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Relationship Between Physical Fitness Tests and Biological Variables Among the Jats of Delhi

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ABSTRACT Physical fitness, a highly complex phenomenon, influenced by an array of bio-cultural factors. Among the biological variables, body size and body physique have been found to influence physical fitness of individuals to a great extent. Using a cross-sectional sample of 580 Jat school children of Delhi, data were collected on their current physical fitness status. A battery of tests including AAHPER (American Association of Health, Physical Education and Recreation) tests with some additions was administered to assess their physical fitness. Ten anthropometric measurements were taken on all the subjects to assess their body size and body physique. Systolic and diastolic blood pressure readings were also taken. The relationship between physical fitness and these biological variables was examined statistically through coefficient of correlation values significant at 5% probability level. Measures of strength (grip strength, broad jump) in boys and girls were found to be positively and significantly associated with most of the body measurements, mesomorphic component of physique and blood pressure. Speed of shuttle run, fifty yard run and balance flamingo tests were found to be negatively and significantly associated with body size in both Jat males and females. Plate tapping and softball throw tests, however, showed positive and significant correlation with body size in Jats. In the remaining tests of physical fitness, their relationship with body size, body physique and blood pressure varied among the two sexes. Results of partial correlation indicated the confounding nature of age in the relationship between physical fitness and biological variables, whereas the results of multilinear regression confirmed the influence of age further in this relationship. Hence, we find that the parameters involved in studying the relationship between physical fitness and biological variables have many implications targeting physical promotion programs among young children.

INTRODUCTION

Physical fitness is the ability to meet the demands of life with vigour and alertness without undue fatigue and to have sufficient energy beyond this to enjoy leisure time activities and meet unforeseen emergencies (Shephard et al., 1986). It provides adequate energy to perform greater amount of work and also helps to recover from fatigue much faster. Individuals and populations show differences in physical fitness as well as in its components, such as strength, muscular endurance, cardio-respiratory endurance, flexibility. Numerous bio-cultural factors such as body size, shape, physiological factors and parental physical activity levels, education, occupation, and income influence physical fitness status of children. A large part of physical fitness is achieved during the growing period and providing training during this period can help in improving physical fitness.

In exploring individual body measurements as indicator of physical fitness, it is important to examine the relationship between various components of physical fitness and body measurement. A significant relationship has been found in earlier studies (Boileau and Lohman, 1977; Delvaux et al., 1999; Docherty and Gaul, 1991; Lefevre et al., 1993; Malina, 1975) between physical performance and body size and shape. In children, body size, especially height and weight, was found to be significantly related to the aerobic performance or the physical work capacity (Adams, 1973; Godfrey, 1973; Krahenbuhl et al., 1985). Body size was also found to have only a moderate or low relationship with running tests of six hundred yard and fifty yard runs (Slaughter et al., 1977). Malina (1975) reported high correlations between body weight and maximal voluntary isometric strength in 9 to 18 years old males. Gilliam et al. (1979) found that age, height and weight for physically active boys and girls 7 to 13 years of age contributed between 66 and 77 per cent of the common variance in isokinetic knee strength. Body physique, as reflected by somatotype components, was reported to influence physical fitness performance (Docherty and Gaul 1991; Hebbelinck et al., 1999; Malina and Rarick, 1973; Slaughter et al., 1977; Mittal et al., 1992). Physical fitness was found to be inversely

related to diastolic blood pressure (Gutin et al., 1990) and systolic blood pressure (Harshfield et al., 199; Hofman and Walter, 1989). Such studies help identify some optimum combination of anthropometric variables for classifying children and youth for various kinds of physical activities. Thus, the present paper focuses to explore the relationship between physical fitness tests and biological variables (body measurements, body physique and blood pressure) in the Jats of Delhi

MATERIALS AND METHODS

The present study was conducted in Delhi, the National Capital of India. Diversity in caste, class, religion and consequently in life-styles, eating habits, dress patterns, marriage rituals and other customs, is the hallmark of Delhi and its inhabitants. Jat is one of the communities residing on the outskirts of Delhi. The present study was conducted on Jats of Delhi covering the rural areas of Majra Dabas, Palam, Delhi Cantt. Surhera, Jaffarpur Kalan, having a preponderance of Jat population. Jat is an endogamous group practising subcaste exogamy as evident from the analysis of the mating pattern collected on the parental subcastes of subjects. They consume a lot of milk and milk products and their diet is generally rich in protein and fat.

