DOI: 10.7860/JCDR/2024/69386.19483

Original Article

Physiology Section

Appetitive Traits and its Association with Body Composition, Anthropometric Indices and Appearance Anxiety in Adults: A Cross-sectional Study

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ABSTRACT

Introduction: Obesity, a major health hazard in both developed and developing countries, is greatly influenced by an individual's eating behaviour or appetitive trait. While eating disorders are known to be associated with abnormal body composition and cardio-metabolic risks, on par with metabolic syndrome, knowledge regarding the relationship between appetitive traits and body composition and anthropometric indices is very limited.

Aim: To assess the appetitive traits of young and middle-aged individuals and correlate them with their body composition, anthropometric indices, and appearance anxiety.

Materials and Methods: Sixty-eight healthy volunteers aged 19-45 years were included in this cross-sectional study. The appetitive traits, appearance anxiety, and perceived body shape of the study participants were assessed using the Adult Eating Behaviour Questionnaire (AEBQ), Appearance Anxiety Inventory (AAI), and Contour Drawing Rating Scale (CDRS). Body composition was assessed using Bioelectrical Impedance Analysis (BIA). The correlation between appetitive trait scores and the study parameters was assessed using the Pearson or Spearman correlation coefficient test. Comparison of appetitive traits between males and females was done using the Independent t-test or Mann-Whitney U test. A p-value <0.05 was considered statistically significant.

Results: There were 43 males and 25 females. Significant negative correlations were observed between food avoidance scores and body composition parameters such as BMI, waist-to-height ratio, lean mass, dry lean weight, body cell mass, basal metabolic rate, and Fat-Free Mass Index (FFMI). While food approach behaviour was similar between females and males, the overall food avoidance behaviour trait (53.4±11.2 vs. 47.26±9.09, p=0.016) and satiety responsiveness (12.28±3.2 vs. 10.51±2.93, p=0.024) were significantly more pronounced in females than in males. Moreover, the food avoidance behaviour of females revealed significant negative correlations with BMI, fat mass, lean mass, body cell mass, basal metabolic rate, Body Fat Mass Index (BFMI), free-fat mass index, and CDRS scores.

Conclusion: The food avoidance trait is associated with abnormal changes in specific body composition parameters in adults. Satiety responsiveness and body dis-satisfaction related to being overweight are more common among young females and are associated with abnormal changes in their body composition.

Keywords: Appetite, Body shape, Food approach, Food avoidance, Obesity

INTRODUCTION

Obesity, an emerging major health hazard, has reached widespread proportions in developed and developing countries. Both overweight and obesity are associated with significant physical and psychosocial co-morbidities [1]. Despite the fact that obesity results from excess energy intake than expenditure, recent studies suggest an interplay of genetic, environmental, and behavioural factors in the etiopathogenesis of obesity [2-5]. There is increasing evidence that individual inherited differences in eating behaviour or appetitive traits (a person's predilection for food) are related to the propensity to gain weight (or not) in the face of the current obesogenic environment (caloric-dense nutrient-deficient foods and sedentary lifestyle) [6]. While appetitive traits can greatly influence the degree of food consumption and, henceforth, body composition, the relationship between these parameters is not well established. Except for the few studies that have reported a relationship between eating behaviour and Body Mass Index (BMI) in children and adolescents [7,8], evidence for the possible effect of appetitive traits on body composition is rather poor in the adult population.

Similarly, body image is closely associated with eating behaviour. The pervasive internalisation of societal body standards and the accompanying pressure to conform, which is often influenced by peers, social media, and cultural factors, impact the appetitive traits of young adults [9,10]. It is well established that eating disorders (binge-eating disorder, anorexia nervosa, bulimia nervosa) are associated with abnormal body composition and cardiometabolic risks on par with metabolic syndrome [11-13]. However, knowledge regarding the relationship between appetitive traits and body composition and anthropometric indices is very limited, especially with respect to the Indian scenario [14-16]. Hence, to address the above-mentioned lacunae, this study assessed the appetitive traits of young and middle-aged individuals and correlated them with their body composition, anthropometric indices, and appearance anxiety.

