

## Predictors of Overweight and Obesity in Rural Indian Adults: A Multivariate Analysis

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### Abstract

**Background:** Rural areas, around Mysore urban agglomeration are influenced by urbanization and are in a phase of socioeconomic and epidemiological transition. Obesity has been one of the major risk factor for diabetes, hypertension and cardiovascular diseases. It is necessary to conduct epidemiological studies to know the burden and determinants of obesity, which helps in planning and implementation of any interventions and allocation of resources.

**Objectives:** i) To estimate the prevalence of overweight and obesity among adults in a rural area of Mysore district. ii) To identify the factors associated with overweight and obesity.

**Materials and methods:** 1423 individuals aged above 18 years were interviewed to collect information about their socio-demographic characteristics, risk profile and measurements of height and weight. Prevalence rate and chi square analysis for each factor was performed. Multiple logistic regression analysis was performed to identify the independent factors associated with overweight and obesity.

**Results:** The overall prevalence of overweight and obesity was 13.2% (189) and 11.5% (164) respectively. Multivariate logistic regression model showed that 45-54 age group (OR 2.30, 95% CI 1.23-4.30), professional adults (OR 3.12, 95% CI 1.36-7.14), class I socio-economic class (OR 2.30, 95% CI 1.03-5.130), increased oil intake (OR 1.50, 95% CI 1.03-2.17), sedentary physical activity (OR 1.84, 95% CI 1.13) as independent risk factors for overweight and obesity among the rural population of Mysore.

**Conclusions:** Rural population of Mysore with high socio-economic status have high BMI status similar to their urban counterparts.

**Keywords:** Obesity; Rural; Prevalence; Multivariate analysis; Mysore.

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### Introduction

Throughout most of the human history, weight gain and fat storage have been viewed

as signs of health and prosperity. Today, however as standards of living continue to rise; weight gain and obesity are posing a growing threat to the health of the people in countries all over the world.[1]

Obesity is the most prevalent nutritional disorder in western countries and among the urban population in developing countries. In recent years it has started prevailing even in rural population. This can be attributed to change in life style and physical inactivity. Obesity results from incorrect energy balance leading to an increased storage of energy, mainly as fat. It is now so common within the world's population that it is beginning to replace under-nutrition and infectious diseases as the most significant contributor to ill health. Thus, obesity should not be regarded simply as a cosmetic problem affecting certain individuals, but a serious ailment that threatens global well being.[1]

India is passing through a transitional phase of socio-economic development which has the potential of altering the nutritional status of her population groups. Rural areas, around Mysore urban agglomeration are influenced by urbanization and are in a phase of socio-economic and epidemiological transition. Due to the long-term consequences, the cost burden of obesity on the health care system is enormous.[2] A better understanding of the numbers and causes can help overcome barriers to the primary prevention of obesity for youth and adults in community

## Material and Methods

A population based Cross-sectional study was carried out at Hadinaru, Nanjangud taluk, Mysore district, Karnataka state, south India. Data collection was carried out from July 2007 to May 2008.

According to NFHS 2 survey, prevalence of overweight or obesity in rural area rose from 2% (1989) to 17% (2003), hence we took 10%, the median value of prevalence to calculate the sample size at 5% level of significance with a relative allowable error (d) of 15% on the

prevalence of overweight or obesity, using the formula  $Z_{\alpha/2} \cdot \sqrt{pq/d^2}$ . Sample size calculated was 1600 for the study.

Household was considered as a sampling unit. An average of three adults was expected in each household and to interview 1600 adults, around 535 households had to be selected. A non response of 10%, in the form of locked houses was expected during the survey and finally 600 households were intended to be studied. As per 2001 census, there were 1200 households in the village, to select 600 households, systematic random sampling technique was used and every alternate house in each lane was selected and persons aged 18 years in the selected household were included in the study. Individuals who had i) Severe chronic illness ii) Physical disability iii) Mental disability and pregnant women were excluded from the study. A total of 484 households were covered and 1423 persons were interviewed (90% response rate). Reasons for non response were locked houses, individuals who had been to work at the time of interview, who had been to a relative's house in a different village and individuals who refused to participate in the study.

