

Role of Obesity and Depression in Food Preference: A Study of Adult Sex Disparities

*¹Sangeeta Singg, ²Justin Pontius

¹Department of Psychology, Sociology, and Social Work, Angelo State University, San Angelo, Texas, USA

²American Heart association, Dallas, Texas, USA

Abstract

Although the relationship between dietary intake and depression has been the subject of investigation for several decades, the exact nature of the relationship has not been clearly identified. The role of demographic factors is also not clear in this relationship particularly in different levels of depression. In this study, three independent variables of obesity, depression, and sex were explored to see if they interact with regard to food preference in terms of macronutrients: carbohydrate, fat, and protein. Foods were also assessed in terms of grams of sugar. Thus, the three macronutrients and sugar in snacks were used as dependent variables. A sample of 440 volunteer adults (age $M = 23$, $SD = 8.49$) from a Southwestern American university completed an approved consent form, demographic questionnaire including a snack preference question, and the Goldberg Depression Questionnaire. Sex was found to be an important factor related to ones choice of snacks containing macronutrients. Among several other findings, a major finding was that men tended to prefer richer snacks with higher grams of carbohydrate, fat, protein and sugar than did women. This finding was considered a reflection of our current state of health consciousness of women which also supported the previous research that currently more men are overweight than women in developed countries. Another finding that depressed participants preferred snacks with higher grams of carbohydrate is explained by the evidence that carbohydrate can relieve depression and elevate mood by high synthesis of serotonin which modulates mood and alleviates depression among other things. Further, the serotonin and depression connection was confirmed by the finding that lean depressed participants, especially men preferred snacks with greater protein which might be blocking the absorption of serotonin. Limitations and practical implications of the findings of the study were also discussed.

Keywords

Obesity, Depression, Serotonin, Macronutrients, Carbohydrate, Fat, Protein, Sugar

Introduction

Obesity has become one of the major global health risks [1]. It is an epidemic in the United States causing a great financial burden on the country and lower quality of life for those who are obese. In 2015, 38% of adults were reported to be obese with the highest rates of 41% for the middle-age adults (age 40-59 years) 38.5% for older adults (age 60+ years), and 34.3% for the younger adults (age 20-39 years). Among all adults (ages 20+), women (36.5%) had higher obesity rates than men (33.1%) [2].

Obesity is also related to depression which is another common problem in the American society. According to the findings of a meta-analysis [3], obesity

and depression are significantly positively related and this relationship is more marked among women than men. The authors of the National Health and Nutrition Examination Surveys, 2005–2010 [4] reported the following pertinent findings about obesity and depression. Adults with

***Corresponding author:** Sangeeta Singg, Department of Psychology, Sociology, and Social Work, Angelo State University, San Angelo, Texas, USA. E-mail: sangeeta.singg@angelo.edu

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depression were more likely to be obese than adults without depression. Of those adults who were depressed, 43% were obese. In every age group, women with depression than without depression were more likely to be obese. Further, the proportion of adults with obesity rose as the severity of depressive symptoms increased. Authors suggested that the understanding of the obesity and depression relationship might help healthcare providers plan better prevention and treatment programs.

One factor that links obesity and depression is the quality of diet. Consumption of processed and fried foods, refined grains and sugars is associated with both conditions [5]. A secondary analysis of data collected by the National Health and Nutrition Examination Surveys from 1999-2004 examined the relationship among major depressive disorder, body mass index (BMI), physical activity, and healthy dietary intake while controlling for demographic variables of young adults aged 20-39 years. Major depressive disorder and obesity were found positively related among women, but an inverse association existed among men. Also, major depressive disorder was inversely associated with healthy dietary intake among women [6].

Although the relationship between dietary intake and depression has been the subject of investigation for several decades [7, 8], the exact nature of the relationship has not been clearly identified [9]. The role of demographic factors is also not clear in this relationship particularly in different levels of depression [10]. It has also been suggested that depressed individuals vary in their responses to particular nutrients depending on their sex [11] and level of obesity [12, 13]. Authors of a review of literature on gender disparities concluded that many socio cultural factors affect gender disparities in obesity, but this issue remains largely “under researched, let alone addressed” [14].

