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Original Research Article

Prevalence of Obesity in Rural and Urban Areas of Puducherry and Comparison of Its Correlates and Comorbidities among Obese and Non-Obese Individuals

Dr. Ramya. M. R[1], Dr. Seetharaman. N[2], Lokeshmaran. A[3], Dr. Hema Priya. S[4]

[1]Assistant Professor, Dept. of Community Medicine, SriVenketeshwara Medical College & Research Center, Puducherry.
[2]Professor and Head, [3]Statistician,
Department of Community Medicine, Mahatma Gandhi Medical College & Research Institute, Puducherry.
[4]Assistant Professor, Dept. of Community Medicine, IRT, Perundurai Medical College, Perundurai, Erode, Tamil Nadu.

Corresponding Author: Dr. Ramya.M.R

ABSTRACT

Background: Obesity is a cluster of non-communicable diseases called "New World Syndrome" and is one of the most neglected public health problems. Obesity is the risk factors for type 2 diabetes, hypertension, cardiovascular diseases, cancers and many more diseases. Aims: To document the prevalence of obesity among adults in Rural and Urban areas of Puducherry and to compare the prevalence of Diabetes and Hypertension among obese & non-obese individuals.

Methods and Materials: A community based cross-sectional study was conducted in the rural and urban areas of Puducherry among 20-60 years age group by simple random sampling technique and 237 individuals were selected from each group. Information regarding socio-demographic characteristics, dietary habits, and height, weight, and blood pressure and blood sugar values were recorded. The data were analyzed and the prevalence was expressed in percentage. Chi-square and unadjusted odds ratios were also used.

Results: The overall prevalence of obesity was 20.46%. The prevalence of obesity among urban area (29.53%) was significantly higher than the rural area (11.39%)($P< 0.001$).The prevalence of obesity was statistically significant with family history of obesity, high intake of junk food($p< 0.001$). About 55.67% and 69.1% were diabetic and hypertensive and their prevalence were significantly higher among obese individuals ($p<0.001$).

Conclusion: The prevalence of obesity were found to be high and hence it can be prevented by changing the lifestyle modification and routine screening of all obese individuals is important for early identification of various comorbidities so that many complications can be prevented.

Key words: Obesity, New World Syndrome, Public health problem, Diabetics, Hypertension

INTRODUCTION

In recent decades, our world is facing a group of health conditions nicknamed "The New World Syndrome" emerging from the increasing sedentary life styles, social and dietary changes. Numerous scientific studies have reported that obesity is the most important risk factor for many diseases such as diabetes, hypertension, osteoarthritis, cardiovascular diseases, some forms of cancers and many more.

A recent World Health Organisation (WHO) report estimates that globally, the obesity prevalence has been more than doubled. More than 1.9 billion adults above 18 years were overweight and among them, over 600 million were obese. The

prevalence of overweight was 39% and obesity was 13%. [1]

According to National Family Health Surveys (NFHS-4), the level of obesity increased from 13.92% in 2005-06 to 19.56% in 2015-16 among women and among men the level increased from 10.35% to 18.04%. Also the urban population is more prone to be obese than rural. In Puducherry, the obesity prevalence was 36.7% among women (15-49 age groups). [2]

Obesity is caused by the abnormal growth and deposition of adipose tissues resulting from either enlargement of fat cells (hypertrophic obesity) or increase in number of fat cells (hyperplastic obesity) or a combination of both. [3]

According to the WHO definition, a body mass index (BMI) of 25 and above is overweight and a BMI of 30 and above is obese. [1] These cut-off values were meant for the global population; however, recent studies have lower cut-offs have been recommended for use. [4-6]

It is evident from the recent studies that increasing BMI escalates the risk of developing comorbidities. A community based quantitative and qualitative assessments of the prevalence and correlates of obesity among the urban and rural population of India is essential to plan and implement a better system for the promotion and protection of individual's health. Taking this issue into consideration, we have taken up a comparative study of the prevalence of obesity and its co-morbidities among adults living in the rural and urban areas of Puducherry.

Aims and objectives:

1. To document the prevalence of obesity among adults aged 20-60 years in a Rural and Urban areas of Puducherry.
2. To compare the socio-demographic and lifestyle factors among obese and non-obese individuals.
3. To compare the prevalence of Diabetes & Hypertension among obese & non-obese individuals.

