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Effects of Socio-Economic and Behavioural Characteristics in Explaining Central Obesity – A Study on Adult Asian Indians in Calcutta, India

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A B S T R A C T

The present cross-sectional study on adult Asian Indians in Calcutta, India was undertaken to look into the effects of socio-economic and behavioural characteristics in explaining waist-hip ratio (WHR). A total of 500 apparently healthy individuals (300 men and 200 women) were subjects in the study. A random sampling procedure using local voter's registration list was followed to select the subjects. Only one adult (≥30 years) from each household was considered as participant. A total of 24 items, 14 socio-economic and 10 behavioural characters were considered. For socio-economic characters, a number of items namely employment status, types of occupation, education status, nature of housing and marital status were taken into consideration. Smoking status, physical exercise by means of outdoor activity, drinking habits and diets on the other hand were considered as behavioural characters. Information on socio-economic and behavioural characteristics was collected using an open-ended schedule specifically designed in this regard. Anthropometric measures namely height, weight and circumference of waist and hip were obtained from participants using standard techniques. The median WHR for men and women was 0.94 and 0.90 respectively. Analysis of variance revealed significant sex difference for all anthropometric measures. It was observed that more women were leading sedentary (outdoor activity not housework was considered) life than men (85.4% vs. 75.4%). Furthermore, women were predominantly non-smokers (98.8%) whereas 40.2% men were smokers as against 51.4% ex-smokers (those who have quitted smoking during past two years). Multiple regression analysis (adjusted for age and sex) of WHR by socio-economic and behavioural characters revealed that occupation, housing, marital status, smoking condition, physical exercise, drinking habits and diets pattern cumulatively explains 75% (R^2=0.75) of total variation of WHR in the study population.

***Key words**: central obesity, socio-economic factors, behaviours, physical activity, Asians, India*

Introduction

Obesity is a chronic, socially stigmatised and costly disease that is rarely incurable and is increasing in prevalence both in developed and developing countries[1–5]. Available evidence hinted that obesity is a socially distributed phenomenon with certain sections at increased risk. Socio-economic and behavioural characteristics are known to have impact on body fat distribution but in less consistent manner[3–5]. The effects of socio-economic and behavioural characteristics in explaining obesity vary with micro-cultural variation hence characteristics also vary from one country to another. Therefore, cumulative effects of socio-economic and behavioural characteristics in identifying obesity vary across the geographical areas.

In people of south Asian origin (i.e. people originally from Indian subcontinent) central obesity alone is a powerful predictor of morbidity and mortality from a number of chronic conditions such as type-2 diabetes mellitus (T2DM), hyper-cholesterolemia, dyslipidemia, hypertension (HT) and coronary heart disease (CHD)[1]. A report[6] to redefining obesity in Asia-Pacific region stated that in Asian populations, mortality and morbidity from CHD is occurring in people with lower body mass index (BMI) and thus they tend to accumulate intra-abdominal visceral fat (IVF) without developing generalized obesity. The metabolic syndrome that has been defined as the constellation CHD risk factors is associated with striking tendency to central obesity [e.g. waist-hip ratio (WHR)] in south Asians although they are no more overweight than Europeans or Americans[7–9].

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There are studies from industrialized countries which have had examined the associations between socio-economic characteristics and obesity in general[10–16]. In industrialized country, an inverse relation between social class and obesity in women and no or less consistent association for the same in men was evident[11,12]. Obesity in general was linked cross-sectionally with marital status[13] and longitudinally with weight gain[14]. Migration status was also related with BMI. In a study on *Swedish* women reported that foreign-born women had higher body fat and central adiposity compared with resident *Swedish* women[12]. Another study pertaining to *Australians* revealed strong gender specific associations between social factors such as employment status, social class, housing situation, migration status etc., and BMI[15,16].

However, it is noteworthy to mention that no such initiative has been taken from developing countries. Furthermore, there existed virtually no study to examine the effects of socio-economic and behavioural characteristics in explaining central obesity either from developed countries or from developing countries. In view of the above, the present cross-sectional investigation on adult Asian Indians in Calcutta was aimed at to investigating the cumulative effects of socio-economic and behavioural characteristics in explaining WHR, a measure of central obesity.

