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Anthropometric measures and body composition of male walkers of the 'All India Inter-University Athletics Championship' in relation to walking performance

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Abstract
The aim of this study was to determine relationship between anthropometric parameters and athletic performance of inter-university level collegiate male athletes. The seven male walkers were randomly selected amongst the 22 walkers of the AIIU Athletic (Men and Women) Championship-2000 organised by G.N.D. University, Amritsar (Punjab). Each athlete was analysed in terms of 53 different variables, *viz.*, anthropometric (39), compositional (13) and performance (1). Physique was quantified in term of stature corrected percentage deviation scores of muscular and non-muscular body girth. Body composition was assessed by measuring skinfold thickness, body fat by using equation of Katch and McArdle (1973) and body density by Siri (1956) equation. The performance of the walkers was assessed on the basis of their rank in the competition. Most of the variables of physique and body composition except elbow diameter had lower value as compared to reference man of Behnke and Wilmore (1974). BMI analysis indicates that one walker (chest no. 292) having BMI less than 18.5 was underweight that might be due to the vigorous training or malnutrition. Only three amongst the selected athletes secured position in the 6th place qualifying standard, *i.e.*, 1 hour 46 minutes 50 second. Study did not reveal any relationship between anthropometric variables and performance.

Keywords: Male walker, anthropometric measurement, reference man performance

1. Introduction
The anthropometric measurement and body composition are some of the important factors for the assessment of health, physical fitness and performance of the athletes. The optimal combination of these variables is helpful in scoring better performance in various kind of physical activities [1, 2]. Physique or body build represents the configuration of the entire body and is related to a high level of achievement in certain sports [3]. It can be visualised in terms of ponderal somatorgram comprising stature corrected percentage deviation scores for muscular and non-muscular body girth [4]. The ponderal somatogram permits the comparisons of individual girths as mass equivalent. This can also be used for comparing body profile of the individual and the group. This is directly comparable to the standards of the Reference Man prescribed by Behnke and Wilmore [5].
The body composition of an athlete can be visualized in terms of the two compartment model of Siri [6]. This model assumes that body is composed of fat and fat free mass (FFM). Body fat comprises two categories, i.e., essential fat and storage fat (non-essential fat). Studies on the body composition in sports science mainly include estimation of storage fat that accumulates in the adipose tissues; its pattern of distribution in the body and lean body mass (LBM). The LBM always contains essential fat (approximately 3% of the body mass in man and 12% in women) that is stored in bone marrow, in the heart, lungs, liver, spleen, kidney, intestine, muscles and lipid rich mass throughout the nervous system. The essential fat in females also includes 5 to 9% sex specific reserve fat stored in breasts, pelvic, buttock and thigh regions. The LBM is a biological lower limit beyond which, person's body mass cannot be reduced without impairing health status or capacity for endurance type exercise.
The present study was undertaken to visualize the overall picture of these parameters in relation to the performance of male walkers of the All India Inter-University Athletics (Men & Women) Championship-2000.

2. Material and Methods

2.1 Selection of subjects

The seven male competitors of 20 km walking were selected randomly amongst the 22 walkers of the All India Inter-University Athletics (Men & Women) Championship, 25th - 29th December 2000 organised by Guru Nanak Dev University, Amritsar (Punjab). The selected subjects belonged to 7 universities located in five states of India, *viz.*, chest no. 197: CSJM, Kanpur (U.P.); Chest No. 207: Delhi University, Delhi (NCR); Chest No. 234: D.D.U. Gorakhpur (U.P.); Chest No. 292: Kumaun University, Nainital (Uttaranchal); Chest No. 371: M.D. University, Rohtak (Haryana); Chest No. 521: Ruhelkhand University, Bareilly (U.P.) and Chest No. 650: Vikram University, Ujjain (M.P.).

2.2 Anthropometric measurements

Each selected subject was analysed in terms of 52 different variables, *viz.*, anthropometric [39] and compositional [13]. The anthropometric variables were measured by using standard equipments like sliding caliper based on Freeman steel measuring tape (Festo Measuring India Ltd., India) and Krups weighing machine (Krups Agencies, India). Both the instruments were pre-calibrated by using Seca Balance (Vogel & Halke Gambh & Co. Hamburg, Germany). All the body measurements were taken following the standard procedure prescribed by Lohman *et al.* [7].

