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ORIGINAL ARTICLE

BODY COMPOSITION AND HAND GRIP STRENGTH IN MALE BRICK-FIELD WORKERS

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Ninety two male brickfield workers and sixty sedentary individuals of 25-45 years were randomly selected from brickfields of West Bengal, India, to evaluate the body composition and hand grip strength among male brickfield workers and to compare the data with their sedentary counterparts. Assessment of body composition by skinfold measurements and determination of hand grip strength (HGS) by hand grip dynamometer indicated significantly higher ($p<0.001$) fatness, skinfold values and body mass index (BMI) among the sedentary individuals though HGS and hand grip endurance were significantly higher ($p<0.001$) among brickfield workers. BMI and %fat values indicated that the subjects were non-obese and non-overweight and regression norms for prediction of %fat from BMI in both the groups were computed as follows : Control Group : $Y = 1.647 X – 22.789$ ($r = 0.92$, $p<0.001$, SEE = 1.01), Brick-field Workers : $Y = 0.747 X – 8.398$ ($r = 0.78$, $p<0.001$, SEE = 1.34). Percentage of lean body mass (%LBM) was significantly higher ($p<0.001$) among brickfield workers whereas absolute LBM value had insignificant variation because of significant difference ($p<0.001$) in body mass between the groups. The present investigation revealed that the daily labour of the brick-field workers hindered the accumulation of body fat and extensive use of their hand and finger muscles enabled them to achieve greater arm strength. The proposed norms for prediction of %fat from BMI will also provide a first-hand impression about the body composition in the studied population.

Key words *: Brickfield workers, %fat, hand grip strength, BMI*

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Introduction

The occupational health of workers refers to the state of body which should remain free of physical and mental stress at the time of work not only for maximum productivity but also to reduce the risks of accidents and proneness to injuries (1). Health hazards in the working environment primarily arrive out of the amount of work load imposed on an individual, either because of industrial need or due to postural distress (2). Anthropometric measurements and body composition are important tools for evaluating the health status as well as nutritional pattern of individuals (2, 3, 4). Moreover, different components of body composition not only reflect various energy balances with relation to the functional and metabolic parameters of the subject, but are also highly correlated with the cardiorespiratory fitness (4, 5, 6, 7).

Skeletal muscle function is influenced by nutrition as well as cardiorespiratory fitness (8) and hand grip strength (HGS) measurement determines motor fitness or skill-related fitness of the entire skeletal musculature of the arm (9).

Several small scale industries are in existence in India of which brick-making industry is one. Despite its immense importance to mankind and society, the other parameters to judge the health and fitness status of the workers engaged in brick making

Table 1 : Physical parameters, anthropometric measurements and hand grip endurance of brick-field workers and control subjects.

Category	Age (years)	Body Height (cm)	Body Mass (kg)	BSA (m^3)	BMI (Kg/m^2)	RPI ($cm/\sqrt[3]{kg}$)	Hand Grip Endrune (min)	
							Left Hand	*Right Hand*
Control Group (N = 60)	34.61 ±4.20	168.0 ±5.13	58.45 ±6.02	1.662 ±0.04	20.71 ±2.57	43.30 ±3.46	1.82 ±0.93	2.18 ±0.86
Brick-field workers (N = 92)	35.01 ±6.51 NS	167.1 ±6.75 NS	54.64 ±5.95 #	1.608 ±0.08 #	19.57 ±2.14 @	44.03 ±4.29 NS	2.47 ±0.78 #	2.82 ±1.03 #

Values are expressed as mean ± standard deviation
NS = Not significant, # $p<0.001$, @ $p<0.01$

jobs in India and abroad have not yet been examined except for pulmonary function testing (11, 12). The present study was therefore conducted to evaluate the body composition and hand grip strength among male brick-field workers and to compare the data with their sedentary or control counterparts.

Materials and Methods

Subjects

Ninety two male brick-field workers and sixty sedentary subjects (as control group) of 25 – 45 years of age were selected for the study from different brick-fields of Hooghly district, West Bengal, India. Control subjects were randomly selected from the administrative staff of those brick-fields from which the male brick-field workers were randomly sampled. The ethical committee and managements of the brick-fields gave necessary written permission to conduct the study. All the subjects gave informed written consent to act as volunteers after being thoroughly explained about the experimental protocol to allay their apprehension and ensure maximum co-operation from them.

