# Kinanthropometric Approach for Identification, Selection and Development of Talent in Sports

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## ABSTRACT

*Kinanthropometry has positive role in identification, selection and development of talent in sports. At the time of talent identification, it helps in verification of chronological ages, examination of development ages, testing of body measurements, prediction of adult height, posture examination and assessment of body composition. The kinanthropometric help at the time of selection of talent includes – testing of body measurement, specific to sports/games/events, assessment of body composition, evaluation of physique/ somatotypes, assessment of maturity status and prediction of minimal values of weight loss for weight category of sports. At the time of development of talent, kinanthropometric approach helps to monitor the body composition and somatotypes, it helps in regular assessment of height, weight ratio and x-scores values. Diagrammatic chart given in the end of this paper gives the gist of application of kinanthropometry in identification, selection and development of talent in sports.*

**KEY WORDS :** Chronological age, Canalization, Dental eruption, BDI

## INTRODUCTION

### Historical Perspective

The word 'Kinanthropometry' is actually kin-anthrop-metry, meaning 'motion-man-measurement'. The science which deals with measurement of man who is alive or in motion. The word kinanthropometry has been derived from morphometry which meant external measurements of body. The word morphometry was later on replaced by Anthropometry, i.e. measuring external and internal measurement of body which may be living or dead. A branch of Anthropometry which studied measurements of sports-persons called as Sports Anthropometry; but, later on in 1980, the word Sports Anthropometry was replaced by Kinanthropometry.

Now, according to ROSS(1980), "Kinanthropometry is study of human size,

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shape, proportion, composition and gross function of the body in order to understand growth, performance, nutrition and exercise".

**KinanthropometricApproach in Identification Selection of Talent in Sports**

There are three major aspects of Kinanthropometry. These are physical growth, body composition and physique. Under physical growth, kinanthropometry studies various processes of growth with respect to age, different status of maturity and various phenomena under motor development. Body composition refers to evaluation of four principle components of the body composition and these are fat, muscle, bone masses and remainder. Physique deals with objective methods of evaluating size, shape and proportion of the body.

Table 1 gives average data of height (cm) and weight (kg) of Indian sports boys and girls. If a boy or girl wants to be a sportsperson, at least at different ages, he or she should have the required body height and body weight as given in the Table 1. Table 2 shows the requirement of general height on different ranges of body weight for Indian population. Table 3 gives talent selection on the basis of height (status) in the different events of track & field for male sportsperson.

**Table-1: Process of Growth (Average data of Height & Weight of Boys & Girls)**

| Age | Height (cm) Boys | Weight (kg) Boys | Height (cm) Girls | Weight (kg) Girls |
|---|---|---|---|---|
| 7.5 | 125.6 | 25.1 | 125 | 24.9 |
| 8.5 | 130.0 | 26.9 | 129.2 | 26.8 |
| 9.5 | 135.6 | 30.0 | 135.0 | 30.1 |
| 10.5 | 140.2 | 32.9 | 139.8 | 32.9 |
| 11.5 | 145.7 | 36.9 | 146.7 | 38.2 |
| 12.5 | 150.7 | 40.5 | 152.6 | 42.8 |
| 13.5 | 158.1 | 46.7 | 158.0 | 41.8 |
| 14.5 | 163.6 | 51.8 | 160.0 | 51.7 |
| 15.5 | 169.9 | 58.4 | - | 55.2 |
| 16.5 | 173.8 | 62.7 | 162.2 | 56.2 |

**Table-2: Data Based on Indian Population**

| Height (cm) | Weight (Kg) Male | Weight (Kg) Female |
|---|---|---|
| 152 | 50-56 | 45-51 |
| 155 | 52-57 | 47-52 |
| 157 | 53-58 | 48-54 |
| 160 | 55-60 | 50-55 |
| 162 | 56-61 | 51-57 |
| 165 | 58-63 | 58-89 |
| 167 | 59-65 | 54-61 |
| 170 | 61-66 | 56-63 |
| 173 | 63-69 | 59-65 |
| 175 | 64-70 | 60-66 |
| 178 | 66-72 | 62-68 |
| 181 | 68-74 | 63-70 |
| 183 | 70-77 | 66-72 |
| 186 | 72-79 | 68-74 |
| 188 | 74-82 | 69-76 |

