



ASSOCIATION BETWEEN THE DIETARY HABIT AND VISCERAL FAT ACCUMULATION IN MALE AND FEMALE ADULTS.

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Abstract: This study delves into the intricate relationship between dietary habits and visceral fat among 200 male and female adults who visited a multispecialty hospital. The study's cross-sectional analysis reveals distinctive patterns in anthropometric measures across various categories. The correlation between dietary habits and visceral fat accumulation highlights intriguing associations, such as visceral fat accumulation negatively correlating with healthy food choice and positively correlating with appetite, sedentary behaviour, irregular meal time, calorie restriction. The ANOVA results strengthen the evidence for a substantial relationship between the dietary habit and visceral fat accumulation in male and female adults. Dietary habits influence the visceral fat accumulation between male and female significant difference by (P value=0.01)24% where male got (63%) and female got (87%) visceral fat percentage out of survey population. This research contributes valuable insights into the complex interplay between dietary habits and visceral fat accumulation within the participants.

KEY WORDS: Visceral fat percentage, Skeletal muscle percentage, lifestyle, diet.

I. INTRODUCTION

In India, visceral fat accumulation is considered an essential condition given its association with disease incidence irrespective of simple weight loss or gain. In this context, treatment for obesity or improvement of metabolic syndrome should focus on the reduction of visceral fat and prevention of visceral fat accumulation. recognizing and addressing the interplay between association of the dietary habit and visceral fat accumulation in male and female adults.

Visceral fat is a type of fat that is stored in the abdominal cavity around vital organs such as the liver, pancreas, and intestines. It is also known as intra-abdominal fat and is considered to be more harmful than subcutaneous fat, which is stored just beneath the skin.

The importance of understanding visceral fat lies in its association with various health risks, including heart disease, type 2 diabetes, and certain types of cancer. Excess visceral fat can lead to insulin resistance, inflammation, and metabolic disturbances, all of which contribute to these health conditions.

Globally, visceral fat has become a significant public health concern due to the rising prevalence of obesity and sedentary lifestyles. The accumulation of visceral fat is a key factor in the development of metabolic syndrome, which is a root cause of conditions that increase the risk of heart disease, stroke, and diabetes. Addressing visceral fat through lifestyle modifications such as diet and exercise is crucial for reducing the burden of obesity-related diseases on a global scale.

I. Research Methodology:

Sample Size: The research involved a sample of 200 male and female patients visiting the Outpatient departments (OP) of a hospital in Chennai.

Sampling: The study employed purposive convenience sampling method.

Type of Study: The research conducted is a descriptive cross-sectional study.

Locale: Local patients visiting the OP of a multi-speciality hospital in Chennai.

Inclusion Criteria:

- Both male and female adults.
- Subjects between 18yrs and 60yrs of age.
- Subjects who are willing to participate in the study.

Exclusion Criteria:

- Participants below the age of 18 years
- Pregnant women
- People suffering from chronic diseases.

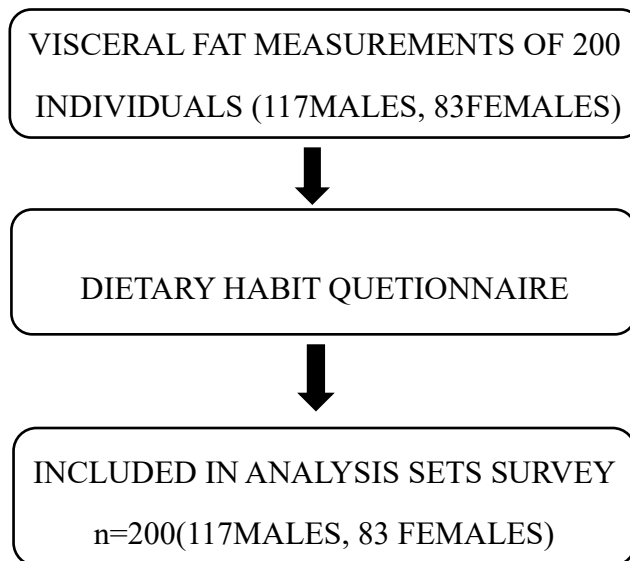
Development of Tools:

- Study merits were explained to the subjects visiting the outpatient clinic of a multispecialty hospital in Chennai. Subjects were enrolled into the study after obtaining oral consent and using convenience sampling technique. Sample size was calculated as $N=200$ aimed for 99% confidence level and a margin of error of $\pm 1\%$.
- Information on demographic profile and anthropometric data were collected from the initial assessment form of the subjects. Anthropometric measurements included; height, weight, body mass index and waist circumference. Pre validated Dietary habit questionnaire developed by Yanagisawa et al. comprising 35 questions relating the association between dietary intake and visceral fat was used as a google form. From this form details about the dietary habits of the subjects were recorded. Measurements Visceral fat percentage and skeletal muscle percentage were done using the bioelectrical impedance (BIA) machine "Omron HBF 212 digital full body composition monitor.

