

Cardiorespiratory Endurance Norm for University Female Athletes in Southwestern Nigeria

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Abstract

The purpose of this study was to evaluate the physical and cardiorespiratory endurance fitness of female athletes in southwestern part of Nigeria with the aim of standardizing cardiorespiratory norms for university female athletes in Southwestern Nigeria. Usage of norms has distinguished America and Australia in sports. Norms are age and gender specific and identifying talents and comparing test results of other groups may be difficult without norms. Foreign norms are not suitable for Nigerians, moreover female endurance norm is not available in Nigeria. The study is an ex-post facto research type. Purposive sampling technique was used to select 1,320 female athletes from five federal and five state universities in Southwestern Nigeria. Variables assessed were age, height, weight, Body Mass Index and endurance in volleyball, basketball, handball, soccer and hockey players. Reliability for the instrument (1.5 mile run) range from 0.27 – 0.90. Data were analyzed using descriptive statistics and Levene's 't' test. Data were compared with Australians' published data. T-score was employed to standardize data for athletes rating. Athletes showed an age range of 15 – 30 years compared with 19 – 29 reported for Australians. Average height of 1.6 – 0.1m, weight 58 – 67kg and BMI 22.5 – 2.9 were lower compared with those for Australians which were height of 1.7 – 0.1m; weight 62.5 – 6.1kg and BMI 21.6 – 1.4. Result showed that endurance of $50.3 \pm 22.0 \text{ml.kg}^{-1} \text{min}^{-1}$ reported for Australians is significantly ($P < 0.05$) higher when compared with $45.3 \pm 24.4 \text{ml.kg}^{-1} \text{min}^{-1}$ for the participants. Endurance T-score between sports showed decrease in this order; volleyball (53.2 ± 10.7); handball (52.5 ± 11.3); soccer (51.1 ± 10.4) basketball (47.7 ± 7.2) and hockey players (44.9 ± 5.2). Based on the assessment, the cardiorespiratory endurance norms for female athletes in Southwestern Nigeria were lower compared with their Australian counterparts. Fitness indices norm reported in T-scores have better advantages for standard rating.

Keywords: cardiorespiratory endurance, female athletes, physical fitness norms, Southwestern Nigeria

INTRODUCTION

Cardiorespiratory endurance is vital for physical fitness and athletic excellence. It is the measure of the maximum oxygen uptake ($\text{VO}_{2\text{max}}$) or the rate of oxygen utilization of the muscles during aerobic exercises. It is the ability of the heart, lungs and circulatory system to supply oxygen to the working muscles (Heyward, 2002, Drwellnessry, 2011, & Frakmoran, 2011). Cardiorespiratory system depends on the efficient respiratory and cardiac system, adequate blood components (red blood cell count, haemoglobin, haematocrit and blood volume); and specific cellular components that helps to utilize oxygen during exercise and sport performance.

According to Heyward (2002), Scott (2009) and Segarsfw (2011), $\text{VO}_{2\text{max}}$ is the ability to perform large-muscle dynamic exercise of moderate-to-high intensity for prolonged periods. WaldenU.edu (2011), stated that, improved $\text{VO}_{2\text{max}}$ is one of the most important benefits of performing regular aerobic exercises. During this exercise, the heart and lungs must supply fuel and oxygen to the working muscles.

Although, $\text{VO}_{2\text{max}}$ has a genetic component, it could be improved with training. Novice exercisers have been able to increase $\text{VO}_{2\text{max}}$ by 20% through training. However, fit athletes who have been able to increase $\text{VO}_{2\text{max}}$ most likely are already near their genetic potential. Any physical activity that lasted for 1 hour or longer is an endurance sport. For example, a tennis match can last for four hours or more. Aerobic activities as running, swimming, bench stepping and bicycling improve $\text{VO}_{2\text{max}}$.

When insufficient oxygen is delivered to the working muscles, the ability to perform work reduces greatly; especially in aerobic sports. According to Quinn (2008), $\text{VO}_{2\text{max}}$ value is a good indication of one's aerobic endurance potential and it helps to monitor a person's training routine over time. It is also a way to compare an athlete to other athletes. Many elite female athletes have higher $\text{VO}_{2\text{max}}$ values than most men do. However, because of differences in body size, composition, blood volume and hemoglobin content, a woman's $\text{VO}_{2\text{max}}$ is generally about 20% lower than that of a man.

Aerobic capacity is the amount of oxygen an individual can possess within a given time. Among physiologists, it is the single most important index of physical fitness. It is associated with heart rate, stroke volume and cardiac output. The heart rate of an average person at rest, who exercises regularly, is between 70 and 75 beats per minute (Adeloye, 2007). WaldenU.edu 2011 stated that VO_{2max} is measured as milliliters of oxygen used in one minute per kilogram of body weight ($ml.kg^{-1}, min^{-1}$). This is because oxygen and energy needs differ relative to size and surface area. This may be more accurate when comparing children and oxygen uptake between sexes.