**Table-3: Talent Selection on the basis of height (Stature) in Sports (Boys of Track & Field)**

| Age (yrs) Sports | 12 | 13 | 14 | 15 | 16 | 17 | Adult |
|---|---|---|---|---|---|---|---|
| Discuss, Hammer & Shotput | 153 | 161 | 166 | 170 | 176 | 180 | 185 |
| 100m & 200m | 145 | 153 | 157 | 161 | 166 | 171 | 175 |
| 400m, 800m, 1500m & Long Jump | 155 | 156 | 160 | 164 | 169 | 173 | 178 |
| 5000m, 10,000m & Marathon | 143 | 151 | 156 | 159 | 165 | 169 | 173 |
| 110mh, Javelin Throw | 151 | 159 | 164 | 168 | 173 | 178 | 183 |
| 400mh, Triple Jump & Pole Vault | 149 | 157 | 162 | 166 | 172 | 176 | 181 |
| High Jump | 154 | 163 | 168 | 172 | 177 | 182 | 187 |

Table 4 shows simple method for prediction of adult height. In this method, we just need to know height of the father and mother of the child and then 13, a universal constant number, is to be subtracted from father's height and it has to be added with mother's height to get the prediction adult height of a male or a female child. Table itself is a descriptive one to explain the detail.

**Table-4: Prediction of Adult Height**

| | | |
|---|---|---|
| Body Height of Father | = | 180.0 cm |
| Body Height of Mother | = | 170.0 cm |
| X | = | 350.00 / 2 |
| | = | 175.0 cm |

**In case of Daughter:**

Subtract 13 out of father's height i.e. 180.0 – 13.0 = 167.0 cm

A daughter can attain adult height between **167.0 – 175 cm**

**In case of Son:**

Add 13 to the mother's height i.e. 170.0 + 13.0 = 183.0 cm

A boy can attain adult height between **170.0 – 183.0 cm**

Table 5 shows valuable information about the developmental status of Indian children. At different chronological ages, there always exist three possibilities. A child may look more than his chronological age i.e. he or she may mature earlier, hence, show better developmental status than his actual chronological age. The difference of his developmental status ranges from 8 to 10 cm more in height and 5 – 8 kg more in body weight. Accordingly an earlier maturer will have all body measurements significantly better developed than a normal or late maturer. In India, all sports competitions are held on basis of age categories. Hence, in such age-based competitions, the children who are matured earlier, perform better than a late maturer or a normal developing child. They are selected for Indian camps or schemes etc, keeping in mind that they are the best stuff and would be performing better, in near future. But, early developing child may or may not perform better later on; whereas, there is a strong possibility that a normal or late maturing child may perform better at a later stage. But, a late or normal developing child is being discarded by earlier matured child during the age based competitions. Hence, there is a dire need in India to study maturity status of our Indian children and categorize them according to their developmental status and should select and develop further according to their biological maturity.

**Table-5: Developmental Status of Children**

| | | Height (cm) | Weight (kg) |
|---|---|---|---|
| 11 | E | 145.173 | 34.047 |
| | N | 139.133 | 30.227 |
| | L | 132.946 | 25.558 |
| 12 | E | 149.620 | 37.75 |
| | N | 144.061 | 33.089 |
| | L | 137.135 | 29.202 |
| 13 | E | 154.700 | 41.825 |
| | N | 149.338 | 37.438 |
| | L | 144.188 | 32.926 |
| 14 | E | 163.385 | 50.031 |
| | N | 155.853 | 41.589 |
| | L | 151.147 | 38.544 |
| 15 | E | 164.603 | 50.610 |
| | N | 158.071 | 44.138 |
| | L | 154.176 | 40.406 |
| 16 | E | 167.947 | 53.494 |
| | N | 165.631 | 49.531 |
| | L | 157.267 | 42.40 |
| 17 | E | 170.052 | 56.329 |
| | N | 167.977 | 53.964 |
| | L | 163.417 | 47.750 |

Another problem in India is the participation of over-aged children. Table 6 shows results of such over age participation from the competition held from 1992 to 2009. There is an urgent need to check this aspect and also to deal more seriously.

Table 7 shows dental assumptionof children of India so as to find out the maturity status (developmental age) and by seeing the presence of a particular teeth, it can be assumed that a child is of what age; whether he is showing correct date of birth record or not. In this regard, Table-8 can further be consulted to verify the dental age. Different sequence of maturation, separately for males and females have been given so as to further cross check the chronological age of a child.

