Food and Nutrition Sciences, 2025, 16(10), 1440-1454
https://www.scirp.org/journal/fns
ISSN Online: 2157-9458
ISSN Print: 2157-944X

Is Anger an Emotional State Related to Overweight and Obesity in Adult Women?

—Affective States and Obesity

Ángel-Haziel Vargas-Huerta[1], Francisco-Miguel Vargas-Luna[2], Regina M. Murillo-Torres[3], Marco Balleza-Ordaz[2], María-Raquel Huerta-Franco[4*]

[1]Division of Engineering and Sciences, Tecnológico de Monterrey (ITESM), Monterrey, México
[2]Department of Physical Engineering, Division of Science and Engineering, University of Guanajuato, Guanajuato, México
[3]School of Medicine and Health Sciences, Tecnológico de Monterrey (ITESM), Monterrey, México
[4]Department of Applied Sciences to Work, Division of Health Sciences, Campus León, University of Guanajuato, Guanajuato, México
Email: *mrhuertafranco@ugto.mx

How to cite this paper: Vargas-Huerta, Á.-H., Vargas-Luna, F.-M., Murillo-Torres, R.M., Balleza-Ordaz, M. and Huerta-Franco, M.-R. (2025) Is Anger an Emotional State Related to Overweight and Obesity in Adult Women? *Food and Nutrition Sciences*, **16**, 1440-1454.
https://doi.org/10.4236/fns.2025.1610084

Received: July 22, 2025
Accepted: October 7, 2025
Published: October 10, 2025

Abstract

Aim: To test whether the *anger* dimension of Food Craving Behavior (FCB) differs across WHO BMI categories in adult women (World Health Organization, 2000), and to summarize patterns for the remaining FCB dimensions and the global score. **Design:** Cross-sectional study of adult women (N = 217). BMI was classified per WHO criteria (World Health Organization, 2000) into normal weight (n = 97), overweight (n = 82), and obesity (n = 38). A validated multidimensional FCB questionnaire yielded a global score and five dimensions (anxiety-stress, depression, leisure, anger, and psychological reactance). **Methods:** One-way ANOVAs compared FCB outcomes across BMI categories. Multiple testing across the five dimension-level ANOVAs was controlled using Holm (primary) and Benjamini-Hochberg FDR (sensitivity) corrections. Tukey HSD was applied only to dimensions remaining significant after correction. **Results:** *Anger* differed significantly across BMI groups, with means (±SD) of 6.71 ± 2.19 (normal), 8.20 ± 2.57 (overweight), and 7.95 ± 2.85 (obesity), F (2, 214) = 8.87, $p = 0.000199$, $\eta^2 = 0.077$; the effect remained significant after Holm/FDR correction. Other dimensions were not significant (all adjusted $p > 0.05$). The global FCB score showed a nonsignificant trend F (2, 214) = 2.35, $p = 0.098$. **Conclusions:** Among FCB dimensions, *anger* is the only domain that differs across WHO BMI categories higher in overweight and obesity than in normal weight-highlighting the relevance of affective processes in weight management for adult women.

Keywords

Anger, Body Mass Index, Food Craving Behavior, Obesity, Overweight, Psychological Reactance, Women

1. Introduction

The prevalence of Food Craving Behavior (FCB) is high across populations, although reported frequencies vary depending on study design, sample size, and population characteristics. FCB is more frequently observed in women, with reported prevalence ranging from 28% to 97% [1]. Sex differences have been described in the intensity and frequency of tonic and trait food cravings, whereas cue-induced cravings have shown less consistent patterns. Overall, women tend to report stronger tonic and trait food cravings [1].

The etiology of FCB is multifactorial and has been interpreted through biological, psychosocial, and cultural frameworks. From a biopsychosocial perspective, prior research suggests that FCB may be triggered by psychological or physiological stress, as well as by emotional states such as anxiety, depression, anger, and food-related psychological reactance [2].

Emotions are adaptive responses involving physiological changes, subjective experiences, and cognitive processing. Although transient, emotional states can substantially influence survival-oriented behaviors, including eating behavior [3]. Individuals naturally strive to enhance positive emotions (e.g., satisfaction, pride, joy, love) and to avoid negative ones such as sadness, anger, anxiety, boredom, and fear [4]. Emotion regulation often aims to reduce the intensity and expression of negative emotions, especially anger, sadness, and anxiety, while enhancing positive states [4]. Although food intake may temporarily generate positive emotions, this effect often reflects a distorted emotional appraisal that fosters maladaptive eating behaviors. Such patterns may result in weight gain, obesity, and subsequent negative affective consequences such as guilt, sadness, and heightened stress or anger, thereby reinforcing the cycle of dysregulated eating [3].

Anger, as a prolonged emotional state, has been associated with both overweight and obesity-complex conditions influenced by psychological, social, and cultural factors. Individuals living with excess weight are frequently exposed to stigma and discrimination, which can provoke emotional and behavioral responses such as frustration, defensive aggression, and social withdrawal [5]. Stereotypes depicting people with overweight as lazy or lacking self-discipline can contribute to feelings of rejection and dehumanization. Moreover, experiences of bullying or exclusion may exacerbate interpersonal conflicts and lead to anxiety, depression, or aggressive responses [5] [6].