Data Collection:

- A total of 200 participants were included in the study. Any participant queries were addressed, and assurances of privacy were provided. Data thus collected were compiled and subjected to statistical analysis.

FLOW CHART OF SURVEY PARTICIPANT



Statistical Analysis:

- Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS).
- Collected data were consolidated using Microsoft Excel.
- Results were used to determine the association between dietary habits and visceral fat accumulation.

III. Results

The study done to find the association between dietary habits and visceral fat accumulation has yielded interesting results which are as follows:

Table 3.1: Demographic Profile

SEX	AGE	N=(200)	BMI(YEARS)	AGE(KG/M ²)	VFA(CM ³)	SMA%
MALE	20-29	11	29.8	5.5%	39.172	23.172
	30-39	30	28.78	15%	38.674	22.845
	40-49	34	28.8	17.5%	37.94	23.508
	50-59	39	29.83	20.5%	37.546	23.192
FEMALE	20-29	28	23.7	14%	31.421	26.325
	30-39	15	28.78	7.5%	32.526	25.586
	40-49	15	27.33	8%	38.743	24.781
	50-59	23	28.98	12%	35.737	23.958

Table 3.1: Percentage and Average Mean. BMI: body mass index; VFA: visceral fat area; SMA%: skeletal muscle percentage.

Differences in BMI in each sex and age group.

Table 3.1: Shows the physical attributes of participants (n=200) by sex and age. Male/Female balance in the survey was (Male-117/Female-83). Participants were classified by age categories.

Male age group between 20-29(N-11) the mean BMI-29.8, Male age group between 30-39(N-30) the mean BMI-28.78, Male age group between 40-49(N-34) the mean BMI-28.8, Male age group between 50-59(N-39) the mean BMI-29.8.

Female age group between 20-29(N-28) the mean BMI-23.7, Female age group between 30-39(N-15) the mean BMI-28.78, Female age group between 40-49(N-15) the mean BMI-27.33, Female age group between 50-59(N-23) the mean BMI-28.98.

The age percentage were calculated (n=200) of male and female according to the participant age group. The average mean is calculated for visceral fat area and skeletal muscle percentage.

Male age group between 20-29(N-11) the average mean VFA%-39.172 and SMA%-23.172, Male age group between 30-39(N-30) the average mean VFA%-38.674 and SMA%-22.845, Male age group between 40-49(N-34) the average mean VFA%-37.94 and SMA%-23.508, Male age group between 50-59(N-39) the average mean VFA%-37.546 and SMA%-233.192.

Female age group between 20-29(N-28) the average mean VFA%-31.421 and SMA%-26.325 , Female age group between 30-39(N-15) the average mean VFA%-32.526 and SMA%-25.586 , Female age group between 40-49(N-15) the average mean VFA%-38.743 and SMA%-24.781 , Female age group between 50-59(N-23) the average mean VFA%-35.737 and SMA%-23.958.

Table 3.2: Factor analysis of 35 dietary habit questions:

	APPETITTE (1)	HEALTHY FOOD CHOICE (2)	SEDENTARY BEHAVIOUR (3)	CALORIE RESTRICTION (4)	IRREGUL AR MEAL (5)
% OF VARIANCE	9.017	4.712	6.171	4.151	4.531
CUMULATIVE % OF VARIANCE	9.413	18.21	9.87	20.013	17.924
1. If someone around me is eating, I end up eating with them.	0.551	0.013	0.019	0.214	0.083
2. Even if I'm not hungry, if it smells good, I eat it.	0.523	0.017	0.084	0.045	0.023
3. I can't help myself from eating when fruits or snacks are out.	0.071	-0.023	0.18	0.063	0.087
4. I eat anything that people give me because otherwise I feel that it's wasteful.	-0.21	-0.01	-0.057	0.021	0.011
5. I overeat when I am depressed.	0.07	0.003	0.036	0.038	0.261
6. I don't have a sweet tooth.	0.273	-0.071	0.01	0.088	-0.033
7. I feel uneasy if I don't buy more than what is needed for food.	0.071	0.009	-0.057	0.005	0.005
8. I like pizza, burgers, donuts, and potato chips.	0.092	-0.074	0.044	0.813	0.639
9. I think that I will be miserable if I don't eat.	0.085	0.036	0.18	0.089	0.041
10. I feel like I'm hungry all day.	0.015	0.07	0.131	0.186	0.028
11. I have late night snacks.	0.241	0.0079	-0.728	0.007	0.089
12. I often have a late-night meal after dinner.	-0.08	-0.013	-0.025	0.032	0.003
13. I get nervous easily.	0.119	0.41	-0.171	0.005	0.022

