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## **Nutrition Correlates of Obesity: Eating Behaviors and Physical Activity Pattern among Adult Men and Women**

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### **ABSTRACT**

**Background:** Etiology of obesity varies among populations, eating and activity behaviors contribute to weight gain.

**Objectives:** The present study aimed to identify eating behaviors and activity pattern of adults with different body weights.

**Method:** This Study considers 60 normal and 140 overweight and obese male and females. Subjects in varying body weights were selected through Purposive sampling. Relevant data obtained using questionnaires. Standard techniques used to measure height, weight, skin fold thickness.

**Results:** Activity pattern and activity cues for normal, overweight and obese male and female were similar. Eating behaviors varied, overweight and obese individuals had 4-5 meals per day against 2-3 meals in normal weight people. Munching habit was significantly higher in obese and overweight subjects and commenced in childhood. Eating while watching TV, chatting and study were higher among obese. The frequency of eating different foods was not different in the 2 groups. Eating cues showed significant differences. Thinking about food, cannot wait for eating, at least taste, pleasure in eating was significantly higher among overweight and obese as compared to normal. Body fat percent was significantly higher in obese individuals.

**Conclusion:** It seems that Poor activity cues and high eating cues and munching habit influence weight gain, considered as behavior change in weight management.

**Key Words:** Obesity; Eating behavior; Physical activity.

### **INTRODUCTION**

Prevalence of overweight and obesity is increasing worldwide at an alarming rate. <sup>(1)</sup> According to recent global estimates, more than one billion people are overweight and 250 million of these are clinically obese. In developing countries like India, obesity coexists with under nutrition. High rates of obesity prevalence is attributed to environments that foster sedentary lifestyles and dietary intakes and eating behaviors linked to positive energy balance. <sup>(2)</sup> Eating behaviors especially eating away from home, predominance of junk food eating increased consumption of

processed foods and lack of knowledge about nutrition are the prime factors positively correlated with overweight and obesity. <sup>(3)</sup> Principally, obesity is associated with a net positive energy balance, wherein, genetic, environmental and psychosocial factors contribute enormously. <sup>(4)</sup> Physical activity has shown to have a positive influence on body weight and inversely proportional to weight change. <sup>(5,6)</sup> Hence the absolute etiology for obesity varies due to geographical locations.

Identifying factors responsible for obesity in communities or populations with high obesity prevalence rate is essential to

pin point modifiable factors. Such information would form bases for developing programs to effectively tackle obesity problem. <sup>(7)</sup> Eating and activity behaviors undoubtedly are correlates of obesity. Eating Behaviors per se include varied actions, feelings, and attitudes towards food. Essentially place of eating, food selection, controls of eating quantity are the measurable parameters. Psychological associations relating to food are the subjective factors that motivate individuals to eat or not to eat. These have been referred in the literature as eating cues, environment also contributes to eating cues; therefore, eating cues, in general, are potential influencing factors associated with obesity. <sup>(8-10)</sup> Activity cues also contribute to obesity; similarly, environment presents activity cues. Hence, these are considered as accessible factor for behavior change in populations for weight management. <sup>(11,12)</sup> The present work was undertaken with the perspective to investigate the relative importance of eating behaviors and physical activity pattern existing in people with normal weight and obesity in city from South India.

## METHODOLOGY

**Study Design:** The present investigation was a quantitative observational study conducted on free living men and women aged 25-50 years. The study was conducted in a major city from South India.

**Sampling design and techniques:** Purposive sampling was employed. Men and women who appeared to be overweight and obese were contacted, they were explained about the objectives of the study and requested to participate. Health clubs, gyms centers, and hospitals were also visited to contact the target population. Those who volunteered to provide information for the study were asked to sign a consent letter on their free will to participate in the study.

