ABSTRACT

The hammer throw is said to have its roots in Scotland and Ireland history. Folklore claims an Irish hero named Cuchulain whirled a chariot wheel with an axle attached to it around his head and released it as the first person to throw a hammer (Black, 1989; Dziepak, 1998). The modern hammer throw first appeared in the 1900 Olympics for men, but Women’s hammer throw was not introduced to the sporting world until 1995. Women’s hammer throw was finally included in the World Track and Field Championships in 1999 and the Olympics in 2000.

For the execution of hammer throw there are numerous factors, which are responsible for performance of hammer thrower, physique and body composition, including the size, shape, form and physical fitness level to play a significant role in this regard. Efficient technique and other motor qualities like strength, speed (power), co-ordination, flexibility and mobility, the suppleness, skill, training, motivation and emotional level and on various other factors of physiological and biochemical nature.

Kinanthropometry is a scientific specialization dealing with the measurement of persons in a variety of morphological perspectives, its application to movement and those factors
which influence movement, including: components of body build, body measurements, proportions, composition, shape and maturation; motor abilities and cardio respiratory capacities; physical activity including recreational activity as well as highly specialized sports performance.

In hammer throw event physical fitness level play a significant role in this regard. Efficient technique and other motor qualities like strength, speed (power), co-ordination, flexibility and mobility, the suppleness, skill, training, motivation and emotional level and on various other factors of physiological and biochemical nature.

The speed is built up in progression to achieve it to the maximum degree towards the third turn to transmit release velocity of 26 to 27 m/sec to the hammer. There is a need to develop a strong but flexible vertebral column and hip joint to enable a wide range of movements and body torque.

An optimal break performance in throwing events is the result of a carefully planned program integrating several components of training. Out of which components like specific and special strength are taken into consideration. The all-round specific strength training is very important as a connecting link between general and specific strength training.
Statement of the problem:

In view of the need for conducting research in the area of morphology and physical fitness of men and women hammer throwing in India, the present research problem has been stated as under:

**PHYSICAL FITNESS AND MORPHOLOGICAL CHARACTERISTICS OF HAMMER THROWERS IN INDIA**

1.4 Hypotheses:

The study has been conducted with the following hypothesis:

2. There will be significant differences in Physical Fitness profile of men and women Hammer throwers at different level of performance.

3. There will be significant differences in body morphology of men and women hammer throwers.

4. There will be significant differences in body Morphology of men Hammer throwers with the standards given by De Garay et al. (1974) study based on 19th Olympic game athletes.
5. There will be differences in Physical Fitness profile at different levels of performance of Indian men and women hammer throwers with norms given by Didier Poppe - 2001.

1.5 **Objectives of the study:**

Present study has been conducted with the following objectives:

1. To find out the significant differences in Physical Fitness profile of men and women Hammer throwers at different level of performance.

2. To access the significant differences in body morphology of men and women hammer throwers.

3. To explore the significant differences in body Morphology of men Hammer throwers with the standards given by De Garay et al. (1974) study based on 19th Olympic game athletes.

4. To find out the differences in Physical Fitness profile at different levels of performance of Indian men and women hammer throwers with norms given by Didier Poppe - 2001.
1.6 Delimitations:

1. The study has been done at performance levels of Indian men and women Hammer Throwers on Physical fitness parameters.

2. The study has been delimited to various parameters of general (Maximum strength, Power, Speed, Explosive power and specific fitness (Special strength) given by Poppe Didier (2001).

3. The study has been delimited to Indian Hammer throwers on Morphological characteristics (Age, Height, Weight, Sitting height, Height weight Ratio, Ponder Index, Three skinfolds, Full arm length, Body fat %, Muscle mass, Bone mass and Somatotype).

4. Morphological characteristics of Indian men Hammer Throwers will be compared with the standards given by de Garay et al. (1974).