Based on this evidence, we hypothesized that women living with overweight or obesity would report higher levels of anger and food-related psychological reactance compared to women with normal weight. Thus, the primary aim of this

study was to compare the five dimensions of FCB among three groups of women: those with normal weight (NW), overweight (OW), and obesity (OB), using a validated multidimensional FCB questionnaire [2].

2. Methods

Ethical Considerations. This study was approved by an institutional Ethics Committee (Approval No. CIBIUG-P-10-2015) and was classified as minimal risk. All participants provided written informed consent before their inclusion. All procedures were conducted in accordance with the ethical standards of the Mexican Ministry of Health and with the 1964 Declaration of Helsinki and its subsequent amendments [7] [8].

Participants. Eligible participants were women residing in urban areas of central Mexico. Recruitment occurred from August 2017 to August 2018 through posters, social media, and in-person outreach in public areas. Inclusion criteria were adult women aged 18 years or older, with reproductive age defined as regular menstrual cycles lasting 21 - 35 days [9]. Eligible participants were required to have sufficient education to independently read, understand, and complete the FCB questionnaire, and to have no anatomical abnormalities or psychiatric disorders affecting eating behavior. Exclusion criteria were the use of medications for weight control or mood disorders (e.g., antidepressants, anxiolytics), and the presence of medical conditions influencing weight or appetite, including diabetes, hypothyroidism, polycystic ovary syndrome, adrenal hyperplasia, Cushing's syndrome, or previously diagnosed eating disorders.

Sample Size and Recruitment. Sample size was estimated using EPIDAT 4.2 based on a population of 874,542 women of reproductive age in the study areas, with an expected FCB prevalence of 86% and an absolute precision of 5%. The calculated sample size was 150; ultimately, 217 women were enrolled through non-probabilistic sampling. All assessments were conducted in a laboratory specializing in occupational and environmental health at a university research facility.

Measures and Instrument Validation. Food Craving Behavior (FCB) was assessed using a 30-item questionnaire previously validated in a sample of women aged 18 to 40 years [2]. The items were developed based on conceptual frameworks of FCB relevant to the local cultural context and encompass five dimensions: anxiety-stress, depression, leisure, food-related psychological reactance, and anger. Factor analysis with orthogonal rotation identified five factors explaining 63.5% of the total variance. The instrument demonstrated excellent internal consistency (Cronbach's $\alpha = 0.92$), with all items showing corrected item-total correlations above 0.2 [2].

Anthropometric Assessment. Height was measured to the nearest millimeter using a Seca® stadiometer. Weight was measured using calibrated digital scales. BMI was calculated using the Quetelet index [10]. All assessments followed the International Society for the Advancement of Kinanthropometry (ISAK) protocol [2].

Statistical Analysis. Data analysis was conducted using STATISTICS v8 (Tulsa, OK, USA). The Kolmogorov-Smirnov-Lilliefors test was used to assess normality. For normally distributed variables ($p > 0.05$), parametric tests were applied. Analyses were two-sided with $\alpha = 0.05$. BMI was operationalized as a three-level factor per WHO cut-offs [10]: normal (18.5 - 24.9 kg/m^2), overweight (25.0 - 29.9 kg/m^2), and obesity (≥30.0 kg/m^2). Continuous variables are presented as means and categorical variables as n (%). Missing data was handled by complete-case analysis on an outcome-by-outcome basis; the sample size for each test is reported in the corresponding table.

Group comparisons across WHO BMI categories were performed with one-way ANOVAs for each FCB dimension (anger, anxiety-stress, depression, leisure, and psychological reactance). We report F, p, and η^2 as the effect size. To control the family-wise error rate across the five-dimension ANOVAs, Holm-Bonferroni correction was prespecified (primary); Benjamini-Hochberg FDR ($q < 0.05$) was used as a sensitivity approach. Post-hoc pairwise comparisons (Tukey HSD) were conducted only for dimensions that remained significant after correction (anger). For completeness, the global FCB score was also analyzed by ANOVA but was not included in the multiple-comparison family.

Distributions of severity categories (None = 0; Mild = 1; Moderate = 2; Severe = 3) by BMI group were compared with Pearson's χ^2 tests (3 × 4 tables; 2 × 3 when dimensions were collapsed to binary levels for sensitivity). When expected cell counts were <5, results were verified with likelihood-ratio χ^2 and/or Fisher's exact test. Effect sizes for contingency analyses were summarized with Cramér's V.

To assess independent associations, multivariable linear regressions were fitted for the global FCB score and each dimension, with BMI (continuous) and age as predictors. Education level (ordinal proxy of socioeconomic status) and physical activity (binary) were included in sensitivity models. Height was excluded due to collinearity. Multicollinearity was evaluated using variance inflation factors (VIF), and BMI was retained for model parsimony. Only the anger model yielded significant two-predictor fit statistics ($R^2 = 0.107$, adj. $R^2 = 0.098$, $p < 0.001$). Robust (HC) standard errors were applied.

3. Results

General Characteristics of the Study Population. Participants were classified by BMI according to WHO criteria (World Health Organization, 2000): normal weight (18.5 - 24.9 kg/m^2; n = 97), overweight (25.0 - 29.9 kg/m^2; n = 82), and obesity (≥30.0 kg/m^2; n = 38). The mean age of the total sample was 28.47 ± 11.71 years. Half of the participants were housewives, 20% were students, and 20% were employees; 10% held a bachelor's degree. The average education level corresponded to upper secondary (high school). Based on a regional socioeconomic classification, 96.7% belonged to a middle socioeconomic level.