**Study population:** 400 subjects were approached, 140 overweight and obese cooperated to complete the questionnaires

and provided complete information. Hence, the population of the present study comprised 140 obese and overweight (67 male and 73 females). Age and gender matched subjects with BMI 18.5-24 were selected in the ratio of 1:2.2- 1:2.5 (normal: overweight and obese) based on their willingness to participate. 60 subjects with normal BMI volunteered (31 males and 29 females).

### Tools for data collection:

1. **Demographic and general information:** information regarding age, religion, education status, occupation status, and economic status and sleep pattern of the participants was obtained using pretested questionnaire prepared for the purpose. It also included questions about type of recreation practiced commonly.
2. **Socioeconomic status (SES):** SES was derived based on subjective information such as occupation, Type of house, vehicle, Education possessed and household gadgets used. Each of these variables was scored and a total sum of scores was distributed into three equal scores and named low, middle and high SES. In the present study the sum of total scores ranged between 5 (least score) to 22 (highest), it was considered <9 as low. 10-15 as middle, more than 16 as high SES. The participants were designated to be in low SES, middle or high depending on their respective scores.
3. **Eating behavior:** This was a detailed questionnaire that included questions relating to eating behavior and practices, likes and dislikes, eating outside home, munching habit, meal skipping etc.
4. **Eating cues:** This was a close ended questionnaire adopted from eating attitude questionnaire. This contained Quarries to depict desire to eat/avoid eating at different situations and attitudes towards eating.
5. **Activity pattern:** The Global Physical Activity Questionnaire (GPAQ) V2.0,

developed by WHO for physical activity surveillance in countries was adopted. It provides information on physical activity of participation in three settings (or domains) Activity at work, Travel to and from places, Recreational activities, as well as sedentary behavior.

- 6. Anthropometric measurements:** Height, weight, skin fold thickness at biceps and triceps, body circumferences such as waist and hip circumference were measured using standard techniques as demanded by Jellifies (WHO Monograph 53).<sup>(13)</sup>

### Statistical Analysis

The data was computed and analyzed for statistical significance; the primary analysis was implemented using SPSS version 21. The data was analyzed for descriptive statistics and the results are presented as mean, SD, and percentages. In order to compare the means, Chi-square and ANOVA were employed. The correlation was also employed to see the association among the factors.

## RESULTS AND DISCUSSION

Demographic characteristics and the general information of the participants are presented in Table 1; it is evident that major proportion of the participants belonged to Hindu religion, while small percentage was Muslims and Christians. All the participants were literates; nearly 50% of them were highly educated and possessed professional and professional master degree. The job status of the participants revealed that 92-100% males and 62-90% females were on jobs. A Higher percentage of women were married (52-64%) as compared to men participants (48%). 50% of participants were from Middle socioeconomic status and only 16- 24% obese and 3-27% normal men and women respectively belonged to the high-income group.

It is evident from table 2 that 28 and 40% of the participants were overweight and obese. Among the obese, a markedly higher proportions were in (67 to 74% of

men and women) obese I category, only 11 to 18% were very obese and were in category II and III. Lifestyle profile of the subjects is presented in tables 3 and 3a, subjects with both normal and higher body weights were found to have lifestyle pattern essentially similar. However, Small differences existed in social activity pattern, a higher percentage of normal weight individuals were socially active as compared to overweight and the obese. It is well documented that sleep is known to be affected by weight; obese individuals are reported to suffer from sleep apnea. In the present study, however higher percentage of normal weight individuals reported poor sleep and pathologically obese had poor sleep.

It is obvious from table 4 that eating behaviors are markedly different among normal weight and obese individuals, indicating a definite association between eating behaviors and weight status. Nonvegetarian practices were more common among obese subjects and percent of non-vegetarians increased linearly with higher body weight status. A further number of meals consumed per day was higher among obese people; a maximum number of meals per day reported by normal weight was 4-5 while the overweight and obese subjects reported to consume 6-7 meals a day. Skipping meals and munching was also found to be more prevalent among obese. Certain contemporary behaviors were also noted such as eating outside home and munching, small differences in every behavior were noted between normal and abnormal weight subjects. It can be seen that behaviors such as skipping meals, munching, age since munching commenced, the frequency of eating outside home occurred in relatively similar percentage. Munching behavior exhibited extremely significant association ( $P = 0.003$ ) to overweight and obesity, wherein the munching prevailed in significantly higher proportion among the obese. Eating attitude was also assessed, attitudes such as “thinking about food”, “cannot wait for

eating”, “cannot avoid at least tasting” and “have pleasure in eating” exhibited extremely significant association to weight status. Least scores were for normal weight while highest scores were found for obese in varying BMI categories.