MATERIALS AND METHODS

A community-based cross sectional study was carried out to document the magnitude of the obesity and its correlates in rural and urban areas of Puducherry. The study was conducted after getting the clearance from Institutional Human Ethics committee. The study was conducted for a period of one year from Sept 2014- Oct 2015. The inclusion criteria of the study were individuals of both sexes belonging to 20-60 years age group and those who were living in rural and urban areas of Puducherry for more than 6 months. The exclusion criteria were pregnant and lactating mothers, bedridden, seriously ill and comatose patients.

The sample size for this study was calculated using the formula recommended in the "WHO Manual for Sample Size Determination in Health Studies-1999", as the prevalence of obesity of adults in India is 2.1% (BMI > 30 is considered as obesity). [7]

p = 0.021

q = 1 - p = 0.979

l = 0.02 (taking 2% as absolute error)

Zα= 1.96 i.e. 5%,

$$n = 1.96 \times \frac{0.021 \times 0.979}{0.02 \times 0.02}$$

n = 197

Accounting for a 20% non-response rate, the sample size was 237, each for the urban and rural areas. Total sample size = 2 X 237 = 474

Names of all individuals were taken from the health centres records. There were a total of 3857 and 2965 'eligible' subjects in urban and rural health centres registers. Individuals were serially numbered and simple random sampling technique was used. House-to-house visits were done and written informed consent was obtained. The primary study tool was a semi-structured questionnaire which included socio-demographic characteristics like age, gender, occupation, socio-economic status, personal and dietary habits, etc. Height and weight were measured as per WHO

recommendation on anthropometric measurements. [8]

The formula used for calculating BMI was weight in kilograms divided by square of height in meters. Using the calculated BMI, the individuals were classified based on World health classification for Asians. [4] The blood pressure was measured as per JNC8 recommendation. [9]

Blood sugar values were measured using a standardized glucometer. Random blood glucose concentration ≥120 mg/dl with or without classical symptoms of diabetes was the operational definition of diabetes for the current study.

The collected data was entered in Microsoft excel; analyzed using SPSS version-16 and Epi-info version 7.1.3.0 statistical packages. Chi-square tests and unadjusted Odds Ratios were used to compare proportions and for quantifying the strength of associations.

RESULTS

A total of 474 adults were studied from the Urban and Rural areas in an effort to document the magnitude of obesity and its correlates. The mean age of the study group was 41.05 (± 10.6) with most (28.69%) in the 30-39 age group and least (17.72%) in the 20-29 age group. Overall, there were more females (58.86%) than males and this female predominance was more pronounced in the 20-29 age-group, where nearly 62% were females.

Among the rural populace, 29.54% were in the 40-49 age groups while 19.41% were in the 20-29 age groups. Among the urban populace, 30.80% were in the 30-39 age groups while 16.03% were in the 20-29 age groups.

Table/Fig 1: Body Mass Index based on geographical distribution (N=474)

Nutritional status (BMI)	Total (%)	Rural (%)	Urban (%)	Chi-square (p value)
Underweight (<18.5)	12 (2.53)	3 (1.26)	9 (3.79)	
Normal (18.5-22.9)	91 (19.20)	45 (18.98)	46 (19.40)	
Overweight (23-27.4)	274 (57.81)	162 (68.35)	112 (47.25)	31.19 (<0.001)
Obese (>27.5)	97 (20.46)	27 (11.39)	70 (29.53)	
Total (%)	474 (100)	237 (100)	237 (100)	

Table/Fig 2: Obesity and socio-demographic characteristics (N=474)