A cross sectional sample of 580 Jat children (308 boys and 22 girls) in the age range of 10 to 18 years was collected. Decimal age was calculated and used for further analysis as the date of birth of all the subjects was known. AAHPER fitness tests viz., pull ups for boys/flexed arm hang for girls, standing broad jump, shuttle run, fifty yard run, and six hundred yard run walk tests were administered. In addition, hand grip strength of both hands, Harvard's step test, sit and reach, softball throw, plate tapping, and balance flamingo stand tests were also included as per the recommendations of the earlier investigators (Claessens et al., 1990; Eurofit Manual-Council of Europe, 1988; Renson et al., 1980). A detailed account of these physical fitness tests and process of their administration is provided in our earlier communication (Gakhar and Malik, 1999). Some body measurements including stature, body weight, upper arm circumference and bicondylar humerus were taken following standard methods (Carter, 1980; Martin and Saller, 1957; Tanner et al., 1969). Anthropometric somatotype analysis was done incorporating these measurements to calculate endomorphic, mesomorphic and ectomorphic components (Carter, 1980; Heath and Carter, 1967). Blood pressure, both systolic and diastolic, was taken using standard methods (Weiner and Lourie, 1981).

Relationship between physical fitness tests and biological factors (body measurements, body physique, blood pressure) was studied by examining the values of coefficient of correlation, coefficient of partial correlation (keeping age as an intermediate variable) and multiple correlation (keeping age as a forced variable). The statistical analysis was done on a Personal Computer using SPSS package.

RESULTS AND DISCUSSION

The values of coefficient of correlation, partial correlation and multiple correlation between physical fitness tests and biological variables (body measurements, physique and blood pressure) for Jat boys and girls are presented in Tables 1, 2 and 3. The measures of strength, such as grip strength, standing broad jump, pull-ups and sit-ups are positively associated with most of the biological variables in Jat boys (Table 1). Grip strengths of both the hands are significantly related positively with height, weight, upper arm circumference, bicondylar humerus, and systolic and diastolic blood pressure in boys. Mesomorphy and ectomorphy in boys are negatively, but significantly correlated with right and left hand grip strengths respectively.

Since both physical fitness and body measurements are associated with age in children, their relationship was studied after eliminating the effect of age by partial correlation. Values of coefficient of partial correlation are comparatively smaller than that of coefficient of correlation, however, the relation is significant statistically with most of the variables. Relationship between right hand grip strength and mesomorphy are confounded by age factor as evident from coefficient of partial correlation values. In other words, on eliminating the influence of age, their relationship faded and became non-significant.

The same holds true for correlation of left hand grip strength with diastolic blood pressure and ectomorphy in boys. Significant values of coefficient of multiple correlation between grip strengths and all the variables prove the influence of age on their relationship.

In Jat girls, right and left hand grip strength are significantly and positively associated with height, weight, upper arm circumference, bicondylar humerus, systolic blood pressure and endomorphy (Table 1). In most of the cases, relationship remains significant when the influence of age is eliminated, although the values of partial correlation are lower than that of correlation. The relation of grip strengths with systolic blood pressure, however becomes non-significant, when age is excluded. Negative significant correlation occurs between right and left hand grip strengths and ectomorphy in girls. Age is found to be the major confounding factor in the relationship of all physical fitness tests and the biological variables, as observed from significant values of coefficient of multiple correlation obtained after taking age as a forced variable.

Broad jump in boys shows significant positive correlation with height, weight, upper arm circumference, bicondylar humerus and blood pressure. It is negatively and significantly associated with mesomorphy. However, when the effect of age is eliminated, it shows non-significant correlation with blood pressure and mesomorphy (Table 1). On the other hand, on introducing age as forced variable, it shows significant correlation with all the body measurements.

