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SEX DIFFERENCE IN PHYSICAL FITNESS, GRIP STRENGTH AND BODY SIZE IN KOLI LABOURERS

ABSTRACT: With a view to investigate sex differences in physical fitness, hand grip strength and body measurements, data on 100 adult Koli males and 100 adult Koli females, in the age range of 18 to 40 years, were collected from Koli, a migrant endogamous caste group belonging to the state of Rajasthan now settled in Delhi. Most of the Kolis in Delhi do labour jobs at various construction sites.
The study reveals that adult Koli males are physically more fit and have greater grip strength than females. Males are significantly taller, heavier, possess greater linear dimensions, breadths (except biiliocristal breadth) and circumferences than the Koli females. Koli females, on the other hand, have greater fat deposition than Koli males.

KEY WORDS: Sex difference — Physical fitness — Grip strength — Koli — Labourers — Body measurements.

INTRODUCTION

Sexual dimorphism is a universal phenomenon evident in all population groups: the degree of dimorphism, however, varies from one population to another. Several investigators have described sex differences in body size (Tanner 1962, Eveleth 1975, Susanne 1975, 1980, Pařízková 1977, Johnston 1980, Bailey 1982), strength (Malina 1980, Malik and Nath 1980) and physical fitness (Shephard 1977, 1980, 1986, Renson et al. 1978). Though some studies in India have examined the sex differences in body size (Sidhu et al. 1985, ICMR 1972), the studies on the sex difference in physical fitness are rare. The present study, therefore, aims at investigating the sex differences in physical fitness, body size and grip strength in Koli labourers.

MATERIAL AND METHODS

Cross-sectional data on 100 adult males (mean age = 29.8 yrs.) and 100 adult females (mean age = 32.2 yrs.), aged 18 to 40 years were collected from an endogamous caste group, the Koli. Recurrent and severe droughts in Rajasthan — a part of the Thar desert, have forced the Koli to migrate out and settle down in Delhi. In Delhi, most of the Koli work as construction labourers, though their earlier occupation in Rajasthan was agriculture.

Stature, sitting height, lower extremity length, transverse chest diameter, antero-posterior chest depth, biacromial breadth, biiliocristal breadth, bicondylar humerus breadth, bicondylar femoral breadth, upper arm, chest and calf circumferences were taken following standard methods (Martin and Saller 1957, Tanner et al. 1969). Skinfolds at triceps, biceps, subscapular, suprailiac, and calf were taken using Holtain's skinfold caliper having a constant pressure of 10 gm/mm^2. The grip strength was measured for the right and the left hand, by a dynamometer, in the arm hanging position. Best of the three trials were recorded, in kg. Cardiovascular endurance of the subjects was evaluated using Harvard step test, following the method described by Weiner and Lourie (1969). For males, the height of the step was kept as 20" (50.8 cm) and for females it was 17" (43.2 cm) high.

To quantify sex differences, Bailey's Index, showing percent sex difference, was calculated using the following formula (Bailey 1982):

Bailey's Index = $(M/F - 1) \times 100$

where, M = Mean value of a parameter in males and F = Mean value of the same parameter in females.

A positive value of the index indicates that males are larger than females, whereas a negative value suggests the contrary. The value of the index, irrespective of its sign, signifies the degree of sexual dimorphism.

RESULTS

Adult Koli females have lower rapid fitness index (RFI) than adult Koli males (*Table 1*). Males are heavier, taller and possess greater linear dimensions, breadths (except biiliocristal breadth) and circumferences, than their female counterparts. Males have greater grip strength in both hands, as compared to females. The sex differences in body measurements and grip strength are statistically significant at 5 % probability level (*Table 1*). Females, however, exhibit higher fatfolds at triceps, biceps, subscapular, suprailiac and calf, than males. The sex differences in skinfolds are statistically significant at 5 % probability level.

Bailey's Index, purporting percent sex dimorphism, reveals that males have nearly 5 to 17 percent bigger body dimensions, than females (*Table 1*). Biacromial breadth, bicondylar humerus breadth, weight and transverse diameter of chest show wider sex differences than lower extremity length, bicondylar femur breadth and antero-posterior diameter of chest. Adult Koli females have nearly 15 % larger pelvic breadth than males. The distribution of fat differs conspicuously at various sites in two sexes; females having greater fat depositions than males at all the sites. The percent sex differences are much higher (more than 38 %) in

TABLE 1. *Sex differences in body measurements, rapid fitness index and grip strength among Kolis of Rajasthan.*