Primary objective: of the study was to assess the appetitive traits among young and middle-aged individuals (19-45 years) using the AEBQ.

Secondary objectives: were to assess the body composition and anthropometric indices of the study participants using BIA and standard anthropometric techniques, the extent of appearance anxiety and perceived body shape of the study participants using the AAI and CDRS and to assess the correlation between the assessed parameters.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Department of Physiology at Jawaharlal Institute of Postgraduate Medical

Education and Research (JIPMER), Puducherry, India, between April-July 2023. The study was conducted in accordance with the principles of the Declaration of Helsinki in 2013. Ethical approval for the study was obtained from the Institute Ethics Committee (JIP/IEC-OS/2023/088). The study details were explained, and written informed consent was obtained from all participants before enrolling them in the study.

Sample size estimation: was done for a single proportion. Considering the prevalence of eating disorders as 13% among young adults in India [14], with an absolute precision of 8% and a 5% level of significance for a time-bound study of four months, the estimated sample size was 68 participants. A convenient sampling technique was followed to recruit the study participants.

Inclusion criteria: Adults (males and females) working as employees in the Institute, aged 19-45 years, who consented to participate in the study were recruited.

Exclusion criteria: Individuals with a known history of chronic or acute medical illnesses, psychiatric disorders, and those on medications for the same, as well as pregnant and lactating women, were excluded from the study.

Procedure

The socio-demographic details of the included participants were collected and entered into a data sheet.

Assessment of appetitive traits: The subject's appetitive trait was assessed using the "AEBQ," a widely used validated measure of individual differences in food approach and avoidance [17]. The AEBQ consists of 35 items that assess eight appetitive traits with three to five items each on a 1-5 Likert agree/disagree scale (1- Strongly disagree to 5- Strongly agree). The food approach sub-scales include food responsiveness, emotional overeating, enjoyment of food, and hunger. The food avoidance sub-scales include satiety responsiveness, food fussiness, emotional undereating, and slowness in eating.

Assessment of body composition: Following a standard protocol [18], the body composition of the study participants was analysed by the BIA technique using the Quad scan 4000 apparatus. The BIA principle involves the estimation of the electrical impedance of an electric current passing through the body. With the subject in the supine position, two signal-introducing electrodes (distal) were placed on the right-side, one on the dorsum of the hand and the other on the foot, while two voltage-sensing electrodes (proximal) were applied on the right-side, one on the wrist and the other on the ankle. After entering the anthropometric details of the subject, the impedance analyser measured the body composition indices (body cell mass (%), extracellular mass, fat-free mass, total body water, body fat (Kg) basal metabolism, lean mass, BFMI, FFMI, and nutritional index) by sensing the drop in voltage across the electrodes.

Anthropometric indices were measured following the International Standards for Anthropometric Assessment [19]. The subjects' height (nearest 0.1 cm) was measured using a wall-mounted stadiometer, and the weight (nearest 0.5 kg) was measured using a digital weighing scale. Neck circumference, waist circumference, and hip circumference, the measures of obesity and cardio-metabolic risk, were measured as follows:

- **Neck circumference (NC):** was measured to the nearest 1 mm in the horizontal plane at a point just below the larynx (thyroid cartilage) and perpendicular to the long axis of the neck.
- **Waist circumference (WC):** was measured to the nearest 0.1 cm in a horizontal plane midway between the inferior costal margin and the iliac crest in a standing position at the end of normal expiration.
- **Hip circumference (HC):** was measured around the pelvis at the point of maximal protrusion of the buttocks.