Gynecological and Obstetric Characteristics. At assessment, 52% of women with regular cycles were in the follicular phase and 48% in the luteal phase. The

mean age at menarche was 12.2 ± 1.5 years. Most participants (84%) reported regular cycles (21 - 35 days), 8% had irregular cycles, and 8% were using hormonal contraceptives. FCB scores did not differ between menstrual phases (t test, $p > 0.05$).

Anthropometric Characteristics and FCB. Significant differences in body weight were observed among the three groups: 55.56 ± 7.21 kg in the normal-weight (NW) group, 69.24 ± 6.56 kg in the overweight (OW) group, and 82.0 ± 9.91 kg in the obesity (OB) group [ANOVA, $F = 186.09$, $p < 0.0001$]. In contrast, mean height did not differ significantly across groups: 160.04 ± 6.09 cm (NW), 158.49 ± 6.39 cm (OW), and 158.42 ± 7.27 cm (OB) [$F = 1.64$, $p = 0.19$]. As expected, BMI values showed statistically significant differences, with means of 21.66 ± 2.24 kg/m^2 (NW), 27.52 ± 1.40 kg/m^2 (OW), and 32.62 ± 2.80 kg/m^2 (OB) [$F = 422.67$, $p < 0.0001$].

Physical Activity. A total of 71.5% of participants reported engaging in some form of physical activity, including household chores; however, they did not follow a regular exercise regimen [11]. No significant differences were found in FCB scores between participants who engaged in physical activity at least three times per week for ≥30 minutes during the last three months and those who were physically inactive (independent t test = –0.43, $p = 0.66$).

FCB Severity and Dimension "Triggers". Moderate global FCB was observed in 68.2% of participants (148/217), whereas severe FCB was present in 31.3% (68/217). Across specific dimensions, the prevalence of ≥ mild report was: depression (100%), food psychological reactance (89.4%), leisure (87.1%), anxiety-stress (82.0%), and anger (39.6%) (all N = 217). Table 1 summarizes the χ^2 comparisons across WHO-BMI categories (World Health Organization, 2000). A significant difference was detected for the anger dimension [$\chi^2 = 23.93$, $p = 0.00054$], with ≥ mild report in 56.1% of participants in the overweight group, 44.7% in the obesity group, and 23.7% in the normal-weight group. In contrast, food psychological reactance did not differ significantly across BMI categories [$\chi^2 = 10.29$, $p = 0.11$], with ≥ mild report rates of 88.7% (NW), 89.0% (OW), and 92.1% (OB).

Table 1. Frequencies of the five dimensions of Food Craving Behavior (FCB) in adult women with normal weight, overweight, and obesity.

Dimension/Severity	NW n (%)	OW n (%)	OB n (%)
Leisure ($\chi^2 = 5.60$, $p = 0.47$)			
None	11 (11.3)	9 (11.0)	8 (21.1)
Mild	74 (76.3)	67 (81.7)	25 (65.8)
Moderate	11 (11.3)	6 (7.3)	5 (13.2)
Severe	1 (1.0)	0 (0.0)	0 (0.0)

Continued

Anxiety-Stress (χ^2 = 6.40, p = 0.38)			
None	21 (21.7)	10 (12.2)	8 (21.1)
Mild	61 (62.9)	63 (76.8)	23 (60.5)
Moderate	14 (14.4)	7 (8.5)	6 (15.8)
Severe	1 (1.0)	2 (2.4)	1 (2.6)
Depression (χ^2 = 4.60, p = 0.33)			
Mild	67 (69.1)	45 (54.9)	22 (57.9)
Moderate	23 (23.7)	31 (37.8)	13 (34.2)
Severe	7 (7.2)	6 (7.3)	3 (7.9)
Anger (χ^2 = 23.93, p = 0.00054)			
None	74 (76.3)	36 (43.9)	21 (55.3)
Mild	22 (22.7)	42 (51.2)	16 (42.1)
Moderate	0 (0.0)	4 (4.9)	1 (2.6)
Severe	1 (1.0)	0 (0.0)	0 (0.0)
Food Psychological Reactance (χ^2 = 10.29, p = 0.11)			
None	11 (11.3)	9 (11.0)	3 (7.9)
Mild	58 (59.8)	34 (41.5)	20 (52.6)
Moderate	22 (22.7)	35 (43.9)	11 (28.9)
Severe	6 (6.2)	4 (4.9)	4 (10.5)
Global FCB (χ^2 = 2.80, p = 0.59*)			
Mild	1 (1.0)	0 (0.0)	0 (0.0)
Moderate	70 (72.2)	53 (64.6)	25 (65.8)
Severe	26 (26.8)	29 (35.4)	13 (34.2)

NW = normal weight; OW = overweight; OB = obesity. FPR = Food Psychological Reactance; FCB = Food Craving Behavior. *For global FCB, ML-χ^2 with Fisher correction was applied: χ^2 = 3.19, p = 0.53.

