

# Determinants of Obesity among Rural Adults in South India – A Cross Sectional Study

Rajalakshmi M.<sup>1</sup>, Amol R. Dongre<sup>2</sup>

<sup>1,2</sup> Department of Community Medicine, Sri Manakula Vinayagar Medical College and Hospital,  
Puducherry, India.

## ABSTRACT

### BACKGROUND

Obesity is characterized by abnormal or excessive fat accumulation and is one of the major health concerns affecting young children, adolescents, and adults, the world over. The main predisposing factors for many non-communicable diseases are overweight and obesity which has high mortality than underweight. Hence, we aimed to study the determinants of obesity.

### METHODS

A cross-sectional study was undertaken among the representative sample of 590 adults in 50 villages of Villupuram district, Tamilnadu. Data was collected by house-to-house survey. Data collection was done using WHO Step questionnaire step-1 and step-2. Analysis was done using SPSS 24 software package.

### RESULTS

The overall prevalence of overweight and obesity was 18.3 % and 33.6 % respectively. Female gender, less physical activity and less consumption of vegetables and fruits were identified as significant risk factors for obesity.

### CONCLUSIONS

More than half (52 %) of adults have overweight or obesity, and some of the factors identified as determinants are preventable. Hence, primordial preventive measures should be applied for reducing BMI in early phase of life especially school going children.

### KEYWORDS

Community, Determinants, Overweight, Obesity, Rural

*Corresponding Author:*

*Dr. Rajalakshmi M.,  
No. 2, 4th Cross Street,  
Sri Moogambigai Nagar,  
Reddiyarpalayam,  
Puducherry-605010, India.  
E-mail: drrajalakshimaha@gmail.com*

*DOI: 10.18410/jebmh/2020/540*

*How to Cite This Article:*

*Rajalakshmi M, Dongre AR.  
Determinants of obesity among rural  
adults in South India – a cross sectional  
study. J Evid Based Med Healthc 2020;  
7(45), 2621-2625. DOI:  
10.18410/jebmh/2020/540*

*Submission 10-08-2020,  
Peer Review 20-08-2020,  
Acceptance 28-09-2020,  
Published 09-11-2020.*

*Copyright © 2020 Rajalakshmi M. et al.  
This is an open access article  
distributed under Creative Commons  
Attribution License [Attribution 4.0  
International (CC BY 4.0)]*

## BACKGROUND

Obesity can be defined as an increase in a person's body weight with respect to his height, but this definition is very simple and is not capable of explaining the aetiologically complex phenotypes of obesity, like those arising out of various metabolic abnormalities and other causes. So many such conditions can't be explained just in terms of body weight and height.<sup>1</sup> Obesity is one of the international health concerns affecting young children, adolescents and adults and it is a leading risk factor for global death and disability and associated with various conditions include diabetes mellitus, cerebrovascular accidents, cardiovascular diseases and carcinomas.<sup>2</sup> Body weight regulation is an intricate interaction between socioeconomic, environmental, and genetic factors, finally, personal behaviours show a leading role in controlling excess body weight.<sup>3</sup>

As per World Health Organization (WHO) 'The World Health Statistics 2019 report' the burden of overweight and obesity among the adults aged 18 years and over were 39 % and 13 % respectively.<sup>4</sup> According to WHO, morbidity and mortality due to obesity are higher when compared to underweight. The factors associated with decreased risk for obesity includes dietary pattern and physical activity. Increased consumption of fresh fruits and vegetables and adequate physical activity helps to remain healthy and control body weight.<sup>5</sup> Hence, the current study was planned to find the determinants of obesity.

## METHODS

The study was conducted in the villages of field practice area of the Rural Health and Training Centre (RHTC) of our tertiary care teaching hospital situated in Thiruvannainallur block of Villupuram district in Tamilnadu by the Department of Community Medicine. The RHTC runs special clinic for non-communicable diseases (NCDs) where screening for obesity and other NCDs were done weekly once on Thursdays. There were around 2100 patients registered and availing services in NCD clinic.

### Study Population and Design

A cross-sectional study design was adopted for our study which was conducted in the rural community among the adult population of the age group 25 to 60 years.