In girls, broad jump is associated positively and significantly with height, weight, and bicondylar humerus (Table 1). The association becomes non-significant, except with height once the effect of age is eliminated by undertaking partial correlations. Ectomorphy is significantly correlated with broad jump after eliminating the influence of age. Significant negative correlation is also observed between broad jump and mesomorphy in girls. All the significant values of coefficient of multiple correlation suggest the confounding nature of age on the relationship between all the variables and broad jump performance in girls.

Pull-ups in boys are positively and significantly correlated with height, weight, upper arm

Table 1: Relationship between Physical Fitness Test (Tests of Strength - Static, Explosive and Functional) and Biological Variables (Body Measurements, Physique and Blood Pressure) in Jat Boys and Girls

Biological Variables	*Grip strength (R)**			*Grip strength (L)**			*Broad jump*			*Pull-ups*			*Sit-ups*		
	r	*pr*	*R*	*r*	*pr*	*R*	*r*	*pr*	*R*	*r*	*pr*	*R*	*r*	*pr*	*R*
Boys															
Height	0.85	0.52	0.87	0.85	0.49	0.87	0.70	0.28	0.72	0.49	0.17	0.51	0.25	0.10	0.26
Weight	0.87	0.63	0.89	0.88	0.64	0.90	0.64	0.18	0.70	0.54	0.29	0.55	0.24	0.09	0.25
Upper arm circumference	0.73	0.41	0.85	0.72	0.37	0.85	0.54	0.12	0.70	0.43	0.16	0.50	0.24	0.10	0.26
Bicondylar humerus	0.73	0.35	0.84	0.72	0.33	0.85	0.63	0.25	0.72	0.36	0.02	0.48	0.24	0.10	0.25
B. P. Systolic	0.41	0.19	0.82	0.41	0.17	0.83	0.28	0.02	0.69	0.17	-0.01	0.48	0.07	-0.01	0.23
B. P. Diastolic	0.32	0.11	0.81	0.31	0.09	0.83	0.02	0.02	0.69	0.04	-0.13	0.50	0.01	-0.07	0.24
Endomorphy	0.06	-0.03	0.81	0.04	-0.06	0.83	0.04	-0.03	0.69	0.03	-0.01	0.48	0.03	0.01	0.23
Mesomorphy	-0.19	-0.03	0.81	-0.19	-0.03	0.83	-0.16	-0.02	0.69	-0.21	-0.12	0.49	-0.01	0.03	0.24
Ectomorphy	-0.10	-0.19	0.82	-0.11	-0.02	0.84	0.05	0.06	0.69	-0.13	-0.50	0.50	0.03	0.03	0.24
Girls															
Height	0.74	0.45	0.78	0.71	0.43	0.75	0.33	0.28	0.33	0.13	0.01	0.17	-0.16	-0.03	0.20
Weight	0.74	0.41	0.77	0.72	0.40	0.74	0.20	0.08	0.21	0.08	-0.10	0.20	-0.23	-0.12	0.23
Upper arm circumference	0.65	0.34	0.08	0.65	0.36	0.73	0.10	-0.02	0.19	0.01	-0.13	0.22	-0.14	-0.01	0.20
Bicondylar humerus	0.44	0.26	0.74	0.44	0.27	0.70	0.12	0.05	0.20	0.03	-0.04	0.18	-0.10	-0.02	0.20
B. P. Systolic	0.19	0.06	0.72	0.18	0.06	0.68	0.04	0.00	0.19	0.06	0.03	0.18	-0.06	-0.02	0.20
B. P. Diastolic	0.08	0.02	0.71	0.06	0.00	0.68	0.06	0.05	0.20	-0.0	-0.02	0.18	-0.14	-0.12	0.23
Endomorphy	0.40	0.16	0.72	0.42	0.20	0.69	0.06	-0.02	0.19	-0.02	-0.11	0.21	-0.13	-0.06	0.21
Mesomorphy	0.01	0.03	0.71	0.02	0.05	0.68	-0.17	-0.17	0.25	-0.06	-0.06	0.18	-0.07	-0.07	0.21
Ectomorphy	-0.41	-0.10	0.72	-0.40	-0.11	0.68	0.02	0.13	0.23	0.00	0.10	0.20	0.19011		0.22