Age of the participants was calculated from the date of birth as recorded in their office register and body mass and body height were measured by a weighing machine fitted with height measuring rod (Avery India Ltd., India). Body mass was measured to an accuracy of $\pm$ 0.25 kg and height to an accuracy of $\pm$ 0.5 cm. Body surface area (BSA), body mass index (BMI) and Reciprocal of Ponderal Index (RPI) were calculated from the equations of DuBois and DuBois (12), Meltzer et al. (13) and Sloan (14), respectively.

Determination of body composition

Body composition was determined from skinfold measurements. Skinfolds were measured by Holtain Skinfold Caliper with constant tension (Holtain Ltd., UK) and different components of body composition were measured by using standardised equations (2, 15).

The TF or total fat determines the body's fat content in absolute value while the %fat determines the body's fat content as a percentage of body weight.

Determination of Hand grip strength

Hand grip strength (HGS) was determined by using a hand grip dynamometer (Inco, Ambala, India) to test the maximum voluntary contraction (8). The best of three trials was accepted with three minutes rest in-between (10). Hand grip endurance (HGE) was determined by asking the subject to maintain 1/3rd of the maximum HGS score for as long as the subject could (8). All the hand grip measurements were taken with the arm straight, i.e.,

Table 2 : Skinfolds and body composition of brick-field workers and control subjects.

Category	Skinfolds (mm)			Body Density (gm/cc)	% fat (%)	% LBM (%)	Total Fat (kg)	LBM (kg)
	Chest	*Abdominal*	*Midthigh*					
Control Group (N = 60)	14.46 ±2.42	20.91 ±2.45	24.56 ±2.14	1.073 ±0.008	11.32 ±4.60	88.68 ±4.61	6.61 ±1.81	51.83 ±1.81
Brick-field workers (N = 92)	8.62 ±3.15 #	14.67 ±2.61 #	18.69 ±2.75 #	1.085 ±0.006 #	6.22 ±2.05 #	93.78 ±2.05 #	3.40 ±1.29 #	51.24 ±1.30 #
Values are expressed as mean ± standard deviation NS = Not significant, # p<0.001								

at 0^0 elbow-angle (8,9).

Statistical Analysis

Unpaired two tail t-test was performed to compute the level of significance of difference between the mean values obtained in two groups. Pearson's product moment correlation and linear regression analysis were also adopted to test the relationship between different parameters and to compute regression norms, respectively.

Results

The physical parameters and hand grip endurance of control subjects and male brick-field workers are presented in Table 1 which depicts statistically insignificant inter-group variation in age, body height and RPI though body mass, BMI, BSA and hand grip endurance were significantly ($p<0.001$ and $p<0.01$) different between these two groups. Hand grip strengths measured from early in the morning, to the end of the day's work in the respective groups are presented in Fig 1. Actually the brick-field workers start working from 5am to avoid heat stress and work up to 5pm in the evening with recess periods from 7am to 9am and 12noon to 2pm. But the office workers, i.e., the control subjects (who are sedentary subjects but occasionally participate in recreational sports) of the study, work from 10am to 5pm with lunch break from 12noon to 1pm.

Table 2 shows the skinfolds and different components of body composition in the control group as well as in the brick-field workers. Significantly lower values ($p<0.001$) of skinfolds with lesser fat content have been depicted among the brick-field workers, though the total muscle content (LBM) did not show any significant inter-group variation.