Index	Indicator	Formula
Body Mass Index (BMI)	Index of general adiposity	Wt (kg)/Ht^2 (m)
Waist: Hip ratio (W/H ratio)	Index of cardiovascular and metabolic risk	WC (cm)/HC (cm)
Waist to Height ratio (W/Ht ratio)	Index of cardiovascular and metabolic risk	WC (cm)/Ht (cm)
Conicity index (CI)	Index of central obesity and cardiovascular risk	CI=WC/0.109×(square root of weight/height)
A Body Shape Index (ABSI)	Index of central obesity and cardiovascular risk	ABSI=WC/(BMI$^{2/3}$×height$^{1/2}$)

Assessment of appearance anxiety: The subject's appearance anxiety was assessed using the "AAI," a 10-item self-report scale that measured the cognitive and behavioural aspects of body image anxiety in general [20,21]. The appearance anxiety was assessed under two subscales: Avoidance (items 1, 3, 5, 7, 9, 10) and Threat Monitoring (items 2, 4, 6, 8). Scores consisted of a total raw score derived by summing each item as well as two subscales with a total cut-off score of 20, indicative of a high-risk of appearance anxiety and the risk of body dysmorphic disorder [22]. Permission to use this inventory for the study was obtained from the authors.

Assessment of perceived body image: The subject's perception of their body image and satisfaction levels were assessed using the CDRS [23]. It comprised a set of nine contour drawings of each gender of escalating measures, showing leaner to wider drawings with points 1 to 9. The subjects were asked to select one of these drawings based on their current appearance and one based on their desired contour. A discrepancy showed dissatisfaction with body image. The score was calculated by subtracting the points of the desired contour from the present contour. A positive score (1 to 8) indicates dissatisfaction with being overweight, and a negative score (-1 to -8) indicates dissatisfaction with being underweight, while a score of zero indicates no dissatisfaction with body image [24,25].

STATISTICAL ANALYSIS

The data were entered into an Excel datasheet, and Statistical Package for Social Sciences (SPSS) version 20.0 was used for the statistical analysis. The linear relationship between the appetitive trait and body composition, anthropometric indices, appearance anxiety, and perceived body shape was assessed using the Pearson or Spearman correlation coefficient test based on the distribution of data. The comparison of appetitive traits between males and females was done using the Independent t-test or Mann-Whitney U test. A p-value <0.05 was considered statistically significant.

RESULTS

Sixty-eight healthy volunteers (43 males and 25 females), with a mean age of 20.94±1.10 years, were recruited for the study. While the mean AEBQ-Food Avoidance score was 49.51±10.28, the median (interquartile range) values of the AEBQ-Food Approach, AAI, and CDRS scores were 52 (45.25, 56.75), 8 (5, 11.75), and 0 (-1, 1), respectively. The mean BMI, W:H ratio, W:Ht ratio, and BMR were 21.6±3.73, 0.81±0.06, 0.45±0.06, and 1591±256, respectively. The median neck circumference, CI, and ABSI were 34 (32, 35.87), 1.19 (1.13, 1.24), and 0.08 (0.07, 0.08), respectively [Table/Fig-1].

The AEBQ-Food Approach score did not reveal any significant correlation with anthropometric indices and body composition parameters. However, significant negative correlations were observed between AEBQ-Food Avoidance scores and body composition parameters such as BMI, waist-to-height ratio, lean mass, dry lean weight, body cell mass, basal metabolic rate, and FFMI [Table/Fig-2]. Neither the food approach nor the food avoidance behaviour was associated with body composition parameters in males. However, in females, their food avoidance behaviour revealed significant negative

Parameters	Values N=68
Age (years) (mean±SD)	20.94±1.10
Gender	
Male	43 (63.2%)
Female	25 (36.8%)
Total	68 (100%)
Weight (kg)#	62.9±12.18
Height (m)#	1.7±0.09
HC (cm)#	95.13±9.23
NC (cm)	34 (32,35.87)
WC (cm)	76 (71,84)
BMI (kg/mt²)#	21.6±3.73
W:H ratio#	0.81±0.06
W:Ht ratio#	0.45±0.06
CI	1.19 (1.13,1.24)
ABSI	0.08 (0.07,0.08)
Fat (Kg)	12.05 (8.83,16.78)
Lean (Kg)	48.15 (39.33,58.78)
Dry lean weight (Kg)	15 (11.78,18.90)
Body cell mass (Kg)#	26.52±6.51
Basal metabolic rate (Kcal)#	1591± 256
BFMI	4 (2.92,5.97)
FFMI	17.3 (14.5,18.87)
AEBQ-Food approach score	52 (45.25,56.75)
AEBQ-Food avoidance score#	49.51±10.28
AAI-Avoidance score	4 (2,6.75)
AAI-Threat monitoring score	4 (2,6)
AAI-Total score	8 (5,11.75)
CDRS score	0 (-1,1)

