



ANTHROPOMETRIC CHARACTERISTICS OF LOWER EXTREMITIES OF ELITE INDIAN FEMALE BOXERS IN RELATION TO DIFFERENT WEIGHT CATEGORIES

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ABSTRACT

Boxing is an intermittent sport characterized by short duration, high intensity bursts of activity. It requires significant anaerobic fitness, and operates within a well-developed aerobic system. Boxing is estimated to be 70-80% anaerobic and 20-30% aerobic. Boxing's work and rest ratio is approximately 3:1. The rule of the amateur boxing has been changed from 3 × 3 round to 2 × 5 round in 1990 world championship competition, and then 4 x 2 rounds with one minute of rest pause in between each bout. The nature of boxing requires athletes to sustain power at a high percentage of maximal oxygen uptakes (VO₂max) (often above lactate threshold, producing high levels of blood lactate leading to premature fatigue). The primary aim of conditioning for boxing is to delay the onset of fatigue by increasing tolerance of lactic acid build-up, increasing the ATP and CP, to improve efficiency of oxygen use, and to improve recovery between intense bursts of activity.

Keywords: Weight Categories, Anthropometric Characteristics of lower Extremities

Introduction:

Physical characteristics and body composition have been known to be fundamental to excellence in athletic performance (6). Specific athletic events require different body types and weights for maximal performance (1). Body composition mainly refers mainly to the evaluation of three principles tissue component of body i.e. muscles bone and fat. The measurement of structure and proportion of the body is called anthropometry it includes such descriptive information as height, weight, and surface area while measure of proportions describe the relationship between height and weight and among lengths, widths and circumferences' of various body segments (10).

Anthropometric measurements are dimensions of the structure of the human body taken at specific sites to give measures of girth and width. They include the body size and body proportions. Measurements of body size include such descriptive information's as height, weight, and surface area. When the measures of body proportions describe relationship between height, weight, among lengths, widths and girths of various body segments it has been observed that top athletes in some sports tend to have those proportions that biologically aid the performance (4).

Boxing is a physically and mentally demanding contact sport. Boxers are required to possess a combination of endurance, strength, stamina, agility, coordination, and speed. Amateur boxing is based on a scoring system where the main objective is to impact the opponent while protecting one's self from impacts. The most desirable outcome is to knock out one's opponent, ensuring a win. In the process boxers sustain numerous punches to the head causing minor or even severe injuries. Dedication and intense training is vital for both amateur and professional boxers to establish effective technique (5).

Objectives of the Study:

The purpose of the study was to compare Anthropometric characteristics of lower extremities of elite Indian female boxers in relation to different weight categories.

Methodology

Subjects:

The subjects for this study were selected from 12th Senior Women National Boxing Championship at T.T. Nagar Stadium, Bhopal, Madhya Pradesh, India. A total of 78 female Boxers were selected from different ten Weight Categories i.e. Light Fly Weight, Fly Weight, Bantam Weight, Feather Weight, Light Weight, Light Welter Weight, Welter Weight, Middle Weight, Light Heavy Weight and Heavy Weight. Age of the subjects was ranging between 16 to 28 years.

Variables:

Following Anthropometric Characteristics of Lower Extremities were selected:

1. Hip Circumference
2. Thigh Circumference
3. Calf Circumference
4. Ankle Circumference

Weight Categories:

Following ten different Weight Categories of female Boxers were selected:

Table 1: Weight categories and their weight in kilogram (kg.)

Sr. No.	Category Name	Weight (kg.)
1.	Light Fly Weight (LFW)	45-48 kg.
2.	Fly Weight (Fl.W)	51 kg.
3.	Bantam Weight (BW)	54 kg.
4.	Feather Weight (FW)	57 kg.
5.	Light Weight (LW)	60 kg.
6.	Light Welter Weight (LWW)	64 kg.
7.	Welter Weight (WW)	69 kg.
8.	Middle Weight (MW)	75 kg.
9.	Light Heavy Weight (LHW)	81 kg.
10.	Heavy Weight (HW)	+81 kg.

Criterion Measures: All the Anthropometric Characteristics of Boxers were measured by anthropometric kit.

Statistical Technique Used

- 1) To Characterize Anthropometric Characteristics of lower extremities elite Indian female boxers in different weight categories, Descriptive Statistics were used.