* Grip Strength (R) and Grip Strength (L) represent Right Hand Grip Strength and Left Hand Grip Strength respectively.
r, pr and R represent coefficients of correlation, partial correlation and multiple correlation respectively.
Underlined values are significant at 5% probability level

circumference, bicondylar humerus and systolic blood pressure (Table 1). Its relation with bicondylar humerus and systolic blood pressure, however, becomes non-significant, once the effect of age is eliminated using partial correlation. Conversely, when age is introduced as forced variable, pull-ups in boys show significant correlation with all the body measurements. Pull-ups are also correlated negatively, but significantly with diastolic blood pressure, mesomorphy and ectomorphy.

Flexed-arm hand in girls is associated significantly with height. The relations of flexed-arm hang with these measurements in girls, however, become non-significant after excluding the influence of age on their relationship. On the other hand, upper arm circumference is significantly and negatively correlated with flexed-arm hang in girls when age factor is not considered. Positive significant values of coefficient of multiple correlation between flexed-arm hang and all the variables confirm the confounding nature of age on their relationship (Table 1).

Sit-ups in boys are significantly and positively correlated with height, weight, upper arm circumference and bicondylar humerus (Table 1), but the relationship is not as strong as between grip strength or broad jump and body measurements. Even the significant relationship between sit-ups and the afore-mentioned measurements range from 0.17 to 0.25. Also, these relationships are influenced to an extent by age factor, as the values of partial correlation coefficients in all of them are statistically non-significant. On the other hand, all the significant values of coefficient of multiple correlation suggest a significant contribution of age in this relationship.

Sit-ups in girls are negatively and significantly correlated with height, weight, upper arm circumference, diastolic blood pressure and endomorphy. However, the correlation values are low ranging from -0.12 to -0.23 (Table 1). On the other hand, it is positively associated with ectomorphy. On excluding the influence of age, it shows negative significant correlation only with weigh and diastolic blood pressure. The values of the coefficient of partial correlation in the latter case, i.e., on excluding age, are lower than those of coefficient of correlation. Positive

Table 2: Relationship between Physical Fitness Tests (Tests of Cardio-respiratory Endurance and Flexibility) and Biological Variables (Body measurements, Physique and Blood Pressure) in Jat Boys and Girls

Biological Variables	*Rapid Fitness Index*			*Six Hundred Yard*			*Sit and Reach*		
	r	*pr*	*R*	*r*	*pr*	*R*	*r*	*pr*	*R*
Boys									
Height	0.16	0.11	0.16	-0.30	0.02	0.47	0.02	-0.02	0.05
Weight	0.12	0.04	0.13	-0.33	0.15	0.49	0.03	0.0	0.04
Upper arm circumference	0.07	-0.01	0.12	-0.28	0.08	0.47	-0.03	0.08	0.10
Bicondylar humerus	0.02	-0.09	0.15	-0.22	-0.01	0.47	-0.08	-0.17	0.17
B. P. Systolic	-0.01	-0.06	0.13	-0.01	-0.05	0.47	0.06	0.05	0.07
B. P. Diastolic	-0.06	-0.10	0.16	0.06	-0.10	0.48	-0.02	-0.04	0.06
Endomorphy	0.04	0.03	0.12	0.02	-0.02	0.47	-0.05	-0.05	0.07
Mesomorphy	-0.25	-0.24	0.26	0.09	0.00	0.47	-0.17	-0.16	0.17
Ectomorphy	0.02	0.02	0.12	0.13	-0.18	0.49	-0.05	0.05	0.07
Girls									
Height	-0.04	-0.02	0.04	0.04	-0.01	0.11	-0.29	-0.18	0.30
Weight	-0.12	-0.15	0.16	0.02	0.07	0.14	-0.26	0.12	0.26
Upper arm circumference	-0.13	-0.14	0.4	0.01	0.05	0.13	-0.24	-0.11	0.26
Bicondylar humerus	-0.18	-0.18	0.18	0.12	-0.08	0.14	-0.25	-0.18	0.29
B. P. Systolic	-0.25	-0.24	0.25	0.02	0.01	0.11	-0.27	-0.24	0.33
B. P. Diastolic	-0.13	-0.13	0.13	0.02	0.02	0.12	-0.12	-0.10	0.25
Endomorphy	-0.16	-0.15	0.16	0.13	-0.10	0.15	-0.14	-0.05	0.24
Mesomorphy	-0.13	-0.13	0.14	0.02	-0.01	0.11	0.01	0.01	0.24
Ectomorphy	0.15	-0.04	0.15	0.02	0.15	0.15	0.08	-0.10	0.24