2.3 Calculation

Physique was quantified in terms of stature corrected percentage deviation scores as described in the body profile technique of Katch *et al.* [4]. The formula used are as under –

(i) Ponderal equivalent (PE) of girth = $\left(\frac{cm}{k}\right)^2 \times$ Stature (dm)

(ii) Percentage deviation score: PD (Muscular girth) = $(X_{mi} - \bar{X}_n)/\bar{X}_n \times 100$ and *PD (Non - muscular girth) = $(X_{ni} - \bar{X}_m)/\bar{X}_m \times 100$

Body composition was assessed by using skinfold thickness measured by Holtan skinfold caliper (Holtan Ltd. Crosswell Crymych, U.K.). The body fat percentage was estimated by using the equation of Katch and McArdle [8], *i.e.*, Body fat (%) = 0.43× triceps fatfold thickness (mm) + 0.58 × subscapula fatfold thickness (mm) + 1.47 and body density by using Siri [9] equation, *i.e.*, B.D. (g/cc) = 495 ÷ body fat (%) – 450. The mean and standard deviations were calculated by using Microsoft excel.

3. Results and Discussion

The sample of seven athletes constitutes approximately 30% of the total population of the participant male walkers of All India Inter-University Athletic Championship 2000, Amritsar (Punjab). The average values of 39 anthropometric variables of the selected subjects are presented in Table 1. It might be due to the genetic factor (especially of skeletal diameters and stature) along with low level of physical training which leads to poor development of the muscular system. Apart from genetic factors, the malnutrition especially inadequacy of zinc in the dietary intake during childhood may also be a factor for poor development of the skeletal system.

The umbilicus abdomen girth revealed highest variability (SD = 8.9) and wrist girth (SD = 0.9), the lowest amongst the girth measurements (Table 1). The standard deviation of skeletal diameter ranged from 0.3 (ankle and knee) to 1.8 (hips). The mean values of various skinfold thickness ranged from 4.6 mm (biceps) to 11.0 mm (midaxillary) whereas standard deviation from 1.4 (chest pectoral) to 7.5 (abdominal). The BMI analysis indicates that chest no. 292 having BMI 18.3 was under weight. BMI < 18.5 might be due to the vigorous physical training or malnutrition whereas chest no. 207 fell under overweight category (BMI between 25.0-29.9). The rest of the walkers come under normal category. The index of androgyny which represents degree of masculinity also had lower value in all the walker as compared to reference man.

The mean anthropometric measures of the walkers had highest positive deviation (9.72%) for abdomen (average) and maximum negative deviation (-10.99) for forearm (Table 2). The conversion of average body girths into ponderal (mass) equivalent shows that abdomen had largest mass (62.61 kg) as compared to any other body area. PE-abdomen is 2.51 kg larger and heavier than the average body weight of 60.1 kg. It means that mass of abdomen at a body weight of 60.1 kg was the projected sign of the abdomen as if of an athlete weighing 62.61 kg. The high positive deviation might be due to the greater mass of adipose tissue in the abdomen area. The highest negative deviation of -10.99% for forearm shows that PE- forearm of 53.17 is relatively small (3.88 kg less) in relation to PE-muscular, *i.e.*, 57.05 kg. In other words, it would be the forearm size of the body weight equals to 53.17 kg. It can be concluded that forearm girth was undersized in comparison to oversized components having positive deviations.

Except the body density, all the variables of body composition had lower values as compared to reference man (Table 3). All the walkers except chest no. 650 had optimum percentage of body fat, *i.e.*, between 8 to 15%. It infers that selected athletes possessed good health status. The chest no. 650 possessed 18.7% body fat and may be considered slightly overweight as per standard prescribed by Nieman [10]. The average body fat percentage of the walkers was slightly higher than 11.5% of the elite Indian male walkers as reported by Sodhi and Sohata [11].

The performance of the walkers was found satisfactory as about 43% of the selected subjects got different rank/positions in the 6th place qualifying standard, *i.e.*, 1 hr. 46 min. 50 sec. for 20 km walking. Chest no. 371 secured 1st rank (1^0 35' 39"), chest no. 292 got 3rd rank (1^0 37' 47") and chest no. 234 - the 4th rank (1^0 38' 02"). Study reveals that the unsuccessful walkers also had good physique and body composition as compared to the position holders. The other factors like lack of proper training, low profile of endurance and psychological attitude may be guessed to be responsible behind their poor performance.