[Table/Fig-1]: Characteristics of study participants.
Values are Median (IQR); #Values are Mean±SD; HC: Hip circumference; NC: Neck circumference; WC: Waist circumference; BMI: Body mass index; W:H ratio: Waist to hip ratio; W:Ht ratio: Waist to height ratio; CI: Conicity index; ABSI scores: A body shape index; BFMI: Body fat mass index; FFMI: Free-fat mass index; AEBQ: Adult eating behaviour questionnaire; AAI: Appearance anxiety inventory scale; CDRS: Contour drawing rating scale

correlations with BMI, fat mass, lean mass, body cell mass, basal metabolic rate, BFMI, and free-fat mass index [Table/Fig-3]. The food avoidance behaviour was significantly more pronounced in females than in males [Table/Fig-4].

Parameter	AEBQ-Food approach	AEBQ-Food avoidance
BMI	-0.041	-0.334a**
W:H ratio	-0.128	-0.069a
W:Ht ratio	-0.049	-0.245a*
CI	-0.063	-0.155
ABSI	0.013	-0.062
Fat (kg)	-0.018	0.033
Lean (kg)	-0.103	-0.308*
DLW	-0.131	-0.268*
BCM	-0.012	-0.423***
BMR	-0.112	-0.413***
BFMI	0.05	0.053
FFMI	-0.054	-0.405***

[Table/Fig-2]: Correlation between appetitive traits and body composition parameters (n=68).
AEBQ: Adult eating behaviour questionnaire; BMI: Body mass index; W:H ratio: Waist to hip ratio; W:Ht ratio: Waist to height ratio; CI: Conicity index; ABSI scores: A body shape index; DLW: Dry lean weight; BCM: Body cell mass; BMR: Basal metabolic rate; BFMI: Body fat mass index; FFMI: Free-fat mass index; Values are Spearman coefficients; aValues are Pearson coefficients; *p<0.05, **p<0.01, ***p<0.001

Parameter	Male		Female	
	AEBQ-Food approach	AEBQ-Food avoidance	AEBQ-Food approach	AEBQ-Food avoidance
BMI	-0.135	-0.171a	0.06	-0.565a**
W:H ratio	-0.14	-0.133	-0.083	-0.039
W:Ht ratio	-0.108	-0.157a	0.018	-0.381a
CI	-0.167	-0.131	0.039	-0.254
ABSI	-0.108	-0.07	0.15	-0.083
Fat (kg)	-0.162	0.12	0.178	-0.580**
Lean (kg)	-0.171	-0.106	-0.064	-0.520**
DLW	-0.22	-0.129	-0.001	-0.373
BCM	-0.101	-0.275a	0.107	-0.633a**
BMR	-0.254	-0.277a	0.088	-0.612a**
BFMI	-0.014	0.062	0.169	-0.647***
FFMI	-0.193	-0.249	0.13	-0.652***

[Table/Fig-3]: Correlation between appetitive traits and body composition parameters in males and females.
AEBQ: Adult eating behaviour questionnaire; BMI: Body mass index; W:H ratio: Waist to hip ratio; W:Ht ratio: Waist to Height ratio; CI: Conicity index; ABSI scores: A body shape index; DLW: Dry lean weight; BCM: Body cell mass; BMR: Basal metabolic rate; BFMI: Body fat mass index; FFMI: Free-fat mass index; Values are Spearman coefficients; aValues are Pearson coefficients; Values are spearman coefficients; A values are pearson coefficients; **p<0.01, ***p<0.001