5. Morphological characteristics of Indian women Hammer Throwers has been compared with other weight throw (Shot put, Discus and Javelin throw) because literature on female has been limited to anthropometric data.

6. In this study 60 male and 30 female hammer throwers has been taken as a sample.
7. The study has been based on different levels of performance of five groups, which starts from 40 meters for male and 30 meters for female hammer throwers with 5-meter differences each.

8. The tests have been conducted from various national competitions, domestic meets, SAI and state sports department centers that are running in India e.g. Allahabad, Mastuana Sahib, NIS Patiala, PAP and BSF Jalandar etc.

9. The data has been collected during competition period of 2007 with the help of coaches and senior players.

1.7 Limitations:

1. The tests can’t be carried out on all subjects together because of non availability all of them at one place at a time.

2. The present study can’t include the Biomechanical aspects for technical analysis.

3. The Morphological characteristics for women can’t be compared with norms, It compared with throwers of other weight i.e. Shot put, Discus and Javelin, as this event has introduced first time for women in 2004 Olympics games and no study has been done in this regard.
4. As athletes of the present study were from the different parts of the country so the present sample is not homogenous in nature.

**Sample:**

For the study, a total number of 60 male and 30 female hammer thrower from the different places of India in 15th September 2007 to 30th December 2007 during the course of various coaching camps, training sessions; they were attending in connection with the national and international competitions were selected as subjects for the study.

In the present study an attempt has been made to investigate the morphological and Physical fitness characteristics of the Hammer throwers in India. The data collected on all throwers were grouped into two group men and women Hammer throwers. Major groups were further divided into sub groups, 5 groups each such as 40m-45m, 45m-50m, 50m-55m, 55m-60m and 60m-65m for men and 30m-35m……….50m-55m for women category.

The standardized tests and measurements were used in the present study:-Height, Weight, Sitting height, Acromial height, Dactylion height, Biacromial breadth, Biliocristal breadth, Femur bicondylar, Humerus biconylar, Wrist, Ankle, Circumference of upper arm, Circumference of forearm,
Circumference of Thigh, Circumference of Calf, Biceps skinfold, Triceps, Forearm, Sub scapular, Supra-iliac, Supraspinale, Thigh and Calf skinfold.

Bench press, Front squat, Dead lift, Snatch, Clean, Vertical Jump, Triple jump, Back shot throw, Front shot throw, 30m standing start. Hammer throw (7.25 Kg men and 4 Kg women) with one turn (m), Hammer throw (6.25 Kg for men and 3 Kg for women (m), Hammer throw (5 Kg for men and 2 Kg for women (m), Hammer throw (8 Kg for men and 5 Kg for women (m).

5.2 CONCLUSIONS:

PHYSICAL FITNESS

Maximum Strength and Power

The results of tests for maximum strength i.e. bench press, front squat and dead lift has shown that almost all the subjects of different level of performances are lacking in maximum strength than the norms given by Didier Poppe. Group no. I is good in bench press and Group II is good in snatch whereas Group II, III and IV are good in clean, but are poor level in other lifts than given norms.

In case of women Groups no. I is good in bench press but having poor level in front squat and dead lift and Group no. II is lacking in maximum strength in all the three tests to a great
extent. Group no. III and IV are good in front squat, but are poor level in bench press and dead lift. Group no. V is good in all the tests of maximum strength except dead lift. As Bompa (1996) rationalized that without a high level of maximum strength power cannot reach high standard. So the level of their maximum strength needs improvements. The dead lift is considered as specific exercise for hammer throwers and our subjects are lacking in this test. According to Pedemonte (1986) specific strength bridges the gap between specialized and non-specific strength. So development of specific strength becomes more important for higher performance.