Materials and Methods

Study population

The study was initiated in the first week of December 1999 and was continued up to last week of December 2004. A total of 500 apparently healthy individuals (300 men and 200 women) from Calcutta were considered under the study. The Calcutta metropolitan area has a total population of almost 1.5 millions with less than 10% illiteracy and more than 50% occupant have college degree. Furthermore, more than 65% of the total population has homeownership. However, no authenticated information on average or median income is available for the people of Calcutta. All participants were aged between 30–68 years and were more or less well educated (60% male participants vs. 41.5% female participants have had college degree) and belonged to middle to upper middle class family (as ascertained from their materials possession). A random sampling procedure using local voter's registration list was followed to select the subjects. Primary information including name, address and age of randomly selected individuals were collected from the same registration list. Prior to actual commencement of the study, written information was sent to all selected individuals and was requested to make an appointment at their respective houses in this regard. Out of 1000 (M: F=1:1) randomly selected individuals, a total 0f 500 individuals had to exclude ultimately either for their chronic illness or for their inability to participate in the study. It is noteworthy to mention that only one adult from each household was considered as participant. Pregnant women and individuals with known illness like ischemic heart disease (IHD), T2DM, HT etc., were not considered under the study.

Anthropometric measures

Anthropometric measures namely height (nearest to 0.2 cm), weight (nearest to 0.5 kg) and circumference (nearest to 0.2 cm) of waist and hip were collected from participants using standard protocols[17]. BMI and WHR were subsequently computed using standard equations.

Socio-economic and behavioural characteristics

A total of 24 items, 14 socio-economic and 10 behavioural characters were considered. Under the socio-economic characters, a number of items namely employment status, types of occupation, education status, nature of housing and marital status were taken into consideration. Smoking status, physical exercise by means of outdoor activity, drinking and diets on the other hand were considered as behavioural characters. Each item was then subdivided into a number of categories. For example, marital status was subdivided into three categories i.e. married, divorced and widow/widower. Similarly education status was subdivided into three categories viz. school (up to 10+2), college and university level. All socio-economic and behavioural information were collected using an open-ended schedule specifically designed in this regard.

Statistical analyses

Descriptive statistics for anthropometric measures and percentiles (5^{th}, 50^{th}, 85^{th} and 95^{th}) for BMI only were calculated separately for sexes. Analysis of variance (ANOVA) was also undertaken to test whether there existed any sex differences in anthropometric measures. Multiple regression analyses of WHR by covariate factors (socio-economic and behavioural characteristics) were subsequently computed and presented as beta coefficient/parameter estimate (β), value (T), percent of variance/coefficient of determinants (R^2), and R^2 change. In multiple regression analysis, R^2 change is the percent of variance explained of a dependent variable by a single independent variable amongst the independent variables.

All statistical analyses were performed using the statistical package for social sciences (SPSS, Version 10). Statistical significance (two-tailed) was set at $p<0.05$.

Results

The distribution of anthropometric variables was not significantly skewed. Intra-observer technical error of measurements (TEM) was calculated for anthropometric measures and the results were found to be within the references values as cited by different authors[17,18]. Therefore, TEM was not incorporated in the analyses.

Anthropometric characteristics of the study population were presented in Table 1. The median age for men and women was 56.2 and 55.8 years respectively with median BMI of 23.6 for men and 22.6 for women was re-

TABLE 1
ANTHROPOMETRIC CHARACTERISTICS OF THE STUDY POPULATION BY GENDER

Variables	Men (n=300)		Women (n=200)	
	Median	SD	Median	SD
Age (years)	56.2	9.2	55.8	10.0
Height (cm)***	165.6	4.6	146.2	7.8
Weight (kg)***	66.4	6.5	49.0	8.6
Body mass index (kg/m^2)**	23.6	3.2	22.6	3.6
Waist circumference (cm)***	91.4	7.6	86.2	5.6
Hip circumference (cm)*	97.4	6.5	95.0	4.6
Waist-hip ratio ***	0.94	0.04	0.90	0.02

