KINANTHROPOMETRY AND PERFORMANCE OF TOP RANKING INDIAN BASKETBALL PLAYERS

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It is understood that the physiological function or performance of an athlete is an adaptation as a result of intensive training, which in turn, has a marked influence on his kinanthropometry i.e. the size, shape, proportion, body composition and gross function (Cureton, 1951; Åstrand, 1956; Tanner, 1964; Hirata, 1966; Carter, 1970; Malhotra et al, 1972; Sodhi, 1976a, b; 1980 Sodhi and Sidhu, 1978). It is also evident from these studies that certain kinanthropometric characteristics are not affected by any type of physical activity. For example, the length of any bony segment of the body which has biomechanically a close relation with performance in many games and events, cannot be altered by any amount of training in the adult. It is, therefore, evident that the natural endowment of such characteristics must be helpful in some biomechanical way to an athlete or sportsman during performance in a game. As the competition demands maximum from the body, it is essential to find a demonstration of the relationship of such bodily characteristics with respect to the requisite mechanical function in a game or event. Parnell (1951) in an anthropometric study of athletes concluded that an individual's choice of athletic events might largely be due to characteristics, probably inborn. Tanner (1964) examined the physique of Olympic track and field athletes and inferred that the athletes were both born and made. The basic structure, he stated, must be present for the possibility of being an athlete to arise. It is, therefore, reasonable to believe that a study of the kinanthropometry and performance can also indicate the requirements of the inbuilt characteristics and the functional and mechanical fitness of a sportsman in a game or event. The present study has, therefore, been conducted on top-ranking Indian Basketball players

to understand the characteristics which are the result of natural endowment or either physical training.

MATERIAL AND METHODS

The present study is based on a cross-section sample of 29 anthropometric measurements on each of the 12 National Basketball team men players and 59 normal controls. The data of the players were collected after the final selection of players who represented India in the Commonwealth Games of 1978, held in Kuala Lumpur. The data for the controls were from students originating from different places in the country and who had come to college or to University in Patiala. It was made sure that none of them had played any game at a senior competition level at any stage of his career.

The anthropometric measurements were taken with standard techniques. The unilateral measurements were taken on the left side of the subjects. Harpenden skinfold calipers designed by Tanner & Whitehouse (1955) were used for estimating the skinfold thickness, and somatotype ratings derived by a modification of the Carter (1970) and Heath-Carter (1967) method.

The corrected cross-sectional areas have been estimated by subtracting the respective skinfold thickness from the total circumference of the respective region, i.e. upper arm, forearm, thigh and calf. The estimate provides an index of musculo-skeletal tissue or lean tissue area in the respective segment.

The data of Basketballers and controls have been analysed statistically in respect of the mean, standard

deviation, test of significance, correlation coefficient and simple linear regression. (The regression of those parameters which showed non-significant correlation value has not been considered in the investigation.)

The performance of the players was recorded from the official reports of the championship matches held in Kuala Lumpur. It was possible to record the individual score of field baskets, the number of rebounds defended and offended, and the average participation time of each player.

RESULTS AND DISCUSSION

Table I indicates that on average, the National team players stand at a height of 185.6 cm with 76.7 kg of body weight. Both the measurements indicate statistically significant difference between the two groups. On average, the players of the present study are considerably taller and heavier than the State level players studied by Sodhi (1976). On the other hand, they are considerably shorter and lighter when compared to the Olympic participants of Basketball in 1960, 1964, 1968 and 1972 (Hebbelinck and Ross, 1974). The tallest of the players in the present investigation measured 213.9 cm in height and 130 kg in body weight. In a performance test of running 52 m dribble with the ball he took maximum time for completion of the event. On

the other hand, the shortest participant was 164.2 cm in stature and 60 kg in body weight. Out of all Basketball players studied, four are shorter than 180 cm of height (Table V). However, it is important to note that the tallest player in the Russian team which participated in the 1964 Olympics was 218 cm high (Hirata, 1966).

It is interesting to note that like body weight and stature the values of various other body measurements of the players also indicate highly significant differences when compared to those of the controls (Tables I and II); they are considerably larger than the non-playing population. However, among the players there is a variability in height.