To compare Anthropometric Characteristics of lower extremities elite Indian female boxers among different weight categories, one way Analysis of Variance (ANOVA) was used and the level of significance was set at 0.05 level.

Results and Findings of the Study:

Table – 2: Descriptive Statistics of Hip Circumference of elite Indian female Boxers in relation to different Weight Categories

Weight Category	N	Mean	Std. Deviation	Std. Error	Min.	Max.
Light Fly Weight (LFW)	14	77.7500	3.90143	1.04270	71.00	85.00
Fly Weight (Fl.W)	9	75.8333	16.51136	5.50379	33.00	90.00
Bantam Weight (BW)	12	81.5917	6.60722	1.90734	62.50	87.00
Feather Weight (FW)	5	82.3800	3.18151	1.42281	78.40	87.00
Light Weight (LW)	9	87.0556	4.75949	1.58650	80.00	94.00
Light Welter Weight (LWW)	7	90.2857	4.95696	1.87355	85.00	99.00
Welter Weight (WW)	6	89.5000	2.66458	1.08781	86.00	93.00
Middle Weight (MW)	5	93.5000	3.00000	1.34164	90.00	98.00
Light Heavy Weight (LHW)	6	97.0000	5.79655	2.36643	90.00	105.00
Heavy Weight (HW)	5	99.0000	16.46208	7.36206	72.00	116.00
Total	78	85.3718	10.67047	1.20819	33.00	116.00

Table 2 shows that the descriptive statistics i.e. Mean, S.D, Std. Error, Minimum and Maximum values of Hip Circumference of elite Indian female Boxers in relation to different Weight Categories.

Table – 3: Analysis of Variance of Hip Circumference of elite Indian female Boxers in relation to different Weight Categories

Source of Variance	Sum of Squares	df	Mean Square	F
Between Groups	4215.415	9	468.379	6.997*
Within Groups	4551.723	68	66.937	

*Significant at .05 level, $F_{.05}(9,68)=2.01$

Table 3 revealed that the obtained ‘F’ value of 6.997 was found to be Significant at 0.05 level, since this value was found higher than the tabulated value 2.01 at 9, 68df.

Table – 4: Scheffe’s Post-Hoc Test for the Comparison of Means of Hip Circumference of elite Indian female Boxers in relation to different Weight Categories

LFW	Fl.W	BW	FW	LW	LWW	WW	MW	LHW	HW
77.7500	75.8333	81.5917	82.3800	87.0556	90.2857	89.5000	93.5000	97.0000	99.0000

“” Significant at .05 level

It is evident from table - 4 that significant difference exists between the means of Light Fly Weight & Light Heavy Weight; Light Fly Weight & Heavy Weight; Fly Weight & Light Heavy Weight and Fly Weight & Heavy Weight.

On the other hand, insignificant difference exists between the means of Light Fly Weight & Fly Weight; Light Fly Weight & Bantam Weight; Light Fly Weight & Feather Weight; Light Fly Weight & Light Weight; Light Fly Weight & Light Welter Weight; Light Fly Weight & Welter Weight; Light Fly Weight & Middle Weight; Fly Weight & Bantam Weight; Fly Weight & Feather Weight; Fly Weight & Light Weight; Fly Weight & Light Welter Weight; Fly Weight & Welter Weight; Fly Weight & Middle Weight; Bantam Weight & Feather Weight; Bantam Weight & Light Weight; Bantam Weight & Light Welter Weight; Bantam Weight & Welter Weight; Bantam Weight & Middle Weight; Bantam Weight & Light Heavy Weight; Bantam Weight & Heavy Weight; Feather Weight & Light Weight; Feather Weight & Light Welter Weight; Feather Weight & Welter Weight; Feather Weight & Middle Weight; Feather Weight & Light Heavy Weight; Feather Weight & Heavy Weight; Light Weight & Light Welter Weight; Light Weight & Welter Weight; Light Weight & Middle Weight; Light Weight & Light Heavy Weight; Light Weight & Heavy Weight; Light Welter Weight & Welter Weight; Light Welter Weight & Middle Weight; Light Welter Weight & Light Heavy Weight; Light Welter Weight & Heavy Weight; Welter Weight & Middle Weight; Welter Weight & Light Heavy Weight; Welter Weight & Heavy Weight; Middle Weight & Light Heavy Weight; Middle Weight & Heavy Weight and Light Heavy Weight & Heavy Weight.