**Speed & Explosive Power**

The average performance in 30m-stand start of all the groups is poor than the given norms except group IV. It shows the lower level of sprinting performance of all subjects. The average performance in vertical jump of all the groups is good than the given norms. The average performance of triple jump is better in all the groups than the given norms. It shows that the subjects have satisfactory explosive power and reactive power for legs. The average performance of all groups in backward shot throw and front shot throw is lower than the given norms. It shows that the subjects having low level of low load speed
strength. This shows that subjects needs to improve speed strength for muscles of lower back.

Performance of women hammer throwers in all the groups in 30m-stand start except group no. I is less than the given norms. It shows the non-satisfactory level of sprinting performance of all subjects. The average performance in vertical jump of all the groups is less than the given norms. The average performance of triple jump is better in group I, II and III than the given norms. It shows that the subjects are having satisfactory explosive power and reactive power for legs. The average performance of all groups in backward shot throw and forward shot throw is lower than the given norms. It shows that the subjects having low level of low load speed strength. The difference in case of backward throw is even more, which shows that subjects needs to improve speed strength for muscles of lower back.

**Special Strength**

The average performance of hammer throw (7.26Kg) with one turn is less than the required norms in case of all the groups excepting Group III. It shows the subjects are poor in the special strength pertaining to action of swings turns and release. The average performance of hammer throw with 6.25Kg, 5 Kg and 8 Kg is less in all groups excepting Group III than given
norms. It reveals the subject don’t have good ability to co-ordinate with different weight implements.

In women groups the average performance of hammer throw (4Kg) with one turn is more than the required norms in case of all the groups excepting group III. It shows the subjects have better the special strength pertaining to action of swings turns and release. The average performance of hammer throw with 2Kg is less in all the groups than the given norms and hammer throw with 3Kg is less in Group I, II, III and V than given norms. It reveals that the subjects don’t have good ability to co-ordinate with light implements. The average performance is 5Kg hammer throw is less in all groups except group I and V. It shows that subjects having less musculature of shoulder and torso and the ability to set him against the strong hammer pull in these groups.

**MORPHOLOGICAL PARAMETERS:**

**Decimal Age (years)**

Men and women Hammer throwers of the present study are found to be approximately of the same age i.e. 21.96 years and 20.43 years, respectively showing significant differences statistically. When compared with Olympic counterpart, the present Hammer throw men hammer throwers were younger and
women hammer throwers are found in the same age range as shown by the different Olympic throwers.

**Body Height (cm)**

The comparison of mean body height of the present Indian men and women Hammer throwers with that of their Olympic counterpart has shown that the present studied Indian Hammer throw men and women hammer throwers are shorter in their body height as compared to their Olympic counterpart. Indian women Hammer throwers are approximately 6 to 7 cm shorter and men Hammer throwers are 10 to 15 cm shorter than their Olympic counterpart.

**Sitting Height (cm)**

The present Hammer throw women Hammer throwers have registered almost the same lengths of their upper and lower body portions and found significant differences. However, the men Hammer throwers have registered less length of legs as compared to their upper portion.

**Body Weight (kg)**

Comparison with International data indicated that Olympic Athletes are found to be heavier then the present studied Hammer throw of men and women. Present studied of Indian Hammer thrower are found to be lighter men approximate 14 Kg and women 5 Kg in their body weight and therefore it is
suggested that they should gain more lean body mass so as to achieve Olympic level physique.

**Height – Weight Ratio and Ponder Index**

Height – Weight ratio and Ponder Index are the two different indicators to access the body size. Body size has the direct influence upon performance. The present Indian Hammer throwers need to improve their height weight ratio and Ponder index as they are found heavier with respect to their body height.

**Body Fat (%)**

Indian Hammer throwers (men and women) are found to have % body fat of 25.31% and 21.68% respectively, showing significant differences. Fat is the dead weight of the body and excess fat than the required level has negative relationship with performance. The values of sum of three skin folds (Triceps, Subscapular and Suprailiac) is found to be similar in the Indian men Hammer throwers and the value is less in case of women as compared to their Olympic counterpart.