Variable	Male (n=43)	Female (n=25)	p-value
AEBQ- Overall food approach trait score	51 (46,56)	52 (44.5,57)	0.774
AEBQ-EF	12 (11,13)	12 (10,14)	0.438
AEBQ-EOE	12 (10,16)	12 (10,18)	0.706
AEBQ-FR	12 (11,13)	11 (10,14.5)	0.595
AEBQ-H#	14.7±3.74	15.44±3.48	0.422
AEBQ-Overall food avoidance trait score#	47.26±9.09	53.4±11.2	**0.016***
AEBQ-EUE#	14.86±4.43	15.84±4.77	0.397
AEBQ-FF#	12.19±3.23	13.64±3.22	0.078
AEBQ-SR#	10.51±2.93	12.28±3.2	**0.024***
AEBQ-SE	9 (7,12)	10 (8,15.5)	0.082

[Table/Fig-4]: Comparison of appetitive traits between males and females.
AEBQ: Adult eating behaviour questionnaire; AEBQ-EF: Adult eating behaviour questionnaire-enjoyment of food; AEBQ-EOE: Adult eating behaviour questionnaire- emotional over-eating; AEBQ-FR: Adult eating behaviour questionnaire-food responsiveness; AEBQ-H: Adult eating behaviour questionnaire-hunger; AEBQ-EUE: Adult eating behaviour questionnaire- emotional under-eating; AEBQ-FF: Adult eating behaviour questionnaire-food fussiness; AEBQ-SR: Adult eating behaviour questionnaire- satiety responsiveness; AEBQ-SE: Adult eating behaviour questionnaire- slowness in eating; CDRS score: Contour drawing rating scale score; Values are median (IQR); p-value-Mann-Whitney U Test; #Values are mean±SD; p-value-independent T-test; *p<0.05

While there was no significant correlation between eating behaviour and appearance anxiety scores, a significant negative correlation was observed between AEBQ-Food Avoidance scores and CDRS scores [Table/Fig-5]. Similarly, a significant negative correlation was observed only between AEBQ-Food Avoidance scores and CDRS scores of females [Table/Fig-6].

Parameter	AEBQ-Food approach	AEBQ-Food avoidance
AAI-Avoidance score	0.175	-0.021
AAI-Threat monitoring score	0.232	0.15
CDRS score	0.005	-0.283*

[Table/Fig-5]: Correlation between appetitive traits, appearance anxiety scores and Contour Drawing Rating Scale (CDRS) scores.
AEBQ: Adult eating behaviour questionnaire; AAI: Appearance anxiety inventory; CDRS: Contour drawing rating scale; Values are spearman coefficients; *p<0.05

DISCUSSION

The appetitive traits, appearance anxiety, perceived body shape and the body composition of the 68 participants, (43 males and 25 females) aged 19-45 years, were assessed using the AEBQ, AAI, CDRS and BIA.

Parameter	Male		Female	
	AEBQ-Food approach	AEBQ-Food avoidance	AEBQ-Food approach	AEBQ-Food avoidance
AAI- Avoidance score	0.167	0.027	0.137	-0.128
AAI- Threat monitoring score	0.272	0.088	0.085	0.141
CDRS score	0.005	-0.149	-0.029	-0.608**

[Table/Fig-6]: Correlation between appetitive traits, appearance anxiety scores and Contour Drawing Rating Scale (CDRS) scores in males and females.
AEBQ: Adult eating behaviour questionnaire; AAI: Appearance anxiety inventory; CDRS: Contour drawing rating scale; Values are Spearman coefficients; **p<0.01

The appetitive trait scores were correlated with anthropometric indices, body composition parameters, appearance anxiety scores, and perceived body shape scores. The study revealed significant negative correlations between AEBQ-food avoidance scores and specific body composition parameters (BMI, W:Ht ratio, lean mass, dry lean weight, body cell mass, BMR, and FFMI) of the study participants. It was also observed that the food avoidance behaviour of females, which was significantly higher than males, showed significant negative correlations with their body composition parameters. Similarly, a significant negative correlation was observed between AEBQ-food avoidance scores and CDRS scores of females.