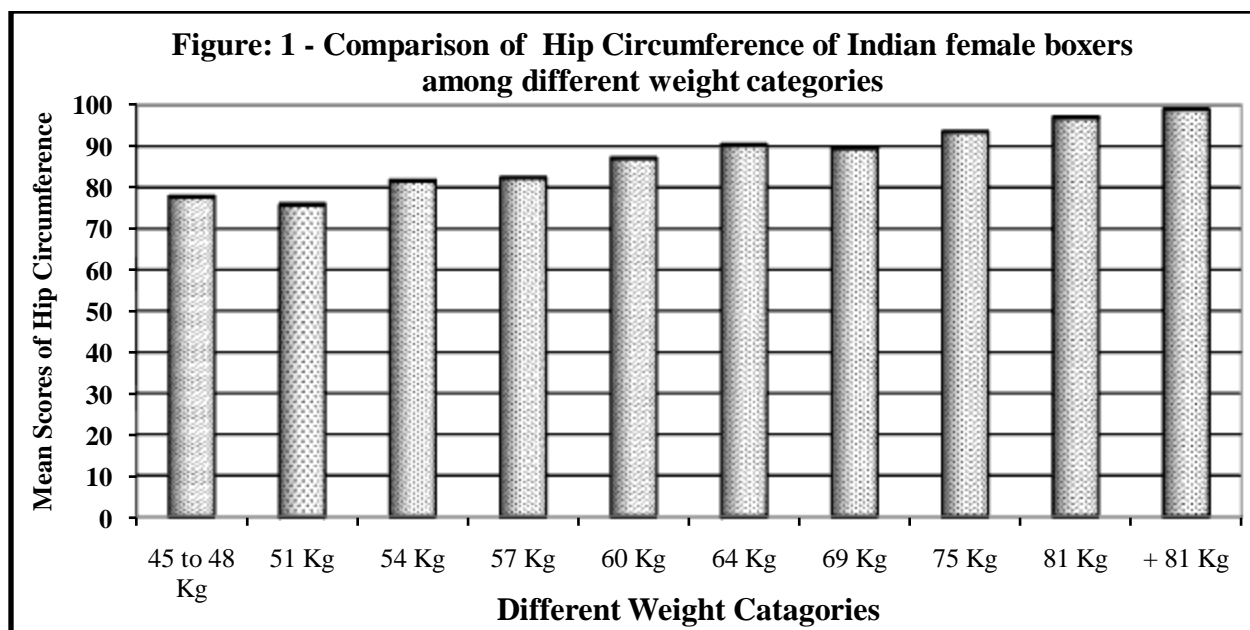


Table – 5: Descriptive Statistics of Thigh Circumference of elite Indian female Boxers in relation to different Weight Categories

Weight Category	N	Mean	Std. Deviation	Std. Error	Min.	Max.
Light Fly Weight (LFW)	14	43.2500	2.15326	.57548	38.40	47.00
Fly Weight (Fl.W)	9	44.1889	2.97424	.99141	40.00	49.00
Bantam Weight (BW)	12	44.8417	1.92942	.55697	42.00	48.00
Feather Weight (FW)	5	44.9800	.79812	.35693	43.60	45.50
Light Weight (LW)	9	45.3889	1.88643	.62881	42.30	48.00
Light Welter Weight (LWW)	7	50.6143	2.92143	1.10420	46.70	56.00
Welter Weight (WW)	6	47.4167	3.13714	1.28073	43.50	53.00
Middle Weight (MW)	5	51.0000	2.12132	.94868	48.00	53.00
Light Heavy Weight (LHW)	6	51.5000	2.07364	.84656	50.00	55.00
Heavy Weight (HW)	5	53.4400	4.52139	2.02203	48.00	60.50
Total	78	46.7269	4.08973	.46307	38.40	60.50

Table 5 shows that the descriptive statistics i.e. Mean, S.D, Std. Error, Minimum and Maximum values of Thigh Circumference of elite Indian female Boxers in relation to different Weight Categories.

