A cross-sectional analysis of obesity among a rural population in coastal Southern Karnataka, India

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RESEARCH

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Abstract

Background
Obesity is a disease condition that is highly prevalent in both developed and developing countries. Obesity accounts for 60% of cases of diabetes, 40% cases of hypertension and 20% of coronary heart disease and stroke. Although obesity is a silent killer in the third world countries, there is less focus on the problem, as the nations are still staggering with problems due to infectious and parasitic diseases. So, the current study was undertaken to highlight the problem.

Method
A cross-sectional community based survey, among individuals of either sex, aged 30 years and above was carried out on 1,239 respondents, using a two-stage stratified, random sampling technique. Data was collected by personal face to face interview using a pre-designed questionnaire and analyzed using Statistical Package for Social Sciences (SPSS) version 11.5.

Results
The overweight category included 21.4% of the subjects. Obesity as per Body Mass Index (BMI) criteria was seen in 6.6% of the individuals but abdominal and truncal obesity was present among 51.7% and 62.1% respectively. Literacy up to secondary education and graduation were identified by the multivariate analysis to be associated with obesity.

Conclusion
The prevalence of central obesity was found to be high, and hence, lifestyle changes and improved physical activity needs promotion among the general population.

Key Words
Prevalence, obesity, body mass index, waist circumference, waist-hip ratio.

Background
Obesity is defined as a state of excess adipose tissue mass. Body weights are distributed continuously in populations, so that a medically meaningful distinction between lean and obese is somewhat arbitrary. Obesity is therefore more effectively defined by assessing its linkage to morbidity or mortality. Although not a direct measure of adiposity; the most widely used method to gauge obesity is the body mass index (BMI). Large scale epidemiologic studies suggest that all-cause, metabolic, cancer and cardiovascular morbidity begin to rise (albeit at a slow rate) when BMIs are ≥25. So a BMI between 25 and 30 should be viewed as medically significant and worthy of therapeutic intervention, especially in the presence of risk factors that are influenced by adiposity, such as hypertension and glucose intolerance.[(1)] The distribution of adipose tissue in different anatomic depots also has substantial implications for morbidity specifically, intra abdominal and abdominal subcutaneous fat, which have been associated with most important complications of obesity such as insulin resistance, diabetes, hypertension, hyperlipidemia and hyperandrogenism in women.
In India, a high prevalence of central obesity and overweight has been recorded in urban areas. Though the prevalence of obesity (BMI ≥30) is usually lower than that observed in the western population, the overweight category (BMI ≥25) includes almost a third to half the population in every survey. Women and men are equally affected. [(2)]

India being a culturally and socially diverse nation, differences would be noted in the region-wise prevalence of obesity, but, research regarding the same is not adequate. This inadequacy necessitated us to study the prevalence of obesity and to study the association between the various correlates for obesity. In addition, the study aimed to assess the feasibility of the conduct of a community based study to understand if the magnitude of obesity was large enough to merit attention and plan intervention measures.

Method

Institutional ethical committee clearance was obtained prior to the initiation of the study (Proposal No. KHEC -74/2006).

We conducted a cross-sectional community based survey over a period of 15 months, among individuals of either sex, aged 30 years and above. The study was carried out in the field practice area of Kasturba Medical College, Manipal, which is situated along the coastal area in the southern part of Karnataka, India. The field practice area covers a population of 45,587 living in 7,164 families spread out in 11 villages, along the coastline. The population in these villages is homogeneous in terms of occupation, socio-economic status, food habits and the findings of one village can be extrapolated to all the other villages. Study population included all men and women aged 30 years and above. Study variables included, socio-demographic characteristics, physical activity, and anthropometric measurements. Pregnant or lactating women up to 12 weeks post-partum were excluded from the study.

Considering the obesity prevalence of 3.5% for rural adults, with an allowable error of 10% and 95% confidence level, the sample size estimated was 1,107. A non-response rate of 20% required a sample of 1,328 to be studied. Two-stage stratified, probability proportional to size sampling technique was used to select the study sample. In the first stage, two villages were selected from the field practice area based on the investigator's convenience. In the second stage, random samples of the study subjects were drawn from each locality of the selected village proportional to their population sizes. The identification of the localities and the households was done with the help of the field auxiliary nurse midwife (ANM). The selection of the lane and the first house, within the locality was done by random selection by employing the procedure described in the cluster sampling technique used for evaluation of universal immunization coverage.[3] Starting from the first house onwards all the houses within the lane were covered continuously, keeping towards the left. This procedure was continued until the sample size for each locality was obtained. Written informed consent was obtained from all the subjects. During house visits, data was collected by personal face to face interview using a pre-designed questionnaire. The questionnaire included details on socio-demographic variables, anthropometric measurements and physical activity status. A pre-tested scale was used to grade physical activity into sedentary, moderate and heavy work based on their daily activities. [4] Socio-economic status was assessed using modified Uday-Parikh scale.

