Innovations

Physiological, Physical, and Morphological Differences between Athletes of Bokoji and Misha athletics projects: A Comparative Study

[1]Degele Shomoro & [2]Abenezer Kemal

[1]PhD in Exercise Physiology, Wachemo University, Hossaena, Ethiopia
[2]MD, General Physician, Wachemo University, Hossaena, Ethiopia

Corresponding author: **Degele S**

Abstract

The aim of this study was to compare physiological and morphological parameters of junior athletics projects. In this study, all male middle and long distance running athletes from Bokoji and Misha athletics projects were participated as samples. Hence, census sampling technique was applied. Data were collected from a total 12 variables: Body Mass Index (BMI), upper leg length (ULL), upper leg circumference (ULC), calf circumference (CC), Speed and Agility (AgSp), Waist Circumference (WC), Triceps (Trps), Sub Scapular (SbSc), Per Cent Body Fat (%BF), Maximum O_2 Volume (Vo_{2max}),Resting Heart Rate (RHR), and Maximum Heart Rate (MHR). SPSS version 20.0 was applied for data analysis. To see significance, independent samples T-test was used. Level of significance was set at 0.05. The results clearly indicated that there were no statistically significant difference found on all anthropometric, physical, body composition and physiological parameters (except Upper Leg Length for which mean difference was significant) between Athletes of Bokoji AP and Misha AP. Finally, it was concluded that Athletes had demonstrated similar athletic performance on all physical and physiological parameters and had similar characteristics of Morphological (Anthropometric) parameters with some exceptions. Further investigation should be conducted in the similar study area.

Key words: *Physiological, morphological, Physical Fitness, athletes*

Introduction

The identification of physical characteristics in a sport modality contributes to its success and enables to spot differences among athletes of different modalities, which is of great interest for both sport coaches and scientists (Jeyaraman et al., 2012). Physiological characteristics and physical fitness measurements play an important role in the successful athletic performances. These parameters further help to predict talents and finance on the potentially best athletes for each sport (Abbaszadegan, Ramezani and Azarbayjani, 2012).

The fact that many of the world's best distance runners originate from distinct regions of Ethiopia and Kenya, rather than being evenly distributed throughout their respective countries (Onywera et al., 2006; Scott et al., 2003 cited in Bouchard and Hoffman, 2011).As revealed by (Nikolaidis, Ziv, Arnon, and Lidor, 2012) that intraindividual variability existed in most of the physical characteristics and physiological attributes. However, the probable intraindividual variability could be due to demographic variations.

On the other hand, for many years in Ethiopia where more than 80 ethnics are living, no study has revealed variations in anthropometric, physiological, and physical fitness characteristics of athletes of distinct locations.

Materials and Methods

For data collection first permission was taken from respective sources. All the necessary information about the study (purpose, procedures, etc.) was explained for the participants in advance. Consent was obtained from the participants by filling and returning back every requirement detailed in the Consent Formand Physical Activity Readiness Questionnaire (PAR-Q).All testing and measurements were conducted with the Ethical Clearance approval of Institutional Review Board of Wachemo University.Tests were conducted in accordance with the International society for the Advancement of Kinanthropometry (ISAK, 2001), Centers for Disease Control and Prevention (CDC, 2007/9), (Horton, 2014)as well as Fitnessgram (Cooper Institute, 1982).

Athletes with health problems were not allowed to take part in the study. Only middle and long distance athletes were eligible to participate in this study. As this is quasi experimental research, tests and measurements were conducted both in the field and laboratory/ gymnasium. Waistcircumference was measured at the level of the narrowest point between the lower costal (10th rib) border and the iliac crest. The triceps Vertical skinfold was measured at the posterior midline of the upper arm. The sub scapular Diagonal fold at a 45 degree angle just 1 to 2 cm below the inferior angle of the scapula measured to the nearest 0.1 mm. %BF was calculated from the two skinfold measurements using regression equation, %BF = 0.43A+ 0.58B + 1.47, where **A**is triceps and **B**is subscapular skinfolds in mm to predict%BF. VO_{2max} was indirectly obtained using a Multistage 20m Shuttle Run Test and the athlete's score is the last level (L) completed and number of shuttles (S) reached. Age, L, and S are required to calculate vo_{2max} before wasIndependent-Samples T-test applied. RHR was taken after 10 minutes upon waking early in the morningwhile MHR was measured immediately after 2 minutes-non-stoppable Jumping Jacks Test using Omron M6 Auto Digital. To measure Strength of the Diaphragm Muscle, Breath-Holding Time Test performed where Sample Person holds air once breath in until he is unable to do. Agility and Speed was assessed using a 20m Agility Shuttle Test from a stationary start and the maximum time scored using standard stop watch. The upper leg length was measured between the anterior superior iliac spine and the middle of the patella. To measure Maximal Calf Circumference, measurement was taken at the maximum girth of the calf at the marked Medial calf skinfold site. The maximum circumference of the thigh girth measurement was taken the right mid-thigh girth at the marked Mid-trochanterion-tibiale-lateralesite. The measurements for upper leg length, waist, thigh girth, and Calf circumference were taken to the nearest 0.1cm each using non-elastic tape.