Table – 6: Analysis of Variance of Thigh Circumference of elite Indian female boxers in relation to different Weight Categories

Source of Variance	Sum of Squares	df	Mean Square	F
Between Groups	863.195	9	95.911	15.357*
Within Groups	424.699	68	6.246	

*Significant at .05 level, $F_{.05}(9,68) = 2.01$

Table 6 revealed that the obtained ‘F’ value of 15.357 was found to be Significant at 0.05 level, since this value was found higher than the tabulated value 2.01 at 9, 68 df.

Table – 7: Scheffe’s Post-Hoc Test for the Comparison of Means of Thigh Circumference of elite Indian female boxers in relation to different Weight Categories

LFW	Fl. W	BW	FW	LW	LWW	WW	MW	LHW	HW
43.2500	44.1889	44.8417	44.9800	45.3889	50.6143	47.4167	51.0000	51.5000	53.4400

“ ← → ” Significant at .05 level

It is evident from table - 7 that significant difference exists between the means of Light Fly Weight & Light Welter Weight; Light Fly Weight & Middle Weight; Light Fly Weight & Light Heavy Weight; Light Fly Weight & Heavy Weight; Fly Weight & Light Welter Weight; Fly Weight & Middle Weight; Fly Weight & Light Heavy Weight; Fly Weight & Heavy Weight; Bantam Weight & Light Welter Weight; Bantam Weight & Middle Weight; Bantam Weight & Light Heavy Weight; Bantam Weight & Heavy Weight; Feather Weight & Light Heavy Weight; Feather Weight & Heavy Weight; Light Weight & Light Heavy Weight and Light Weight & Light Heavy Weight.

On the other hand, insignificant difference exists between the means of Light Fly Weight & Fly Weight; Light Fly Weight & Bantam Weight; Light Fly Weight & Feather Weight; Light Fly Weight & Light Weight; Light Fly Weight & Welter Weight; Fly Weight & Bantam Weight; Fly Weight & Feather Weight; Fly Weight & Light Weight; Fly Weight & Welter Weight; Bantam Weight & Feather Weight; Bantam Weight & Light Weight; Bantam Weight & Welter Weight; Feather Weight & Light Weight; Feather Weight & Light Welter Weight; Feather Weight & Welter Weight; Feather Weight & Middle Weight; Light Weight & Light Welter Weight; Light Weight & Welter Weight; Light Weight & Middle Weight; Light Welter Weight & Welter Weight; Light Welter Weight & Middle Weight; Light Welter Weight & Light Heavy Weight; Light Welter Weight & Heavy Weight; Welter Weight & Middle Weight; Welter Weight & Light Heavy Weight; Welter Weight & Heavy Weight; Middle Weight & Light Heavy Weight; Middle Weight & Heavy Weight and Light Heavy Weight & Heavy Weight.