Theoretically, the more oxygen you can use during high-level exercise, the more ATP (energy) you can produce. This is often the case with elite endurance athletes, who typically have very high VO_{2max} value. VO_{2max} is the highest rate of oxygen consumption attainable during maximal or exhaustive exercises. As exercise intensity increases so does oxygen consumption. However, a point is reached where exercise intensity can continue to increase without the associated rise in oxygen consumption (Fitness Testing, 2011)

Physical fitness norms are valuable tools used by experts for assessing athletic performance and drawing training programmes. A norm is a standard by which a performance can be rated. It is frequently expressed as percentiles or standard scores, like T-score and Hull scores (Docherty, 1996). A norm should be up to date and preferably of local origin. It must be based on a large homogenous population. In order to establish the strength and weaknesses of an athlete, test results were compared to that of counterparts in the same training group, the same sport or similar population. These tests can range from elaborate and expensive laboratory tests to simple and inexpensive laboratory field test (Rob, 2003).

According to Adeloye (2007), the interpretation of test results require that you determine how important each of the components tested is to the overall performance in a given sport. For example, while a poor result in a body fat test for basketball player may be of special concern, it is not as vital as poor result in an endurance test. However, a poor result in VO_{2max} test is a danger to performance of high intensity of both short and long duration. The importance of cardiorespiratory endurance fitness to man and athletes in particular cannot be overemphasized. Physical fitness is the ability to perform daily tasks vigorously and alertly, with energy left over for enjoying leisure-time activities and meeting emergency demands (Y! Geocities, 2002).

At the international level, there has been an increase of women in championships. In recent time, there has been a surge of athletes from African nations such as Nigeria, Kenya and South Africa. According to (Adeloye, 2007), Fiona (2000), reported that, there has been an increase of women competitors in various sports. The Nigeria female soccer team-Super Falcons have done Nigeria proud at both national and international competitions. At the FIFA women's world cup-Germany 2011, Perpetual Nwocha emerged the African footballer of the year having scored two goals against Canada after the team lost to France. Delta queens of Asaba banked the second position in 2011 female league. Nigerian female athletes have made a mark in sports development. The purpose of this study was to evaluate the physical and cardiorespiratory endurance fitness of female athletes in Southwestern part of Nigeria with the aim of standardizing suitable cardiorespiratory endurance norms for university female athletes in Southwestern Nigeria using Australian norms.

Hypotheses

The following hypotheses were tested.

1. The cardiorespiratory endurance norms for university female athletes in Southwestern Nigeria will not be significantly determined
2. There will be no significant difference between the university female athletes in Southwestern Nigeria and Australian established cardiorespiratory endurance norm.
3. The type of game played will not be a significant determinant of any difference in cardiorespiratory endurance of university female athletes in Southwestern Nigeria.

METHODOLOGY

The research design for this study was the ex-post-facto type. The population was the university (five states and five federal) female athletes in Southwestern Nigeria. This composed of these states – Oyo, Ogun, Ondo, Ekiti, Lagos and Osun. All female players of volleyball, basketball, handball, soccer and hockey in these universities, were included. The target participants for this study were one thousand three hundred and twenty (1,320) university female athletes. They were selected using purposive sampling technique. Participants comprised all athletes in each of the five games and others that regularly practice with them. All participants were given informed consent form to complete.

Instrument

- 1) The pro-survisor Accusplit digital battery operated stop watch model number 601x with the capacity of 40 minutes to 1/100 sec and 24 hour to 1 sec, (made in China).

- 2) A calibrated wall from 5.0 centimeters to 2.5 metres
- 3) The HANA bathroom scale model No BR 9011 with the capacity of 120 kilograms (made in Japan)
- 4) 1 – 5 mile run was used to test VO_{2max} Heywar (2002) reported a reliability ranges from $r=0.27 - 0.90$, while Adeloye (2007) reported a reliability of $r= 0.88$

All tests were conducted at the gymnasium and sports field of selected universities. About 20 – 25 participants were tested each day, between 7a.m – 9a.m and or 4 – 6pm. Four trained research assistants were employed. There were four stations. The order of testing was as follows:

1. Participant’s age was recorded in years to the nearest birthday.
2. Weight was recorded in kilograms. Participants were to be dressed in light clothing
3. Height was measured in centimeters barefooted.
4. VO_{2max} test: Participants were allowed to go at their pace on a 400-metre track. Participants were instructed to cover 1.5 miles distance in the fastest possible time. Walking was allowed. The elapse time was recorded to the nearest second as participant crossed the finish line. The prediction equation developed by George Vehrs, Alisen, Fellingham and Fisher (1993), reported by Heyward (2002) was used to estimate VO_{2max} prediction equation for 1.5 mile = $88.02 - 0.1656 (Bw.Kg) - 2.76 (time, min) + 3716 (gender)^b$ b = gender, ‘I’ for male an ‘O’ for female.