Kiika [12] pointed out that body composition affect the athletic performance. Ashwarya and Joseph [13] studied the anthropometric parameters and body composition status of young sports persons and concluded that male and female athletes have normal anthropometric measurement and body composition scores except muscle mass. They also mentioned that performance in sports and physical activity it directly influenced by the body composition and physique.

Table 1: Average measures of some anthropometric variables of male walkers in relation to Reference Man

Variables	*Reference Man	Chest No							Mean	S.D.
		197	207	234	292	371	521	650		
(A) Girths (cm)										
Muscular Components										
1. Shoulders	110.8	107.0	107.5	102.0	100.0	105.0	104.0	111.0	105.2	3.7
2. Chest	91.8	85.0	89.0	89.0	82.0	89.0	88.0	90.0	87.4	2.9
3. Biceps (flexed)	31.7	31.5	33.2	26.0	25.0	29.0	28.0	28.0	28.7	2.9
4. Forearm	26.9	26.0	25.0	24.0	22.0	24.0	23.0	24.0	24.0	1.3
5. Thigh	54.8	51.0	54.0	49.5	46.0	47.0	48.0	53.0	49.8	3.0
6. Calf	35.8	35.5	34.5	34.0	30.0	34.0	33.0	33.4	33.5	1.7
Non-Muscular Components										
7. Waist	77.0	77.0	85.0	72.0	75.0	76.0	74.0	71.0	75.7	4.6
8. Umbilicus abdomen	79.8	81.0	94.0	68.5	70.0	74.0	73.0	72.0	76.1	8.9
9. Hips (Buttocks)	93.4	89.0	91.0	85.0	85.0	86.0	87.0	88.0	87.3	2.2
10. Knee	36.6	37.5	37.0	34.0	35.5	34.0	33.0	35.0	35.1	1.7
11. Wrist	17.3	16.0	17.0	16.0	15.0	17.0	15.0	15.2	15.9	0.9
12. Ankle	22.5	21.0	20.7	21.0	18.0	20.0	19.0	29.5	21.3	3.8
(B) Skeletal Diameter (cm)										
13. Shoulder (biacromial)	40.6	34.0	33.6	35.5	36.0	34.0	34.5	35.0	34.7	0.9
14. Chest	30.0	25.5	27.5	26.6	29.6	25.6	26.0	26.6	26.8	1.4
15. Elbow (humerus biepicondylar)	7.0	8.7	9.6	9.6	9.0	9.1	9.0	9.6	9.2	0.4
16. Hips (biiliac)	28.6	29.4	30.7	28.6	26.1	30.6	27.0	30.0	28.9	1.8
17. Bitrochantric	33.3	34.5	36.3	33.5	30.8	35.3	34.5	34.8	34.2	1.7
18. Wrist (bistyloid)	5.6	6.1	6.2	5.9	5.4	6.2	6.5	6.1	6.1	0.3
19. Knee (femur bicondylar)	9.3	9.4	10.3	8.7	9.4	9.0	9.1	9.5	9.3	0.5
20. Ankle (bimalleolar)	7.0	6.0	6.1	6.2	6.1	6.5	6.4	6.7	6.3	0.3
(C) Skinfold (mm)										
21. Triceps	-	11.0	11.4	4.6	9.8	4.8	5.4	20.2	9.6	5.5
22. Biceps	-	3.2	5.4	3.2	5.4	3.8	3.9	7.2	4.6	1.5
23. Chest (pectoral)	-	6.0	7.0	3.6	4.6	6.5	6.3	7.8	6.0	1.4
24. Midaxillary	-	10.0	10.0	10.0	7.4	10.2	9.5	20.2	11.0	4.2
25. Subscapular	-	12.0	14.0	7.8	10.6	8.0	8.2	14.8	10.8	2.9
26. Suprailiac	-	17.6	9.0	3.8	11.2	6.0	6.2	20.6	10.6	6.3
27. Abdominal	-	11.0	9.0	7.0	12.6	5.2	5.2	26.6	10.9	7.5
28. Midthigh (anteror)	-	18.8	8.0	5.4	11.0	8.0	9.1	14.1	10.6	4.5
29. Suprapatellar	-	7.5	8.0	8.0	7.0	5.8	6.0	14.2	8.1	2.8
30 Medial Calf	-	13.8	9.6	14.0	13.5	4.9	5.0	12.0	10.4	4.0
(D) Other Variables										
31. Age (yr)	20-24	18.0	20.0	19.0	21.0	20.0	19.0	22.0	19.8	1.3
32. Stature (cm)	174.0	165.5	160.1	170.2	166.9	176.0	170.0	163.6	167.0	5.2
33 Body weight (kg)	70.0	61.0	65.0	60.0	51.0	62.0	60.0	62.0	60.1	4.4
34 Sitting height (cm)	-	87.0	86.0	89.0	89.0	85.0	84.0	92.0	87.4	2.8
35.Leg (subischial) length (cm)	-	78.5	74.1	81.2	77.9	91.0	86.0	71.6	80.0	6.7
(E) Indices and Ratios										
36. Body mass index (kg/M^2)	23.1	22.3	25.4	20.7	18.3	20.0	20.8	23.2	21.1	2.3
37. Index of Androgyne	93.2	72.6	70.1	77.9	81.9	71.4	76.5	75.0	75.0	4.1
38. Sitting height » Stature ×100	-	52.6	53.7	52.3	53.3	48.3	49.4	56.2	52.3	2.7
39 Waist » Hip circumference	0.8	0.9	0.9	0.8	0.9	0.9	0.9	0.8	0.9	0.0