Ethical clearance was obtained from the Institutional ethical committee before the initiation of the study. Informed consent was obtained from each study participant.

Data was collected by personal face to face interviews, using a predesigned questionnaire. Questionnaire included details on individual's socio-demographic characteristics, information on risk factors for obesity. Current history of hypertension/diabetes, alcohol consumption pattern, fat consumption pattern and physical activity status was obtained from each individual.

B G Prasad modified classification was used to assess the socio-economic status of the rural population, which is based on the per capita income per month.[3]

Physical activity was assessed and classified as sedentary, moderate and rigorous activity. Sedentary activity was defined, if the individual was doing routine activities and /or doing less

than 2 hours of moderate activity per day and with no active exercise or walking ( e.g. job involving desk work, mainly doing domestic activities, viewing television or reading, woman having a servant for washing and cleaning purposes). Moderate activity, if the individual was doing activities like office work, walking to the field, walking for half an hour every day, cooking with the help of motorized equipment, gardening, feeding cattle for 2-8 hrs and doing less than 2 hours of rigorous activity per day. (e.g. home maintenance activities like cooking, sweeping and mopping the floor, gardening, feeding cattle or livestock, washing linen/cloth by hand, carrying firewood, drawing water from well etc). Rigorous activity, if a person was doing activities like manual labour without the help of motorized equipment, lifting and transport of heavy weight objects etc. for more than 2 hours per day or doing moderate activity for more than 8 hours per day. (Example: agricultural work in fields, pulling a cart or rickshaw, quarry work, cycling, rowing, carpentry, masonry, women doing their household activities as well as working in field or at construction sites or doing cleaning and

washing in other's houses etc).

Based on the visible fat consumption/ person/month, the individuals were grouped into either as consuming more than 1 kg of visible fat or otherwise.[4,5]

Height was measured to the nearest 0.5 cm, with the subject standing erect without foot wear, with gaze horizontal, on which the scale was marked with the measuring tape. Body weight of the study subject was measured, to the nearest 0.5 kg using a standard Krupp's weighing machine. Subjects were instructed to wear minimal clothing (as culturally appropriate) and no footwear while their weight was being measured. Cut off levels for overweight and obesity were taken as Body Mass Index "> or =" 23 and "> or =" 25 respectively. (WHO Asia Pacific guidelines).[4] A standard mercury sphygmomanometer (Diamond Co. BP Apparatus, Pune, India) was used for recording the blood pressure. Hypertension was defined if Systolic Blood Pressure was "> or =" 140 mm of Hg and/or Diastolic Blood Pressure "> or =" 90 mm of Hg,

**Table 1: Prevalence of Overweight and Obesity among Adults in Relation to their Socio Demographic Characteristics**

Characteristics	Total n=1423	Overweight [%]	Obese [%]	p value
<b>Age</b>				
18-24yrs	243	22 [9.1]	5 [2.1]	
25-34yrs	323	40 [12.4]	24 [7.4]	
35-44yrs	286	42 [14.7]	38 [13.3]	<0.001
45-54yrs	227	35 [15.4]	37 [16.3]	
55-64yrs	176	30 [17.0]	30 [17.0]	
>65yrs	178	20 [11.9]	30 [17.9]	
<b>Sex</b>				
Female	713	86 [12.1]	85 [11.9]	0.003
Male	710	103 [14.5]	79 [11.1]	
<b>Education</b>				
Illiterate	744	89 [12.0]	73 [9.8]	
<10yrs of schooling	487	64 [13.1]	70 [14.4]	0.005
>10yrs of schooling	192	36 [18.8]	21 [10.9]	
<b>Occupation</b>				
Professional	44	11 [25]	12 [27.3]	
Agriculturist	242	43 [17.8]	31 [12.8]	<0.001
Skilled	63	9 [14.3]	5 [7.9]	
Laborer	343	31 [9.0]	17 [5.0]	
Housewives	500	72 [14.4]	66 [13.2]	
Businessmen	67	10 [14.9]	11 [16.4]	
Students/ Unemployed	164	13 [7.9]	22 [13.4]	
<b>Socio-economic status</b>				
Class I	121	29 [24.0]	36 [29.8]	
Class II	138	26 [18.8]	26 [18.8]	
Class III	401	63 [15.7]	51 [12.7]	<0.001
Class IV	484	52 [10.7]	42 [8.7]	
Class V	279	19 [6.8]	9 [3.2]	