ANOVA revealed significant sex differences at *p<0.05, **p<0.01., ***p<0.001

TABLE 2
PERCENTILES OF BMI BY AGE GROUPS AND SEX

Sex	Age groups (In years)	Percentiles			
		5th	50th	85th	95th
Men	30–39	20.4	23.6	24.6	25.0
	40–49	20.2	23.4	24.2	25.3
	50–59	20.0	23.2	24.0	24.6
	60+	19.8	22.9	23.6	24.2
Women	30–39	19.4	22.6	23.3	23.8
	40–49	19.2	22.4	23.0	24.0
	50–59	19.0	22.3	23.2	24.3
	60+	18.6	22.0	22.3	23.1

BMI – body mass index

corded. The median WHR for men and women was 0.94 and 0.90 respectively. ANOVA revealed significant sex difference for all anthropometric measures. However, no significant sex difference was observed for age.

Percentiles distribution of BMI by age groups and sex was presented in Table 2. It revealed that 95th percentile of BMI in the age group of 40–49 for male (25.3) and 50–59 for female (24.3) was the maximum (highest) BMI observed in the study.

The socio-economic and behavioural characteristics of the study population were presented in Table 3. Results revealed that 75.6% and 34.5% men and women respectively were employed wherein 40% male and 20% female were either sales person and /or personal service providers. So far as homeownership was concerned, almost 40% individuals of both sexes had residence with two or more rooms. Women in the study were predominantly non-smokers (98.8%) whereas 40.2% men were smokers as against 51.4% ex-smokers (those who have quitted smoking during past two years). More women were leading sedentary (outdoor activity not housework was considered) life than men (85.4% vs. 75.4%). Only 5.5% men and 0.2% women used to take alcohol more than twice a week. As far as diets were concerned, 4.2% male vs. 5% female was vegetarian. It was also observed that 45.5% men and 40.4% women used to consume vegetables and fruits at least thrice a week. However, it is noteworthy to mention that these percentages didn't differ significantly (using Chi-square) between sexes. Age and sex composition of the study indicated that out of total participants, 55.8% male and 50% female subjects were belonged to age group of 50–59 years.

The result of the multiple regression analysis (adjusted for age and sex) of WHR was presented in Table 4. It was observed that even after adjusted for linear effects of age and sex, independent variables viz. BMI, occupation, education status, housing, marital status, smoking, physical exercise, drinking habits and diets *cumulatively* explained 75% (R^2=0.75) of total variation of WHR. Furthermore, sedentary behaviour or physical inactivity alone explained 12.5% of total variation of WHR in the study population.

Discussion

Obesity is a major public health burden of affluent countries and is becoming increasingly widespread in many developing societies e.g. India where large-scale urbanization is taking place and in turn brings with effective changes in lifestyles attributable to evolving circumstances of chronic diseases like obesity, diabetes etc[20]. Primary and secondary prevention of obesity requires

TABLE 3
SOCIO-ECONOMIC AND BEHAVIORAL CHARACTERISTICS OF THE STUDY POPULATION BY GENDER

Items	Men (n=300)	Women (n=200)
Employment (%)	75.6	34.5
Occupation (%)		
Officials/administrators	10.6	5.5
Sales persons/personal service providers	40.0	20.0
Mechanical workers including technical persons	25.0	9.0
Government pension holders	13.0	5.0
Education (%)		
School (up to 10+2)	35.2	58.5
College	60.4	41.5
University	4.4	1.0
Housing (%)		
Own	70.8	65.5
Rented	29.2	35.5
Two or more rooms	40.6	39.2
Marital status (%)		
Married	90.6	91.0
Divorced	5.4	4.6
Widow/Widower	4.0	4.4
Smoking status (%)		
Current smokers	40.2	1.2
Ex smokers (Quit during past 2 years)	51.4	0.0
Never smokers	8.4	98.8
Physical exercise (%)		
Sedentary	75.4	85.4
30 minutes brisk walking Thrice a week (at least)	14.6	12.6
Swimming/Cycling (At least 15 minutes, thrice a week)	10.0	2.0
Drinking (%)		
Alcohol consumption (More than twice a week)	5.5	0.2
Diets (%)		
Vegetarians	4.2	5.0
Low fat and salt diets (%)	31.5	34.6
Vegetables and fruits (At least thrice in a week)	45.5	40.4
Fried snacks/ fast foods (At least thrice in a week)	15.2	20.6
Age in years (%)		
30–39	11.0	12.2
40–49	19.0	17.4
50–59	55.8	50.0
60+	14.2	20.4

strategies based on adequate knowledge about how socio-economic and behavioural factors promote weight gain[20] particularly in and around the waist. The present cross-sectional study on Asian Indians in Calcutta had examined the effects of socio-economic and behavioural characteristics in explaining WHR.