**Table-6: Percentage of Boys & Girls found Over Age during All India Rural Sports Competitions held from 1992 to 2009**

| Year | Boys | | Girls | | Over Age | |
|---|---|---|---|---|---|---|
| | Participation N | Over Age N | Participation N | Over Age N | Boys % | Girls % |
| 1992 | 719 | 67 | 508 | 26 | 9.32 | 5.12 |
| 1993 | 488 | 104 | 369 | 14 | 21.31 | 3.79 |
| 1994 | 773 | 207 | 533 | 29 | 26.78 | 5.44 |
| 1995 | 537 | 159 | 382 | 44 | 29.60 | 11.51 |
| 1996 | 663 | 180 | 400 | 60 | 27 | 15 |
| 1997 | 673 | 179 | 430 | 50 | 27 | 12 |
| 2000 | 838 | 253 | 401 | 70 | 30 | 17 |
| 2001 | 789 | 243 | 388 | 68 | 31 | 18 |
| 2002 | 804 | 263 | 466 | 90 | 33 | 19 |
| 2003 | 890 | 260 | 449 | 78 | 29 | 17 |
| 2004 | 823 | 243 | 456 | 60 | 30 | 13 |
| 2005 | 778 | 206 | 436 | 23 | 26 | 5 |
| 2006 | 615 | 90 | 280 | 15 | 15 | 5 |
| 2007 | 820 | 201 | 500 | 23 | 24.51 | 4.6 |
| 2008 | 704 | 103 | 540 | 43 | 14.63 | 7.96 |
| 2009 | 832 | 197 | 480 | 28 | 23.67 | 5.83 |

**Table-7: Dental Eruption**

(Deciduous teeth – 6 months – 30 months on 2½ years)

**Eruption of Permanent Teeth**

| | | |
|---|---|---|
| 1st Molar | = | 6 – 7 yrs |
| Central Incisors | = | 6 – 8 yrs |
| Lateral Incisors | = | 7 – 9 yrs |
| Canines | = | 9 – 12 yrs |
| 1st & 2nd Pre-Molar | = | 10 – 12 yrs |
| 2nd Molar | = | 11 – 13 yrs |
| 3rd Molar | = | 17 – 21 yrs |

**Table-8: Appearance of Signs of Maturation (According to GRIMM)**

| Girls (♀) | Boys (♂) |
|---|---|
| Broadening of the hips (10 yrs) | Enlargement of testicles and penis (11 yrs) |
| Rounding of the hips (10 & 11 yrs) | Appearance of pubic hair (12 & 13 yrs) |
| Development of Breasts (11 & 12 yrs) | Swelling of the mammilla (13 yrs) |
| Appearance of pubic hair (11, 12 & 13 yrs) | Projection of the thyroid cartilage, change of voice (14 yrs) |
| Appearance of hair in armpits (13 & 14 yrs) | Appearance of hair in armpits (14 yrs) |
| Menarche (12, 13 & 14 | First nocturnal emissions (15 & 16) |

Body developmental method is a simple and economical method to verify one's chronological age. Table 9 to 12 are self-explanatory to depict the developmental age of a child. Further, through Body Development Index, as indicated by the Table13, the adult height predictions can also be made.

**Table-9: Formulae for Calculation of Body Development index (BDI)**

Body Development Index (BDI) =

$$\frac{\text{Middle Breadth* X 2 Forearm Circumference (Corrected) **}}{\text{Body Height X 10}}$$

$$\text{*Middle Breadth} = \frac{\text{Biacromial Breadth + Biliospinale Breadth}}{2}$$

**Forearm Circumference (Corrected) = Forearm Circumference given – Rohrer Index (RI) ***

$$\text{***Rohrer Index} = \frac{\text{Body Weight}}{\text{Body Height}^3 \text{ X } 10} \quad \frac{\text{Kg}}{\text{M}^3 \text{ X } 10}$$

| | | |
|---|---|---|
| Name | : | Raju |
| Sex | : | Male |
| Date of Birth | : | 07.01.1996 |
| Calculate Age | : | 14+ years |
| Height | : | 152 Cm |
| Weight | : | 41 kg |
| Biacromial Diameter | : | 33.0 cm |
| Biliospinale Breadth | : | 21.0 cm |
| Forearm Circumference | : | 20.0 cm |