**Table 2: Prevalence of Overweight and Obesity According to Dietary Characteristics**

Characteristics	Total n=1423	Overweight [%]	Obese [%]	p value
<b>Diet</b>				
Vegetarian	976	148 [15.2]	13 [13.4]	<0.001
Mixed	447	41 [9.2]	33 [7.4]	
<b>Oil quantity</b>				
>1kg/month/person	527	106 [20.1]	103 [19.5]	<0.001
<1kg/month/person	896	83 [9.3]	61 [6.8]	
<b>Type of oil</b>				
Palm oil	276	31 [11.2]	25 [9.1]	
Sunflower oil	544	88 [16.2]	94 [17.3]	<0.001
Ground nut oil	38	2 [5.3]	2 [5.33]	
Mixed	565	68 [12.0]	43 [7.6]	
<b>Frequency of bakery food intake</b>				
Daily	20	3 [15.0]	6 [30.0]	<0.001
Once a week	362	73 [20.2]	65 [18.0]	
Occasionally	1041	113 [10.9]	93 [8.9]	
<b>Alcohol intake</b>				
No	1292	170 [13.2]	148 [11.5]	0.948
Yes	131	19 [14.5]	16 [12.2]	

and/or on treatment with antihypertensive (JNC VII criteria).

Data analysis was performed using Epi-info software Version 3.5.3. Overall prevalence of obesity and prevalence rate (in %) for each of the factors was estimated. Statistical significance was evaluated at 5% level of significance utilizing chi-square test. Multiple logistic regression analysis was performed with obesity as the dichotomous outcome variable (dependent variable) and age, type of occupation, socio-economic status, fat intake, history of current diabetes mellitus and hypertension and physical activity as independent variables.

## Results

Overall prevalence of overweight and obesity was 13.2% and 11.5% respectively. Age wise the prevalence of both overweight and obesity was high among older age group i.e. 17% overweight among 55-64 age group and 17.9% obese among >65 years. Least prevalence of both overweight (9%) and obesity (2%) was seen among 18-24 age group. Prevalence of overweight was more among males (14.5%) than females (11.9%). Prevalence of obesity was high among professional adults (27%) and least among labourers (5%). A significant positive

correlation of was observed with socio-economic class and prevalence of overweight and obesity. (Table 1)

Higher prevalence of overweight and obesity was observed among vegetarians, adults consuming more than 1 kg oil per month, adults consuming sunflower oil and those who daily consumed bakery products. (Table 2)

Higher prevalence of both overweight and obesity was observed among those adults who had history of diabetes (25.7%, 48.6%) and hypertension (20.7%, 33.8%). Our study showed the inverse relation between level of physical activity and prevalence of overweight and obesity. (Table 3)

The independent factors associated with the prevalence of overweight/obesity were

**Table 3: Prevalence of Overweight and Obesity According to Clinical Characteristics and Physical Activity**

Characteristics	Total n=1423	Overweight [%]	Obese [%]	p value
<b>H/O of Diabetes</b>				
No	1388	180 [13.0]	147 [10.6]	<0.001
Yes	35	9 [25.7]	17 [48.6]	
<b>H/O of Hypertension</b>				
No	1210	145 [12.0]	92 [7.6]	<0.001
Yes	213	44 [20.7]	72 [33.8]	
<b>Physical activity</b>				
Sedentary	500	70 [14.0]	103 [20.6]	
Moderate	510	79 [15.5]	47 [9.2]	<0.001
Rigorous	413	40 [9.7]	14 [3.4]	