Although an outline for exploring relations between social factors and obesity had been proposed[21] however, hardly any study till date have had examined the mechanism underlying these relation. One possible reason is that these associations are attributable to differences across social groups in weight related behaviours. It seems reasonable to say that differences in food consumption, level of physical activity and other weight related behaviours completely account for differences in obesity prevalence across the societies. In the present cross-sectional examination, *healthy* behaviors by means of outdoor physical activity, dietary factors, smoking habits together with socio-economic factors would account a substantial variation (R^2=0.75 or 75%) of centralized obesity to which people of Indian subcontinent are said to be genetically predisposed. Results also demonstrated that neither social nor behavioural factors alone were as useful as the full model (i.e. both social and behavioural

TABLE 4
MULTIPLE REGRESSION ANALYSIS OF WAIST-HIP RATIO BY BMI, SOCIO-ECONOMIC AND BEHAVIORAL CHARACTERISTICS (ADJUSTED FOR AGE AND SEX)

Explanatory Variable/Predictors	Dependent variable – waist-hip ratio (WHR)		
	β	T	R^2 change
Body mass index – BMI	0.018	1.106	0.002
Occupation			
Officials/administrators	0.047	2.334**	0.035
Sales persons/personal service providers	0.828	2.217*	0.024
Mechanical workers including technical persons	0.013	1.202	0.007
Government pension holders	0.025	1.235	0.001
Education (%)			
School (up to 10+2)	0.001	1.102	0.000
College	0.022	1.123	0.002
University	0.011	1.002	0.000
Housing			
Own	0.012	1.212	0.006
Rented	0.021	1.215	0.003
Two or more rooms	0.065	2.965***	0.048
Marital status			
Married	0.013	1.201	0.005
Divorced	0.609	2.633***	0.059
Widow/Widower	0.002	1.003	0.000
Smoking status			
Current smokers	0.092	9.208***	0.034
Ex smokers	–0.697	–2.356**	0.021
Never smokers	–0.777	–2.936***	0.065
Physical exercise			
Sedentary/Physical inactivity	0.131	3.305***	0.125
30 minutes brisk walking thrice a week (at least)	–0.094	–2.947***	0.077
15 minutes Swimming/Cycling thrice a week (at least)	–1.802	–3.162***	0.061
Drinking			
Alcohol consumption (More than twice a week)	0.006	1.213	0.002
Diets			
Low fat and salt diets	0.046	2.032*	0.075
Vegetables and fruits (At least thrice in a week)	–0.609	–2.633***	0.059
Fried snacks/ fast foods consumption at least thrice in a week)	0.062	3.108***	0.046
Full model or $R^2 = 0.75$			

Significant at *p< 0.05, ** p<0.01, ***p<0.001, BMI – body mass index

characteristics) in explaining WHR among the study population.

However, it is noteworthy to mention that behavioural characters were measured at one point of time only, whereas it is likely that both kinds of obesity (general or central) results from an energy imbalance accumulated over an extended period of time[2]. Further prospective studies with repeated evaluation of both social and behavioural factors and weight changes with strict vigil on waistline are required. However, no such initiative has been initiated either from developed or from developing countries.

Previous studies suggested that smokers have lower body weights than their nonsmoking counterparts because smoking increases basal metabolism and energy expenditure[22] or because of an effect of smoking on energy intake[23]. In these studies cigarette consumption was inversely associated with BMI and was predictive of lower BMI regardless of gender. Ironically, in the present study, somewhat opposite trend was noticed. It was observed that both ex smoking and never smoking habits had significant negative impact on WHR (cumulative they had explained almost 9% of total variation of WHR) whereas positive association was established between WHR and smokers (R^2=0.034). It is noteworthy to mention that comparison (result was not shown) between smokers and non-smokers (including ex-smokers) revealed significantly (p<0.01) higher WHR for group per-

taining to smokers with no significant difference in the level of BMI between the groups. Lack of studies considering central obesity has had restricted author to compare findings with other similar findings across the social groups.