*Reference Man of Behnke and Wilmore (1974) [5]; S.D. = Standard deviation

Table 2: Ponderal equivalent (PE) and percentage deviation scores of an average physique of the male walkers

Sr. No.	Variables	Constant (k)	Average Measurement (cm)	PE = $\left(\frac{cm}{k}\right)^2$ × Stature (dm) (Average Stature =16.7 dm)	Percentage Deviation (PD*)
(A)	**PE – Muscular**				
1.	Shoulders	55.40	105.2	60.22	+ 0.80
2.	Chest	45.90	87.4	60.55	+ 1.36
3.	Biceps	15.85	28.7	54.75	- 8.34
4.	Forearm	13.45	24.0	53.17	-10.99
5.	Thigh	27.40	49.8	55.17	- 7.65
6.	Calf	17.90	33.5	58.49	+ 2.09
(B)	**PE- Non Muscular**			$\bar{X}_m$= 57.05	
7.	Abdomen (average)	39.20	75.9	62.61	+ 9.72
8.	Hips	46.70	87.3	58.36	- 2.28
9.	Knee	18.30	35.1	61.44	+ 7.67
10.	Wrist	8.65	15.9	56.43	-1.1
11.	Ankle	11.25	21.3	59.86	+ 4.92

* PD (Muscular girth) = $(X_{mi} - \bar{X}_n)/\bar{X}_n \times 100$ and *PD (Non – muscular girth) = $(X_{ni} - \bar{X}_m)/\bar{X}_m \times 100$

Table 3. Performance, body composition and percentage deviation scores of physique of male walker in relation to reference man

Variables	*Reference Man	Chest No.							Mean	S.D.
		197	207	234	292	371	521	650		
(A) Performance										
1. Rank/Position	-	-	-	IV	III	I	-	-		
(B) Body Composition										
2. Body Weight (kg)	70.0	61.0	65.0	60.0	51.0	62.0	60.0	62.0	60.1	4.4
3. Body Fat (%)	15.0	13.2	14.5	8.0	11.8	8.2	8.5	18.7	11.8	4.0
4. Absolute Body Fat (kg)	10.5	8.0	9.4	4.8	6.0	5.1	5.1	11.6	7.1	2.6
5. Essential Fat Mass (kg)	2.1	1.8	2.0	1.8	1.5	1.9	1.8	1.9	1.8	0.1
6. Storage Fat Mass (kg)	8.4	6.2	7.5	3.0	4.5	3.2	3.3	9.8	5.4	2.6
7. Lean Body Mass (kg)	61.7	54.8	57.5	57.0	46.6	58.8	56.7	52.2	54.8	4.2
8. Fat Free Body Mass (kg)	59.6	53.0	55.6	55.2	45.0	56.9	54.9	50.4	53.0	4.1
9. Muscle Mass (kg)	31.3	27.3	29.1	26.9	22.8	27.8	26.9	27.8	26.9	2.0
10. Bone Mass (kg)	10.4	9.1	9.7	8.9	7.6	9.2	8.9	9.2	9.0	0.7
11. Essential Fat of LBM (kg)	1.9	1.6	1.7	1.7	1.4	1.8	1.7	1.6	1.6	0.1
12. Muscle Mass of LBM (kg)	30.8	27.4	28.8	28.5	23.2	29.4	28.3	26.1	27.4	2.1
13. Bone Mass of LBM (kg)	10.4	9.3	9.8	9.7	7.9	10.0	9.6	8.9	9.3	0.7
14. Body Density (g/cc)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.0
(C) Percentage Deviation										
Muscular components										
15. Shoulders	0	-0.8	-7.5	0.4	1.4	2.5	9.5	-2.1	+0.80	-
16. Chest	0	-8.8	-7.6	11.4	-0.7	7.3	14.2	-6.2	+1.36	-
17. Biceps (flexed)	0	5.1	7.8	-20.3	-22.6	-4.5	-3.1	-23.9	-8.34	-
18. Forearm	0	-0.6	-15.1	-5.7	-16.7	-9.2	-9.2	-22.3	-10.99	-
19. Thigh	0	-7.9	-4.5	-3.3	-12.3	-16.1	-4.7	-8.7	-7.65	-
20. Calf	0	4.6	-8.7	6.9	-12.6	2.9	5.6	-15.1	-2.09	-
Non-Muscular Components										
21. Abdomen (Average)	0	9.6	36.2	-3.1	19.0	7.5	7.0	-6.7	+9.72	-
22. Hips (Buttocks)	0	-2.0	-0.8	-0.1	15.3	-0.4	5.6	-0.4	+2.28	-
23. Knee	0	13.3	6.8	4.1	31.0	1.4	-1.0	2.6	+7.67	-
24. Wrist	0	-7.7	0.9	3.2	4.7	13.4	-8.5	-13.4	-1.10	-
25. Ankle	0	-6.0	-11.6	5.1	-10.9	-7.2	-13.2	92.9	+4.92	-