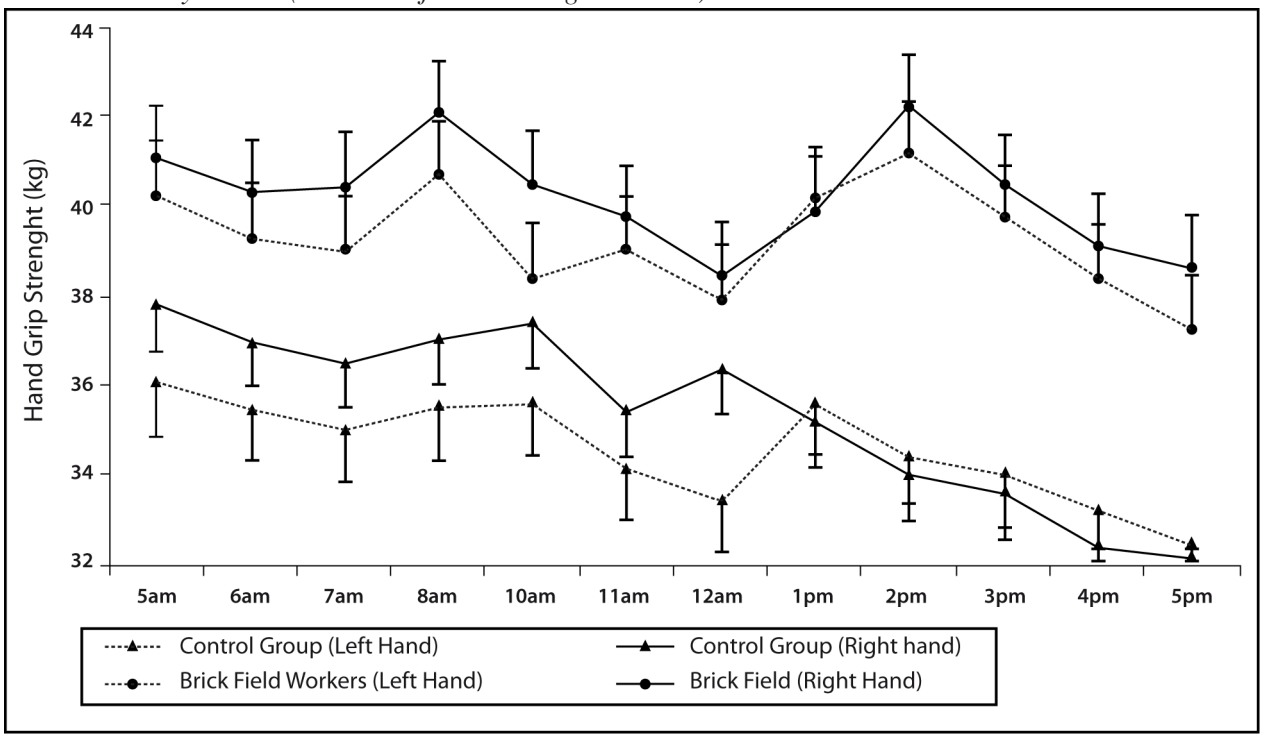
BMI indicated significant ($p<0.001$) positive correlation with %fat in both the groups and corresponding prediction norms are presented in figure 2.

Discussion

BMI, an accepted index for detection of obesity (4) is within the normal range in all the groups. Observed BMI values indicated that the subjects were non-obese and non-overweight (17) as per the available classification (13).

All the skinfolds were significantly higher ($p<0.001$) in the control group indicating that control subjects have a greater quantity of subcutaneous fat. This is also reflected in the occurrence of significantly higher ($p<0.001$) value of %fat among control subjects than the brick-field workers. Though there was a significant inter-group difference ($p<0.001$) in the BMI value, the inter-group variation in RPI (which indicates the linearity of an individual's stature) was not significant. This finding further indicated that brick-field workers have a lower extent of fat accumulation per unit of their body mass and that is perhaps the cause for existence of significant positive correlation ($p<0.001$) between BMI and %fat in both the groups (Fig 2). Regression