To use this equation, seconds were converted to minutes by dividing the reading in seconds by 60

5. Body Mass Index (BMI) was calculated with $Bw/h^2kg.m$

DATA ANALYSIS

This study was designed to assess and standardize cardiorespiratory (VO_{2max}) norm for university female athletes in Southwestern Nigeria. The data for this study were analyzed using the mean, standard deviation, percentages and T-score eliminates all decimals sign and reduce computational errors. The Levene’s t-test was employed to determine the significant difference between the participants’ mean scores and the Australian’s established norms. The mean scores were used to standard of comparison in agreement with Rob (2003)

However, the Australian established norms were not reported in T-scores. Analyses of Variance (ANOVA) was used to determine the probability that the mean scores of the five groups of athletes deviated from one another, the Scheffe type post hoc test was applied to all comparison of means scores for different games to find out the difference that existed and determine which means are significantly different. All hypotheses were fully tested at 0.05

alpha level. Data were presented in tables, bar charts and graphs.

Table 1: Age distribution, frequency and percentage of participants

| Age range (years) | Frequency | % |
|-------------------|-----------|------|
| 15 – 19 | 299 | 22.7 |
| 20 – 24 | 878 | 66.5 |
| 25 – 29 | 141 | 10.7 |
| 30 > above | 2 | 0.1 |
| Total | 1320 | 100 |

Table 1, is illustrated in Fig. 2 The age range of 299 participants – 22.7% were between 15 – 19 years, while 878 = 66.5% of the sample size was within the age range of 20 – 24 years. Participants within the age range of 25 – 29 years were 141 = 10.7% of the sample size, while 2 participants = 0.1% were 20 years and above.

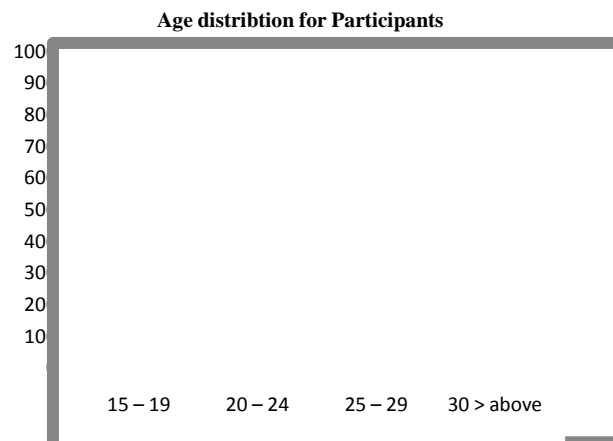


Fig 1. Age distribution for participant

Table 2: Physical characteristics and cardiorespiratory test’s score of participants

| Variable N = 1,320 | Means | SD | Range |
|--|-------|------|--------------|
| Height | 1.6 | 0.1 | 1.1 – 1.9 |
| Weight | 58.8 | 6.7 | 40.0 – 100.0 |
| Body Mass Index | 22.5 | 2.9 | 100.0 |
| Cardiorespiratory | 13.0 | 3.3 | 9.5 – 3.8 |
| Endurance (sec) | 45.3 | 24.2 | 1.6 – 28.3 |
| VO_{2max} prediction (ml.kg ⁻¹ .min ⁻¹) | | | 6.9 – 120.7 |

Table 2 showed a mean height of $1.6 \pm 0.1m$ and a range of 1.1 – 1.9m. The mean weight was $58.8 \pm 6.7kg$ and a range of 40.0 – 100kg. The mean BMI was 22.5 ± 2.9 with a range of 9.5 – 53.8. Most participants had normal body weight in accordance with the WHO classification of weight and obesity based on BMI value, which is 18.24.9 (Heyward, 2002). A mean score of $13.0 \pm 3.3sec$ and a range of 1.6 – 28.3sec were obtained for cardiorespiratory endurance test. VO_{2max} prediction showed a mean score of $45.3 \pm 24.2 ml.kg^{-1} min^{-1}$ and a range of 6.9 – 120.7ml.kg⁻¹ min⁻¹

Table 3: Frequency distribution and percentage of participants by type of game

| Type of Game | Frequency | % |
|--------------|-----------|------|
| Soccer | 294 | 22.3 |
| Volleyball | 303 | 23 |
| Basketball | 180 | 13.6 |
| Handball | 270 | 20.5 |
| Hockey | 273 | 20.6 |
| Total | 1320 | 100 |

Table 2 and fig. 2 show that volleyball game recorded the highest number of participants, 303 = 23.0%. For soccer, 294 = 22.3% of the sample size. Hockey game had 273 = 20.6%. Handball game obtained 270 = 20%. Basketball game recorded the lowest size of 180 = 13.6%.