### Sample Size, and Sampling

Epi Info software version 3.5.4 was used to calculate sample size, where the prevalence of hypertension, which is a prevalent NCD, as 33 % based on various studies reported from Tamil Nadu<sup>6</sup> and keeping 1.5 as a design effect. The sample size was further inflated, considering 15 % as non-response among the respondents in the local community. Thus, the final sample size was 590 respondents. A list of all 50 villages of three Primary Health Centres

(Thiruvannainallur, Iruvelpattu, and Sirumadurai) in Villupuram district in Tamil Nadu was obtained from Block Development Office of Thiruvannainallur. Representative sample of 590 participants was selected by two-stage cluster sampling method. Population proportional to size method was adopted to select 30 clusters from the list of 50 villages. To begin with, cluster interval (3935) was calculated by dividing the total number of population (118,072) and the number of clusters. Later, a random number (3352), which lied between one and cluster interval was generated using the random number generator in Epi Info software. At the second stage, 20 respondents (25 - 60 years) were selected from each selected cluster by the "random walk" method.<sup>7</sup> To reach the sample size of 590, from the first 29 clusters, 20 respondents were selected, and in the last cluster, ten respondents were selected.

### Tool Used for Data Collection

The WHO STEP questionnaire step-1 and step-2 was used to collect information on sociodemographic variables such as age, gender, sociodemographic status, addiction to tobacco and alcohol use, fruits and vegetable consumption and physical activity.<sup>8</sup> Pilot testing of questionnaire on a convenient sample of 30 adult respondents (25 - 60 years) in the area other than the study site using a "conventional pilot testing technique"<sup>9</sup> was done.

### Data Collection Procedure

House-to-house visit by the trained investigators for the selected respondent by conversational interview technique, where if required, the respondents were offered clarifications on the asked questions. The English version of the questionnaire was administered by the native Tamil speaking investigator.

Informed consent was obtained. WHO steps questionnaire which was pre-designed and pre-tested was utilized to collect data on their sociodemographic details. The socioeconomic status was assessed by the color of ration card. The educational status was classified as illiterate, primary (1 - 5 standards), middle school (6 - 8 standards), high school (9 - 10 standards), higher secondary (11 - 12 standards) and degree.

Lifestyle factors such as fruits and vegetable consumption, physical activity and history of addiction were measured. Information on self-reported hypertension, diabetes, and healthcare seeking for this condition was collected.

### Operational Definitions

As per World Health Organization the following operational definitions were used in the present study.

Definition of "ever smoker" and "current smoker" were one who had smoked at least once in their lifetime and one who had smoked for past 1 month respectively.<sup>8</sup>

"Past users" of alcohol was defined as one who had consumed alcohol within the past 1 year. The amount of alcohol consumed per day was classified based on a number

of cuttings of alcohol. One cutting was taken as equivalent to 45 ml of alcohol.<sup>8</sup>

Physical activity was measured as one of the risk factors for NCD. The person was labelled as physically inactive when metabolic equivalent was < 600 per week, and the person was said to be physically active when metabolic equivalent was > 600 per week.<sup>10</sup>

**Anthropometric Measurements**

WHO - Steps standards of anthropometric measurements guidelines was used for measuring height, weight, waist circumference, and hip circumference.<sup>11</sup> According to standards for adult Asian Indian, BMI value < 18.5 was categorized as underweight, 18.5 - 22.9 was categorized as normal, between 23 - 24.9 as overweight, and ≥ 25 as obesity.<sup>12</sup> Males with waist circumference value > 90 cm and females > 80 cm was considered as abnormal. Waist-hip ratio value > 0.9 for males and > 0.85 for females was considered as abnormal.

In addition, blood pressure was measured for all the respondents using a mercury sphygmomanometer in the upper limb. Since the participants had already been seated for 15 min for behavioural measurements, blood pressure was measured immediately after the step one questions. Three blood pressure measurements were taken 3 min apart, and the average was taken.<sup>11</sup> Blood pressure was classified as per the Joint National Committee (JNC) eight guidelines, when systolic blood pressure (SBP) < 120 mm Hg and diastolic blood pressure (DBP) < 80 mm Hg were classified as normal, SBP 120 – 139 mm Hg or DBP 80 – 89 was classified as prehypertension and SBP ≥ 140 mm Hg or DBP ≥ 90 mm Hg was classified as hypertension.