TABLE II
Statistical values of arm and leg measurements of Controls and Basketball players

Measurement (cm)	Control	National Team Players	Student's 't' test
	Mean ± S.D.	Mean ± S.D.	
1. Upper arm circum.	25.2 ± 2.1	28.2 ± 1.8	4.64*
2. Forearm circum.	24.2 ± 1.3	26.8 ± 2.0	5.71*
3. Upper arm length	32.2 ± 1.6	35.7 ± 2.6	6.08*
4. Forearm length	25.1 ± 1.1	27.8 ± 2.4	6.06*
5. Hand length	19.5 ± 1.0	21.5 ± 2.3	4.76*
6. Humerus bicondylar dia.	6.6 ± 0.3	7.4 ± 0.8	5.54*
7. Upper extremity length (3+4+5) No.	76.8 ± 3.1	85.0 ± 7.0	6.47*
8. Thigh circum.	45.2 ± 3.5	53.3 ± 4.0	7.16*
9. Calf circum.	32.2 ± 2.0	36.8 ± 3.1	6.44*
10. Thigh length	40.1 ± 2.2	44.3 ± 3.3	5.50*
11. Lower leg length	38.5 ± 2.0	43.1 ± 4.0	5.96*
12. Foot length	26.2 ± 1.0	29.1 ± 2.7	6.32*
13. Femur biocondylar dia.	9.3 ± 0.4	10.4 ± 1.1	5.99*
14. Subischial length (Stature - sit. ht.)	81.1 ± 4.0	92.3 ± 8.3	7.16*

*significant at $p < 0.05$

TABLE I

Statistical values of various measurements of Controls and Basketball Players

Measurement (cm)	Control	National Team Players	Student's 't' test
	Mean ± S.D.	Mean ± S.D.	
1. Body weight (kg)	58.0 ± 6.7	76.7 ± 18.1	6.20*
2. Stature	170.0 ± 6.1	185.6 ± 13.1	6.39*
3. Sitting height	88.9 ± 3.5	93.3 ± 6.8	3.29*
4. Biacromial dia.	38.1 ± 1.8	40.0 ± 2.7	3.11*
5. Bicristal breadth	26.4 ± 1.4	29.1 ± 2.9	4.93*
6. Chest breadth	25.1 ± 1.5	27.3 ± 2.0	4.53*
7. Chest depth	18.3 ± 1.3	20.8 ± 2.2	5.41*
8. Chest circum.	85.3 ± 5.1	95.1 ± 7.1	5.61*
9. Body surface area (cm ²)	173 × 10 ² ± 11 × 10 ²	208 × 10 ² ± 30 × 10 ²	6.90*

*significant at $p < 0.05$

The subischial:sitting height ratio and the regression of subischial length upon stature indicate proportionately significantly longer leg length in players than that of the controls (Table III; Fig. 1). The regression of arm length upon stature does not indicate any considerable difference between the two groups (Fig. 1). However, the arm:sitting height ratio shows significantly longer arms with respect to trunk length in the case of players, evidently due to proportionately shorter trunks. The arm:subischial length also indicates significantly longer legs among the players than in the controls. The biacromial:stature and biacromial:bicristal ratios indicate relatively narrow shoulder breadth in the players (Table III). The regression of biacromial diameter upon stature also indicates similar results (Fig. 3). The regression of bicristal breadth upon stature does not indicate any notable characteristic in this respect.

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(BASKETBALL PLAYERS)

The average value of the reciprocal of the ponderal index ($Ht^3/\sqrt{wt}$) and the regression of body weight upon stature do not indicate significant difference in weight between the two groups (Table III, Fig. 2). Similarly the regression of lower leg length upon forearm length does not indicate any considerable difference between the two groups (Fig. 3). However, the regression of bicondylar femoral upon bicondylar humeral widths depicts much greater relative width of the knees in the case of players.