Body Development Index (BDI)

$$= \frac{\text{Middle Breadth X 2 Forearm Circumference (Corrected)}}{\text{Body Height X 10}}$$

$$\text{Middle Breadth} = \frac{\text{Biacromial Breadth + Biliospinale Breadth}}{2}$$

$$= \frac{33.0+21.0}{2}$$

$$= 27.0$$

$$\text{Rohrer Index} = \frac{\text{Body Weight}}{\text{Body Height}^3 \text{ X } 10} \quad \frac{\text{kg}}{\text{M}^3 \text{ X } 10}$$

$$= \frac{41}{(1.52)^3 \text{ X } 10}$$

$$= 1.16$$

Corrected Rohrer Index = - 0.5

Forearm Circumference (Corrected) =

Forearm Circumference given – Rohrer Index (RI) (Corrected)

$$= 20+0.5$$

$$= 20.5$$

$$\text{B.D.I} = \frac{27.0 \text{ X } 2 \text{ X } 20.5}{150 \text{ X } 10}$$

$$= 0.73$$

**Table-10: Mean value of Rohrer Index with correction figure**

| Rohrer Index (Correction) | Forearm Circumference (Correction) | Rohrer Index | Forearm Circumference |
|---|---|---|---|
| 0.90 | +3.7 | 1.07 | +1.0 |
| 0.91 | +3.5 | 1.08 | +0.8 |
| 0.92 | +3.4 | 1.09 | +0.6 |
| 0.93 | +3.2 | 1.10 | +0.5 |
| 0.94 | +3.1 | 1.11 | +0.3 |
| 0.95 | +2.9 | 1.12 | +0.2 |
| 0.96 | +2.7 | 1.13 | +0.0 |
| 0.97 | +2.6 | 1.14 | +0.2 |
| 0.98 | +2.4 | 1.15 | -0.3 |
| 0.99 | +2.3 | 1.16 | -0.5 |
| 1.00 | +2.1 | 1.17 | -0.6 |
| 1.01 | +1.9 | 1.18 | -0.8 |
| 1.02 | +1.8 | 1.19 | -1.0 |
| 1.03 | +1.6 | 1.20 | -1.1 |
| 1.04 | +1.5 | 1.21 | -1.3 |
| 1.05 | +1.3 | 1.22 | -1.5 |
| 1.06 | +1.1 | 1.23 | -1.6 |
| 1.23 | -1.6 | 1.36 | -3.7 |
| 1.24 | -1.8 | 1.37 | -3.8 |
| 1.25 | -1.9 | 1.38 | -4.0 |
| 1.26 | -2.1 | 1.39 | -4.2 |
| 1.27 | -2.3 | 1.40 | -4.3 |
| 1.28 | -2.4 | 1.41 | -4.5 |
| 1.29 | -2.6 | 1.42 | -4.7 |
| 1.30 | -2.7 | 1.43 | -4.8 |
| 1.31 | -2.9 | 1.44 | -5.0 |
| 1.32 | -3.2 | 1.45 | -5.1 |
| 1.33 | -3.2 | 1.46 | -5.3 |
| 1.34 | -3.4 | 1.47 | -5.5 |
| 1.35 | -3.5 | 1.48 | -5.6 |
| - | | 1.49 | -5.8 |
| - | | 1.50 | -5.9 |

**Table-11: - Norms for BDI values to assess developmental age of Indian male children**

| BDI Value | Developmental Age (Yrs) |
|---|---|
| 0.668 | 10.000 |
| 0.685 | 11.000 |
| 0.700 | 12.000 |
| 0.739 | 13.000 |
| 0.765 | 14.000 |
| 0.792 | 15.000 |
| 0.848 | 16.000 |
| 0.895 | 17.000 |

**Table-12: Norms for BDI to assess RUS bone age of Indian male children**

| BDI Value | RUS Bone Age |
|---|---|
| 0.668 | 10.5 |
| 0.685 | 11 |
| 0.700 | 12 |
| 0.739 | 13.6 |
| 0.765 | 14 |
| 0.792 | 15 |
| 0.848 | 16 |
| 0.895 | 17 |

**Table-13: Mean values of BDI and predicted adult height of Indian male children**

| BDI VALUES | PREDICTED ADULT HEIGHT | |
|---|---|---|
| | Mean | S.D. |
| .668 | 173.212 | 5.374 |
| .685 | 170.48 | 6.212 |
| .700 | 173.088 | 6.443 |
| .739 | 172.329 | 6.019 |
| .792 | 170.021 | 5.834 |
| .848 | 171.072 | 6.655 |
| .895 | 171.528 | 5.632 |

Table 14 shows maximum velocity for height for male children, the age bracket of 13 to 13 ½ years registers a maximum increase of 5.4 cm followed by 13 ½ to 14 years of age, which registers an increase of 4.6 cm in height. Practically speaking the age 13 to 14 years is very crucial in male children and thereby needs very special attention.