SPSS; version 20.0 was used for the data analysis. To compare mean difference, Independent-Samples T-testwas applied. The level of significance was set at 0.05. In addition, Standard Norms (ACSM, 2013; Jeukendrup & Gleeson, 2010) were used to compare the study subjects' performances against the Norm. Descriptive statistics such as mean and standard deviation were calculated to describe the physical characteristics of the study subjects.The results concerning the significant mean difference on the morphological,body composition and physiological parameters were analyzed and presented as follows:

Results and Discussions

Table 1: Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
TRCP (mm)	Equal variances assumed	.338	.567	-1.865	22	.076	-1.16667	.62563	-2.46415	.13081
	Equal variances not assumed			-1.865	20.814	.076	-1.16667	.62563	-2.46845	.13511
SbSp (mm)	Equal variances assumed	.225	.640	.410	22	.686	.33333	.81340	-1.35355	2.02022
	Equal variances not assumed			.410	21.897	.686	.33333	.81340	-1.35401	2.02068

As the*Independent Sample T-Test on the table-1 revealed,*the results from triceps measurements indicated that there was no statistically significant mean difference between the two groups where the mean value for Misha AP was 5.8333±1.33712 and 7.0000±1.70561 for Bokoji. Similarly, related to sub scapular (SbSp) no statistically significant mean difference found since the mean value for Misha AP was 7.6667±1.922751and 7.3333±2.059715 for Bokoji.

Before applying *Independent Sample T-Test*, per cent of body fat (%BF) was calculated from the two skinfold measurements (triceps and Subscapular) for each sample using population specific (Young men, ages 17 to 26 years) equation: % Body fat = 0.43A+ 0.58B + 1.47, where A is triceps skinfold in (mm) and B is subscapular skinfold in (mm) to predict percentage body fat (McArdle, Katch, Katch, 2015). Having calculated %BF, comparison was made between groups by applying *Independent Samples Test.* Accordingly, the mean score for Mish Athletics Project was 8.7425±1.56346 whereas the mean score for Bokoji Athletics Project was 9.5408±1.67297. From the table-2*Independent Samples Test* revealed that there was no statistically significant mean difference between the two groups as alpha value is higher than p-value.

Table 2: Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
BF(%)	Equal variances assumed	.004	.949	-1.208	22	.240	-.79833	.66101	-2.16919	.57252
	Equal variances not assumed			-1.208	21.900	.240	-.79833	.66101	-2.16955	.57289

Regarding Waist circumference, as shown on the table 3, an *Independent Sample T-Test* revealed that there was no statistically significant difference (alpha value is higher than p-value) between the two groups where the mean value for Misha AP was 73.5833±4.981025 and 70.250000±3.467380 for Bokoji AP.

Table 3:Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
WC(cm)	Equal variances assumed	.277	.604	1.903	22	.070	3.33333	1.75198	-.30006	6.96672
	Equal variances not assumed			1.903	19.633	.072	3.33333	1.75198	-.32562	6.99228

Heart Rate and Diaphragm Muscle Strength and Endurance

Table 4: Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
RHR	Equal variances assumed	11.421	.003	.213	22	.833	.917	4.302	-8.005	9.838
	Equal variances not assumed			.213	14.243	.834	.917	4.302	-8.295	10.129
MHR	Equal variances assumed	3.217	.087	1.206	22	.240	7.750	6.424	-5.572	21.072
	Equal variances not assumed			1.206	16.044	.245	7.750	6.424	-5.865	21.365
vo_{2max}	Equal variances assumed	3.414	.078	-.300	22	.767	-.8083	2.6948	-6.3969	4.7803
	Equal variances not assumed			-.300	15.454	.768	-.8083	2.6948	-6.5374	4.9207
DMS	Equal variances assumed	17.688	.000	.884	22	.386	16.50833	18.67809	-22.22765	55.24432
	Equal variances not assumed			.884	12.138	.394	16.50833	18.67809	-24.13648	57.15315