Physical activity is indicative of body status; it is well-known that lack of physical activity promotes fat accumulation eventually leading to overweight and obesity. Activity pattern is part of lifestyle in contemporary societies, environment put forth sedentary cues; hence, it is important to assess physical activity of individuals in general and obese people in particular. Obese and overweight were less active as compared to the normal weight participants.

Obesity and overweight among populations have considered as a threat to nations development. In developed countries obesity is considered as a social problem, nevertheless, developing countries are competing with developed countries in the rate of obesity prevalence. Etiology and the nature of the problem, in developing countries, however, are different in developing countries. Nutrition transition has explained partly the role of food availability, eating attitude and pattern of eating in causation of obesity. The association between activity levels and weight status is well recognized, therefore exercise is considered as an essential metabolic component for maintaining health and ideal body weight.

Nations confronting obesity as a public health issue have introduced strategies for a comprehensive awareness program as public health approach. Literature provides ample research evidence indicating behavior change approach to be effective in regulating body weight in the population. In order to develop nutrition programs for obesity reduction meant for public use, detailed understanding of the dietary behaviors of the target population is essential. This will create bases to identify potential mediators of program behaviors

and action directing weight management. Our results have sorted the unique differences in lifestyle variables and eating behaviors among overweight and obese individuals. Overweight and obesity are prevalent in all the SES, the general profile of obese and non-obese subjects has remained essentially similar. People with normal weight experienced poor sleep more than those of overweight. Fifty percent of participants with pathological obesity were found to experience poor sleep.

Eating behaviors, in general, differ among obese and overweight individuals as compared to normal weight participants, however; our results indicated a statistically significant association between a few behaviors. Most important are a number of meals consumed per day, practicing non vegetarianism and munching. Munching habit exhibited statistically significant association to overweight and obesity. Although munching was observed to be a common behavior prevalent in the selected population, it appeared to have a positive influence on obesity. Attributes of munching like, time of munching and age from when started also were found to have a statistical association. Munching behavior has therefore potent obesogenic effect.

Eating attitude is a powerful mediator for appetite; associating eating attitudes to overweight and obesity revealed useful information to speculate meal size or frequency of eating occurring in populations. Such information is vital for developing strategies for behavior change by identifying the right approach for behavior change or effective nutrition education program to tackle obesity. Activity pattern also varied profoundly among the two comparative groups; participants with normal weight had markedly higher MET for physical activity, transportation, and recreation. Although contributions from each of these activity components were small but has made marked effect on total energy expenditure.