14. I hardly chew my food at all.	-0.112	0.19	-0.007	0.171	0.021
15. I think I eat faster than others.	0.309	0.084	0.031	0.011	0.01
16. I proactively choose foods with lots of dietary fibre.	0.42	0.042	0.083	0.038	0.261
17. I try to hold off on animal fats and instead get plant-based or fish fats.	0.08	0.041	-0.017	0.088	0.044
18. I am proactive in eating green and yellow vegetables.	-0.131	-0.064	0.081	0.005	0.261
19. I like fish more than meat.	-0.119	-0.016	-0.005	0.646	0.023
20. I am cooperative.	-0.005	0.072	0.102	-0.592	-0.103
21. I don't exercise much.	-0.065	0.071	0.013	-0.518	-0.106
22. I think I am more out of shape than overeating.	0.021	0.052	0.107	0.217	-0.022
23. I don't like walking or biking.	0.088	0.021	0.702	0.19	0.038
24. If there is an elevator or Escalator, I use it.	0.083	0.091	0.005	0.523	-0.015
25. I am lazy.	0.01	0.072	-0.381	0.127	0.428
26. I am proactive.	-0.059	0.013	0.003	0.023	0.204
27. I consciously hold back from eating too much to avoid weight gain.	-0.017	0.024	0.089	0.007	0.047
28. I eat less because I feel guilty about overeating.	-0.014	0.017	-0.521	0.087	0.704
29. I try to buy lower calorie foods.	0.008	0.018	-0.021	0.121	-0.013
30. I think I tend to gain weight more readily than others.	0.088	0.728	-0.731	-0.107	0.041
31. I am insightful.	0.087	0.692	0.231	-0.004	0.022
32. I often have a delayed dinner because of work.	0.005	0.712	0.321	0.126	0.038
33. My mealtimes are irregular.	-0.035	-0.041	0.721	0.321	0.011
34. I am a night owl who doesn't do well in the morning.	-0.599	-0.071	0.133	0.171	0.031
35. I finish dinner 2 or more hours earlier than bedtime	0.089	0.013	0.127	0.307	-0.017

Table 3.2: shows eigenvalues and factor loadings of dietary habit factors calculated by the factor analysis of the dietary habit questionnaire. The identified factor analysis of the dietary habit questionnaire revealed the following five main dietary factors: “Appetite,” “Healthy food choice,” “Sedentary behaviour,” “Calorie restriction ,” and “Irregular mealtime based on the content of questions with a large factor loading. The factor loadings represent the correlation between each variable and the underlying factor. Positive loadings indicate a positive relationship between the variable and the factor, while negative loadings indicate a negative relationship. Higher absolute values of loadings indicate that the variable is more strongly associated with the underlying factor.

Factor 1: Appetite

- Variables 1, 2, 3, 5, 8, 9, 10, 11, 15, and 16 have high loadings on this factor.
- This factor seems to capture eating behaviours related to appetite, cravings, and emotional eating. It includes tendencies to eat when others are eating, eat based on smell, overeat when depressed, eat late-night snacks, and prefer certain types of foods (e.g., pizza, burgers).

Factor 2: Healthy Food Choice

- Variables 16, 17, 18, and 19 have high loadings on this factor.
- This factor reflects proactive and health-conscious food choices, such as choosing foods with dietary Fiber, plant-based or fish fats, and green and yellow vegetables, as well as preferring fish over meat.

Factor 3: Sedentary Behaviour

- Variables 21, 23, 24, and 25 have high loadings on this factor.
- This factor captures sedentary behaviours and attitudes toward physical activity, including low exercise levels, disliking walking or biking, using elevators/escalators, and self-identifying as lazy.

Factor 4: Calorie Restriction

- Variables 28, 30, and 32 have high loadings on this factor.
- This factor represents attitudes and behaviour’s related to calorie restriction and weight management, such as eating less due to guilt about overeating, trying to avoid weight gain by consciously holding back from eating too much, and having delayed dinners due to work.

Factor 5: Irregular Meal

- Variables 33 and 34 have high loadings on this factor.
- This factor reflects irregular meal patterns and preferences for meal timing (e.g., delayed dinners due to work, irregular mealtimes) and sleep patterns (e.g., being a night owl).

Table 3.3 – Comparison of dietary factor scores between survey, sex and age groups:

		APPETITTE (1)	HEALTHY FOOD CHOICE (2)	SEDENTARY BEHAVIOUR (3)	CALORIE RESTRICTION (4)	IRREGULAR MEAL (5)
DIETARY FACTOR SCORE	SURVEY	-0.01±0.73	0.01±0.71	0.00±0.86	0.00±0.71	0.01±0.73
PVALUE'	SURVEY	0.015	0.017	0.072	0.008	0.026
	AGE	0.000	0.000	0.000	0.023	0.000
	SEX	0.000	0.000	0.010	0.007	0.000

Mean ± SD. 1 Analysis of variance fixed effect: survey, sex, and age group.