It was evident that an *Independent Samples T-Test* (Table4) demonstrated that there was no statistically significant mean difference between the two groups on all physiological variables where the mean value for Misha AP were 62.92±13.892, 72.50±19.961, 52.167±8.480923, and 90.8417±63.08746 on the RHR, MHR,

vo_{2max}, andDMS respectively. On the other hand, the mean value for Bokoji AP were 62.00±5.394, 64.75±9.836, 52.975±3.900, and 74.33±14.367472on the RHR, MHR, vo_{2max}, andDMS respectively.
The results showed that the ability of the Athletes' Resting Heart Rate (RHR) during rest and Maximum Heart Rate (MHR) during exercising to pump out blood did not show significant differences between the two groups as they are from different geographic location. Similarly, the results from the vo_{2max} which was first calculated from the Shuttle and Level counted whilerunning *20m Shuttle Run Test* had not demonstrated the difference between the teams. The cardiorespiratory fitness (VO_{2max}), the ability of the lungs and heart to deliver maximum oxygen for the muscle cells, affected by some factors such as training, altitude, etc. but the two athletic projects are from similar altitude (high altitude) found between 2600-2900m above sea level. On the other hand, the results of diaphragm muscle strength and endurance tested by holding air once breathed in for maximum time without breathing out until unable to do so was almost similar for the groups.

Morphological (Anthropometric) Parameters

Table 5: Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
U LL(cm)	Equal variances assumed	.001	.973	-13.466	22	.000	-9.16667	.68072	-10.57840	-7.75493
	Equal variances not assumed			-13.466	21.873	.000	-9.16667	.68072	-10.57888	-7.75446
ThC (cm)	Equal variances assumed	.004	.951	.255	22	.801	.28750	1.12802	-2.05187	2.62687
	Equal variances not assumed			.255	21.988	.801	.28750	1.12802	-2.05195	2.62695
CC (cm)	Equal variances assumed	.008	.931	1.749	22	.094	1.20833	.69074	-.22416	2.64083
	Equal variances not assumed			1.749	21.663	.094	1.20833	.69074	-.22546	2.64212

According to the current study, *Independent Samples T-Test* revealed that the result found on the Thigh Circumference (ThC) for Misha AP (mean: 48.00±2.730) was almost similar with results for Bokoji AP (mean: 47.713±2.795) as there was statistically no significant mean difference observed (table 5). Similarly, no significant mean difference was obtained on calf circumference measurements (CC) between groups. However, the result on the Upper Leg Length (ULL) demonstrated significant mean difference where the mean value of ULL measurement for Misha AP was 39.7500±1.60255and 48.9167±1.72986 for Bokoji AP which implying longer leg length with higher mean value.

On the other hand, only one physical fitness variable was tested using *10m Agility Shuttle Test to test* anaerobic endurance, speed, and agility of the athletes. Because the parameter is also an important factor in identifying future successful runners in running athletics event.

Independent Samples T-Test, as indicated on the table 6**,** demonstrated that there was no statistically significant mean difference observed between the two groups where the mean value for Misha AP was 12.0467±0.54235 and 12.1817±1.01076 for Bokoji AP. One can understand that athletes showed almost similar performance to cover the distance within shortest time while running *10m Agility Shuttle Test.*

Table 6: Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
AgSp (sec)	Equal variances assumed	5.912	.024	-.408	22	.687	-.13500	.33113	-.82173	.55173
	Equal variances not assumed			-.408	16.849	.689	-.13500	.33113	-.83411	.56411

Discussions of the Results

Today it has been realized that champion in different sports differ in their anthropometric and physiological characteristics that correspond to some extent with particular requirements of their respective events (Singh and Singh, 2013).

According to the researchers and authors, these variations in anthropometric characteristics attributed to hereditary characteristics (ethnicity) as well as other favorable environmental conditions (Lucia et al., 2006) and (Larsen, 2003).

In this part results from the morphological (anthropometric) measurements, physiological and physical parameters discussed according to the aim of the study.The results concerning the physical characteristics, physiological and morphological parameters of the participants were analyzed and presented in detail.