**Table-14: The maximum velocity for height as per age**

| The actual increments being | | |
|---|---|---|
| 11½ - 12 years | = | 2.8 cm |
| 12-12 ½ years | = | 3.3 cm |
| 12 ½-13 years | = | 4.0 cm |
| 13-13 ½ years | = | 5.4 cm |
| 13 ½ - 14 years | = | 4.6 cm |
| 14-14 ½ years | = | 3.7 cm |
| 14 ½ - 15 years | = | 2.2 cm |

Table 15 shows canalization of growth. Growth is a highly systematic process and its organization works in a regular and channelized way. The head and brain are the first parts of the body who attain their full growth followed by leg length. In the leg length first foot attain its full size followed by calf and thigh length. Third part of the body which attains its full growth, is hip breadth followed by shoulder breadth, chest breadth, trunk length and chest depth the part of the body which attain its full length in the last is the Arm length. This canalization of human growth is important for providing training to different sports children.

**Table-15: Canalization of growth**

Head & brain
↓
Leg length ← Foot length ← Calf length ← Thing length
↓
Hip breadth
↓
Shoulder Breadth
↓
Chest Breadth
↓
Trunk Length
↓
Chest Depth
↓
Arm Length ← Hand length ← Fore arm length ← Upper arm length
↓

**(* Harrison et al., 1977)**

Three principle tissue components of body i.e., muscle, bone and fat, play a vital role in athletes' performance status; and thus, evaluation of these components is very much useful in order to appreciate nutritional status and monitor corrective treatment of an athlete. Therefore, Table 16 to 18 describes the methods of calculating the fat mass (%), muscle mass (%) and bone mass (%) respectively, of an individual and the recommended value for both male and female athletes. In addition to fat, muscle and bone, there are some other essential components that play a vital role for proper functioning of the body. These components include water and body fluids. Table 19 describes about the importance of water and its role in body composition.

**Table-16: Fat Mass (% & kg)**

- Recommended Value for Female Athletes 12 – 15 %v
- Recommended Value for Male Athletes 10 – 12 %

**Formula to calculate % fat:-**

$$\% \text{ fat} = \frac{\text{Body Height}^2 \times 10{,}000}{\text{Body Weight}}$$

**Table-17: Muscle Mass (% & kg)**

- Recommended medal winning value for Female Athletes 50 to 55 % of the body weight
- Recommended medal winning value for Male Athletes 55 to 60 % of the body weight (kg)

**Formula to calculate Muscle Mass :-**

$$\text{Mass (kg)} = \frac{L \times k_2 \times r^2}{1000}$$

$L$ = Body Height (cm)

$k_2$ = Constant = 6.5

$$r = \frac{r_1 + r_2 + r_3 + r_4}{4}$$

$r_1$ = Upper arm circumference (cm)

$r_2$ = Fore arm circumference (cm)

$r_3$ = Thigh circumference (cm)

$r_4$ = Calf circumference (cm)

**Table-18: Bone Mass (% & kg)**

- Recommended values for Female Athletes 8-10 kg
- Recommended values for Male Athletes 10-12 kg (14 kg for weight category sports )

**Formula to calculate Bone Mass:-**

$$O\ (kg) = \frac{L \times k_1 \times o^2}{1000}$$

$L$ = Body Height (cm)

$k_1$ = 1.2

$$o = \frac{o_1 + o_2 + o_3 + o_4}{4}$$

$o_1$ = Wrist diameter (cm)
$o_2$ = Elbow diameter (cm)
$o_3$ = Knee diameter (cm)
$o_4$ = Ankle diameter (cm)

**Table-19: Importance of water**

The wonder of water!!!!

- 25 % of your bones are water!
- 75 % of your Muscles are water!
- 76 % of your Brain Consist of water!
- 82 % of your Blood is water!
- 90 % of your Lungs are water!