Mean Scores of FCB Dimensions. Table 2 shows the mean global FCB score (86.51 ± 11.35; maximum = 120). By BMI category, means were 84.66 ± 12.08 (NW), 87.96 ± 9.38 (OW), and 88.08 ± 12.84 (OB). Although higher values were observed in the overweight and obesity groups compared with normal weight, differences were not statistically significant [F(2, 214) = 2.35, p = 0.098]. Figure 1

illustrates significant differences in anger scores across BMI groups [F(2, 214) = 8.87, p = 0.000199, η^2 = 0.077], with the highest mean in overweight (8.20 ± 2.57), followed by obesity (7.95 ± 2.85) and normal weight (6.71 ± 2.19). In contrast, food psychological reactance did not differ significantly [F(2, 214) = 2.19, p = 0.114], with means of 9.60 ± 4.06 (NW), 10.76 ± 3.53 (OW), and 10.45 ± 3.57 (OB) (Figure 2).

Table 2. FCB dimensions across WHO-BMI groups (ANOVA with Holm and FDR corrections).

FCB Dimensions	NW (n = 97) Mean ± SD	OW (n = 82) Mean ± SD	OB (n = 38) Mean ± SD	F	p	p *Holm*	p *FDR*
Anger	6.71 ± 2.19	8.20 ± 2.57	7.95 ± 2.85	8.87	0.0001	0.001	0.001
Leisure	9.30 ± 2.96	9.18 ± 2.39	9.45 ± 3.06	2.99	0.052	0.21	0.131
Anxiety-Stress	7.42 ± 2.80	7.78 ± 2.61	8.03 ± 3.08	0.78	0.46	0.92	0.55
Depression	6.05 ± 2.08	6.40 ± 2.17	6.24 ± 2.26	0.60	0.55	0.92	0.55
Psychological Reactance	9.60 ± 4.06	10.76 ± 3.53	10.45 ± 3.57	2.19	0.11	0.34	0.19
Global FCB	84.66 ± 12.08	87.96 ± 9.38	88.08 ± 12.84	2.35	0.098	—	—

FCB = Food Craving Behavior. Degrees of freedom for all ANOVAs were (2, 214). Holm and FDR corrections were applied across the five dimension-specific ANOVAs (anger, leisure, anxiety-stress, depression, psychological reactance). The global FCB score is reported for completeness but was not included in the multiple-comparison correction set. *p Holm* = *p*-value adjusted using Holm's sequential correction for multiple comparisons. *p FDR* = *p*-value adjusted using the False Discovery Rate (Benjamini-Hochberg) procedure.

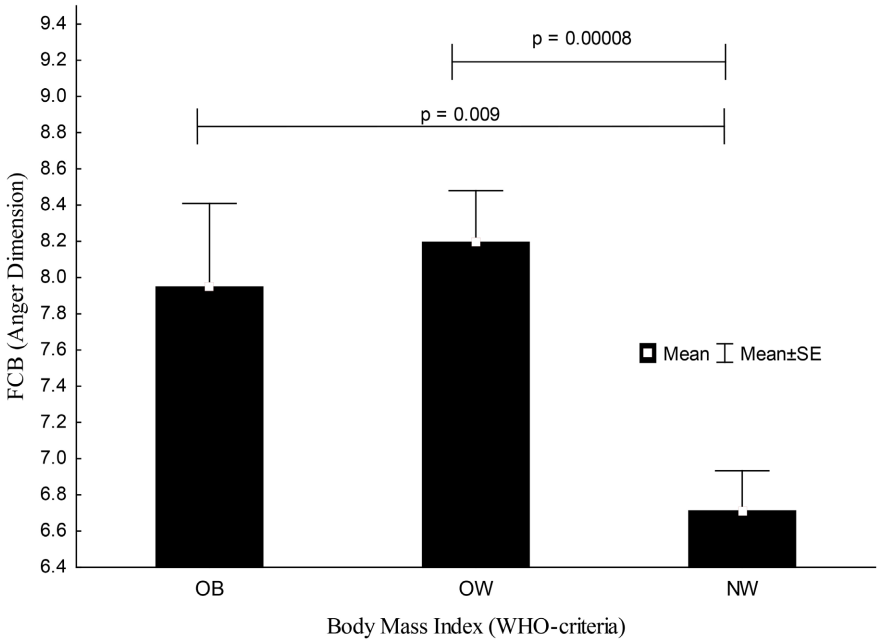

Figure 1. Shows the results of the anger dimension as a trigger of food craving behavior in the three groups studied. NW= Participants living with Normal Weight; OW = Participants living with Overweight; OB = participants living with obesity. FCB = Food Craving Behavior.