Furthermore, men and women who were divorced or had unstable union had higher WHR than persons in stable union. In fact, divorced status had explained almost 6% of total variation of WHR in the study population. This fact implies that important events in the life cycle may precipitate the onset of central obesity via psychological stress that may influence metabolism and body fat distribution[24]. Somewhat conflicting trend was observed in a longitudinal study where weight gains after marriage and weight loss after bereavement in both men and women[14].

Sedentary behaviour or physical inactivity had positive impact on waistline; in fact, sedentary behaviour alone had explained 12.5% of total variation of WHR. Similarly, low fat and salt diets along with sufficient (at least thrice in a week) intake of fruits and vegetables had cumulatively explained almost 14% of total variation of central obesity. It further demonstrated that healthy behaviour by means of outdoor physical activity and proper dietary management is important determinants for the onset of central obesity and body's fat free mass[25]. Therefore, outdoor physical activity (e.g. 30 minutes brisk walking thrice a week) with less consumption of fried foods and greater intake of fruits should be recommended to shed body fat particularly from *in* and *around* waistline.

However, the main limitation of the study was that it was performed on relatively small sample size and therefore, is not representative of the Asian Indian population. Owing to considerable ethnic and cultural heterogeneity in Asian Indian population, it is imperative to study other social groups to see the trend observed also exists among them. Results obtained from such studies would be utilized to develop effective central obesity prevention strategies. However, to best of my knowledge no real attempt in this plight has so far been attempted from Indian subcontinent.

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UTJECAJ SOCIOEKONOMSKIH OBILJEŽJA I NAČINA ŽIVOTA NA RAZVOJ CENTRALIZIRANOG TIPA DEBLJINE – ISTRAŽIVANJE ODRASLIH INDIJACA IZ KALKUTE, INDIJA

S A Ž E T A K

Transverzalno istraživanje odraslih azijskih Indijaca iz Kalkute, Indija napravljeno je s ciljem procjene utjecaja socioekonomskih obilježja i načina života na omjer opsega struka i bokova (WHR – waist-hip ratio). U istraživanju je sudjelovalo ukupno 500 zdravih osoba (300 muškaraca i 200 žena). Ispitanici su odabrani metodom slučajnog odabira korištenjem lokalne glasačke liste. Za sudionika je odabrana samo jedna odrasla osoba (≥ 30 godina starosti) iz pojedinog domaćinstva. Ukupno su uzeta u obzir 24 pokazatelja od čega 14 socioekonomskih i 10 obilježja načina života. Kao socioekonomski pokazatelji u obzir su uzeti: status zaposlenja, zanimanje, stupanj obrazovanja, uvjeti stanovanja i bračno stanje. S druge strane, navike pušenja, fizička aktivnost u slobodno vrijeme, navike pijenja alkohola i prehrambene navike uzete su kao pokazatelji načina života. Podaci o navedenim pokazateljima prikupljeni su pomoću upitnika otvorenog tipa specijalno osmišljenog za ovu priliku. Antropometrijske mjere – visina, težina te opseg struka i bokova uzeti su standardnim tehnikama. Srednja vrijednost WHR iznosila je 0,94 za muškarce i 0,90 za žene. Analizom varijance utvrđene su značajne razlike među spolovima za sve antropometrijske mjere. Utvrđeno je da više žena vodi sjedilački način života (u obzir su uzimane samo fizičke aktivnosti u slobodno vrijeme, ne i kućanski poslovi) u odnosu na muškarce (85,4% vs. 75,4%). Nadalje, žene su većinom bile nepušači (98,8%) dok je 40,2% muškaraca bilo pušača, a 51,4% bivših pušača (oni koji su prestali s pušenjem u posljednje dvije godine). Multipla regresijska analiza (prilagođena s obzirom na dob i spol) WHR-a s obzirom na socioekonomska obilježja i obilježja načina života, pokazala je da zanimanje, stambeni prostor, bračni status, navike pušenja, fizička aktivnost, navike pijenja i prehrambene navike kumulativno objašnjavaju 75% (R^2=0,75) ukupne varijacije WHR-a u proučavanoj populaciji.