Food approach traits characterised by food responsiveness, emotional overeating, enjoyment of food, and hunger are known to be associated with overweight and obesity. Similarly, the link between overweight and obesity and disordered eating behaviour has also been reported in previous studies [26-29]. The present study did not reveal any significant association between food approach behaviour and the body composition parameters of the study participants. In line with these results, the study by Jinbo He et al., also failed to observe a relationship between BMI and food approach traits [16]. However, the studies by Mallan KM et al., and Claudia Hunot et al., found positive associations between BMI and food approach traits [15,17]. The discrepancy in these study results could be attributed to cultural differences and the presence of stronger self-control among young adults.

In line with the previous literature [30,31], significant negative correlations were found between food avoidance scores and body composition parameters such as BMI, waist-to-height ratio, lean mass, dry lean weight, body cell mass, basal metabolic rate, and FFMI. Thus, young adults with food avoidance behaviour such as satiety responsiveness, food fussiness, emotional undereating, and slow eating are at lower risk of gaining weight. It is reported that the presence of food fussiness along with increased satiety responsiveness would result in decreased caloric intake and protection against overweight/obesity. In addition, slow eating also increases the feeling of satiety and protects against overeating [16]. The results of this study are also in line with these reports, as evident by the relationship between food avoidance behaviour and specific body composition parameters.

Appetitive traits greatly influence an individual's eating behaviour, resulting in either a positive or negative approach toward food. In addition, the fear of becoming obese, unhappiness with one's body image, and irrational restrictions in energy intake to become skinny are very common in today's teenagers and young adults, posing an increased risk of malnutrition and psychological disorders [32].

In this study, the overall food avoidance behaviour trait score and especially the satiety responsiveness score were found to be significantly higher among females than males. These results could be attributed to the increased concern about body image, greater likelihood of dieting, and greater beliefs in the importance of healthy diets among females compared to males. This finding is in line with the results of the study by Wardle J et al., [33]. In addition, unlike in males, the food avoidance behaviour of females revealed significant negative correlations with several body composition parameters such as BMI, fat mass, lean mass, body cell mass, basal metabolic rate, BFMI, and free-fat mass index which may be due to poor or under eating.

Although there was no significant correlation between the eating behaviour and appearance anxiety of the participants, the food avoidance behaviour revealed a significant association with dissatisfaction with the body image for being overweight or obese, a finding significantly high in females compared to males, as reported in previous studies [34,35]. The use of standardised tools for the assessment of appetitive traits, appearance anxiety, perceived body image and satisfaction, and objective assessment of body composition and anthropometric indices adds substantial evidence to the limited but growing literature on the association between the factors mentioned above in the Indian context.

Limitation(s)

Firstly, the subjective nature of the questionnaires poses a potential response bias. Secondly, considering the study participants' age group, the study results cannot be generalised to the entire population.

CONCLUSION(S)

Food avoidance behaviour was associated with abnormal changes in specific body composition parameters, more so in females than males. Food approach behaviour was not associated with body composition parameters, appearance anxiety, or perceived body shape in both genders. Food avoidance traits, especially the satiety responsiveness and body dissatisfaction of being overweight, are more common among young females, which may affect their body composition and overall well-being. An in-depth understanding of appetitive traits and their effect on body composition parameters, appearance anxiety, and body image perception can help prevent the development of eating disorders among young adults.

Author declaration: The abstract was presented in the Institute's research day program and is published in its souvenir.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Jan 02, 2024
- Manual Googling: Feb 19, 2024
- iThenticate Software: Apr 10, 2024 (14%)

ETYMOLOGY: Author Origin

EMENDATIONS: 8

AUTHOR DECLARATION:
- Financial or Other Competing Interests: Golden Jubilee Short-Term Research Award for Undergraduate Students (GJ STRAUS)
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. No

Date of Submission: **Jan 02, 2024**
Date of Peer Review: **Feb 17, 2024**
Date of Acceptance: **Apr 12, 2024**
Date of Publishing: **Jun 01, 2024**