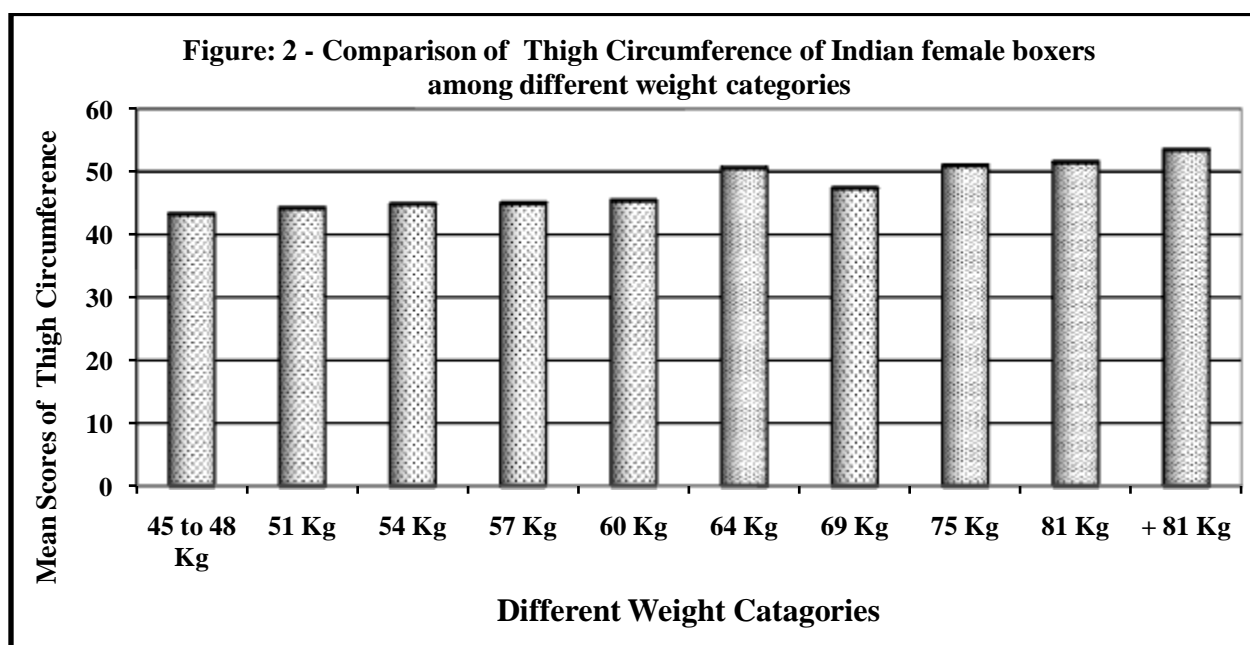


Table – 8: Descriptive Statistics of Calf Circumference of elite Indian female Boxers in relation to different Weight Categories

Weight Category	N	Mean	Std. Deviation	Std. Error	Min.	Max.
Light Fly Weight (LFW)	14	32.0786	1.95258	.52185	30.00	35.70
Fly Weight (FW)	9	34.0778	.91074	.30358	32.50	35.20
Bantam Weight (BW)	12	34.3083	2.38001	.68705	32.00	40.00
Feather Weight (FW)	5	34.3600	2.09476	.93680	33.00	38.00
Light Weight (LW)	9	35.1000	1.81384	.60461	33.00	39.00
Light Welter Weight (LWW)	7	36.5000	1.97906	.74801	34.00	39.00

Welter Weight (WW)	6	36.4000	1.51658	.61914	34.00	37.50
Middle Weight (MW)	5	39.2000	1.35093	.60415	37.50	41.00
Light Heavy Weight (LHW)	6	40.0833	2.65361	1.08333	36.00	43.00
Heavy Weight (HW)	5	42.1600	3.16670	1.41619	38.80	46.00
Total	78	35.5949	3.44624	.39021	30.00	46.00

Table 8 shows that the descriptive statistics i.e. Mean, S.D, Std. Error, Minimum and Maximum values of Calf Circumference of elite Indian female Boxers in relation to different Weight Categories.

Table – 9: Analysis of Variance of Calf Circumference of elite Indian female Boxers in relation to different Weight Categories

Source of Variance	Sum of Squares	df	Mean Square	F
Between Groups	634.497	9	70.500	17.121*
Within Groups	280.001	68	4.118	

*Significant at .05 level, $F_{.05}(9,68)=2.01$

Table 9 revealed that the obtained ‘F’ value of 17.121 was found to be Significant at 0.05 level, since this value was found higher than the tabulated value 2.01 at 9, 68 df

Table – 10: Scheffe’s Post-Hoc Test for the Comparison of Means of Calf Circumference of elite Indian female Boxers in relation to different Weight Categories

LFW	Fl. W	BW	FW	LW	LWW	WW	MW	LHW	HW
32.0786	34.0778	38.3083	34.3600	35.1000	36.5000	36.4000	39.2000	40.0833	42.1600

“ ← → ” Significant at .05 level

It is evident from table - 10 that significant difference exists between the means of Light Fly Weight & Light Welter Weight; Light Fly Weight & Welter Weight; Light Fly Weight & Middle Weight; Light Fly Weight & Light Heavy Weight; Light Fly Weight & Heavy Weight; Fly Weight & Middle Weight; Fly Weight & Light Heavy Weight; Fly Weight & Heavy Weight; Bantam Weight & Middle Weight; Bantam Weight & Light Heavy Weight; Bantam Weight & Heavy Weight; Feather Weight & Light Heavy Weight; Feather Weight & Heavy Weight; Light Weight & Light Heavy Weight; Light Weight & Heavy Weight; Light Welter Weight & Heavy Weight and Welter Weight & Heavy Weight.