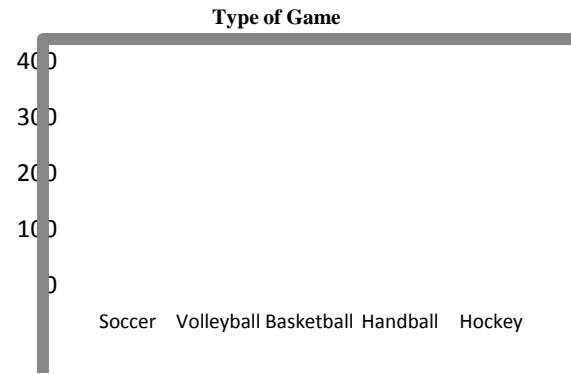


Fig. 2: Bar chart for frequency distribution of participants by type of game

RESULT AND DISCUSSION

Hypotheses 1: The cardiorespiratory endurance norms for university female athletes in Southwestern Nigeria will not be significantly determined.

Table 4: Descriptive statistics of participants cardiorespiratory endurance test scores by type of game played

| Variables | Basketball | Hockey | Handball | Soccer | Volley-ball |
|--|---|---|--|---|---|
| Cardiorespiratory Endurance [ml.kg ⁻¹ min ⁻¹] | \bar{X} = 37.1 SD = 7.2 Range = 29.8 – 44.3 | \bar{X} = 33.0 SD = 5.1 Range = 26.8 – 38.2 | \bar{X} = 51.2 SD = 9.8 Range = 40.7– 59.3 | \bar{X} = 48.0 SD = 10.4 Range = 40.7– 33.4 | \bar{X} = 53.1 SD = 10.9 Range = 42.5– 53.6 |

Volleyball players recorded the highest score of 53.1 ± 0.9ml.kg⁻¹ m⁻¹ and a range of 42.5 – 53.6 in CRE, while handball players had a score of 51.2 ± 9.8ml.kg⁻¹ m⁻¹ and a range of 40.7 – 59.3 a score of 48.0 ±10.4 ml.kg⁻¹ m⁻¹ and a range of 37.6 – 58.4

were obtained by soccer player, while basketball players recorded a score of 37.1 – 7.2 ml.kg⁻¹ m⁻¹ and a range 29.8 – 44.3. The lowest score of 33.0 ±5.1 ml.kg⁻¹ m⁻¹ and a range of 26.8 – 38.2 were obtained by hockey players in CRE.

Table 5: Participants’ mean T-score for cardiorespiratory endurance

| Dependent Variable (N=1320) | \bar{X} | SD | N | Mean | SD | N | Mean | SD |
|-------------------------------|-----------|------|-----|------|------|-----|------|-----|
| Cardiorespiratory Endurance | 49.9 | 9.9 | 702 | 43.9 | 4.4 | 58 | 70.3 | 4.1 |
| VO _{2max} Prediction | 50.0 | 10.0 | 805 | 43.9 | 2.8 | 37 | 85.7 | 3.7 |
| | | | | | 16.7 | 221 | 68.6 | 1.8 |
| | | | | | 0.3 | 4 | 80.8 | 0.6 |

KEY

N = No of participants, \bar{X} = Mean, SD = Standard Deviation, CRE = Cardiorespiratory Endurance

The mean T-score rating above showed that in the 1.5mile run test, 58 participants who recorded a mean T-score of 70.3 ± 4.1>T-score 50. A mean T-score of 85.7±3.7>T-score of 50 were obtained by 37 participants. VO_{2max} prediction result shows that, 221 of the sample size had a mean T-score of 68.6

±1.8>T-score of 50. A mean T-score of 80.8 ± 0.6 were obtained by 4 participants. A mean T-score of 49.9±9.9 obtained in 1.5 mile run test by 702 participants and a mean T-score of 50.0±10.0 in VO_{2max} prediction recorded by 802 female athletes.