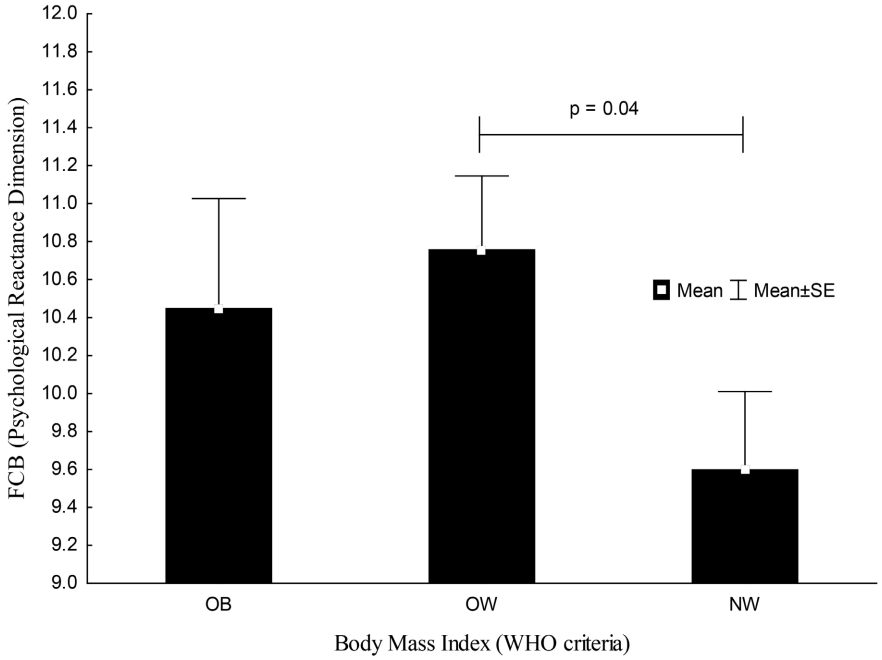

Figure 2. Shows the results of the food psychological reactance dimension as a trigger of food craving behavior in the three groups studied. NW= Participants living with Normal Weight; OW = Participants living with Overweight; OB = participants living with obesity. FCB = Food Craving Behavior.

Predictors of Food Craving Behavior. Multiple regression models (Table 3) indicated that BMI was a significant positive predictor of Anxiety-Stress (B = 0.224, p = 0.046), whereas age was not significant. For the Anger dimension, both BMI (B = 0.124, p = 0.003) and age (B = 0.032, p = 0.054) showed positive associations, with age reaching a marginal level of significance. Model fit statistics for anger indicated R^2 = 0.107, adjusted R^2 = 0.098, F = 12.77, p < 0.001, RMSE = 2.42. In contrast, Psychological Reactance showed only a trend-level effect for BMI (p = 0.059), while age was nonsignificant. For the Global FCB score, neither BMI (p = 0.089) nor age (p = 0.724) reached statistical significance. These findings suggest that higher BMI is consistently associated with greater FCB severity, particularly in the anxiety-stress and anger dimensions. Figure 3 illustrates the positive association between BMI and FCB scores. Table 3 summarizes the regression models.

Additional Analysis. We examined multicollinearity among BMI, weight, and height using variance inflation factors (VIF); models with VIF > 5 were refined. To control family-wise error across the five ANOVAs on FCB dimensions, we applied Holm–Bonferroni correction (primary) and Benjamini-Hochberg FDR (sensitivity). Multiple linear regressions were re-run adjusting for socioeconomic status (proxied by education level) and physical activity (≥3 sessions/week vs. inactive) [11], with robust standard errors.

Multiple-comparison correction. After Holm-Bonferroni adjustment across the five ANOVAs, the anger dimension remained significant (p-adjusted = 0.0005), while food psychological reactance was not (p-adjusted = 0.08). Under BH-FDR,

anger remained significant (q = 0.0005) and food psychological reactance was marginal (q = 0.050).

Collinearity diagnostics. Analyses indicated overlap between BMI and weight (VIF values to be reported). In sensitivity models excluding weight and adjusting for education level and physical activity, BMI remained a significant predictor of global FCB and of the anxiety-stress and anger dimensions (coefficients and 95% CIs to be updated after reclassification).

Table 3. Multiple regression of FCB outcomes on BMI and age.

Outcome	Predictor	B	SE B	β	SE β	t	p
Anxiety-Stress	BMI	0.224	0.110	0.190	0.094	2.007	0.046
	Age	−0.035	0.040	−0.084	0.096	−0.876	0.382
Anger	BMI	0.124	0.042	0.224	0.076	2.952	0.003
	Age	0.032	0.016	0.147	0.076	1.940	0.054
Psychological Reactance	BMI	0.142	0.075	0.179	0.094	1.896	0.060
	Age	−0.024	0.027	−0.086	0.096	−0.890	0.375
Global FCB	BMI	0.384	0.224	0.162	0.094	1.713	0.089
	Age	−0.028	0.080	−0.034	0.097	−0.353	0.724

FCB = Food Craving Behavior; BMI = Body Mass Index (kg/m^2); Age = years; B = unstandardized coefficient; β = standardized coefficient; SE = standard error. All models include a constant. Height was removed from all models. Only the anger model had reported two-predictor fit statistics at this time.