**Ethical Issues**

SMVMCH Research Committee and Institutional Ethics Committee (human studies) (IEC No – 85 / 2014) clearance was obtained before initiating the study. Those respondents, who were newly diagnosed hypertensive were referred to our RHTC for free medical treatment.

**Data Entry and Statistical Analysis**

Data was entered into Epi Info (version 3.5.4) software package. IBM Statistical package for the social science, version 24 (SPSS Inc., Chicago, Illinois, USA) package was used for statistical analysis.

Descriptive statistics for sociodemographic variables were calculated. Chi-square test was applied to proportions to test the level of significance. The level of significance was fixed at 5 %. StatCalc program in Epi Info software was used to calculate 95 % confidence interval (CI) values.

Bivariate analysis and multivariate analysis was performed to find out the associations (odds ratio) between "Overweight and Obesity" (dependent variable) and 10 independent variables such as age category, gender, socioeconomic status, marital status, history of addiction, physical inactivity, dietary (fruits and vegetable consumption) practices and comorbidities.

Bivariate analysis of outcome variables (overweight and obesity) with various available risk factors and the resultant unadjusted odds ratio (OR) along with its 95 % confidence intervals were analysed to find significant associated factors. Adjusted OR was calculated by multivariate logistic regression analysis to know the variables that best predict the risk of development of overweight and obesity among the study sample. The level of significance was set at 5 %.

The study followed the guidelines of "Strengthening the Reporting of an Observational Study in Epidemiology" (Strobe Checklist) for reporting the cross-sectional study.

**RESULTS**

As shown in Table 1, out of 590 respondents 71 [12 %; CI: 9.4 - 14.6] were underweight, 108 [18.3 %; CI: 15.1 - 21.4] were overweight and 198 [33.6 %; CI: 29.7 - 37.3] were obese. The overall prevalence of overweight and obesity was found to be 51.8 % (CI: 46.2 - 55.4).

Characteristic	Number (n = 590)	n (%)	Unadjusted OR (95 % CI)	P Value	Adjusted OR (95 % CI)	P Value
<b>Age Group</b>						
25 - 34	149	79 (53)	1.064	0.744		
≥ 35	441	227 (51.5)	1			
<b>Gender</b>						
Female	304	176 (57.9)	1.650	0.003	1.643	0.003
Male	286	130 (45.5)	1			
<b>Socioeconomic Status</b>						
Above Poverty Line (APL)	483	246 (50.9)	1	0.336		
Below Poverty Line (BPL)	107	60 (56.1)	1.230			
<b>Marital Status</b>						
Married	538	278 (51.7)	1	0.765		
Others	52	28 (53.8)	1.091			
<b>Tobacco Use</b>						
Yes	113	67 (59.3)	1.450	0.080		
No	477	239 (50.1)	1			
<b>Alcohol Use*</b>						
Yes	112	56 (50)	0.912	0.661		
No	478	250 (52.3)	1			
<b>Physical Activity</b>						
Active	294	160 (54.4)	1	0.016	1	0.027
Inactive	296	146 (49.3)	1.815			
<b>Fruits Consumption in a Typical Week</b>						
Never consumed to consumed 1 - 2 days	490	251 (51.2)	1.164	0.491		
≥ 3 days consumption	100	55 (55)	1			
<b>Vegetables Consumption in a Typical Week</b>						
Never consumed to consumed 1 - 2 days	32	10 (31.3)	2.485	0.020	2.458	0.022
≥ 3 consumption	558	296 (53)	1			
<b>Comorbidities</b>						
Hypertension	72	40 (55.5)	1.296	0.392		
Diabetes	35	14 (40)	1.507			
Normal	483	252 (52.2)	1			