On the other hand, insignificant difference exists between the means of Light Fly Weight & Fly Weight; Light Fly Weight & Bantam Weight; Light Fly Weight & Feather Weight; Light Fly Weight & Light Weight; Fly Weight & Bantam Weight; Fly Weight & Feather Weight; Fly Weight & Light Weight; Fly Weight & Light Welter Weight; Fly Weight & Welter Weight; Bantam Weight & Feather Weight; Bantam Weight & Light Weight; Bantam Weight & Light Welter Weight; Bantam Weight & Welter Weight; Feather Weight & Light Weight; Feather Weight & Light Welter Weight; Feather Weight & Welter Weight; Feather Weight & Middle Weight; Light Weight & Light Welter Weight; Light Weight & Welter Weight; Light Weight & Middle Weight; Light Welter Weight & Welter Weight; Light Welter Weight & Middle Weight; Light Welter Weight & Light Heavy Weight; Welter Weight & Middle Weight; Welter Weight & Light Heavy Weight; Middle Weight & Light Heavy Weight; Middle Weight & Heavy Weight and Light Heavy Weight & Heavy Weight.

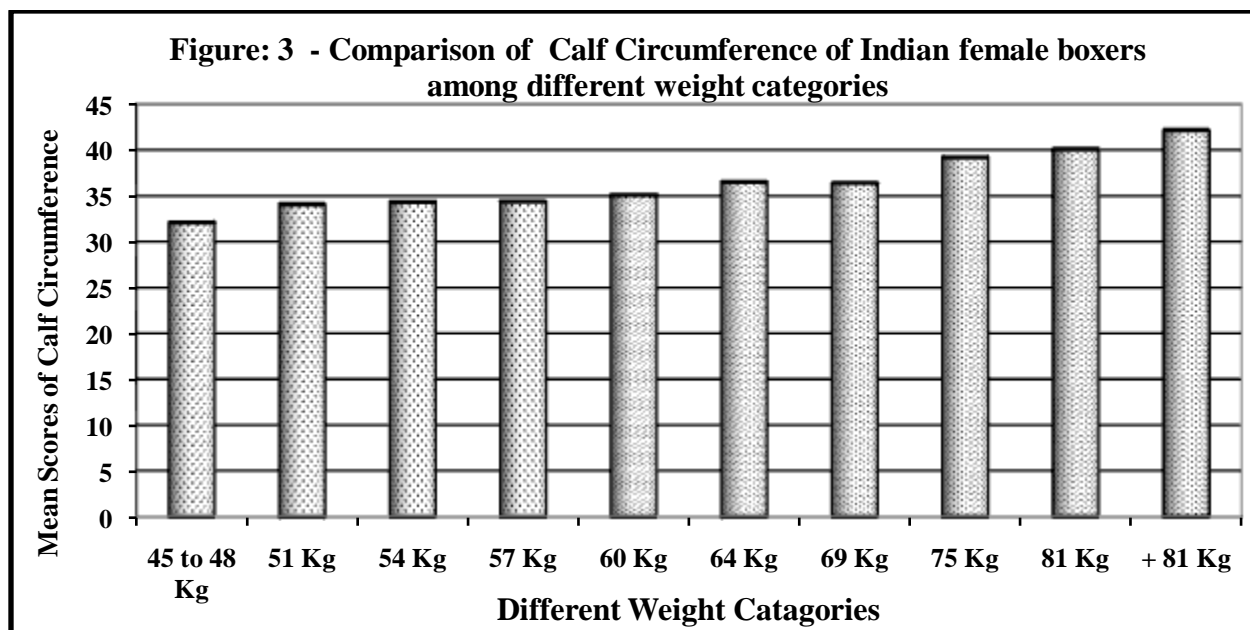


Table – 11: Descriptive Statistics of Ankle Circumference of elite Indian female Boxers in relation to different Weight Categories