r, pr and R represent coefficients of correlation, partial correlation and multiple correlation respectively.
Underlines values are significant at 5% probability level.

significant correlation is observed between sit-ups and all the variables when age is introduced as a forced variable.

Rapid fitness index in boys is significantly and positively correlated with height and weight (Table 2). It is negatively linked mesomorphy in boys, whereas in girls it is negatively associated with weight, upper arm circumference, bicondylar humerus, blood pressure (systolic and diastolic), endomorphy and mesomorphy (Table 2). While the relation between rapid fitness index and most of these variables remain significant even when the effect of age is eliminated using partial correlation, age is found to a major confounding factor in its relation with bicondylar humerus and diastolic blood pressure in boys, and with ectomorphy in girls. In girls, its relation with ectomorphy is significant when age is introduced as a forced variable. Besides, significant values of coefficient of multiple correlation with all the variables in boys and with weight, bicondylar humerus, systolic blood pressure and endomorphy in girls also prove the confounding nature of age.

Six hundred yard run-walk is positively and significantly correlated with ectomorphy in boys and bicondylar humerus and endomorphy in girls (Table 2). It is negatively and significantly associated with height, upper arm circumference and bicondylar humerus in boys. Age is a confounding factor in determining the relationship between six hundred yard run-walk and all the biological variables in boys as visible from statistically significant values of coefficient of multiple correlation (R). However, in girls age is found to be a major confounding factor in case of its relationship with endomorphy and ectomorphy.

Sit and reach is associated significantly but negatively with mesomorphy in boys and with height, weight, upper arm circumference, bicondylar humerus, blood pressure (systolic and diastolic) and endomorphy in girls (Table 2). However, when the influence of age is eliminated using partial correlation it shows significant negative correlation with bicondylar humerus in boys. On the other hand, girls show non-significant correlation with upper arm circumference and endomorphy when age is excluded. When age is introduced as forced variable, both boys and girls show a significant relationship between sit and reach and all the biological variables.

Table 3: Relationship between Physical Fitness Test (Tests of Agility, Speed and Balance) and Biological Variables (Body Measurements, Physique and Blood Pressure) in Jat Boys and Girls.