Measurements	Males		Females		Sex Difference	
	Mean	S. D.	Mean	S. D.	% age	t-value
Linear measurements						
Stature	163.8	6.15	151.7	5.72	7.97	14.49
Sitting height	81.3	3.69	74.5	4.91	9.12	11.08
Lower extremity length	92.8	4.70	87.9	4.63	5.57	7.43
Diameters						
Transeverse chest diameter	25.4	1.88	23.0	2.27	10.40	8.15
Antero-posterior chest diameter	17.9	1.51	16.9	1.68	5.91	4.43
Biacromial breadth	35.8	2.89	30.6	2.63	16.90	13.30
Biiliocristal breadth	23.1	1.35	27.2	1.86	−15.07	3.92
Bicondylar humerus	6.2	0.47	5.4	0.42	14.81	12.69
Bicondylar femur	8.0	0.57	7.6	0.51	5.26	15.11
Circumferences						
Calf circumference	29.0	2.19	26.6	2.10	9.02	7.89
Upper arm circumference	23.0	1.81	21.7	1.92	5.99	4.97
Chest circumference	81.0	5.13	76.4	18.28	6.02	2.42
Skinfolds						
at Triceps	5.3	1.66	8.7	3.12	−39.08	9.27
at Biceps	5.9	2.19	8.9	3.50	−33.70	7.26
Subscapular	8.5	1.79	9.7	3.67	−12.37	2.94
Suprailiac	6.6	2.32	7.4	3.29	−10.81	1.98
Calf	5.9	1.87	9.2	3.70	−35.86	5.45
Strength — hand grip						
Right hand	36.1	8.40	29.8	7.01	20.94	5.69
Left hand	34.3	8.42	28.1	6.99	21.95	5.66
Average	35.2	8.12	29.0	6.76	21.35	5.89
Weight	48.2	6.24	42.7	6.52	12.8	6.12
Rapid fitness index	106.8	9.20	81.1	10.89	31.7	17.66

All the values of t are significant at 5 % probability level.

skinfolds at biceps, triceps and calf, whereas they range between 10 to 13 % in suprailiac and subscapular skinfolds. The differences are also marked in rapid fitness index and grip strength.

In an earlier study, Komi (1981) observed that in the age range of 15 to 24 yrs., the values of body measurements in females range between 81 to 92 percent as those of the values in males. In Koli, the female values in different body measurements lie between 80 and 94 percent of the male body dimension values.

DISCUSSION

From the results it is evident that sex differences are marked in the rapid fitness index, grip strength, weight, linear measurements, breadths, circumferences and skinfold measurements. Except skinfolds and pelvic breadth, the values of stature, sitting height, lower extremity length, transverse chest breadth, sagittal chest depth, biacromial breadth, bicondylar femoral breadth and circumferences are higher in males than in females. This finding is in accordance with the observations of earlier investigations (Bailey 1982, Pařízková 1977, Eveleth 1975, Stini 1975, Susanne 1975, Johnston 1980, Susanne 1980). Similarly, higher fat depositions in females have been reported in a number of populations (Eveleth and Tanner 1976).

Sex difference in adult height has its primary cause in the late onset of adolescent growth spurt and longer period of growth in boys than in girls, rather than a difference gain (Hauspie et al. 1980, Largo at al. 1980, Tanner 1962, 1975). The effect of nutritional intake and daily activity pattern on body size is well established (Stini 1969, 1975, Eveleth 1975, Hamilton 1975, Hall 1978). Though a systematic investigation on the nutritional intake is still awaited, the common trend observed suggests that the Koli males have substantially greater nutritional intake than the Koli females. In Kolis, a poor labour community having limited food resources, the difference in nutritional intake is an additional factor responsible for reduced body size in Koli females.

Grip strength of both right and left hands is nearly 6 kg more in males than in females. Similar results were reported in earlier investigations (Montoye and Lamphiear 1977, Malina 1980, Nath and Malik 1982). As strength is related to the number and absolute size of the active muscle fibres, therefore men are stronger as they have more muscle mass (Wells 1985, Sharpe and Liemohn 1986). However, because strength increases faster than the muscle size during pubertal period, the difference in muscle size may not be the only explanation for the sex difference in strength (Lamb 1978). Daily activity pattern, for example, can to a great extent influence the muscle strength (Wells 1985). Therefore the sex differences in strength in Koli can also be accorded to the differences in physiological maturity and habitual activity.

Since males have large muscle mass and lesser fat than females, they are able to generate more aerobic energy than females (Katch and McArdle 1977, Pařízková 1977, Shephard 1986). Also for reasons not clearly known, adult men have approximately 6 % more red blood cells and 10 to 14 percent greater haemoglobin concentration than women (Astrand 1956, Astrand and Rodahl 1977). This, in turn, increases the oxygen carrying capacity in men, and enables them to circulate more oxygen during exer-cise, giving them an edge over females in work capacity. The sex differences in RFI in Koli can thus be ascribed to the significantly lower fat depositions and larger muscle mass. Though it is hard to determine the contribution of haemoglobin concentration in the absence of available data on Koli, it is not possible to ignore its role either. In addition to this, some of the socio-cultural factors, such as shyness and the lesser opportunities for Koli women to do exercise vigorously and regularly, might have resulted in greater RFI values in men than in women.

Clearly, sex differences in Kolis are conspicuous in body size, muscle strength and physical fitness. Males are physically more fit, have greater grip strength than females. They are taller, heavier and possess overall larger body size, with the exception of pelvic breadth. Koli females, on the other hand, have significantly higher fat depositions. It may be concluded that the marked sexual difference in RFI in Kolis is not only because of differences in physiological parameters, body size and nutritional status, but also due to variation in physical activity patterns and social habits.

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