Weight was recorded using a standard weighing scale (Krups weighing scale, New Delhi, India) that was kept on a firm horizontal surface. Weight was recorded to the nearest 500 gm. Height was recorded using a non-stretchable measuring tape to the nearest 1 cm. Subjects were requested to stand straight in bare feet, with heels together, back against the wall, arms loosely at their side and looking forward. Frankfort plane of measurement was applied meaning that head was positioned such that the lower margins of the orbit were in the same horizontal plane as the external auditory meati, i.e., the corner of the eyes horizontal to the middle of the ear.

Body mass index (BMI) was calculated using the formula, weight (kg) / height (m^2). Waist circumference was measured to the nearest 0.1 cm at the mid-point between costal margin and iliac crest using a non-stretchable measuring tape. Hip circumference was measured at the level of the greater trochanters (widest portion of the hip) to the nearest 0.1 cm by a measuring tape, while the subject was standing with the arms by the side and feet together. Waist-hip ratio was calculated as the ratio of waist circumference over hip circumference. [5] Waist and hip circumference measurements were taken with the clothes on.

A person was considered to be obese if body mass index (BMI) ≥30 kg/m^2 and overweight when BMI ≥25 kg/m^2. Central/abdominal obesity was considered to be present when waist circumference (WC) ≥94 cm in males and ≥80 cm in females. Waist hip ratio (WHR) >1 for males and >0.85 for females was defined as truncal obesity. [6, 7]

Eligible subjects unavailable during the first house visit were approached on another pre-informed date as per their convenience. Even after two such visits if the subject was non-compliant, then he/she was considered as a non-respondent.

Prevalence of obesity and associated variables with obesity are presented as percentages. A chi-square test was used to compare the prevalence between obesity and the different correlates. To study the impact of selected socio-demographic factors, and other risk factors on prevalence of obesity, we performed a multiple logistic regression analysis with obesity as a dichotomous outcome and age, sex, religion, occupation, socio-economic status and physical activity. All statistical analysis were performed using Statistical Package for Social Sciences (SPSS) version 11.5. A p-value less than 0.05 was considered significant.

Results

The baseline characteristics of the study subjects are as shown in Table 1. The total sample studied was 1,239 (response rate of 93%) of which 434 (35%) were males and 805 (65%) were females. There was poor representation of males in the study sample as most of them were employed overseas or in the neighbouring states and many were involved in occupations such as fishing and unskilled daily wage labour and thus, were not available during the survey. Of the total study subjects, 85.6% were Hindus, 8.6% Muslims and 5.7% Christians. The literate proportion in the sample was 81.2%, out of whom 60.7% were females and

39.3% were males. Socio-economic status assessed by modified Uday-Parikh scale for rural areas showed that 70.1% belonged to middle class, 27.6% to lower class and 2.3% to upper class. Half of the study population had a normal BMI while the overweight category included 21.4% of the subjects. In the study, 6.6% of the individuals were found to be obese by BMI classification. Central and truncal obesity was predominant among the females (69.8% and 88.3% respectively). Among the individuals with normal BMI, 213 (80.4%) had central obesity while 179 (67.5%) had truncal obesity, pointing towards the characteristic features of the thin fat Indian.

Religion was found to be associated with obesity, by univariate analysis [χ^2 =6.21 (LR), p value=0.045]. The prevalence of obesity in the study population was significantly associated with education status (p=0.001) and socio-economic status (p=0.013). The unadjusted odds for secondary level of schooling and graduation were 3.69 (95% CI=1.46,9.34) and 7.71(95% CI=2.58,23.00) respectively, as compared to illiterates. The unadjusted odds ratio was found to be significant only for individuals from the middle socio-economic class (OR=2.29, 95% CI=1.22, 4.30) as compared to individuals belonging to low socio-economic class. Although occupation was not identified to be a significant risk factor in the univariate analysis, the odds of being obese were higher for skilled workers, businessmen and housewives, as compared to unskilled labourers. Physical activity was not found to be a significant risk factor (χ^2_{trend} - 0.76, p-value - 0.381).