Comparison of the dietary factor score between survey, sex, and age groups are shown in **Table 3.3**. As expected, there were significant differences in dietary habits between the sex and age groups. This indicates that adjustment of sex and age was necessary to analyse the relationship between eating habits and visceral fat accumulation in this research.

TABLE 3.4 – Estimated BMI and visceral fat area by quartiles of each dietary factor score:

		Q1	Q2	Q3	Q4	ANOVA ¹	Q1 VS Q4
APPETITE	MALE/ FEMALE	63/72	57/62	71/87	80/70		
	AGE	33.7±0.2	48.2±0.1	40.5±0.2	38.1±0.2		
	BMI ²	22.3±0.1	22.3±0.2	22.8±0.2	22.8±0.1	<0.001	<0.001
	VISERAL FAT ²	58±1	76±1	81±1	62±1	<0.001	<0.001
HEALTHY FOOD CHOICE	MALE/ FEMALE	64/99	74/91	28/73	88/99		
	AGE	38.6±0.1	40.2±0.1	42.6±0.2	41.5±0.2		
	BMI ²	21.5±0.1	23.2±0.1	23.5±0.1	22.9±0.1	<0.001	n.s
	VISERAL FAT ²	68±1	70±1	76±1	74±1	<0.01	<0.01
SEDENTARY BEHAVIOUR	MALE/ FEMALE	82/99	77/82	78/94	81/99		
	AGE	41.9±0.1	46.7±0.2	43.1±0.2	40.5±0.2		
	BMI ²	21.6±0.1	22.9±0.1	23.5±0.1	22.2±0.1	<0.001	<0.001
	VISERAL FAT ²	68±1	70±1	74±1	76±1	<0.001	<0.001
CALORIE RESTRICTION	MALE/ FEMALE	73/69	99/77	82/74	65/82		
	AGE	47.3±0.1	41.7±0.1	40.2±0.3	42.7±0.2		
	BMI ²	21.6±0.1	22.9±0.9	22.9±0.1	23.5±0.1	<0.001	<0.001
	VISERAL FAT ²	58±1	76±1	81±1	73±1	<0.001	<0.001
IRREGULAR MEAL TIME	MALE/ FEMALE	79/83	81/69	77/82	92/72		
	AGE	40.3±0.1	42.4±0.2	40.9±0.1	41.2±0.2		
	BMI ²	22.8±0.1	21.6±0.1	25.4±0.1	21.7±0.1	<0.001	<0.001
	VISERAL FAT ²	57±1	63±1	72±1	76±1	<0.001	<0.001

Mean ± SE. 1 Fixed effect: quartiles of each dietary factor score; covariates: sex and age. 2 Data were log-transformed for ANOVA.

Table 3.4 Shows sex- and age-adjusted BMI and visceral fat area according to quartiles of each dietary factor score. There was a significant difference in visceral fat area . Across quartiles of each factor score (ANOVA, $p < 0.01$ for All), with Q4 showing a significantly larger visceral fat area compared with Q1, except for scores of “Healthy food choice.” As for “Healthy food choice,” Q4 (i.e., the highest Factor score) showed a significantly smaller visceral fat area. On the other hand, while a significant difference was observed in BMI across the quartiles of each factor score, the difference in BMI between Q1 and Q4 was not significant for “Healthy food choice”.

Differences in BMI across quartiles of the “Healthy food choice” factor score was not significant (Table 4). This table strongly associated with sedentary behaviour, irregular meal time, appetite in higher in visceral fat percentage and lesser skeletal muscle percentage. healthy food choice was negatively associated with higher in visceral fat percentage and lesser skeletal muscle percentage.

This table reveals that the dietary habits influence the visceral fat accumulation between male and female significant difference by 24% where male got (63%) and female got (87%) visceral fat percentage out of survey population.

IV Discussion:

The results of our study examining the interplay between dietary habits and visceral fat accumulation among male and female adults provided valuable insights. The dietary habit questionnaire allowed the assessment of dietary habits involved in the visceral fat accumulation at an individual level. Moreover, we found that visceral fat is highly associated with dietary habits; people with high visceral fat level have low skeletal muscle percentage and vice versa.

This study reveals that the dietary habits influence the visceral fat accumulation. Between male and female the difference was by 24%, which was significant (P value = 0.01). Where male got (63%) and female got (87%) visceral fat percentage out of survey population. Hence females have 24% higher visceral fat percentage than males.

This questionnaire could be used to provide suggestions for dietary modification to achieve visceral fat reduction on an individual basis. Physical exercise at moderate level with well-balanced diet helps in the visceral fat reduction.

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