**Table 1: Demographic characteristics of the participants (%)**

Variables	Characteristics	Obese and Overweight		Normal weight	
		Gender		Gender	
		Males	Females	Males	Females
No.	-	67	73	31	29
Age (yrs)	25 -34	41(61.1)	48(65.7)	20(64.5)	21(72.4)
	35 – 44	8(11.9)	11(15.0)	6(19.3)	4(13.7)
	>45	18(26.8)	13(17.8)	5(16.1)	4(13.7)
	Mean±SD	34.3±9.58	34.3±8.92	33.3±8.63	32.5±8.70
Religion	Hindu	58(86.5)	60(82.1)	28(90.3)	20(68.9)
	Muslims	5(7.4)	9(12.3)	8(25.8)	2(6.8)
	Christians	4(5.9)	4(5.4)	1(3.2)	1(3.4)
Education	SSLC + diploma	11(16.4)	16(21.9)	7(22.5)	3(10.3)
	Gradates	24(35.8)	20(27.3)	8(25.8)	9(31.0)
	Post Graduates	13(19.4)	29(39.7)	7(22.5)	12(41.3)
	Professionals	10(14.9)	3(4.1)	2(6.4)	0(0.00)
	Prof. Master	9(13.4)	5(6.8)	7(22.5)	5(17.2)
Job status	On Job	62(92.5)	45(61.6)	31(100.0)	26(89.6)
	Jobless	3(4.4)	-	-	-
	Retired	2(2.9)	-	-	-
	Home makers	-	28(38.3)	-	3(10.3)
	Married	32(47.7)	47(64.3)	15(48.3)	15(51.7)
Marital status	Unmarried	33(49.2)	25(34.2)	16(51.6)	14(48.2)
	Divorced	2(2.9)	1(1.3)	-	-
Socio Economic Status (SES)	Low	15(22.3)	22(30.1)	6(19.3)	6(20.6)
	Middle	36(53.7)	39(53.4)	15(48.3)	15(51.7)
	High	16(23.8)	12(16.4)	10(3.2)	8(27.5)

**Table 2: %Distribution of selected populations according weight status**

Gender	Weight categories based on BMI(age= 25-50 yrs)					
	Normal 18.5-24	Over weight BMI 25-30.0	Obese	Obesity		
				Obese I BMI 30.1-35	Obese II BMI 35.1-40	Obese III BMI > 40
Male	31(31.3)	40(40.4)	28(28.3)	19(67.9)	4(14.3)	5(17.9)
Female	29(28.7)	37(36.6)	35(34.7)	26(74.3)	5(14.3)	4(11.4)

**3. Lifestyle behaviors among the subjects: comparison between normal weight, overweight and obese.**

**Table 3a: Recreation activities**

Activities	Obese and Overweight N=140		Normal N=60	
	Frequency	Percentage	Frequency	Percentage
Watching TV ,Listening to music ,Listening to radio	126	90	51	85
Spending time with friends outside ,going to movie	77	55	33	55
Going to hotels	13	9	12	20
Attending to parties	4	3	13	22
Social activities	8	6	12	20
Sports	11	8	19	32

**Table 3b: Sleep pattern of participants**

Sleep pattern	Weight category ----based on BMI					Chi-square
	Normal	Overweight	Obese I	Obese II	Obese III	
Good sleep	34(56.7)	51(66.2)	29(64.4)	7(77.7)	5(55.5)	0.649 <sup>NS</sup>
Poor sleep	26(43.3)	26(33.7)	16(35.5)	2(22.2)	4(44.4)	

**Table4: Dietary behavior among the participants: According to BMI**

Eating behaviors		Weight Category -- No(%) BMI					Chi-square	P
		Normal	Overweight	Obese I	Obese II	Obese III		
		N=60	N=77	N=45	N=9	N=9		
Type of diet	Vegetarian	29(48.3)	35(45.4)	14(31.1)	1(11.1)	3(33.3)	16.208 <sup>a</sup>	0.040 <sup>NS</sup>
	Non Vegetarian	31(51.7)	42(54.5)	31(68.8)	8(88.8)	6(66.6)		
No. of meals/day	2-3	50(83.3)	54(70.1)	34(75.5)	7(77.7)	7(77.7)	16.208 <sup>a</sup>	0.040 <sup>NS</sup>
	4-5	10(16.7)	20(25.9)	7(15.5)	0(0.0)	2(22.2)		
	6-7	0(0.0)	3(3.8)	4(8.8)	2(22.2)	0(0.0)		
Skipping meals	Yes	20(33.3)	29(37.6)	18(40.0)	2(22.2)	3(33.3)	1.359 <sup>a</sup>	0.851 <sup>NS</sup>
Meals most skipped	Breakfast	8(40.0)	15(51.7)	12(66.6)	2(100.0)	1(33.3)	16.627 <sup>a</sup>	0.164 <sup>NS</sup>
	Lunch	11(55.0)	5(17.2)	5(27.7)	0(0.0)	1(33.3)		
	Dinner	1(5.0)	9(31.0)	1(5.5)	0(0.0)	1(33.3)		
Munching habit	Yes	17(28.3)	23(29.8)	26(57.7)	2(22.2)	6(66.6)	16.188 <sup>a</sup>	0.003 <sup>*</sup>