*Reference Man of Behnke and Wilmore (1974) [5].
S.D. = Standard deviation

4. Conclusion

The overall study may be concluded as under

- The majority of anthropometric measures except of elbow diameter had lower value as compared to that of reference man of the same age group.
- The degree of masculinity in walkers also had lower value than the reference man.
- Study did not find any relationship between anthropometric measurements and performance of the walkers. The lack of proper training may be responsible for the poor performance of the walker having good physique.

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6. References

1. Brocherie F, *et al.* Relationship between anthropometric measures and athletic performance with special reference to repeated-sprint ability in the Qatar national soccer team. Journal of Sports Science. 2014;32(13):1-12.
2. Desalew GW, Woldeyes DH, Abegaz BA. The relationship between anthropometric variables and race performance. Journal of Sports Medicines. 2019;10:209-216.
3. Manila RM. Anthropometry, physical performance and fitness. In: Anthropometry: The individual and the population (eds. Ulijaszek, S.J. and Taylor, C.G.N.M.), Cambridge University Press, Cambridge; c1994. p. 160-177.
4. Katch FJ, Behnke AR, Katch VL. The ponderal somatogram: Evaluation of body size and shape from anthropometric girth and stature. Hum Bio. 1987;59(8):439-458.
5. Behnke AR, Wilmore JH. Evaluation and Regulation of Body Build and Composition. New Jersey: Englewood Cliffs, Prentice Hall; c1974. p. 235.
6. Siri WE. Body composition from fluid spaces and density In: Techniques for Measuring Body Composition (eds. Brozek, J. and Henachel, A.), Washington, D.C.: National Academy of Sciences; c1961, p. 223.
7. Lohman TG, Roche AF, Martorell R. (eds) Anthropometric Standardization Reference Manual. Champaign, IL: Human Kinetics; c1988.
8. Katch FI, McArdle WD. Prediction of body density from simple anthropometric measurements in college- age men and women. Hum Biol. 1973;45:445.
9. Siri WE. Gross compostion of the body. In: Advances in Biological and Medical Physics (Vol.4) (eds: Lawrence, J.H. and Tobias, C. A.) New York: Academic Press; c1956.
10. Nieman DC. Fitness and Sports Medicine: An Introduction (Palo Alto C.A.) Bull Publishing Co; c1990.
11. Sodhi HS, Sahota AS. Body composition of Indian top ranking male sportsmen. Souvenir 6th Nat. Conf. & Seminar on Physical Education hnd Sports Sciences, University of Kalyani, Kalyani; c1990.
12. Kiika D. How does body composition affect athletic

performance? The Sports Education; c2020. https:// the sports edu.com/body composition- definition/
13. Aishwarya R, Joseph Mini. Anthropometric parameters and body composition status of young sports persons in Kerala. International Journal of Physical Education, Sports and Health. 2023;10(2):215-222.