The mean age of the athletes were 16.75±.676 which comply the regulation of IAAF, under seventeen (U-17) standards for athletics projects. On the other hand, the mean height and weight of the athletes were 1.7250±.04681 and 56.8042±4.27261 respectively.

Body Composition Variables

There are several important reasons for measuring body composition: (1) To assess the decrease in body fat weight that occurs in response to a weight-management program. Body composition measurement throughout the entire weight-loss process helps people make informed decisions about their diet and exercise programs. (2) To help athletes determine the best body composition for performance. Most athletes are very concerned with body composition. In some sports such as wrestling, gymnastics, ballet dancing, body building, and distance running, athletes attempt to reach the lowest body fat levels possible. In other sports such as weight lifting, football, baseball, and rowing, a large fat-free mass is paramount. Accurate body composition measurement is critical to guide athletes as they seek the optimal level of fat and fat-free mass associated with their sport (Nieman, 2011). In this current study, the results on all body Composition Variables (body mass index, waist circumference,per cent of body fat (%BF), and Triceps and Sub Scapular skinfolds) demonstrated no differences between Misha AP and Bokoji AP.

Physiological and Physical Variables

Exploring the association between exercise capacity and relevant physiological parameters may provide the scientific background for developing new training methods or physiological tests that may benefit athletes, and provide coaches and exercise physiologists with novel insight into the importance for optimizing training and performance. The results of recent study show that athletic performance such as sprinting is determined by physiological characteristics (skeletal muscle fiber type) (Mohr, Thomassen, Girard, Racinais and Nybo, 2016).

For this current study, VO_{2max}, Resting and Maximum Heart Rate, and Diaphragm Muscles Strength and Endurance were selected as study variables. In addition, Agility and speed of athletes was tested as a physical fitness parameter. However, athletes of both group showed similar performances. Regardless of variations in the training approach /methods, the probable reason for the similarity of the results in physiological and physical fitness parameters could be similar environmental weather condition and altitude, that is, the two athletic projects are from similar altitude (high altitude) found between 2600-2900m above sea level.

According to recent literatures reviewed, in addition to those, anthropometric and physical fitness factors, athletic performanceis determined by environmental factors such astraining/conditioning, skill level, climate/temperature, altitude, nutrition: food + water, sleep, recovery, etcalthough the degree how much it can affect is arguable (Roos and Roos, 2012).

Morphological (Anthropometric) Parameters

There are many reasons why measurements of body dimensions are taken. Adoption of a standard profile and methodology allows comparisons to be made locally, nationally and internationally between sample groups (ISAK, 2001). Big number of researchers dealt with anthropometric characteristics of high level sportsmen, trying to reveal optimal morphological profile for specific sport activity (Bašinac, Mikic and Pojskic, 2009).

In this study Upper Leg Length, Thigh Circumference, and Calf Circumference were selected as a crucial parameters for runners since these variables measurements are directly related to muscle size /mass and the length of stride taken between legs during running. Except for Upper Leg Length, Circumference measurements were similar for the athletes of both groups. But, in the Upper Leg Length results showed Athletes of Bokoji AP had higher leg length than its counterpart.

In conclusion, the null hypothesis stated that there might not be differences in body composition, physiological, and Morphological (Anthropometric) Parameters between Athletes of Bokoji AP and Misha AP.Analyzing raw data using *Independent Samples T-Test*,*2-tailedTest* was applied to see the significant mean difference in order to prove the hypothesis already stated. The results clearly indicated that at 5% level of significance, there is enough evidence to support the claim that there were no statistically significant difference found on all anthropometric, physical, body composition and physiological parameters (except Upper Leg Length) between Athletes of Bokoji AP and Misha AP. since *"Alpha"* is greater than *"P"* value; this is enough evidence to *Accept* the null hypothesis. However, the null hypothesis was *rejected* for Upper Leg Length as there was difference found between the two groups.

Conclusion

Based on the results obtained, the researchers have drawn conclusions as follows:

- Athletes had demonstrated similar athletic performance on all physical and physiological parameters
- Athletes had similar characteristics of Morphological (Anthropometric) Parameters with some exceptions
- Athletes of both teams were from similar environmental conditions (high altitude ranging 2600m-2900m above sea level) which could be probable reason for the similar athletic performance especially on cardiorespiratory fitness.

Interest conflict

We, both the Author and the Co-author do not have interest conflict in case on our authorship and correspondence.

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