Univariate analysis revealed religion, occupation, socio-economic status, literacy to be positively associated with obesity; while multiple logistic regression using forward LR option in analysis, retained only literacy up to secondary education (adjusted OR=3.42, 95% CI=1.34,8.69) and graduation (adjusted OR=7.58, 95% CI=2.53,22.71), as significant variables for obesity (BMI classification) as shown in Table 2. Although physical activity and occupation are known to be associated with obesity, the multivariate model did not pick up these confounders as significant variables.

Discussion

Body mass index is promulgated by the WHO as the most useful epidemiological measure of obesity. It is nevertheless a crude index that does not take into account the distribution of body fat, resulting in variability in different individuals and populations. [8] Independent of the overall level of adiposity or corpulence as assessed by the BMI, abdominal fat accumulation measured using waist circumference and waist-hip ratio, is recognized as a potent risk factor for type 2 diabetes and cardiovascular disease (CVD). [9] BMI is not considered to be a good estimate of obesity in Asian Indians as they have a characteristic obesity phenotype, with relatively lower BMI but with central obesity. Several reports suggest that for any given BMI, Indians tend to have increased waist circumference. Further, Indians also tend to have excess body fat, abdominal and truncal adiposity. For any given waist circumference, they have increased body fat accumulation and for any given body fat, they have increased insulin resistance. These features have been referred to as the 'Asian Indian Phenotype'. [10]

Our study noted a high prevalence of obesity (BMI classification) and was comparable to a few studies done in other countries and studies done on selected populations in India. [11, 12] Gopinath N et al observed that the prevalence of obesity was highest among housewives (33.9%) and lowest among unskilled workers (11.8%) (p <0.001). The prevalence rate was 32.2% in professionals and 29.2% among business community. [13] Jafar TH et al reported a prevalence of 25% (BMI ≥23 kg/m^2) for overweight and obesity obtained from data of 8,972 people aged 15 years or more from the National Health Survey of Pakistan. The factors significantly associated with overweight and obesity included greater age (adjusted OR=1.11, 95% CI=1.09-1.13), residing in urban areas (adjusted OR=2.20, 95% CI=1.62-2.99), being literate (adjusted OR=1.25, 95% CI=1.09-1.44) and belonging to high socio-economic status (adjusted OR=1.56, 95% CI=1.06-2.26). [14] The above study findings correlated well with our study.

Among Muslims with sedentary and light physical activity, 8 (12.7%) individuals had BMI ≥30 kg/m^2, while among Christians and Hindus 4 (10.8%) and 34 (6.3%) individuals had BMI ≥30 kg/m^2 respectively, in our study population. Similarly, among housewives and skilled workers with sedentary and light physical activity, 28 (7.8%) and 5 (11.6%) subjects had BMI ≥30 kg/m^2 respectively. Thus, this association between religion, occupation and obesity may be partly explained by level of physical activity in these groups, although further studies need to be done to prove the hypothesis. Similar observations have been made in Malaysia among 972 women aged 20–59 years, wherein the prevalence of obesity using WHO criteria was 16.7%. Obesity was found to be significantly associated with age (p = 0.013), ethnicity (p = 0.001), religion (p = 0.002), schooling (p = 0.020), educational level (p = 0.016) and marital status (p = 0.001). [15] Association of obesity and physical activity in adult males of Nepal, revealed that those in to the business, vocational and clerical works, those who were more literate and those in the higher socio-economic status were significantly associated with obesity even after correcting for physical activity. [16] A cross-sectional study in rural China too, reported the association of obesity with gender, diet, physical activity, education levels, and ethnicity. [17] These findings highlight the need for longitudinal studies in order to prove the hypothesis relating to the role of diet, physical activity and other socio-demographic characteristics in causation of obesity.

The interpretation and comparability of prevalence data on obesity is difficult, as the defining criteria vary for different populations and generalisability of the results is questionable. In the study, anthropometric measurements were done by a single trained investigator in order to have a uniform pattern of data collection. It is true that waist and hip circumference measurements taken with the clothes on, could lead to measurement error, but it has to be accepted that in a rural setting, taking such measurements and that too of female subjects with adequate privacy becomes a major issue. Although, such error cannot be ruled out, it

was the best that could be done in the present setting. The authors do agree that there was a poor representation of males in the study sample and that diet assessment was not included as an objective of the current study. Diet was excluded due to the practical problems of acceptability and feasibility of conducting diet surveys in the community. Nevertheless, the study provides enough evidence to initiate large scale studies on obesity and risk factors unique to this population.