Biological Variables	*Shuttle Run*			*Plate Tapping*			*Fifty Yard Run*			*Softball Throw*			*Balance*		
	r	*pr*	*R*	*r*	*pr*	*R*	*r*	*pr*	*R*	*r*	*pr*	*R*	*r*	*pr*	*R*
Boys															
Height	-0.59	-0.11	0.65	0.22	0.04	0.24	0.28	0.17	0.29	0.67	0.28	0.69	-0.31	0.05	0.06
Weight	-0.50	0.04	0.65	0.24	0.08	0.25	-0.30	0.02	0.67	0.65	0.26	0.68	-0.29	-0.01	0.02
Upper arm circumference	-0.34	0.19	0.66	0.11	0.07	0.25	-0.22	0.08	0.27	0.58	0.23	0.68	-0.25	0.02	0.03
Bicondylar humerus	-0.36	0.20	0.66	0.50	-0.18	0.29	-0.16	0.02	0.67	0.59	0.22	0.67	-0.26	0.01	0.02
B. P. Systolic	-0.18	0.09	0.65	0.01	-0.08	0.25	-0.08	-0.02	0.67	0.36	0.16	0.67	-0.19	0.11	0.12
B. P. Diastolic	-0.19	0.01	0.64	-0.02	-0.10	0.26	-0.01	-0.07	0.67	0.32	0.15	0.66	-0.16	0.10	0.10
Endomorphy	0.05	0.15	0.65	-0.13	-0.16	0.28	-0.01	0.06	0.67	0.07	0.01	0.65	-0.08	0.08	0.08
Mesomorphy	0.41	0.37	0.70	-0.26	-0.22	0.32	0.21	-0.10	0.67	-0.11	0.03	0.65	0.14	0.00	0.02
Ectomorphy	-0.16	-0.19	0.66	-0.03	-0.04	0.24	0.06	0.09	0.27	-0.01	-0.02	0.65	-0.01	0.06	0.07
Girls															
Height	-0.16	0.02	0.53	-0.33	0.01	0.44	-0.12	0.17	0.70	0.45	0.18	0.49	-0.15	0.06	0.16
Weight	-0.06	0.22	0.56	0.34	0.01	0.44	-0.18	0.03	0.69	0.41	0.08	0.47	-0.05	-0.01	0.14
Upper arm circumference	-0.08	0.17	0.55	0.34	0.06	0.45	-0.14	0.05	0.69	0.35	0.07	0.47	-0.03	-0.01	0.14
Bicondylar humerus	-0.04	0.27	0.58	0.04	-0.14	0.46	-0.02	0.09	0.69	0.16	-0.01	0.46	-0.01	0.06	0.16
B. P. Systolic	0.02	0.02	0.53	0.07	-0.01	0.44	0.00	-0.06	0.69	0.09	0.01	0.46	-0.07	0.02	0.15
B. P. Diastolic	-0.01	-0.07	0.53	0.08	0.05	0.44	0.03	-0.09	0.69	0.09	0.05	0.46	-0.10	0.01	0.15
Endomorphy	0.01	-0.14	0.54	0.18	0.00	0.44	0.00	-0.03	0.69	0.26	0.08	0.47	-0.07	-0.01	0.15
Mesomorphy	0.11	0.31	0.59	-0.06	-0.06	0.45	0.00	-0.04	0.69	0.08	-0.09	0.47	0.13	-0.01	0.15
Ectomorphy	-0.03	-0.19	0.55	-0.23	-0.01	0.44	0.15	0.08	0.69	-0.14	0.10	0.47	-0.07	0.02	0.15

r, pr and R represent coefficients of correlation, partial correlation and multiple correlation respectively.
Underlined values are significant at 5% probability level

Shuttle run is significantly and positively correlated with mesomorphy in boys (Table 3). It is negatively correlated with height, weight, upper arm circumference, bicondylar humerus, blood pressure (systolic and diastolic) and ectomorphy. The correlation between shuttle run and all these variables, except blood pressure, remain significant even when age is excluded. In girls, shuttle run is significantly and negatively associated with height (Table 3). When the influence of age is eliminated, shuttle run in girls show significant positive correlation with weight, upper arm circumference, bicondylar humerus and mesomorphy, and significant negative correlation with endomorphy and ectomorphy. However, on introducing age as forced variable, significant positive correlation is observed between shuttle run performance in boys and girls and all the biological variables. Age, therefore, acts as a confounding factor in their relationship.

Plate tapping is positively and significantly correlated with height, weight and upper arm circumference in boys (Table 3) and weight, upper arm circumference and endomorphy in girls. It is negatively and significantly correlated with endomorphy and mesomorphy in boys and with height and ectomorphy in girls. When the effect of age is eliminated, none of the biological variables show significant correlation with plate tapping in girls, whereas in boys it shows significant negative correlation with bicondylar humerus, endomorphy and mesomorphy. On the other hand, significant positive correlation occurs between plate tapping and all the biological variables in both Jat boys and girls on introducing age as a forced variable.