Socio-demographic characteristics		Total	Obese (%)	Non Obese (%)	Odds Ratio (95%CI)	Chi-square (p value)
Age-group						0.345 (0.951)
	20-29	84	17 (20.24)	67 (79.76)	1	
	30-39	136	30 (22.06)	106 (77.94)	1.115 (0.571-2.177)	
	40-49	129	26 (20.16)	103 (79.84)	0.995 (0.501-1.972)	
	50-60	125	24 (19.20)	101 (80.80)	0.937 (0.467-1.874)	
Gender						0.452 (0.502)
	Female	279	60 (21.50)	219 (78.50)	1.169 (0.740-1.849)	
	Male	195	37 (18.97)	158 (81.03)	1.000	
Region						23.966 (<0.001)
	Urban	237	70 (29.54)	167 (70.46)	3.260 (2.000-5.312)	
	Rural	237	27 (11.39)	210 (88.61)	1.000	
Education						5.829 (0.212)
	Illiterate	103	19 (18.45)	84 (81.55)	1	
	Primary	75	20 (26.67)	55 (73.33)	1.608 (0.787-3.283)	
	Middle	190	33 (17.37)	157 (82.63)	0.929 (0.498-1.733)	
	Higher secondary	42	7 (16.67)	35 (83.33)	0.884 (0.341-2.291)	
	Graduate and above	64	18 (28.12)	46 (71.88)	1.730 (-0.190-3.619)	
Occupation						7.344 (0.394)
	Daily labour	131	28 (21.37)	103 (78.63)	1.000	
	Farmer	9	1 (11.11)	8 (88.89)	0.460 (0.055-3.832)	
	Clerical job	19	4 (21.05)	15 (78.95)	0.981 (0.301-3.190)	
	Business	22	9 (40.91)	13 (59.09)	2.547 (0.987-6.565)	
	Unemployed	58	10 (17.24)	48 (82.76)	0.766 (-1.065-1.704)	
	Housewife	162	33 (20.37)	129 (79.62)	0.941 (0.534-1.657)	
	Fisherman	5	1 (20)	4 (80)	0.920 (0.098-8.559)	
	Others	68	11 (16.18)	57 (83.82)	0.710 (0.329-1.531)	
Socio-economic status*						4.156 (0.385)
	Class I	15	6 (40)	9 (60)	1.000	
	Class II	106	19 (17.9)	87 (82.1)	0.328 (0.104-1.030)	
	Class III	130	25 (19.2)	105 (80.8)	0.357 (0.116-1.096)	
	Class IV	178	37 (20.8)	141 (79.2)	0.394 (0.131-1.176)	
	Class V	45	10 (22.2)	35 (77.8)	0.429 (2.096-1.494)	

* - Socio-economic classification based on modified Prasad Classification

The prevalence of obesity was found to be 16%, 23.94%, 22.73% and 14% among smokers, who consume alcohol, betel nut chewers and tobacco chewers. The observed association of prevalence of obesity and personal habits was not statistically significant.

Out of 259 married women, the prevalence of obesity was 75% among nulliparous women while it was 17.30% among females who had >3 pregnancies. The difference observed had statistical significance (<0.05).

The prevalence of obesity was 57.50% among who had family history of obesity compared to 17.05% among those who reported no family history of obesity. The observed association between the prevalence of obesity and family history of obesity was found to be statistically significant (p value <0.001).

Dietary habits and obesity

The prevalence of obesity was 26.32% and 20.22% among vegetarians and those consumed mixed diet but the difference observed was not statistically significant. The prevalence of obesity among those consuming vegetables for >3times/week (16.9%) was lower when compared to those consuming vegetables <3times/week (25%) and the difference observed was statistically significant (p<0.03). The risk of being obese among those who consumed vegetables for <3times/week was 1.6times that of those who consumed >3times/week. The prevalence of obesity among those who had not consumed fruits (past one week) (30.8%) was higher than those who had consumed fruits for >3times/week (15.4%). The difference observed was found to be statistically significant (p<0.003). The risk of being obese among those who never consumed fruits were 2.4 times odds of being obese than those who consumed fruits for >3times/week. The prevalence of obesity among those who reported to have consumed 'junk foods' for >3times/week (53.8%) was more when compared with those who reported to have not consumed 'junk foods' (20.2%) during the past one week. The difference observed was statistically significant. There was 4.6 times risk of being obese among those who eat junk foods for >3times/week than those who never eat junk foods.

Table/Fig 3: Prevalence of Diabetes among obese & non-obese individuals (N=474)

	Total N	Diabetic (%)	Non-diabetic (%)	Odds ratio (95%CI)	chi square (p value)
Obese	97	54 (55.67)	43 (44.33)	13.000(7.653-22.39)	113.3 (<0.001)
Non-obese	377	33 (8.75)	344 (91.25)	1.000	
Total	474	87	387		

Among 97 obese individuals, 55.67% were diabetic and among 377 non-obese, only 8.75% were diabetic. The observed difference in the prevalence of diabetes among obese and non-obese individuals was found to be statistically significant (p<0.001). The risk of being diabetic was 13 times higher among obese individuals than those who were non-obese (Table/Fig 3).

Table/Fig 4: Prevalence of hypertension among obese & non-obese individuals (N=474)

	Total N	Hypertension (%)	Non-hypertension (%)	Odds ratio (95%CI)	Chi square test (p value)
Obese	97	67 (69.1)	30 (30.9)	17.813(10.412-30.475)	146.218 (<0.001)
Non obese	377	42 (11.1)	335 (88.9)	1.000	
Total	474	109	365		

Among 97 who were obese, 69.1% were found to be hypertensive and among 377 non-obese individuals, only 11.1% were found to be hypertensive. The observed difference in the prevalence of hypertension among obese and non-obese individuals had statistical significance (p<0.001). The risk of being hypertensive was 17 times higher among obese than non-obese (Table/Fig 4).