Weight Category	N	Mean	Std. Deviation	Std. Error	Min.	Max.
Light Fly Weight (LFW)	14	19.8857	.82914	.22160	18.00	21.10
Fly Weight (FW)	9	21.1889	1.34949	.44983	20.00	24.00
Bantam Weight (BW)	12	21.4833	1.19304	.34440	20.00	23.60
Feather Weight (FW)	5	21.7000	1.09772	.49092	20.50	22.60
Light Weight (LW)	9	21.4444	.84574	.28191	20.50	23.00
Light Welter Weight (LWW)	7	22.0143	.65936	.24922	21.00	23.00
Welter Weight (WW)	6	22.3500	.90277	.36856	21.00	23.60
Middle Weight (MW)	5	22.9000	.89443	.40000	22.00	24.00
Light Heavy Weight (LHW)	6	23.3833	1.24967	.51017	22.00	25.00
Heavy Weight (HW)	5	22.8000	.83666	.37417	22.00	24.00
Total	78	21.6077	1.40775	.15940	18.00	25.00

Table 11 shows that the descriptive statistics i.e. Mean, S.D, Std. Error, Minimum and Maximum values of Ankle Circumference of elite Indian female Boxers in relation to different Weight Categories.

Table – 12: Analysis of Variance of Ankle Circumference of elite Indian female Boxers in relation to different Weight Categories

Source of Variance	Sum of Squares	df	Mean Square	F
Between Groups	82.399	9	9.155	8.869*
Within Groups	70.197	68	1.032	

*Significant at .05 level, $F_{.05}(9,68)=2.01$

Table 12 revealed that the obtained ‘F’ value of 8.869 was found to be Significant at 0.05 level, since this value was found higher than the tabulated value 2.01 at 9, 68 df.

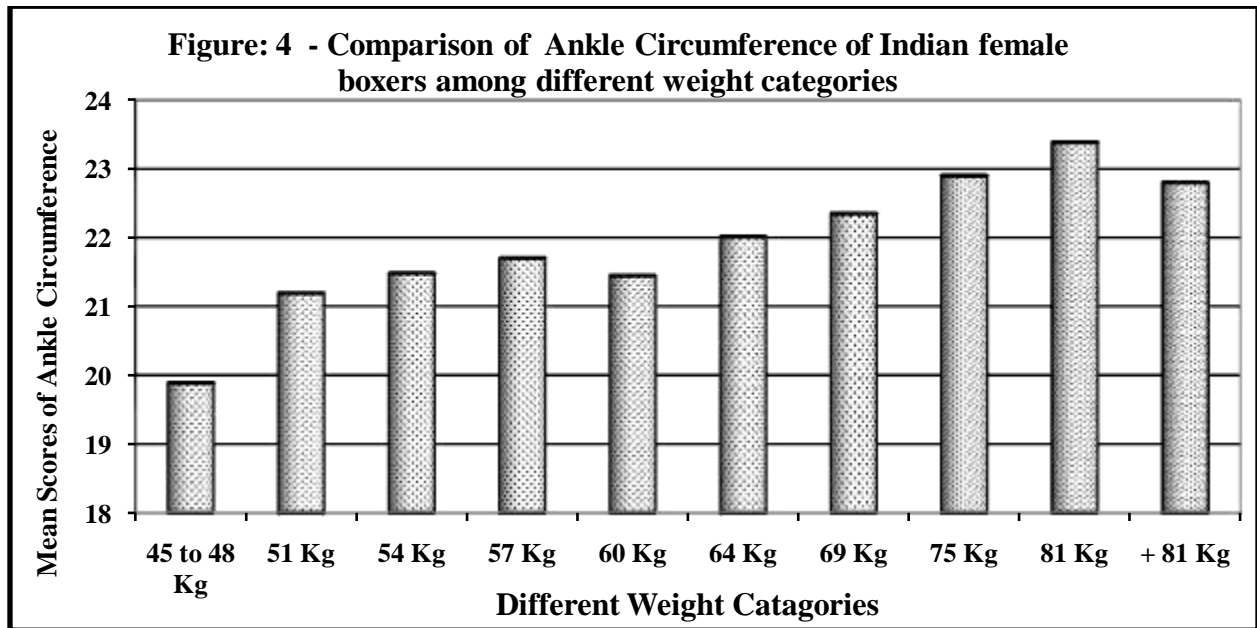
Table – 13: Scheffe’s Post-Hoc Test for the Comparison of Means of Ankle Circumference of elite Indian female Boxers in relation to different Weight Categories

LFW	FLW	BW	FW	LW	LWW	WW	MW	LHW	HW
19.8857	21.1889	21.4833	21.7000	21.4444	22.0143	22.3500	22.9000	23.3833	22.8000

“↔” Significant at .05 level

It is evident from table - 13 that significant difference exists between the means of Light Fly Weight & Light Welter Weight; Light Fly Weight & Welter Weight; Light Fly Weight & Middle Weight; Light Fly Weight & Light Heavy Weight and Light Fly Weight & Heavy Weight.