**Table 1. Binary and Multivariate Analysis of Determinants of Overweight and Obesity (n = 590)**

In bivariate analysis, the female respondents had 1.650 times higher odds of developing overweight and obesity compared to males. The odds of developing overweight and obesity was 1.164 times high among participants who never consumes to consumes vegetable 1 to 2 days in a week compared to those who consumes ≥ 3 days in a typical week. As compared to physically active, physically inactive had 1.815 times higher odds of developing overweight and obesity. Diabetes patient had 1.507 times higher odds of

developing overweight and obesity. In multivariate analysis, four factors such as female participants, physically inactive and those who never consumes to consumes vegetables one or two days in a week emerged as predictors of obesity.

## DISCUSSION

We found that 18.3 % were overweight and 33.6 % were obese. Thus, overall, 52 % of the respondent had a problem of overweight and obesity. The significant determinants were female gender, less physical activity and less consumption of vegetables and fruits.

Overall, in India the prevalence of obesity was 20.7 percent. In a National Family Health Survey (NFHS) across the various states and Union Territories in India found the prevalence of obesity as 13.6 % in Madhya Pradesh, 19.9 % in West Bengal, 26 % in Manipur, 30.9 % Tamilnadu, 33.2 % in Andhra Pradesh, 33.5 % in Delhi and Goa and 36.7 % in Puducherry.<sup>13</sup> Thus, the prevalence of obesity showed considerable inter-state variations where the values ranged from 13.6 % to 36.7 %, which are relatively low among north states of India as compared to southern states in India. Such a variation in prevalence of obesity between northern and southern states in India could be due to socio-economic status and education level which are positively associated with the prevalence of obesity by Jayawardena et al.<sup>14</sup>

Rengma et al in North-East India found that adults in the age groups of 40 - 49 years, those completed education  $\geq$  9<sup>th</sup> standard, part time occupation and with monthly income  $\geq$  Rs 10000 were significant determinants of overweight and obesity.<sup>15</sup> Mungreiphy et al studied the relationship of ethnicity with overweight / obesity and they found that Manipur adults have high central adiposity due to androidal pattern of fat deposition.<sup>16</sup> Chhabra et al in Delhi found that higher income group, urban residents and female gender had higher odds of overweight or obesity.<sup>17</sup> Little et al among rural South Indians found that the reasons for higher BMI / obesity were as people in south India have higher wealth index, very less consumption of non-vegetarian fatty diet, increased n-6 polyunsaturated fatty food consumption, absence of livestock, very minimal physical activity, sedentary behaviours (television viewing), low rurality index and high caste.<sup>18</sup> An another study done in Puducherry by Venugopal et al found that physically inactivity as significant determinant of Metabolic syndrome.<sup>19</sup>

It is cumbersome to develop an intervention strategy for older adults as they have chronic disabling diseases, low basal metabolic rates, varied calorie requirements, work related stress and greater reductions in energy requirements. Behaviour change communication strategy need to be planned to make these target population adapt to physical activity. Health belief model focusing on the individual's fear about complications of obesity need to be utilized to promote sustained behaviour change in older adults at the individual level. But an effective BCC (Behaviour Change Communication) strategy integrating two or more models may be applied in mass approach. The type and frequency of physical activity need to be altered depending

on the individual's health status which includes diabetes mellitus, hypertension, cardiovascular diseases and osteoarthritis. We need to create an enabling surrounding like walking in figure of eight, for the females in order to ensure their privacy and convenience.

The strength of the study was, first it was being done in a representative sample, selected in a wider geographical area of three Primary Health Centres in a rural setting. Secondly, the present study used a valid and pre-tested questionnaire for NCD surveillance in our community setting. However, the limitations of cross sectional such as temporality of association between exposures and outcome cannot be assured.

## CONCLUSIONS

The prevalence of obesity was found to be high. Hence, primordial preventive measures at the level of school and college going children by creating awareness regarding physical activity and healthy diet should be applied for reducing BMI as it may have a better impact on community. Special efforts must be made to improve physical activity and dietary habits of the individuals from early age so that the occurrence of obesity can be prevented.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

Financial or other competing interests: None.

Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

## REFERENCES

- [1] Hurby A, Hu FB. The epidemiology of obesity: a big picture. *Pharmacoeconomics* 2015;33(7):673-689.
- [2] Chan RSM, Woo J. Prevention of overweight and obesity: How effective is the current public health approach? *Int J Environ Res Public Health* 2010;7(3):765-783.
- [3] Hebebrand J, Hinney A. Environmental and genetic risk factors in obesity. *Child and adolescent psychiatric clinics of North America* 2009;18(1):83-94.
- [4] World Health Organization. *World Health Statistics*. 2019. [https://www.who.int/gho/publications/world\\_health\\_statistics/2019/en/](https://www.who.int/gho/publications/world_health_statistics/2019/en/)
- [5] Tetens I, Alinia S. The role of fruit consumption in the prevention of obesity. *Journal of Horticultural Science and Biotechnology* 2009;84(6):47-51.
- [6] Subburam R, Sankarapandian M, Gopinath DR, et al. Prevalence of hypertension and correlates among adults of 45-60 years in a rural area of Tamil Nadu. *Indian J Public Health* 2009;53(1):37-40.
- [7] Chromy JR. *Probability Proportional to Size (PPS) Sampling*. SAGE Research Methods, 2008. <https://www.srmo.sagepub.com/view/encyclopedia-of-survey-research-methods/n405.xml>. [Last accessed on 2020 Apr 16].

- [8] World Health Organization. WHO STEPS Instrument. [http://www.who.int/chp/steps/STEPS\\_Instrument](http://www.who.int/chp/steps/STEPS_Instrument). [Last accessed on 2020 Jun 15].
- [9] Presser S, Couper MP, Lessler JT, et al. Methods for testing and evaluating survey questions. American Association for Public Opinion Research. *Public Opin Q* 2004;68(1):109-130.
- [10] World Health Organization. Global Physical Activity Questionnaire (GPAQ) Analysis Guide. [http://www.who.int/chp/steps/resources/GPAQ\\_Analysis\\_Guide.pdf](http://www.who.int/chp/steps/resources/GPAQ_Analysis_Guide.pdf). [Last accessed on 2020 May 12]
- [11] World Health Organization. Section 3: Guide to Physical Measurement (step 2) Overview. [http://www.who.int/chp/steps/Part3\\_Section3.pdf](http://www.who.int/chp/steps/Part3_Section3.pdf). [Last accessed on 2020 Apr 12].
- [12] World Health Organization. Western Pacific Region. The Asia-Pacific perspective: redefining obesity and its treatment. 2000. <http://www.wpro.who.int/nutrition/documents/docs/Redefiningobesity.pdf>. [Last accessed on 2020 May 16].
- [13] National Family Health Survey (NFHS-4). India Fact Sheet 2015-16 [cited Jun 30]. <http://rchiips.org/NFHS/NFHS-4Report.shtml>
- [14] Jayawardena R, Byrne NM, Soares MJ, et al. Prevalence, trends and associated socio-economic factors of obesity in South Asia. *Obes Facts* 2013;6(5):405-414.
- [15] Rengma MS, Sen J, Mondal N. Socio-economic, demographic and lifestyle determinants of overweight and obesity among adults of Northeast India. *Ethiop J Health Sci* 2015;25(3):199-208.
- [16] Mungreiphy NK, Dhall M, Tyagi R, et al. Ethnicity, obesity and health pattern among Indian population. *J Nat Sci Biol Med* 2012;3(1):52-59.
- [17] Chhabra P, Chhabra SK. Distribution and determinants of body mass index of non-smoking adults in Delhi, India. *J Health Popul Nutr* 2007;25(3):294-301.
- [18] Little M, Humphries S, Patel K, et al. Factors associated with BMI, underweight, overweight and obesity among adults in a population of rural south India: a cross-sectional study. *BMC Obesity* 2016;12(3):1-13.
- [19] Venugopal V, Dongre AR, Saravanan S. Prevalence and determinants of metabolic syndrome among the rural adult population of Puducherry. *Indian J Community Med* 2019;44(1):21-25.