Table 6: Participants’ mean T-score by type of game played

| Dependent Variable | Soccer [n=294] | | Volleyball [n=303] | | Basketball [n=180] | | Handball [n=270] | | Hockey [n=273] | |
|---------------------------------|----------------|------|--------------------|------|--------------------|------|------------------|------|----------------|-----|
| | \bar{X} | SD | \bar{X} | SD | \bar{X} | SD | \bar{X} | SD | \bar{X} | SD |
| Cardiorespiratory Endurance | 50.6 | 11.9 | 50.6 | 10.9 | 50.7 | 10.7 | 48.3 | 9.9 | 49.9 | 4.8 |
| VO _{2max} (Prediction) | 51.1 | 10.4 | 53.2 | 10.7 | 46.7 | 7.2 | 52.5 | 11.3 | 44.9 | 5.2 |

In VO_{2max} prediction, soccer players had a mean T-score of 50.6±11.9. Volleyball players obtained a mean T-score of 50.6±10.9. Basketball players recorded a mean T-score of 50.7±10.7. Handball

players had a mean T-score of 48.3 ± 9.9. Hockey players obtained a mean T-score of 49.9 ± 4.8. Basket ball had the highest mean T-score while handball players obtained the lowest mean T-score in

VO_{2max}. Figure 3 and 4 shows the T-curve and bar chart of VO_{2max}.

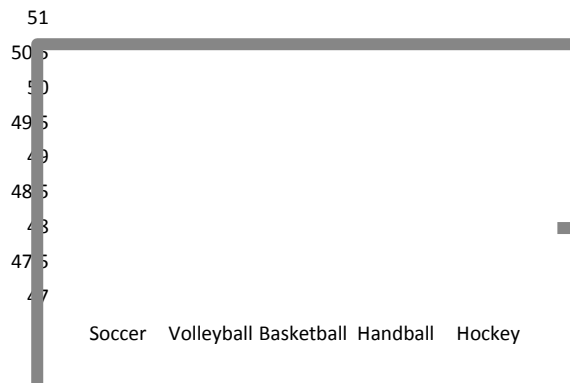


Fig 3. T-Score for cardiorespiratory endurance

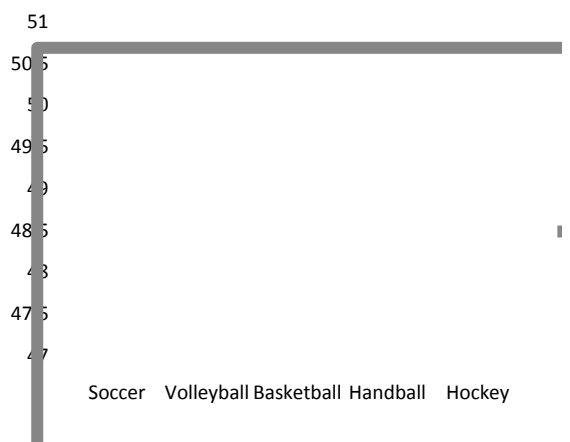


Fig 4. Bar Chart for cardiorespiratory endurance

Soccer players recorded a mean T-score of 51 ± 10.4 in VO_{2max} prediction. Volleyball players obtained a mean T-score of 53.2 ± 11.3 was recorded for handball players. Hockey had a mean T-score of 44.9 ± 5.2 . Volley ball players obtained the highest mean T-score while hockey players obtained the lowest in VO_{2max} prediction. Figure 5 and 6 illustrates the mean T-curve and bar chart of VO_{2max} prediction by the type of game played.



Fig 5. T-Score for cardiorespiratory endurance



Fig 6. Bar Chart for V02MAX Prediction

The null hypothesis (H₀), which stipulated that the cardiorespiratory endurance norms for university female athletes in Southwestern Nigeria, will not be significantly determined is therefore rejected.

Hypothesis 2

There will be no significance between the cardiorespiratory endurance norm of university female athlete in Southwestern Nigeria and Australian established cardiorespiratory endurance norm.

Table 7: Levene’s t-test for equality of variance in cardiorespiratory endurance of participants and Australian athletes.

| | Country | N | \bar{X} | SD | Crit t | Cal t | dif | sig. |
|--|-------------|------|-----------|------|--------|-------|------|------|
| CRE [ml.kg ⁻¹ min ⁻¹] | Australian | 17 | 50.3 | 5.1 | 1.9 | 22.0 | 1319 | 0.0* |
| | S/W Nigeria | 1320 | 45.3 | 24.2 | | | | |

CRE – Cardiorespiratory Endurance (VO_{2max})

The participants’ mean score was 45.3 ± 24.2 ml.kg⁻¹ min⁻¹ while the Australian’s mean score was 50.3 ± 5.1 ml.kg⁻¹ min⁻¹ (Tumility, 2000). The calculated result of t 22.0 greater than the critical t 1.9 p<0.05 indicated a significant different in cardiorespiratory endurance of participants and that of Australian athletes in favour of Australian athletes. Therefore, the null hypothesis (H₀) which stipulated that there will be no significant difference between the cardiorespiratory endurance norm of university female athletes in Southwestern Nigeria and Australian established norm is rejected.

Hypothesis 3

The type of game played will not be a significant determinant of any difference in cardiorespiratory endurance of the university female athletes in Southwestern Nigeria.