The most crucial nutrient for your body is water

- The quality of your tissues, their performance and resistance to injury is absolutely dependent on the quality of water you drink
- A muscle dehydrated by more than 3% can lose upto 10 % of its contracted strength.
- To store each precious gram of glycogen, your body need 2.7 g of water.

Evaluation of morphological characteristics viz. size and shape of an individual may be useful in selecting suitable form of physical activity and advantageous in performance. In view of the context a comparative analysis of average height and weight of Indian men and women athletes of different events with the Olympic men and women is represented in Table 20 & 21. Besides the significance of height and weight, the demands of substantial amount of adipose tissue and muscle is different for specific sports event. Thus, correct evaluation of the type of body i.e. somatotype

may be helpful to indicate athletes' ability of performance. Table 22describes the somatotypes of Indian men and women of different sports events compared with Olympic men and women of various events. Formula to calculate different categories of somatotype have been described in Table 23.

**Table-20: Body height (cm)**

| Event | Indian Men | Olympic Men | Indian Women | Olympic Women |
|---|---|---|---|---|
| 100-m | 174.56 | 176.10 | 163.77 | 166.30 |
| 200-m | 176.82 | 176.82 | 157.36 | 157.30 |
| 400-m | 176.09 | 178.00 | 163.72 | 168.00 |
| 800-m | 172.10 | 178.70 | 156.90 | 169.20 |
| 1500-m | 169.90 | 177.60 | 157.70 | 164.50 |
| 3000-m | 164.75 | 177.50 | - | - |
| 5000-m | 170.30 | 174.50 | 154.40 | - |
| 10,000-m | 174.50 | 172.70 | 154.40 | - |
| 20 km Walker | 173.31 | 176.90 | 165.60 | - |
| Long Jump | 175.42 | 182.00 | 166.20 | 170.00 |
| Triple Jump | 179.83 | 182.00 | 166.90 | 169.50 |
| High Jump | 176.12 | 186.80 | 174.50 | 175.50 |
| Javelin Thrower | 177.34 | 183.00 | 158.90 | 180.20 |
| Hammer Thrower | 176.25 | 185.00 | 165.20 | - |
| Discuss Thrower | 183.85 | 189.10 | 169.31 | 175.00 |
| Shotput | 180.80 | 190.20 | 165.60 | 176.50 |
| Decathlon | 177.20 | 187.20 | - | - |
| Heptathlon | - | - | 172.70 | - |
| Pole vault | 168.10 | 181.00 | 158.50 | - |

**Table-21: Body weight (KG)**

| Event | Indian Men | Olympic Men | Indian Women | Olympic Women |
|---|---|---|---|---|
| 100-m | 68.11 | 71.50 | 55.41 | 57.80 |
| 200-m | 70.51 | 70.50 | 51.50 | 57.50 |
| 400-m | 67.92 | 71.20 | 55.50 | 57.50 |
| 800-m | 60.57 | 67.70 | 47.16 | 56.00 |
| 1500-m | 59.90 | 66.00 | 44.73 | 58.50 |
| 3000-m | 54.26 | 65.40 | - | - |
| 5000-m | 60.16 | 62.80 | 46.24 | - |
| 10,000-m | 63.50 | 62.00 | 45.27 | - |
| 20 km Walker | 61.48 | 68.70 | 51.97 | - |
| Long Jump | 74.60 | 74.00 | 54.60 | 59.50 |
| Triple Jump | 73.73 | 76.60 | 59.60 | 60.20 |
| High Jump | 62.67 | 77.70 | 61.50 | 62.80 |
| Javelin Thrower | 79.70 | 91.00 | 61.56 | 68.50 |
| Hammer Thrower | 88.53 | 108.3 | 71.20 | - |
| Discuss Thrower | 99.73 | 112.0 | 72.55 | 86.80 |
| Shotput | 104.4 | 116.5 | 74.50 | 87.00 |
| Decathlon | 74.37 | 84.70 | - | - |
| Heptathlon | - | - | 59.69 | - |
| Pole vault | 69.50 | 75.00 | 54.45 | - |