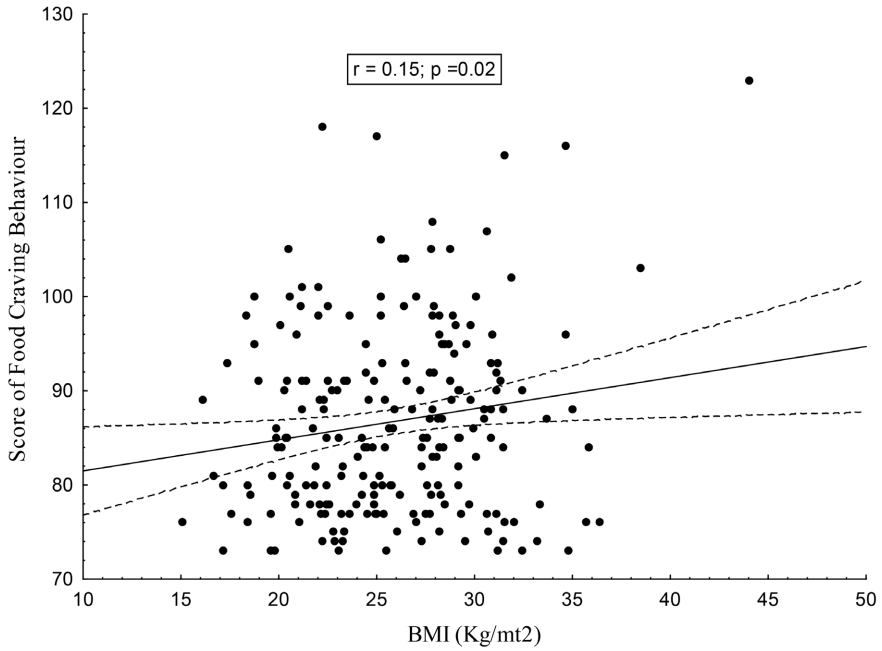

Figure 3. Relationship between Food Craving Behavior variables and Body Mass Index (BMI) in the studied sample of women.

4. Discussion

Is craving for food a more frequent problem in women living with overweight and obesity? This study demonstrated a high prevalence of Food Craving Behavior (FCB) in adult women (mean age: 28.4 ± 11.7 years), with moderate levels observed in 68.2% and severe levels in 31.3% of participants. These frequencies exceed those reported in a previous study of younger women (mean age: 23 years) with predominantly normal weight, where severe FCB was observed in only 14.6% of the sample [2]. Across FCB dimensions, depression symptoms were present in all participants, predominantly at a mild level. Food psychological reactance (89.4%), leisure restriction (87.6%), and anxiety-stress (82.2%) also emerged as frequent dimensions. In contrast, anger was less prevalent overall (39.7%), yet it was the only dimension that differed significantly across BMI categories, with higher scores in women with overweight and obesity compared to those with normal weight ($p < 0.001$). These findings are consistent with previous research showing that emotional states including anger, depression, and anxiety can influence food cravings and contribute to maladaptive eating behaviors [3] [12]. Moreover, ecological momentary assessment (EMA) studies—real-time evaluations of psychological states in daily life—confirm robust associations between stress and craving in naturalistic settings [13].

Several mechanisms may explain the association between anger and food cravings in overweight and obese women. First, anger may trigger cravings for comfort foods rich in sugar and fat as a coping strategy [14] [15]. Second, activation of the stress response may elevate cortisol, which has been linked to abdominal adiposity, insulin resistance, hunger, and increased cravings [14] [16] [17]. Third, palatable foods engage reward-related brain regions (including the ventral tegmental area, nucleus accumbens, amygdala, hippocampus, and prefrontal cortex) providing transient relief from negative effects [18] [19]. Fourth, recurrent emotional eating may reinforce maladaptive craving patterns over time. Finally, weight-related stigma may exacerbate emotional distress and further amplify craving behaviors in women with excess weight [15] [20].

Association between BMI and FCB in adult women. In the global assessment, almost all participants across BMI categories reported moderate or severe FCB, with no significant differences between normal weight, overweight, and obese groups ($\chi^2 = 2.80$, $p = 0.59$). These findings suggest that elevated FCB may be a generalized phenomenon among adult women rather than a feature specific to excess body weight [21].

Predictors of Food Craving Behavior. The multiple regression analyses demonstrated that BMI was consistently associated with higher food craving severity in affective dimensions, particularly anxiety-stress and anger. Notably, the anger model showed the strongest fit, with BMI emerging as a significant predictor and age contributing a marginal effect, suggesting that both adiposity and life stage may influence susceptibility to anger-related cravings [22]. These findings reinforce the notion that excess weight is not only linked to physiological conse-

quences but also to heightened vulnerability in specific emotional domains [23]. Psychological reactance exhibited only a trend-level association with BMI, which may indicate that this dimension is less directly influenced by body composition or more context-dependent [24]. In contrast, the global FCB score did not show significant predictors, underscoring that the emotional subdomains capture more nuanced associations than the aggregated score. Overall, these results highlight the importance of targeting affective processes (especially anger) in strategies for weight management and the prevention of maladaptive eating in women [25].

Previous studies have reported both positive associations between FCB and BMI [2] and null findings [21], which may reflect methodological differences. A limitation of the present study is the reliance on BMI, as it does not distinguish between lean and fat mass. However, recent cross-sectional data indicate that emotional eating increases energy intake in overweight and obese women, supporting the relevance of this pathway [26].

Affective states and food craving behavior. All five FCB dimensions (depression, anger, anxiety-stress, food psychological reactance, and leisure) were analyzed across BMI groups. Leisure emerged as a highly prevalent trigger, reported by 87.6% of women with normal weight, 89.0% of those with overweight, and 78.9% of those with obesity. Cravings often arose during rest, boredom, or social gatherings involving food. Although boredom is frequently mentioned as a trigger, empirical research on its role in FCB remains scarce [19].

Variability in global FCB prevalence across studies may stem from differences in measurement tools, conceptual definitions, inclusion criteria, and sampling [25]-[27]. To minimize such inconsistencies, the present study used a validated questionnaire with robust psychometric properties [2]. Still, questions remain regarding food cravings in the absence of hunger, their relationship with disordered eating, and their contribution to overweight and obesity risk.