Table 8: One-way Analysis of Variance in Cardiorespiratory endurance of participants by the type of game played.

| Dependent Variable | | Sum of Squares | Mean Squares | F | Sig. |
|--|----------------|----------------|--------------|-------|------|
| Cardiorespiratory Endurance (sec) | Between groups | 21.2 | 30.4 | 2.7 | 0.1 |
| | Within groups | 14623.0 | 11.1 | | |
| | Total | 14745.2 | | | |
| VO _{2max} Prediction ml.kg ⁻¹ .min ⁻¹ | Between groups | 82802.2 | 20700.5 | 39.6* | 0.0* |
| | Within groups | 68636.1 | 522.4 | | |
| | Total | 769638.3 | | | |

The result of F 2.7 p<0.05 in cardiorespiratory endurance and F 39.6 p<0.05 in VO_{2max} prediction indicated that by type of game played, a significant difference existed for all participants. Therefore, the null hypothesis (H₀), which stipulated that the type of game played will not be significant determinant of

any difference in cardiorespiratory endurance of the university female athletes in Southwestern Nigeria is rejected. The result was therefore subjected to the Scheffe post hoc tests to determine the mean scores that were significantly different.

Table 9: Scheffe multiple comparison of cardiorespiratory endurance of participants by the type of game played.

| Dependent Variable | (i) Type of game | (j) type of game (i - j) | Mean Difference | SE | Sig. |
|--|------------------|--------------------------|-----------------|-----|------|
| Cardiorespiratory Endurance | Soccer | Volleyball | -5.1 | 2.0 | 0.1* |
| | | Basketball | 11.0 | 2.1 | 0.0* |
| VO _{2max} Prediction ml.kg ⁻¹ .min ⁻¹ | Volley | Handball | -3.2 | 2.0 | 1.0* |
| | | Hockey | 15.0 | 2.0 | 0.0* |
| | | Basketball | 16.0 | 2.1 | 0.0* |
| | | Handball | 2.0 | 2.0 | 1.0* |
| | | Hockey | 20.0 | 2.0 | 0.0* |
| | Basketball | Handball | 14.0 | 2.1 | 0.0* |
| | | Hockey | 4.1 | 2.1 | 1.0* |
| | Handball | Basketball | 14.0 | 2.1 | 0.0* |
| | | Hockey | 18.1 | 2.0 | 0.0* |

* Indicate pairs of groups that are significantly different from each other at p<0.05

Between soccer and basketball, the Scheffe result shows a mean difference of 11.0 and this is significant at p<0.05. This result indicated that, soccer plays scored significantly higher in VO_{2max} than basketball players. For soccer and hockey, the Scheffe post hoc result showed a mean difference of 15.0, which is significant at p<0.05. The result indicated that, soccer players scored significantly higher than hockey players did in VO_{2max}. Between basketball and volleyball the Scheffe post hoc result showed a mean difference of 16.0 and higher in VO_{2max} than basketball players. For volleyball and hockey, the Scheffe post hoc that volleyball players scored significantly higher in VO_{2max} than hockey players. Between basketball and handball, the Scheffe post hoc result showed a mean different of 14.0, which is significant at p<0.05. The result showed that, handball players scored significantly higher in VO_{2max} than basketball players. For handball and hockey, the Scheffe post hoc result showed a mean difference of 18.1 and this is significant at p<0.05. The result indicated that, handball players scored significantly higher in VO_{2max} than hockey players. Volleyball players obtained the highest score while hockey players had the lowest score in VO_{2max}. Good aerobic endurance is very vital for success in soccer game than in volleyball. Hence, soccer players were not at their best in VO_{2max} test.

DISCUSSION

The physical characteristics of the athlete showed an age range of 15-30 years compared with 19-29 years reported for Australian athletes. The average heights of 1.6 + 0.1m, body weight of 58 +6.7 kg and BMI of 22.5 +2.9 obtained from the survey, were lower than those for Australian athletes, which were height of 1.7±0.1m, body weight of 62.5±6.1kg and BMI of 21.6±1.4. In agreement with Heyward (2002), the southwestern Nigeria female athletes had normal BMI. A mean T-score of 49.9±9.9 was recorded for height and weight of participants.

Cardiorespiratory Endurance (VO_{2max})

The T-score results for VO_{2max} show decrease in the following order: Volleyball players [53.2 ±10.4], Basketball players [46.7± 7.2] and hockey players [44.9 ± 5.2]. Volleyball players were higher in VO_{2max} than basketball and hockey players. In a study on fields' hockey players, Lawrence and Polglaze [2000], reported that oxygen uptake during play was 50.3 ±5.1 ml.kg⁻¹.min⁻¹. Hockey players in this study did not meet the standard. All participants obtained a mean T-score of 49.9±9.9 that is approximately average.