Conclusion

The study brings to light the fact that obesity is gradually gaining foothold in the general population, and also that large scale community based studies could be planned and such studies need to be undertaken, as obesity is not perceived as a major threat by most people. In the present analysis, abdominal obesity was found to be high, especially among the females which need to be addressed in order to reduce the burden of this risk factor for development of other chronic diseases. It is also true that changes have been noted in the lifestyle of the population, which could have contributed to the above finding. There have not been similar studies in the past in the same region, against which comparisons could be made. So, future research in this direction is the need of the hour.

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PEER REVIEW
[AMJ office use only]

CONFLICTS OF INTEREST
The authors declare that they have no competing interests.

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Figures and Tables

Table 1: Characteristics of the study subjects

Variables	Males No. (%) n= 434	Females No. (%) n= 805	Total No. (%) n= 1239
Age group (Yrs.)			
30-39	115 (26.5)	252 (31.3)	367 (29.6)
40-49	123 (28.4)	183 (22.8)	306 (24.6)
50-59	77(17.7)	138 (17.1)	215 (17.4)
≥60	119 (27.4)	232 (28.8)	351 (28.4)
Literacy			
Illiterate	39 (9.0)	194 (24.1)	233 (18.8)
Primary (1-4)	68 (15.7)	128 (15.9)	196 (15.8)
Secondary (5-12)	282 (65.0)	452 (56.1)	734 (59.3)
Graduation and above	45 (10.3)	31 (3.9)	76 (6.1)
Occupation			
Unskilled	82 (18.9)	219 (27.3)	301 (24.4)
Unemployed / retired	117 (27.0)	6 (0.7)	123 (9.9)
Skilled	178 (41.0)	26 (3.2)	204(16.5)
Service	57 (13.1)	9 (1.1)	66 (5.3)
Housewife	0	545 (67.7)	545 (43.9)
Physical activity			
Sedentary	70 (16.1)	67 (8.3)	137 (11.1)
Light	131 (30.3)	372 (46.3)	503 (40.6)
Moderate	166 (38.2)	352 (43.7)	518 (41.8)
Heavy	67 (15.4)	14 (1.7)	81 (6.5)
BMI			
<24.9	316 (72.8)	576 (71.6)	892 (72.0)
25.0-29.9	92 (21.2)	173 (21.5)	265 (21.4)
≥30.0	26 (6.0)	56 (6.9)	82 (6.6)
Waist and hip measurements			
Central obesity	78 (18.0)	562 (69.8)	640 (51.7)
Truncal obesity	58 (13.4)	711 (88.3)	769 (62.1)

Table 2: Summary table of significant correlates for obesity*

Variable	Unadjusted OR	95% CI	p-value **	Adjusted OR#	95% CI	p-value ##
Religion						
Hindu	1.00	1.00	**0.045**	1.00	1.00	
Muslim	**2.03**	**1.05,3.91**		**2.10**	**1.07,4.08**	**0.029**
Christian	2.04	0.93,4.45		1.68	0.76,3.71	**0.193**
Literacy						
Illiterate	1.00	1.00	**0.001**	1.00	1.00	
Primary (1-4)	2.71	0.92,7.94		2.42	0.82,7.14	0.109
Secondary (5-12)	**3.69**	**1.46,9.34**		**3.42**	**1.34,8.69**	**0.010**
Graduation and above	**7.71**	**2.58,23.00**		**7.58**	**2.53,22.71**	**<0.001**
Occupation						
Unskilled	1.00	1.00	0.093	-	-	
Unemployed	1.82	0.18,18.27		-	-	
Semi skilled	2.71	0.63,11.66		-	-	
Skilled	**4.34**	**1.16,16.20**		-	-	
Business	**6.37**	**1.52,26.56**		-	-	
Professional	1.02	0.99,1.04		-	-	
Housewife	**3.81**	**1.16,12.48**		-	-	
Retired	3.01	0.73,12.34		-	-	
Seasonal occupation	2.70	0.71,10.19		-	-	
Socio-economic status						
Low	1.00	1.00	**0.013**	-	-	
Middle	**2.29**	**1.22,4.30**		-	-	
High	3.30	0.87,12.46		-	-	

* obesity based on BMI classification
** obtained by chi-square test
# obtained by multiple logistic regression analysis (forward LR method, adjusted for age and gender)
obtained by multiple logistic regression analysis