TABLE III
Statistical values of body proportions of Controls and Basketball players

Measurement (Ratios)	Control Means $\pm$ S.D.	National Team Players Means $\pm$ S.D.	Student's 't' test
1. Subischial/sitting height	0.91 $\pm$ 0.5	0.99 $\pm$ 0.09	4.53*
2. Upper extremity/subischial length	0.9 $\pm$ 0.03	0.9 $\pm$ 0.04	2.78*
3. Upper extremity/sitting height	0.9 $\pm$ 0.04	0.9 $\pm$ 0.05	3.89*
4. Biacromial dia./stature	0.2 $\pm$ 0.01	0.2 $\pm$ 0.01	3.09*
5. Biacromial dia./Bicristal breadth	1.4 $\pm$ 0.08	1.4 $\pm$ 0.09	2.57*
6. Forearm/upper arm length	0.8 $\pm$ 0.03	0.8 $\pm$ 0.02	0.32
7. Femoro/tibial ratio	0.96 $\pm$ 0.03	0.97 $\pm$ 0.03	1.09
8. Chest depth/breadth	0.7 $\pm$ 0.06	0.8 $\pm$ 0.06	1.82
9. Stature/chest circum.	2.0 $\pm$ 0.13	1.95 $\pm$ 0.08	1.21
10. Reciprocal of ponderal index	44.0 $\pm$ 1.67	43.9 $\pm$ 1.5	0.24

*significant at $p < 0.05$

In somatotypes, the average ratings of the players and the controls do not show any significant difference (Table IV), but it is important to note that on average the National players are just 0.37 ± 0.26 unit more mesomorphic than the latter. In ectomorphy, however, the difference between the two groups is seen to be very narrow. The rating of the endomorphic component is found to be about half a unit less in the case of players. In the somatochart, most of the players are distributed in the meso-ecto, ecto-meso and endo-mesomorphic sectors of the triangle as compared to that of the controls who are scattered in all sectors around the middle of the triangle. The present results are not in conformity with those of Hebbelinck and Ross (1974) who reported an ecto-mesomorphic somatotype as the prototype for Basketballers. However, it is worth mentioning here that the top-ranking Indian Basketball players studied in the present investigation could not even qualify in the Asian Basketball Championship. The low performance standard of Indian Basketballers at the International level may be due to small number of ecto-mesomorphs.

TABLE IV

Statistical values of somatypes and corrected cross-section

Variables	Controls	Basketball players	Student's 't' test
	Mean ± S.D.	Mean ± S.D.	
I — Somatypes			
1. Endomorphy	3.5 ± 1.4	3.0 ± 0.9	1.14
2. Mesomorphy	3.3 ± 0.8	3.7 ± 0.9	1.36
3. Ectomorphy	3.6 ± 1.3	3.5 ± 1.1	0.47
II — Corrected Cross-sectional areas (cm²)			
4. Upper arm	43 ± 6	55 ± 7	6.13*
5. Forearm	39 ± 4	51 ± 8	6.72*
6. Thigh	139 ± 19	204 ± 35	8.92*
7. Calf	72 ± 8	97 ± 17	7.64*

*significant at $p < 0.05$

The average values of corrected lean tissue areas of upper arm, forearm, thigh and calf are found to be significantly greater in the players than those in the controls (Table IV). The regressions of the lean tissue area of the thigh and the calf upon that of upper arm indicate considerably greater relative development of musculo-skeletal tissue in the lower extremities of Basketballers than those of the controls (Fig. 4). The Basketballers in the Indian team showed much greater variation in the size as evident from the tallest and shortest, and three other players shorter than 180 cm in stature (SD = 13.10 cm). The shortest player was selected for the National team because he proved good in distant shooting in the National competitions for more than two years. However, it is noticed that his relative performance in the Championship is very poor (Table V). His average participation time in all matches was lowest (2 min 53 s) among all players. The scoring rate of this player is also lowest as he scored six field Baskets in the seven matches played by him. He was not fielded in the remaining two matches. Perhaps his physical disadvantages are the probable reasons for his failure.