**Table 4: Multivariate Correlates of Obesity**

Characteristics	Unadjusted Odd's ratio 95%CI	p value	Adjusted Odd's ratio 95%CI	p value
<b>Age</b>				
18-24yrs				
25-34yrs	0.29 [0.17-0.49]	0.001	1.03 [0.45-2.39]	0.929
35-44yrs	0.58 [0.38-0.89]	0.014	1.54 [0.79-3.02]	0.202
45-54yrs	0.91 [0.60-1.39]	0.684	2.30 [1.23-4.30]	0.009
55-64yrs	1.09 [0.71-1.69]	0.677	1.73 [0.95-3.15]	0.073
>65yrs	1.22 [0.77-1.92]	0.390	1.78 [0.99-3.20]	0.052
<b>Occupation</b>				
Student/unemployed				
Professional	4.03 [2.00-8.12]	0.000	3.12 [1.36-7.14]	0.007
Agriculturist	1.62 [1.02-2.57]	0.04	1.58 [0.86-2.9]	0.143
Skilled	1.05 [0.52-2.12]	0.885	1.61 [0.71-1.9]	0.26
Labourer	0.60 [0.37-.97]	0.03	1.49 [0.83-2.7]	0.23
Housewives	1.40 [.92-2.14]	0.114	2.12 [1.2-3.8]	0.00
Business	1.68 [.89-3.18]	0.109	1.40 [0.66-2.9]	0.38
<b>Socio-economic status</b>				
Class V				
Class I	10.40 [6.12-17.66]	<0.001	2.30 [1.03-5.13]	0.041
Class II	5.42 [3.22-9.12]	<0.001	1.85 [0.94-3.62]	0.072
Class III	3.56 [2.27-5.56]	<0.001	1.67 [0.97-2.89]	0.062
Class IV	2.16 [1.37-3.39]	0.001	1.56 [0.95-2.55]	0.073
<b>Education</b>				
>10yrs of schooling				
Illiterate	0.65 [0.46-0.94]	0.022	0.3 [0.1-1.4]	0.98
<10yrs of schooling	0.89 [0.62-1.29]	0.571	1.8 [0.78-1.93]	0.07
<b>Diet</b>				
Vegetarian				
Mixed	2.01 [1.51-2.68]	<.001	1.36 [0.93-1.99]	0.106
<b>H/O of Diabetes</b>				
Yes				
No	0.10 [0.04-0.23]	<0.001	0.26[0.10-0.66]	0.005
<b>H/O of hypertension</b>				
No				
Yes	4.91 [3.62-6.65]	<0.001	0.41[0.17-0.96]	0.042
<b>Frequency of bakery food intake</b>				
Occasionally				
Daily	3.31 [1.35-8.10]	0.009	0.64 [0.21-1.90]	0.426
Once a week	2.49 [1.92-3.24]	<0.001	1.24 [0.79-1.94]	0.347
<b>Physical activity</b>				
Rigorous				
Sedentary	3.51 [2.50-4.94]	<0.001	1.84 [1.13-2.99]	0.013
Moderate	2.18 [1.53-3.09]	<0.001	1.55 [0.98-2.45]	0.061
<b>Oil quantity</b>				
< 1kg/ month/ person				
> 1kg/ month/ person	3.43 [2.67-4.40]	<0.001	1.50 [1.03-2.17]	0.032

identified by performing multivariate logistic regression analysis. Multivariate logistic regression model showed that 45-54 age group (OR 2.30, 95% CI 1.23-4.30), professional adults (OR 3.12, 95% CI 1.36-7.14), class I socio-economic class (OR 2.30, 95% CI 1.03-5.13), increased oil intake (OR 1.50, 95% CI 1.03-2.17), sedentary physical activity (OR 1.84, 95% CI 1.13-2.99) were independently associated with the prevalence of overweight and obesity among rural adults. (Table 4)