**Table-22: Somatotype**

| Event | Indian Men | Olympic Men | Indian Women | Olympic Women |
|---|---|---|---|---|
| 100-m | 1.9-5.0-3.0 | 1.9-5.0-2.8 | 3.0-3.6-3.0 | 2.7-3.9-3.0 |
| 200-m | 1.8-4.4-3.0 | 1.7-5.0-2.8 | 2.8-3.7-2.4 | 0.7-3.9-2.9 |
| 400-m | 1.9-4.2-3.0 | 1.5-4.6-3.4 | 2.3-3.5-2.8 | 2.0-3.3-3.7 |
| 800-m | 2.0-4.0-3.5 | 1.4-4.1-3.6 | 1.5-3.3-3.2 | 2.0-3.3-3.7 |
| 1500-m | 2.0-3.5-3.2 | 1.4-4.1-3.6 | 2.0-2.5-3.9 | 2.0-3.3-3.7 |
| 3000-m | 1.8-3.8-3.3 | 1.4-4.1-3.6 | - | - |
| 5000-m | 1.8-4.4-3.3 | 1.4-4.1-3.6 | 2.5-3.4-2.8 | - |
| 10,000-m | 1.6-4.0-3.4 | 1.4-4.1-3.6 | 2.2-3.3-2.8 | - |
| 20 km Walker | 1.5-4.3-3.5 | 1.6-4.7-3.4 | 2.2-2.6-3.4 | - |
| Long Jump | 1.6-6.0-2.0 | 1.7-4.6-3.4 | 1.9-3.0-3.4 | 2.3-3.2-4.0 |
| Triple Jump | 1.3-6.0-2.9 | 1.7-4.6-3.4 | 1.6-4.2-2.7 | - |
| High Jump | 3.0-1.4-3.4 | 1.7-4.6-3.4 | 1.5-2.9-3.7 | 2.3-2.9-4.0 |
| Javelin Thrower | 2.8-6.3-1.2 | 2.3-5.9-2.1 | 4.7-4.6-1.1 | 3.4-4.0-3.0 |
| Hammer Thrower | 3.6-6.4-0.8 | 3.5-7.1-1.0 | 5.2-5.1-0.6 | - |
| Discuss Thrower | 3.7-6.9-0.6 | 3.5-7.1-1.0 | 4.0-5.1-1.3 | 5.3-5.2-1.7 |
| Shotput | 4.4-8.2-0.2 | 3.5-7.1-1.0 | 4.9-5.8-0.6 | 5.3-5.2-1.7 |
| Decathlon | 2.0-5.3-2.4 | 1.8-5.6-2.5 | - | — |
| Heptathlon | - | - | 2.5-3.0-3.8 | 2.4-3.6-3.1 |
| Pole vault | 1.7-6.7-1.4 | 1.5-4.8-3.2 | 1.9-3.0-2.0 | - |

**Table-23: Formula to calculate Somatotype/ Physique**

**Endomorphy :-**

$= -0.7182 + 0.1451(x)^2 - 0.00068(x)^2 + 0.0000014(x)^3$

Where 'x' is the sum of triceps, sub scapular and supra spinale skinfolds all in millimeters.

**Mesomorphy :-**

= 0.858(Humerus width) + 0.601(femur width)+ 0.188( corrected arm circumference)

+0.161 ( corrected calf circumference) – ( Height x 0.131) + 4.50

**Ectomorphy:-**

= { (HWR ) x 0.732 - 28.58 }

where

Height Weight Ratio (HWR) = { Height (cm)/ [ Weight (kg) ] ⅓ }

If HWR < 40.76 but > 38.25 then

Ectomorphy = HWR x 50.463- 17.63

If HWR ≤ 38.25, then a rating of 0.1 is assigned for Ectomorphy

## CONCLUSION

From the above discussion it can be concluded that the knowledge of Kinanthropometry may be applied –

❖ AT THE TIME OF TALENT INDENFICATION
- * Verification of Chronological Age.
- * Examination of development age.
- * Testing of Body Measurements.
- * Prediction of Adult Height.
- * Posture Examination.
- * Assessment of body Composition.

❖ AT THE TIME OF TALENT SELECTION
- * Testing of Body Measurements Specific to Sports/ Game/ Event.
- * Assessment of Body Composition.
- * Evaluation of Physique/ Somatotypes.
- * Assessment of Maturity Status.
- * Predicting minimal values of weight loss for weight categories sports persons.

❖ AT THE TIME OF DEVELOPMENT OF TALENT
- * Monitoring of body composition.
- * Monitoring of Somatotypes.
- * Regular assessment of Height Weight Ratio.
- * Regular examination of x-score values.

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