**Muscle Mass (kg)**

In order to get the medal in the competitions like Olympic, Asian and Commonwealth Games, men and women athletes must have 55 to 60% and 50 to 55% of muscle mass, respectively. Present Indian Hammer throwers, both men and women have been found to possess lower values 38.58Kg
(45.46%) for men and 26.61 Kg (39.81%) for women of muscle mass as compared to the above given normative values.

**Bone Mass (kg)**

Indian Hammer throwers (men and women) are found to have bone mass 12.1Kg and 7.07Kg respectively.

**Somatotype**

Somatotype characteristics of the present study Hammer throw men have revealed that they are found to be almost same in endomorphy, less in mesomorphy and ectomorphy component as compared to the Olympic throwers. However, Indian women Hammer throwers though found less in endomorphy, mesomorphy and ectomorphy components as that of their Olympic counterpart.

**Hypotheses Testing:**

1. The first hypothesis stated that there will be significant differences in Physical Fitness profile of men and women Hammer Throwers at different level of performance. This hypothesis is partially accepted as all the selected physical fitness variables do not show significant relationship. Bench press, front squat, Dead lift, snatch, clean, 30m for women, triple jump for men, back shot throw, Front shot throw, 7.26 Kg hammer throw with one turn for men & 4Kg for women, 6.25Kg hammer throw for men & 3Kg for
women, 5Kg hammer throw with for men & 2Kg for women, 8Kg hammer throw for men & 5Kg for women are significant related with physical fitness, whereas, 30m standing start for men, Vertical jump, Triple jump for women do not show significant relationship.

2. Hypothesis No. 2 states that there will be significant differences in body morphology of men and women hammer throwers. This is also partially accepted as all the selected morphological parameters do not show significant relationship among the groups. Decimal age, Sitting for women, Body weight, Ponder index for women, Three Skinfolds, Muscle mass for men, Fat mass, Full arm length for women, Endomorphy for women, components are found significant relationship, whereas, Body height, Sitting for men, Height weight ratio, Ponder index for men, Bone mass, Muscle mass for women, Full arm length for men, Endomorphic for men, Mesomorphic, Ectomorphic do not show significant relationship.

3. The third hypothesis stated that there will be significant differences in body Morphology of men Hammer throwers with the standards given by de Garay et. al. (1974) study based on 19th Olympic game athletes. This hypothesis is accepted for Decimal age for men, Body height, Body
weight, Ponder index, Three skinfold for women, Endomorphy for women, Mesomorphic, Ectomprphic and not accepted with Decimal age for women, Height weight ratio, Three skinfold for men, Endomorphy for men.

4. The forth hypothesis stated that there will be differences in Physical Fitness profile at different levels of performance of Indian men and women hammer thrower with norms given by Poppe Didier -2001. This hypothesis is accepted for which are equal or more than the normative values Bench press in group I for men and women, Front squat in group III, IV & V for women, Snatch in group II both for men and women, Clean in group II, III & IV for men and I, II and IV for women. 30m standing start in group -IV for men and group-V for women, vertical jump for men hammer throwers in all groups, Triple jump in group I, II, III & IV for men, 7.26 Kg hammer throw with one turn in group III for men, 4Kg hammer throw with one turn in group I, II, IV & V for women, 6.25 Kg hammer throw for men in group III, D, 3Kg hammer throw in group IV for women, E, 5 & 8 Kg hammer throw for men in group III, F, 5 Kg hammer throw in group I & III for women.
Significance of the study:

This study will lead to important training guidelines for improving the performance of Indian Hammer Throwers. It will be helpful for selecting Hammer Throwers at early ages. The results study will be helpful for guideline and counseling about the body Morphology and physical fitness of hammer throwers. The study will be helpful for talent identification of novice throwers. Conclusions may be helpful to the coaches to identify the training selected changes. Results of present study may serve as yardsticks for other hammer throwers to have to same morphological characteristics of physical fitness test.