which were determined in our study were higher than CV values of children which were determined by Berthoin et al. (2006) with continuous and intermittent runs (CV of continuous runs = 2.5 ± 0.28 m/sec.,, CV of intermittent runs =3.17 ± 0.33 m/sec.). IAAF-WJC is the most superior organization for junior runners and this difference is a natural conclusion. Also Berthoin at al. (2006) performed this study on eight to eleven years old children and this situation could have effect on this difference.

CV values of professional elite soccer players which were determined by Denadai et al. (2005) (4.01 ± 0.31 m/sec.) were lower than CV values in our study. There could be difference between aerobic fitness levels of professional elite soccer players and elite runners participated to the international organizations.

CV values of our study were higher than CV values of adult subjects which Bull et al. (2008) determined on treadmill with Lin-TD model (3.64 ± 0.36 m/sec.). The cause of this difference could be testing on treadmill. Also aerobic fitness levels of adult subjects could be different from elit athletes' participated to international organizations. Similarly, CV values of adult male subjects which were determined by Housh et al. (2001) (3.81 ± 0.31 m/sec.) sustained these predictions.

CV (3.97 ± 0.40 m/sec.) and anaerobic work capacity (AWC) were termed as ADC (124 ± 43 m.) values of adult persons were lower than values of our study (17). Our study included international organizations performance of elite athletes and values of our study are higher than theirs is expected normally.

CV (4.48 ± 0.54 m/sec.) values of highly trained middle and long distance runners (18) were lower values of our study. Similarly, Anaerobic running capacity (ARC) was termed as ADC in our study (205 ± 70 m.) (3) was lower ADC values of our study. CV and ARC values in the study of Bosquet et al. (2006) were determined with Lin-TD model on treadmill. Although Lin-TD model was used in our study was used for determining CV and ARC in this study, CV and ARC values were different from CV and ADC values of our study. The cause of this could be different test ground (treadmill and tartan ground difference) and the differences among aerobic fitness levels of athletes.

Famous international organizations requirehigh athlete motivation as well physical fitness. Therefore athletes participated to international organizations had world records at various competitions. In this context, motivational factors could have effects on differences among values of other studies at literature and our study as well superior aerobic fitness levels of elite athletes. Although it is accepted that Olympic Games (OG) is the most superior international organization in the world, mean CV values of IAAF-WC was higher than the CV mean values of OG. This consequence could result from different numbers of international organizations in our study.

CV and ADC values of thirteen IAAF-WC and twenty-two OG organizations were estimated because of different organization numbers.

5. CONCLUSION

It was seen that there were no difference between CV values of IAAF-WC, IAAF WJC, IAAF-CC and OG organizations without difference between CV values of IAAF-WC and OG organizations. Besides, any difference wasn't determined among ADC values of organizations. It was said that four organizations had similar CV and ADC values. CV and ADC values were estimated with Lin-TD model was defined as a model with two parameters. CV and ADC values of international organizations can be estimated by using other models as linear velocity, nonlinear and exponentinal models. CV is an important indicator of aerobic fitness levels of athletes. Other international organizations can be evaluated by using CV values indicate aerobic fitnes levels and can be compared with current international organizations.

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