5. Conclusion

This study revealed a high prevalence of food craving behavior across all BMI categories, including women with normal weight. Anger was the only affective dimension that differed significantly between groups, with higher scores in overweight and obese women. Food psychological reactance was also highly prevalent, although without group differences. Importantly, regression analyses identified BMI as a predictor of global FCB severity and of specific affective subscales (anxiety-stress and anger), even after adjustment for sociodemographic and behavioral factors. These findings underscore the importance of integrating emotional and psychological components into comprehensive strategies for the prevention and management of overweight and obesity in women.

Authors' Contributions

Conceptualization: M.R. Huerta-Franco, F.M. Vargas-Luna
Methodology: M.R. Huerta-Franco, R.M. Murillo-Torres

Formal Analysis: Á.H. Vargas-Huerta, F.M. Vargas-Luna, M. Balleza-Ordaz
Resources: F.M. Vargas-Luna & M. Balleza-Ordaz
Writing-Original Draft: M.R. Huerta-Franco, R.M. Murillo-Torres
Writing-Review & Editing: Á.H. Vargas-Huerta, M. Balleza-Ordaz
Supervision: M.R. Huerta-Franco
Project Administration: Á.H. Vargas-Huerta, F.M. Vargas-Luna
Funding Acquisition: F.M. Vargas-Luna, M. Balleza-Ordaz

Acknowledgments

The authors gratefully acknowledge the financial support provided by the University of Guanajuato (DAIP Project Grant No. 224/2019) and sincerely thank all the participants who contributed to this research.

Materials Availability

No laboratory or intervention materials were used. Psychological and anthropometric instruments are detailed and cited in the manuscript.

Conflicts of Interest

The authors declare that they have no affiliations with or involvement in any organization or entity with financial interests in the subject matter of this manuscript.

References

[1] Hallam, J., Boswell, R.G., DeVito, E.E. and Kober, H. (2016) Gender-Related Differences in Food Craving and Obesity. *Yale Journal of Biology and Medicine* (*YJBM*), **89**, 161-173. https://pubmed.ncbi.nlm.nih.gov/27354843/

[2] Moreno-Frías, M., Chaudhari, S. and Huerta-Franco, M. (2017) Relationship of Food Craving Behavior with Body Mass Index and Body Composition in Reproductive Age Females. *Food and Nutrition Sciences*, **8**, 699-713. https://doi.org/10.4236/fns.2017.87049

[3] Barbee, K.G. and Timmerman, G.M. (2015) Emotional Eating, Nonpurge Binge Eating, and Self-Efficacy in Healthy Perimenopausal Women. *Journal of Holistic Nursing*, **33**, 298-307. https://doi.org/10.1177/0898010115569574

[4] Wolfe, H.E., Livingstone, K.M. and Isaacowitz, D.M. (2022) More Positive or Less Negative? Emotional Goals and Emotion Regulation Tactics in Adulthood and Old Age. *The Journals of Gerontology*: *Series B*, **77**, 1603-1614. https://doi.org/10.1093/geronb/gbac061

[5] Puhl, R.M. and Heuer, C.A. (2010) Obesity Stigma: Important Considerations for Public Health. *American Journal of Public Health*, **100**, 1019-1028. https://doi.org/10.2105/ajph.2009.159491

[6] Tomiyama, A.J. (2019) Stress and Obesity. *Annual Review of Psychology*, **70**, 703-718. https://doi.org/10.1146/annurev-psych-010418-102936

[7] Mazzanti Di Ruggiero, M.D.L.Á. (2015) Declaración de Helsinki, principios y valores bioéticos en juego en la investigación médica con seres humanos. *Revista Colombiana de Bioética*, **6**, 125-145. https://doi.org/10.18270/rcb.v6i1.821

[8] World Medical Association (2013) Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. *JAMA*, **310**, 2191-2194.

[9] Barriga-Pooley, P. and Brantes-Glavic, S. (2019) Normal Menstrual Cycle. In: Lutsenko, O.I., Ed., *Menstrual Cycle*, Elsevier, 15-38.

[10] World Health Organization (2000) Obesity: Preventing and Managing the Global Epidemic. Report of a WHO Consultation, WHO, 1-253.

[11] American College of Sports Medicine (2010) ACSM's Health-Related Physical Fitness Assessment Manual. 3rd Edition, Lippincott Williams & Wilkins, 2-16.

[12] Chao, A.M., White, M.A., Grilo, C.M. and Sinha, R. (2017) Examining the Effects of Cigarette Smoking on Food Cravings and Intake, Depressive Symptoms, and Stress. *Eating Behaviors*, **24**, 61-65. https://doi.org/10.1016/j.eatbeh.2016.12.009

[13] Dicker-Oren, S.D., Gelkopf, M. and Greene, T. (2024) Momentary Stress-Induced Food Craving: An Ecological Momentary Assessment Study Comparing Perceived Interpersonal and Non-Interpersonal Stressors. *Stress and Health*, **40**, e3402. https://doi.org/10.1002/smi.3402

[14] Dallman, M.F., Pecoraro, N.C. and la Fleur, S.E. (2005) Chronic Stress and Comfort Foods: Self-Medication and Abdominal Obesity. *Brain, Behavior, and Immunity*, **19**, 275-280. https://doi.org/10.1016/j.bbi.2004.11.004