On the other hand, insignificant difference exists between the means of Light Fly Weight & Fly Weight; Light Fly Weight & Bantam Weight; Light Fly Weight & Feather Weight; Light Fly Weight & Light Weight; Fly Weight & Bantam Weight; Fly Weight & Feather Weight; Fly Weight & Light Weight; Fly Weight & Light Welter Weight; Fly Weight & Welter Weight; Fly Weight & Middle Weight; Fly Weight & Light Heavy Weight; Fly Weight & Heavy Weight; Bantam Weight & Feather Weight; Bantam Weight & Light Weight; Bantam Weight & Light Welter Weight; Bantam Weight & Welter Weight; Bantam Weight & Middle Weight; Bantam Weight & Light Heavy Weight; Bantam Weight & Heavy Weight; Feather Weight & Light Weight; Feather Weight & Light Welter Weight; Feather Weight & Welter Weight; Feather Weight & Middle Weight; Feather Weight & Light Heavy Weight; Feather Weight & Heavy Weight; Light Weight & Light Welter Weight; Light Weight & Welter Weight; Light Weight & Middle Weight; Light Weight & Light Heavy Weight; Light Weight & Heavy Weight; Light Welter Weight & Welter Weight; Light Welter Weight & Middle Weight; Light Welter Weight & Light Heavy Weight; Light Welter Weight & Heavy Weight; Welter Weight & Middle Weight; Welter Weight & Light Heavy Weight; Welter Weight & Heavy Weight; Middle Weight & Light Heavy Weight; Middle Weight & Heavy Weight and Light Heavy Weight & Heavy Weight.



Discussion of the findings:

Meena, T. R., Chandershakhar, S. & Vishal (7) have completed a study on ‘‘A Study to Characterize Upper Arm and Waist Circumference of Indian Female Boxers among Different Weight Categories’’. They found significant ($p < .05$) difference among different weight categories of Indian female boxers in relation to upper arm and waist circumference. Another study conducted by Sidhu (8) on the topic ‘‘Kinanthropometric Measurements in Players of Athletics and Boxing - A Comparative Study’’. The results of the study in general reveal that boxers are bulky, taller and heavier than athletes; the significant differences however were noted in chest circumference between the two groups. Boxers in general are found to possess more deposition of subcutaneous fat in the regions of biceps, triceps and calf than the athletic group. However in statistical terms it is significant only in the triceps and calf regions. Comparison has also been made between senior and junior athletes and boxers by dividing the subjects into 15-20 and 20-25 year age groups. In the present study, significant difference was found in relation both the selected variables. But in case of the application of Scheffe’s Post-Hoc Test, insignificant difference was found only in some adjacent weight categories. Significant difference was found in some weight categories. This might be due to the difference in deposition of subcutaneous fat and difference of morphological structure. These studies are directly supported the result of present study.

Conclusions:

1. In relation to Hip Circumference of elite Indian female boxers among different weight categories, significant difference was found, since the obtained ‘‘F’’ value 6.997 was found higher than the tabulated value 2.01 (9, 68) at 0.05 level of significance.

2. In relation to Thigh Circumference of elite Indian female boxers among different weight categories, significant difference was found, since the obtained “F” value 15.357 was found higher than the tabulated value 2.01 (9, 68) at 0.05 level of significance.
 3. In relation to Calf Circumference of elite Indian female boxers among different weight categories, significant difference was found, since the obtained “F” value 17.121 was found higher than the tabulated value 2.01 (9, 68) at 0.05 level of significance.
- In relation to Ankle Circumference of elite Indian female boxers among different weight categories, significant difference was found, since the obtained “F” value 8.869 was found higher than the tabulated value 2.01 (9, 68) at 0.05 level of significance.

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