The participants mean score of 45.2± 24.2 ml.kg⁻¹.min⁻¹ was significantly [p>0.05] lower, when compared with the score of 50.3 ±22.0 ml.kg⁻¹ min⁻¹ reported by Tumilty (2000), for Australian athletes,

Stapff [2000], reported the mean score of $49.5 \pm 3.8 \text{ ml.kg}^{-1}.\text{min}^{-1}$ for Australian Basketball players, which was higher than the score of $37.1 \pm 7.2 \text{ ml.kg}^{-1}.\text{min}^{-1}$ recorded by Laurence and Polgaze [2000], for Australian hockey players was also higher than the score of $33.0 \pm 5.1 \text{ ml.kg}^{-1}.\text{min}^{-1}$ was obtained by soccer players in this study.

The VO_2 max normative data reported by Mackenzie (2004), comprised of different grades from very poor to superior. For the age range of 20-29, the score of $<23.6 \text{ ml.kg}^{-1}.\text{min}^{-1}$ was rated very poor, while $> 41.0 \text{ ml.kg}^{-1}.\text{min}^{-1}$ was superior. The participants $\text{VO}_{2\text{max}}$ score $45.2 \text{ ml.kg}^{-1}.\text{min}^{-1}$ was rated superior, yet it below the score of $50 \text{ ml.kg}^{-1}.\text{min}^{-1}$, that was the desired standard for female athletes reported by Tumilty (2000). Mackenzie (2004), reported a mean score of about 2.7 litre/min for all female athletes which was higher than the participants score. Also, for female volleyball players, $53.2 \text{ ml.kg}^{-1}.\text{min}^{-1}$ was reported and it is in close agreement with Tumilty (2000), who reported about $50 \text{ ml.kg}^{-1}.\text{min}^{-1}$ for female athletes.

The analysis of variance result revealed that a significant difference existed for all participants across the five games. In line with the T-score results, the Scheffe post hoc result revealed that volleyball, handball and soccer players were superior to basketball and hockey players in $\text{VO}_{2\text{max}}$. The performance of basketball and hockey players are rated average. Good aerobic endurance ($\text{VO}_{2\text{max}}$) is very important in soccer particularly has worked demanded of players has tended to increase over the years (Tumilty 2000).

CONCLUSION AND RECOMMENDATION

Based on the assessment of cardiorespiratory endurance it was concluded that, the norms for female athletes in the Southern Nigeria were lower compared with those of their Australian counterparts. This implies that the foreign athletes were superior to the Southwestern Nigeria athletes in $\text{VO}_{2\text{max}}$. Volleyball players who recorded the highest score were higher in $\text{VO}_{2\text{max}}$ than players of other sports in this study. Cardiorespiratory endurance norms were indispensable tools for athletic excellence. T-norms should be adopted because of their obvious advantages. They eliminate all decimals, Signs and reduce computational errors, T-scores are universal methods of expressing and interpreting scores. Regular assessment and evaluation of athletes' fitness indices should be given priority by institutions and Nigerian government.

REFERENCES

Adeloye, E.O. (2007). Assessment and standardization of norms on selected health and performance fitness indices for University female athletes Southwestern Nigeria. Ph.D. Dissertation, University of Ibadan.

Docherty, D. (1996). Field Tests and test batteries. Measurement in pediatric exercise science Canadian society for exercise physiology, Human Kinetics. 55-83.290.

drwellnessry.com.(2011). Cardiorespiratory endurance. Definition. Retrived Jan 7, 2011 from drwellnessry.com/fitness.Definition.html.

Fiona, M. (1999). 1998- the year of women in athletics. The special demands of modern athletics on women- a completing athletes perspective. Retrieved June 29, 1999, from Throwers Quiz Guest Book IAAF. Canthrow.com

Fitness Testing. (2011). Maximum oxygen consumption. $\text{VO}_{2\text{max}}$ norms. Retrieved from August 3, 2011 from Fitness Testing> Test> Aerobic Endurance.

frankmoran fitness.com,(2011). Cardiorespiratory endurance. Definition. Retrieved Jan 7, 2011. From www.frankmoranfitness.com/fitnessglossary.html.

George.J. Vehrs, P., Allsan, Fellingham. P., and Fisher A.C. (1993). $\text{VO}_{2\text{max}}$ estimate from a submaximal 1-mile track jog for sit college- age individuals. Medicine and Science in Sports and Exercise. 25:401-406.

Heyward, V.H.(2002). Advanced fitness assessment and exercise prescription 4th Ed, USA. Illinois Human Kinetics books Champain. 49-52,77.

Lawrence .S. & Polgaze, T.(2000). Protocols for physiological assessment of male and female field hockey players. In Gore, C.J., Ed Physiological tests for elite athletes. USA Australian Sorts Commission.293.