**Table 4 to be continued...**

<b>Time of munching</b>	Morning	1(5.9)	1(4.3)	6(23.0)	0(0.0)	1(16.6)	36.544 <sup>a</sup>	0.002*
	Afternoon	4(23.6)	0(0.0)	1(3.8)	0(0.0)	0(0.0)		
	Evening	10(58.8)	21(91.3)	18(69.2)	1(50.0)	5(83.3)		
	Night	2(11.7)	1(4.3)	1(3.8)	1(50.0)	0(0.0)		
<b>Age since munching habit</b>	Childhood	9(53.0)	7(30.4)	5(19.2)	1(50.0)	5(83.3)	35.420 <sup>a</sup>	0.000 <sup>*</sup>
	Adolescence	4(23.5)	7(30.4)	12(46.1)	0(0.0)	1(16.7)		
	Adulthood	4(23.5)	9(39.1)	9(34.6)	1(50.0)	0(0.0)		
<b>Frequency of eating outside/wk</b>	Once	41(68.3)	47(61.0)	28(55.5)	9(100.0)	7(77.7)	10.819 <sup>a</sup>	0.820 <sup>NS</sup>
	Twice	8(13.3)	13(16.8)	6(13.3)	0(0.0)	1(11.1)		
	Three times	6(10.0)	9(11.6)	4(8.8)	0(0.0)	0(0.0)		
	Four times	1(1.7)	3(3.8)	3(6.6)	0(0.0)	1(11.1)		
	Daily	4(6.7)	5(6.4)	4(8.8)	0(0.0)	0(0.0)		
<b>Preference of place to eat</b>	Eating in restaurant	60(100)	71(92.2)	41(91.1)	9(100.0)	8(88.8)	6.334 <sup>a</sup>	0.176 <sup>NS</sup>
<b>Eat while watching TV</b>	Yes	34(56.7)	53(67.5)	26(57.7)	6(66.6)	6(66.6)	2.749 <sup>a</sup>	0.601 <sup>NS</sup>
<b>Eat while chatting with friends</b>	Yes	23(38.3)	32(41.5)	19(42.2)	3(33.3)	6(66.6)	2.853 <sup>a</sup>	0.583 <sup>NS</sup>
<b>Eat while studying</b>	Yes	7(11.7)	17(22.0)	15(33.3)	1(11.1)	2(11.1)	7.869 <sup>a</sup>	0.096 <sup>NS</sup>
<b>Alcohol consumption</b>	Teetotalers	50(83.3)	57(74.0)	33(73.3)	7(77.7)	5(55.5)		
	Drinkers	10(16.6)	20(25.8)	12(26.6)	2(22.2)	4(44.4)		
<b>Frequency of drinking</b>	Once/ wk	5(50.0)	9(45.0)	5(41.7)	0(0.0)	1(25.0)		
	Occasionally( party drink)	5(50.0)	11(55.0)	7(58.3)	2(100.0)	3(75.0)		