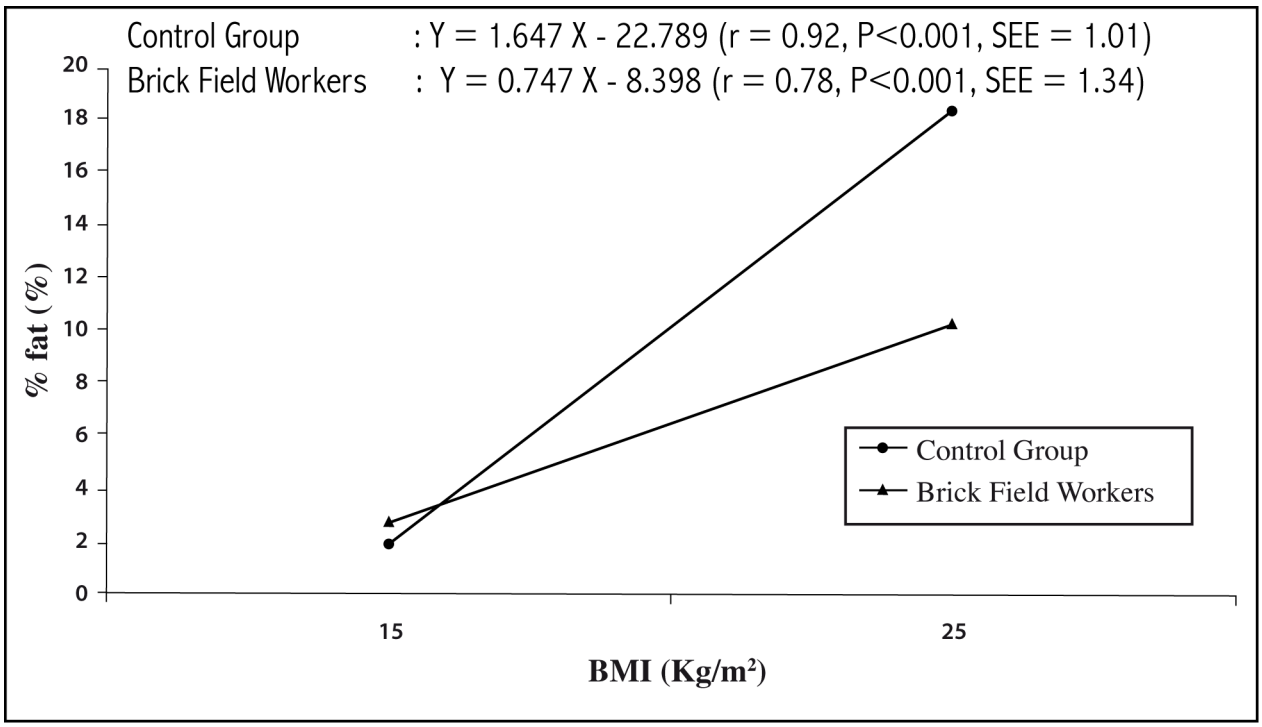
Figure 1 : Hand grip strength among brick-field workers and control subjects during different times of day's work (all the subjects were right-handed)



norms could be computed for prediction of %fat from BMI in the studied population with considerably low values of standard error of estimate (SEE). Though %LBM was significantly higher ($p<0.001$) among brick-field workers, the absolute value of LBM did not show any inter-group variation because of significant inter-group difference ($p<0.001$) in the body mass parameter.

Fluctuations in the HGS score has been depicted in both the groups (Fig 1) in day-long recording of hand muscle power by hand grip dynamometer. The brick-field workers have

Figure 2 : Regression norms for prediction of % fat from BMI in male brick-field workers and control group



significantly higher values of hand grip strength (HGS) in both the hands through out the day, i.e., during pre-working condition as well as during working schedule (Fig 1). The HGS decreased gradually with working period (either during household work or in the brick-field jobs or office work) but increased after recess periods (7am to 9am and 12noon to 2pm in case of brick-field workers and 12 noon to 1pm in case of control group, i.e., office workers). Not only HGS but also hand grip endurance was also significantly higher ($p<0.001$) among the workers. This is not surprising because of the extensive use of hand muscles as well as finger muscles for the working activities in brick-field workers. This is probably because of the fact that brick-field workers have higher percentage of LBM; the more the LBM the greater will be the energy output and the endurance capacity (2, 5, 17, 18). The HGS score in both the groups are higher than those reported for Italian males (19), Indian underweight, overweight and normal weight adolescent (8) and adolescent sportspersons of India (8, 9).

The existence of a greater percentage of muscularity among these workers than their sedentary counterparts was clearly because of their regular labour that prevented the accumulation of fat in the body. The working habits are equivalent to training schedules and available reports indicate that mild to vigorous training programmmes significantly reduce the fat weight (2, 19 - 21).

These observations reflected higher fatness among sedentary individuals than brick-field workers although variation in body linearity was insignificant. Hand grip strength and hand grip endurance were also higher among the workers involved in the brick building jobs. Moreover, the proposed norms for prediction for %fat from BMI will easily provide a first hand impression about the body composition in the studied population.

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