Table/Fig 5: Prevalence of comorbidities among study population (N=474)

Comorbidities*	Number	%
Dyslipidemia	20	4.22
Breathlessness	45	9.50
Coronary heart disease (CHD)	32	6.75
Osteoarthritis	89	18.78
Cancer	5	1.05
Menstrual irregularities	31	6.54
Impaired fertility	16	3.38

* - multiple responses elicited

Table/Fig 6: Distribution of other comorbidities among obese and non-obese (N=474)

Comorbidities	Obese (97)	Non-obese (377)	Chi-square (P value)
Dyslipidemia			25.446 (0.000)
Yes	13 (13.4)	7 (1.9)	
No	84 (86.6)	370 (98.1)	
Breathlessness			11.658 (0.001)
Yes	18 (18.6)	27 (7.2)	
No	79 (81.4)	350 (92.8)	
Coronary Heart Disease			27.001 (0.000)
Yes	18 (18.6)	14 (3.7)	
No	79 (81.4)	363 (96.3)	
Osteoarthritis			6.562 (0.10)
Yes	27 (27.8)	62 (16.4)	
No	70 (72.2)	315 (83.6)	
Cancer			1.185 (0.276)
Yes	2 (2.1)	3 (0.8)	
No	95 (97.9)	374 (99.2)	
Menstrual irregularities			8.623 (0.003)
Yes	13 (21.7)	18 (8.2)	
No	47 (78.3)	201 (91.8)	
Impaired fertility			0.030 (0.863)
Yes	3 (3.1)	13 (3.4)	
No	94 (96.9)	364 (96.6)	

The prevalence of dyslipidemia was 13.4% and 1.9% among obese and non-obese individuals. The observed association had statistical significance (P<0.001). The prevalence of breathlessness among obese and non-obese individuals was 18.6% and 7.2%. The observed difference was statistically significant. (P<0.001). The prevalence of CHD was 18.6% among obese and 3.7% among the non-obese individuals. The observed association between obesity and CHD was statistically significant. (p<0.001). The prevalence of menstrual irregularities was 21.7% and 8.2% among obese and non-obese individuals. The association between obesity and menstrual irregularities was statistically significant. (p<0.05). (Table/Fig 6)

DISCUSSION

In this section, we would be discussing the findings of our study in relation to other similar studies and exploring the possible reasons behind the various findings.

In the current study, among 474 adults, the overall prevalence of Overweight was 57.81% and Obesity was 20.46%. In a similar study done in Pune, the prevalence of obesity was 43% among adults. [10] Another study done in Kerala, the obesity and overweight prevalence was 40.7% and 24%. [11] The current study uses the most recent WHO recommended cut-off values for Asian populations for Overweight/Obesity classification whereas most of the studies cited here have used cut-offs that are either lower or higher than the ones used in the current study.

The prevalence of obesity in urban area (29.53%) was high when compared to the rural areas (11.39%). When compared to the national average also the urban area has more prevalence than the rural area. [2] This was lower than the prevalence of obesity estimated in a study done in Hyderabad, with 37% in urban area [12] and 25% in rural area. [13] Interestingly, in our study, the prevalence of overweight was actually higher among the rural group (68.5%) compared to urban group (47.25%). According to a study done in Surat, the prevalence of obesity was lower when compared to our study with 12.8% in rural and 14.6% in urban area. [14] In this study, the mean age was 41.05 with most (28.69%) in the 30-39 age group; we had more females (58.86%) than males (41.14%) but no statistical significant difference between obesity and gender. According to National Family Health Survey4 about 20.7% of women and 18.6% men were overweight and obese among adults aged 15-49 years. [2] Also in a study done in Westbengal, the prevalence of obesity was highest among females (29.33%) than males (9.67%) and there was statistical significance between obesity and gender. [15] This shows that obesity is more prevalent in urban area and among female population.