Mackenzie, B. (2005). $\text{VO}_{2\text{max}}$. Retrieved March 16, 2005. From <http://www.brainmac.demon.co.uk/ivo2max.htm>.

Reilly T. Secher, N., Snell, P. and Williams, C.1990, Australian State team test results.

Rob, W.(2003). Fitness testing guide. Rob's home of fitness testing. Retrieved August 22,2003 from <http://topedsports.com/testing/fitttest.html>.

Quinn, E. (2008). VO₂max Norms for women. Normal values and rankings for VO₂max for women Retrieved August 3, 2011 from About.com Guide.

Scott, J.R. (2009). Cardiorespiratory endurance. Retrieved Jan 7, 2011 from About .com. health's Disease and condition content. Medical Review Board.

segarfws.com (2011). Cardiorespiratory endurance. Definitions. Retrieved Jan 7, 2011 from segarfws.com/predefinitions.html.

Stapff, A. (2000). Protocols for the physiological assessment of basketball players. Gore, C. J., Ed Physiological Tests for Elite Athletes USA Australian Sports Commission. 277.231

Tumilty, D. (2002). Protocols for the physiological assessment of male and female soccer players Gores, C. J. Ed Physiological tests for elite Athletes. USA. Australian Sports Commission. 358,359

WaldenU.edu.2011.VO₂max measures aerobic

**APPENDICES
SELECTED NORMATIVE DATA**

**APPENDIX 1
Body mass Index Norm**

| Classification | BMI Value |
|----------------|-------------|
| Underweight | <18.5 |
| Normal Weight | 18.5 – 24.9 |
| Overweight | 25.0 – 29.9 |
| Obesity | |
| Class I | 30.0 – 34.9 |
| Class II | 35.0 – 39.9 |
| Class III | ≥40.0 |

Heyward, V. H. 2002. Advance Assessment and Exercise Prescription 4th Ed. The data is from the report of World Health Organisation WHO, 1998. University of New Mexico Human Kinetics Book Campaign 182, 183.

**APPENIX II
Body Mass Index Norm**

| Classification | General Population | Athletes Female |
|----------------|--------------------|-----------------|
| Lean | | <12 |
| Acceptable | <17 | 12 – 25 |
| Moderately | 17 – 28 | - |
| Overweight | 28 – 33 | >25 |
| | >33 | |

Rob, W. 2005. For interpretation an evaluation of the result, the norm and the Nornogram for Body Mass Index were used.

**APPENDIX III
VO₂max[ml.kg⁻¹.min⁻¹] Test Scores of Hockey Players**

| N | Av | SD | Range |
|-----|------|-----|--------------|
| 126 | 51.3 | 4.7 | 39.8 – 63.61 |

Source: Lawrence, S. and Polglaze, T, 2000 Australian Sports Commission
Result of 12 years regular assessment of field hockey players

**APPENDIX IV
VO₂max[ml.kg⁻¹.min⁻¹] Test Scores of Volleyball Players**

| Av | SD |
|------|-----|
| 46.8 | 5.5 |

Source: Reilly T., Secher, N., Snell, P. and Williams, C. 1990
Australian State team test results.

**APPENDIX V
VO₂max Norm for Women**

| Age | Very Poor | Poor | Fair | Good | Excellent | Superior |
|---------|-----------|------|-------|-------|-----------|----------|
| 13 – 19 | <25.0 | 25.0 | 31.0– | 35.0– | 39.0– | >41.9 |
| 20 – 29 | <23.6 | – | 34.9 | 38.9 | 41.9 | >41.0 |
| 30 – 39 | <22.8 | 30.9 | 29.0– | 33.0– | 37.0– | >40.0 |
| | | 23.6 | 32.9 | 36.9 | 41.0 | |
| | | – | 27.0– | 31.5– | 35.7– | |
| | | 28.9 | 31.4 | 35.6 | 40.0 | |
| | | 22.8 | | | | |
| | | – | | | | |
| | | 26.9 | | | | |

Quinn, E. 2008. VO₂max Norm for Women. Adapted from cooper Institute for Aerobic Research

**APPENDIX VI
Maximal Oxygen Uptake (ml/kg/min) in Various Population Groups**

| Athletes | Age | Males | Females |
|-------------------|---------|---------|---------|
| Baseball/Softball | 18 – 32 | 48 – 56 | 52 – 57 |
| Basketball | 18 – 30 | 40 – 60 | 43 – 60 |
| Soccer | 22 – 28 | 54 – 64 | 50 – 60 |
| Volleyball | 28 – 33 | | 40 – 56 |

Fitness Testing, 2011. VO₂max in athletes and non athletes. Adapted from Wilmore and Costill, 2005.