**Table 5: Eating attitudes as expressed by the participants**

BMI category	Normal		Overweight		Obese I		Obese II		Obese III		ANOVA	
	BMI± SD										F	Sig.
Thinking about food	7.8 <sup>a</sup>	3.37	8.25 <sup>ab</sup>	2.53	10.4 <sup>b</sup>	3.8	10.3 <sup>b</sup>	4.06	9.66 <sup>ab</sup>	5.33	4.99	.001
Cannot wait for eating	6.5 <sup>a</sup>	2.8	6.4 <sup>a</sup>	2.7	8.4 <sup>a</sup>	3.5	7.2 <sup>a</sup>	3.4	7.4 <sup>a</sup>	2.7	3.94	.004
Cannot avoid at least tasting	3.9 <sup>a</sup>	1.8	4.5 <sup>ab</sup>	2.1	5.7 <sup>b</sup>	2.6	5.0 <sup>ab</sup>	2.4	5.5 <sup>b</sup>	2.3	4.653	.001
Have pleasure in eating	7.13 <sup>a</sup>	2.93	8.18 <sup>ab</sup>	2.61	9.0 <sup>bc</sup>	2.2	10.1 <sup>c</sup>	1.96	8.0 <sup>ab</sup>	3.5	24.72	.001
Want to eat always	5.7 <sup>a</sup>	2.5	5.9 <sup>a</sup>	2.4	6.9 <sup>a</sup>	3.0	6.3 <sup>a</sup>	3.3	5.9 <sup>a</sup>	3.1	1.77	.136
Food has to be delicious to eat	2.7 <sup>a</sup>	1.15	3.1 <sup>ab</sup>	1.2	3.4 <sup>ab</sup>	1.3	3.9 <sup>b</sup>	1.05	3.5 <sup>b</sup>	1.5	3.88	.005
Eating is more than any other work	8.6 <sup>a</sup>	4.1	8.8 <sup>a</sup>	3.7	10.7 <sup>a</sup>	4.5	9.1 <sup>a</sup>	3.17	9.4 <sup>a</sup>	5.1	1.92	.108

**Table 6a: Total Physical Activity performed /day by participants according to weight. (%)**

Weight category	Males			Females			
	Low	Moderate	High	Low	Moderate	High	
Normal	22(71.0)	2(6.4)	7(22.6)	22(75.9)	5(17.2)	2(6.9)	
Overweight	15(37.5)	15(37.5)	10(25.0)	22(59.4)	5(13.5)	10(27.0)	
Obese I	8(42.1)	6(31.5)	5(26.3)	19(73.0)	3(11.5)	4(15.3)	
Obese II	2(50.0)	0(0.0)	1(25.0)	3(60.0)	2(40.0)	1(20.0)	
Obese III	3(60.0)	0(0.0)	2(40.0)	2(50.0)	1(25.0)	1(25.0)	
Chi-square	Values	14.557 <sup>a</sup>			7.032 <sup>b</sup>		
	Asymp.Sig	0.068			0.533		

Figures in parenthesis are percentage  
 a.8cells (53.3%) have expected count less than 5.The minimum expected count is .70  
 b. 8cells (60.0%) have expected count less than 5.The minimum expected count is .63

**Table 6b: Major components of the total physical activity of the participants**

Percentage of physical activity on average per day (MET)							
Weight category	N	Physical activity		Transport		Recreation	
		Mean±SEm	95%CI	Mean±SEm	95%CI	Mean±SEm	95%CI
Normal	60	5.40±2.36	0.67-10.13	19.13±4.37	10.37-27.89	38.63±5.85	26.92-50.35
Over weight	77	5.20±0.87	3.45-6.95	4.22±0.84	2.55-5.95	6.75±0.74	5.26-8.23
Obese I	45	4.89±1.09	2.68-7.10	3.08±0.79	1.47-4.68	4.56±0.91	2.72-6.41
Obese II	9	3.30±2.23	-1.85-8.46	1.07±0.76	-0.68-2.82	3.24±2.17	-1.67-8.24
Obese III	9	3.44±1.87	-0.86-7.76	2.11±0.95	0.12-3.99	4.70±2.45	-1.31-10.03

MET: Presented as Kcal/kg/hr.

## CONCLUSION

Our results have strongly contributed to understanding that it is essential to develop database regarding eating behaviors and attitudes of people in general and overweight and obese individual in particular. Such information would provide a basis to construct effective messages for tacking behavior modification among people having risk for obesity.

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