On the contrary, the tall players seem to have various advantages in Basketball. The tallest pivoter at 213.9 cm had maximum advantage in this regard, his average participation time in all matches was 22 min 7 s and only three other players played for a greater time. However, he scored 96 field baskets which was the highest in the Indian team during this Championship. The other pivoter at 199.2 cm is also extremely tall and scored a total of 62 field baskets in all matches. The former offended 39 and defended 29 rebounds and the latter offended 39 and defended 24 rebounds. It is, therefore, evident that tallness, especially in the case of pivoters, plays a great role in this game. A correlation of stature with scored field baskets, offended rebounds

TABLE V

The Individual performance of players during championship tournaments

Player No.	Stature (cm)	Average participation time*	Field Baskets scored	Rebounds Offd.	Defend.
1.	177.2	27' 05"	19	19	6
2.	181.4	26' 54"	34	29	14
3.	199.2	22' 54"	62	39	24
4.	213.9	22' 07"	96	39	29
5.	183.6	19' 30"	33	23	12
6.	195.1	18' 25"	52	17	22
7.	178.0	17' 41"	33	6	6
8.	186.6	12' 27"	34	12	14
9.	172.8	12' 23"	13	12	4
10.	192.0	11' 25"	33	19	16
11.	182.4	6' 08"	8	4	5
12.	164.5	2' 25"	6	1	1

* Participation time is the exact time of play recorded by the official time keepers for each player during the competition.

and defended rebounds shows significant relationships in each case (Table VI). The correlation is highest (0.92) in the case of scored field baskets. The regression lines also show a positive relationship between stature and game performance (Fig. 5). It is, therefore, evident that stature has a significant role to play in this game. The shorter the stature of a man, the lesser the performance of the players during competition. The speed test conducted on all players showed the two pivoters to be slower than other players in the team. However, as they are at the top in performance but slow in speed, tallness seems to be more important in this respect than speed especially in the pivoters.

CONCLUSIONS

It has been found that Basketball players possess typical kinanthropometric characteristics. Tallness plays an important role in the performance in this game and shortness seems to be highly disadvantageous. The results of the study indicate that of the team positions 'pivoters' must be extremely tall for building a better team. Apart from this, players with relatively long legs, narrow shoulders and broad knees seem to have a biomechanical advantage in this game. In other respects such as average somatotypes they are not considerably different from the controls, however, the muscular development of their limbs are far better than the latter with greatest effect in the lower extremity than in the upper.

The Indian Basketball players, when compared with their Olympic counterparts, were found to be considerably lighter in weight and shorter in stature.

TABLE VI

Values of correlation coefficients and linear regressions between various measurements of Controls and Basketball players

	Control			National team players		
	Corr. Coeff. 'r'	Regression Equation		Corr. Coeff. 'r'	Regression Equation	
		a	b		a	b
1. Subischial length (cm) — Stature (cm)	0.85	-12.667	0.552	0.89	-12.275	0.563
2. Upper extremity length (cm) — Stature (cm)	0.78	9.762	0.394	0.97	-11.198	0.518
3. Biacromial diameter (cm) — Stature (cm)	0.72	1.883	0.213	0.73	12.147	0.150
4. Body weight (kg) — Stature (cm)	0.47	-29.803	0.516	0.85	-142.757	1.182
5. Subischial length (cm) — Upper extremity length (cm)	0.83	-1.410	1.074	0.86	6.207	1.013
6. Femur bicondylar (cm) — Humerus bicondylar	0.56	3.790	0.832	0.88	1.818	1.166
7. Lean tissue thigh (cm ²) — Lean tissue upper arm (cm ²)	0.72	45.654	2.183	0.94	-41.749	4.396
8. Lean tissue calf (cm ²) — Lean tissue upper arm (cm ²)	0.54	40.120	0.740	0.86	-11.720	1.957
9. Stature — Field baskets	—	—	—	0.92	-296.900	1.790
10. Stature — Offended Rebounds	—	—	—	0.76	-117.130	0.730
11. Stature — Defended Rebounds	—	—	—	0.85	-106.380	0.642

REGRESSION LINES

(BASKETBALL PLAYERS)

— FIELD BASKETS SCORING
 OFFENDED REBOUNDS
 - - - - DEFENDED REBOUNDS

SOMATOTYPES

(BASKETBALL PLAYERS)

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