In the current study, the prevalence of obesity among graduates (28.12%) was

higher when compared to illiterates (18.4%) and the difference showed no statistical significance. A study has reported a high statistical significance between obesity and educational status with prevalence of 42.2% among individuals who had higher secondary and above and 15.7% among high school educated. [16] In the present study, the obesity prevalence was found to be highest among business people (40.91%) and lowest among farmers (11.11%). This is probably because of the largely passive work culture practised by business people compared that with the farmers. The difference in prevalence of obesity observed among the different occupational groups had not statistically significant though. In the study done in Chennai, the prevalence was more among retired/ old age dependent (50%) and lowest among unskilled workers (23.7%). The difference was not statistically significant. [16] In the current study; the prevalence of obesity was 40% in class 1 and 18.6% in class V socio-economic status as per modified Prasad classification. The difference had no statistical significance. Whereas in a study done in Calicut, the prevalence of obesity was high in class IV (31.56%) and lowest among class I (8.33%) socioeconomic status as per Prasad classification and the difference had statistical significance. [17]

In our study, the prevalence of obesity is 16%, 23.94%, 22.73% and 14% among smokers, alcoholic, betel-nut chewers and tobacco chewers respectively. No statistical significance was observed between obesity and personal habits in our study. A similar study [18] reported a prevalence of 14.10% among alcoholic and 18.73% among tobacco chewers. The difference in prevalence of obesity was found to be statistically insignificant.

Out of 259 married women, 4 women were nulliparous women, out of which 3 women were found to be obese and out of 104 women who conceived >3times, 18 were found to be obese. A study done in Chennai, reported a statistical significance between number of pregnancies and overweight/obesity. [16]

In the present study, the prevalence of obesity was found to be 57.50% among those who had family history of obesity and 17.05% among those with no family history of obesity. High statistical significance was found between prevalence of obesity and family history of obesity. In a similar study, the prevalence of obesity/overweight among those who has family history of obesity was 55.5% and that among those without family history of overweight/obesity was 23.6% and the difference was statistically highly significant. [18]

In the current study, we noticed no statistical significance between obesity and type of diet. In another study, the prevalence of vegetarian was 53.12% and mixed diet was 46.87%. No significant association observed. [19] In this study, prevalence of obesity was lower among those who consume vegetables for >3times/week than those who consume <3times/week and the difference were statistically significant. In a previous study, consumption of vegetables in relation to obesity/ overweight was found to be statistically insignificant. [16] In the present study, the prevalence of obesity among those who had not consumed fruits was higher than those who consumed fruits for >3times/week. The observed difference was found to be statistically significant. In a similar study the obesity was more among those who consumed fruits less frequently and the difference was statistically significant. [16] In the current study, the prevalence of obesity was more among those who consumed junk foods for >3times/week than those who have not consumed junk foods during past one week. The difference observed was statistically significant. In a similar study, there was statistical significance found between obesity and fast foods. [10]

In the present study, among 97 obese and 377 non-obese individuals, 55.67% and 8.75% were found to be diabetics and 69.1% and 11.1% were found to be hypertensive. The observed difference in the

prevalence of diabetes and hypertension among obese and non-obese individuals was found to be statistically significant. A similar study was done in Hyderabad among rural and urban obese individuals, 3.74% and 12.16% had hypertension and 0.78% and 13.52% had diabetics. [12, 13] In a study done in Punjab, a high prevalence of hypertension (64.07%) and diabetes (35.94%) in obese individuals were observed and the differences were statistically significant. [19]

In our study, among obese individuals, the prevalence of dyslipidemia was 13.4%, breathlessness was 18.6%, coronary heart disease was 18.6% and menstrual irregularities were 21.7%. The observed associations of obesity with dyslipidemia, breathlessness, coronary heart disease, menstrual irregularities were statistically significant. In a study done in Hyderabad, among rural and urban obese individuals 26.58% and 31.08% had joint pains, 5.06% and 8.01% had respiratory diseases and 1.35% had Coronary artery disease. [12, 13]

CONCLUSION

Based on our objectives and the methodology employed, we found out that the overall prevalence of obesity among our study group is 20.46%. The prevalence of obesity was more in urban areas (29.53%) when compared to rural areas (11.39%) and is more common among females (21.50%) than males (18.97%). The traditionally observed difference in obesity levels among urban and rural communities seem to be slowly blurring. Though the prevalence of 'obesity' (BMI $\geq$27.5) was lower in rural areas, the prevalence of 'overweight' (BMI 23-27.4) was actually higher among rural populace.

The prevalence of obesity correlated significantly with positive family history of obesity, high intake of junk foods. The prevalence of hypertension, diabetes and coronary heart disease between both the genders were found to be significantly higher among obese individuals. Hence changing the lifestyle modification can prevent it.

Thus, routine screening of all overweight and obese individuals is important for early identification of various comorbidities so that many complications can be prevented.

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