[15] Evers, C., Marijn Stok, F. and de Ridder, D.T.D. (2010) Feeding Your Feelings: Emotion Regulation Strategies and Emotional Eating. *Personality and Social Psychology Bulletin*, **36**, 792-804. https://doi.org/10.1177/0146167210371383

[16] Epel, E.S., McEwen, B., Seeman, T., Matthews, K., Castellazzo, G., Brownell, K.D., *et al.* (2000) Stress and Body Shape: Stress-Induced Cortisol Secretion Is Consistently Greater among Women with Central Fat. *Psychosomatic Medicine*, **62**, 623-632. https://doi.org/10.1097/00006842-200009000-00005

[17] Rosmond, R. (2005) Role of Stress in the Pathogenesis of the Metabolic Syndrome. *Psychoneuroendocrinology*, **30**, 1-10. https://doi.org/10.1016/j.psyneuen.2004.05.007

[18] Volkow, N.D., Wise, R.A. and Baler, R. (2017) The Dopamine Motive System: Implications for Drug and Food Addiction. *Nature Reviews Neuroscience*, **18**, 741-752. https://doi.org/10.1038/nrn.2017.130

[19] Kenny, P.J. (2011) Reward Mechanisms in Obesity: New Insights and Future Directions. *Neuron*, **69**, 664-679. https://doi.org/10.1016/j.neuron.2011.02.016

[20] Havermans, R.C., Vancleef, L., Kalamatianos, A. and Nederkoorn, C. (2015) Eating and Inferring: The Role of Boredom in Food Intake and Food Choice. *Health Psychol Open*, **2**.

[21] Imperatori, C., Innamorati, M., Continisio, M., Contardi, A., Tamburello, S., Lamis, D.A. and Fabbricatore, M. (2014) The Association among Food Craving, Binge Eating Severity, and Weight Status: A Moderation Analysis in a Sample of Overweight and Obese Patients. *The Journal of Nervous and Mental Disease*, **202**, 899-904.

[22] Neseliler, S., Han, J. and Dagher, A. (2017) Functional Neuroimaging of Food Craving in Overweight and Obese Women: Distinct Neural Responses to Hunger and Satiety. *Appetite*, **117**, 214-222.

[23] Konttinen, H., Männistö, S., Sarlio-Lähteenkorva, S., Silventoinen, K. and Haukkala, A. (2010) Emotional Eating, Depressive Symptoms and Self-Reported Food Consumption. A Population-Based Study. *Appetite*, **54**, 473-479. https://doi.org/10.1016/j.appet.2010.01.014

[24] Meule, A., Lutz, A., Vögele, C. and Kübler, A. (2012) Food Cravings Discriminate Differentially between Successful and Unsuccessful Dieters and Non-Dieters. Valida-

tion of the Food Cravings Questionnaires in German. *Appetite*, **58**, 88-97. https://doi.org/10.1016/j.appet.2011.09.010

[25] Koenders, P.G. and van Strien, T. (2011) Emotional Eating, Rather than Lifestyle Behavior, Drives Weight Gain in a Prospective Study in 1562 Employees. *Journal of Occupational & Environmental Medicine*, **53**, 1287-1293. https://doi.org/10.1097/jom.0b013e31823078a2

[26] Hormes, J.M. and Rozin, P. (2010) Does "Craving" Carve Nature at the Joints? Absence of a Synonym for Craving in Many Languages. *Addictive Behaviors*, **35**, 459-463. https://doi.org/10.1016/j.addbeh.2009.12.031

[27] Potenza, M.N. and Grilo, C.M. (2014) How Relevant Is Food Craving to Obesity and Its Treatment? *Frontiers in Psychiatry*, **5**, Article No. 164. https://doi.org/10.3389/fpsyt.2014.00164

Supplementary Material S1. Variance Inflation Factor (VIF) Diagnostics

Variance Inflation Factor (VIF) analyses were conducted for the regression models including *BMI* and *Age* as predictors of Food Craving Behavior (FCB) outcomes. VIF values were approximately 1.38 for both predictors, with corresponding tolerances of 0.72, which are well below accepted thresholds for moderate (VIF > 5) or severe (VIF > 10) multicollinearity. These results indicate that the regression coefficients for BMI and Age are stable, and their standard errors are not inflated by collinearity. The exclusion of anthropometric variables highly correlated with BMI (*i.e.*, Weight and Height) is therefore methodologically justified. Consequently, the observed associations-particularly the significant effects of BMI on the *Anger* and *Anxiety-Stress* dimensions can be interpreted with confidence.

Note: VIF values apply to the specific models with BMI and Age as predictors. Should additional correlated predictors be introduced (e.g., Weight, Height, or interaction terms), VIF diagnostics should be re-evaluated.

Table S1. Variance inflation factors (VIF) for predictors in multiple regression models。

Outcome	Predictor	VIF	Tolerance
All models (Anxiety-Stress, Anger, Psychological Reactance, Global FCB)	Age	1.38	0.72
All models (Anxiety-Stress, Anger, Psychological Reactance, Global FCB)	BMI	1.38	0.72

VIF = Variance inflation factor; Tolerance = 1/VIF. Values < 5 (tolerance > 0.2) indicate no problematic multicollinearity. BMI = Body Mass Index.