Softball throw in boys is significantly and positively associated with height, weight, circumference of the upper arm, bicondylar humerus and blood pressure (systolic and diastolic) (Table 3). Even when age is excluded, these relationships remain significant. Mesomorphy is negatively associated with softball throw in boys. In girls, softball throw is associated significantly and positively with all the body measurements. It also shows significant positive correlation with endomorphy and significant negative correlation with ectomorphy. When age is excluded, only height shows positive significant correlation with softball throw in girls. Significant positive correlation is, however, observed with all the biological variables both in boys and girls, on introducing age as forced variable.

Balance is associated significantly and negatively with height, weight, upper arm circumference, bicondylar humerus and blood pressure (systolic and diastolic) in boys (Table 3). The relationship with mesomorphy is also significant, but positive. Age is not a confounding factor in the performance of this skill in boys. In girls, balance is associated significantly and negatively with height, and positively with mesomorphy. These variables show non-significant correlation with balance in girls on eliminating the influence of age. When age is introduced as a forced variable, balance shows positive significant correlation with height, bicondylar humerus, blood pressure, endomorphy, mesomorphy and ectomorphy.

Generally the boys engage in physical and sports activities much more often than the girls (Manios et al., 1999; Michaud et al., 1999; Renson and Vanreusel, 1990). The socialisation of Jat boys and girls regarding sports and physical activity is quite different, which explains the sex-related differences in physical fitness. Culture stereotypic gender preferences in physical activity begin at a very young age, and this differentiation cannot be attributed only to gender differences in physical fitness. Rowland (1996) explained the gender-related differences in physiological responses to physical fitness exercises through sex differences in body composition. There is a marked change in body composition during puberty. Girls accumulate body fat, whereas boys increase their muscle mass. The relationship between the size of the body (i.e. exercising muscle mass) and the body fat which it is obliged to carry, is of utmost importance in fitness related studies. This relationship changes both with age and sex as is evident from the result of the study.

SUMMARY AND CONCLUSION

The relationship of physical fitness tests with

biological factors suggest that the measures of strength in boys are generally related with body measurements, mesomorphic component of physique, and blood pressure. Performance of boys in other physical fitness tests, such as six hundred yard run, shuttle run, fifty yard run, softball throw and balance flamingo, is also influenced by body measurements, mesomorphy, and some of the other biological factors. In girls, however, measures of static and explosive strengths are related to body measurements, components of physique and blood pressure. Similarly, some of other tests of physical fitness in girls, viz., rapid fitness index, sit and reach, limb movement and softball throw in girls are also influenced by these biological factors.

In Jat males, grip strength, standing broad jump, pull-ups and sit-ups are strongly related to stature and weight indicating that an increase in body size results in an increase in these fitness tests. The same trend is also observable in Jat females, but the relationship is not as strong as in the males. Also, the females show an inverse relationship between body size and sit-ups. Rapid fitness index in positively associated with body size in Jat boys, but not in girls. Six hundred yard run-walk speed has an inverse relationship with body size in Jat males, but not so in the females. Sit and reach has an inverse relationship with body size in Jat females, but not in Jat males. Body size, in terms of height and weight, is generally positively associated with plate tapping and softball throw in both Jat males and females. On the other hand, body size is negatively associated with shuttle run speed, fifty yard run speed and balance in both the sexes.

Most of the physical fitness tests as well as the body measurements increase with age from 10 to 18 years. Knowing that age is a confounding factor in examining the relation between physical fitness tests, the relationship between the two was also examined using partial correlation, controlling the effect of age. Two statistically significant informations emerge. Firstly, that there is a decrease in partial correlation as compared to correlation, delineating that age is really a confounding factor. Secondly, in case where correlation was significant, the relationship between physical fitness test and biological factors was real and independent of age. Similarly, the relationship was examined by introducing age as a forced independent variable. Results of multilinear regression confirm the confounding nature of age in the relationship of physical fitness tests and biological factors.

From the foregoing discussion, it may be concluded that physical fitness is a highly complex phenomenon. Other than age and sex, physical fitness is influenced by numerous biological factors such as body size and body shape. The parameters involved in studying the relationship between body measurements and physical fitness have implications for Health Educators and Physical Instructors in the appropriate targeting of physical activity promotion programs among young children.

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