## Discussion

Overall prevalence of obesity was 11.5%; with

marginally higher prevalence in females i.e. 11.9% than males 11.1%, whereas the prevalence of overweight was higher in males 14.5% than females 12.1%. In contrast, a study among Bengalee women by Mithu Bhadra *et al*[6] showed a higher prevalence of 17.45% of obesity and 37.42% of overweight. A study by Venkatramana *et al*[2] among rural population of Andhra Pradesh showed a prevalence of obesity among females (2.7%) than males (1.03%) and higher prevalence of overweight among males (13.3%) than females (9.7%), which is similar to our study. After puberty both males and females display a marked increase in appetite for fat, but the rise is much earlier and to a greater extent in females, which

increases their risk of becoming obese. Prevalence of obesity increased from 2% in 18-24 years age group to 17.9% in >65 years age group. This linear relationship between age and prevalence rate of obesity was also seen by N Gopinath *et al*. [7] The prevalence of obesity had an inverse relationship with level of education in the present study. This may be attributed to education which brings awareness about diet and consequences of obesity. Haq Nawaz *et al* [8] found that 33% of below high school level educated subjects, 27% of high school educated subjects and 23% above high school (college) educated subjects were overweight. But as per NFHS-2, prevalence rate of obesity in females increased with higher educational status. [9] This can be attributed to sedentary lifestyle which most of the educated and working class women follow. In a study of obesity among north Indian women by Agrawal *et al* [10] it was found that women working as professional/technical/managers were more prone to be overweight and obese than those working in other fields, which was similar to the present study.

A significant correlation of higher socio-economic class and prevalence of overweight and obesity among rural adults was the striking factor in our study. Various research studies by Singh *et al*, [11] Griffiths and Bentley *et al*, [12] Dhurandhar and Kulkarni *et al*, [13] on obesity in India have found prevalence to be higher among economically betteroff persons. A higher prevalence of overweight among high-socio economic group has been postulated to be linked to cultural norms that may favour fat body shapes. [14] Cultural practices concerning food and physical activity are also possible explanations for the higher BMI among high-socio economic group. It has been shown that higher income groups in India consume a diet containing 32% of energy from fat compared with 17% in lower-income groups. [15] It is possible that high-socio economic status women in India still face multiple barriers to engage in physical activity and healthy eating habits despite having more knowledge about healthy food, healthy behaviour and resources. [12]

Sedentary activity resulted in higher prevalence of overweight and obesity in our

study. "The surgeon general's report on physical activity and health" [16] mentioned that "low levels of activity, resulting in fewer calories used than consumed, contribute to high prevalence of obesity". Sedentary work demands considerably less energy when compared to moderate work, if calorie intake remains higher than the requirement a positive energy balance occurs, if it persists for long term can lead to weight gain. Anita P Naidu *et al* also found that, obesity was relatively more in the subjects doing sedentary work, they observed that 95% of male obese and 96% of female obese subjects were sedentary workers. [17]

Food habits are the way in which individuals or groups of person responses to social and cultural pressures, choose, consume, and make use of available foods. [18] As populations become more westernised, dietary composition changes to include more saturated fat and less fibre.

Higher prevalence of overweight and obesity among known diabetic and hypertensive subjects in the study matches with the observations made by N Gopinath *et al* and Haq Nawaz. [7,8] Swami *et al* [20] found that prevalence of hypertension was 82.5% among overweight elderly in comparison to 45.8% among non-overweight.

High socio-economic status, physical activity and dietary habits are the significant factors for positive change in the BMI status of adults, by logistic regression results which matches the result of other studies. [11,17]

## Conclusion

One fourth of the rural population in Mysore are either overweight or obese. High socio-economic status of an individual determines the food pattern and physical activity of the rural adults and thereby their high BMI status. A behavioural change communication is essential for the rural people so that they adopt a physically active lifestyle and thus reduce obesity related morbidities.

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