No study to our knowledge has examined the three variables of obesity, depression, and sex together to see if they interact with regard to food preference in terms of macronutrients and sugar in the preferred foods. Thus, the present study aimed to explore any possible interaction among these three variables using them as the independent variables while the dependent variables were macronutrients (carbohydrate, fat, and protein) and sugar identified in the preferred snack with the help of the Instant Weight Loss™ designed by MICRO Blvd Inc. [15]. Sugar was also examined because most food labels list carbohydrate and sugar content.

Method

A sample of 440 volunteer adults (age $M = 23$, $SD = 8.49$) from a Southwestern American university complete and approved consent form, demographic questionnaire including a snack preference question, and the Goldberg Depression Questionnaire (GDQ) [16]. Majority of the participants were single (74%), women (70%), from middle socioeconomic status families (89%), and Caucasian (69%).

Previous research [17] had warned that sensory appeal of certain snacks might unduly influence participants' choices. Therefore in the present study, participants were asked to write the name of any snack they desired to eat at the moment. Also, they were asked to choose a snack rather than a meal since previous research [18] indicated that food preference is better revealed in snack choices rather than in scheduled mealtime food choices.

All tests used in the present study were self-report tests. The 18-question GDQ [15] is a test of signs and symptoms associated with depression. Two categories of depression used in the present study were Non-Depressed (scores 0-21) and Moderate/Severely Depressed (scores 22 or more). Obesity was measured by the body mass index (BMI), expressed as weight in pounds divided by height in inches squared and multiplying by a conversion factor of 703 [19]. Two categories used in the present study were Lean (BMI 24.9 or less) and Overweight/Obese (BMI 25.0 and above). To calculate the macronutrients (carbohydrate, fat, and protein) and sugar in any snack, Instant Weight Loss™ [15] was used. This program contains a database of nutrient values for over 13,000 foods, including many items found in the supermarkets.

Results

The sample consisted of 306 (70%) Lean (L) and 134 (30%) Overweight/Obese (O); 340 (77%) Non-Depressed (ND) and 100 (23%) Depressed (D) participants. The nationwide prevalence rate of these conditions among college students was similar to our sample, 33% Overweight/with Class I Obesity within the 30 days of data collection and 20% Sad/Depressed [20]. The data were analyzed using 2 x 2 x 2 (Obesity x Depression x Sex) factorial analyses of variance ($\alpha = .05$). The Means and Standard Deviations for the three macronutrients and sugar are presented in Table 1 and F Values are presented in Table 2. Statistically significant results of the present study are presented below.

Table 1: Mean Scores and (Standard Deviations) for Men and Women’s Craved Grams of Macronutrients by Obesity and Depression.

Macro-nutrients	Lean	Overweight/ Obese	All	ND	All	NDD	All
Carbohydrate							
Men	54.9 (45.6)	74.1 (44.9)	60.0 (45.8)	50.3 (29.9)	52.6 (31.7)	51.0 (30.2)	55.3 (39.4)
Women	38.6 (20.6)	51.6 (40.8)	41.1 (29.8)	36.9 (26.7)	43.3 (61.7)	38.8 (40.0)	40.1 (32.5)
All	42.3 (32.1)	57.1 (42.6)	45.3 (39.5)	43.0 (28.9)	47.3 (50.4)	44.3(36.3)	45.0(35.3)
ND Men – 52.9 (39.4) Women – 38.2 (26.1) D Men – 62.7 (39.3) Women – 48.9 (48.2) All ND - 42.5 (31.3); D - 53.3 (45.8)							
Fat							
Men	26.5 (25.4)	34.4 (26.5)	18.1 (25.7)	23.0 (30.1)	18.1 (17.9)	21.6 (27.2)	25.1 (26.5)
Women	11.9 (14.8)	12.0 (10.3)	11.9 (14.2)	15.5 (20.4)	18.0 (21.9)	16.2 (20.7)	16.2 (20.7)
All	15.2 (18.8)	17.5 (18.4)	15.6 (18.8)	18.9 (25.4)	18.1 (20.0)	18.6 (23.8)	16.6 (20.4)
ND Men – 24.9 (27.5) Women – 12.6 (16.3) D Men – 25.7 (23.5) Women – 13.9 (15.1) All ND - M = 16.21 (20.9); D - M = 17.7 (18.9)							
Protein							
Men	22.7 (28.3)	42.7 (57.7)	26.9 (36.8)	31.2 (79.1)	14.5 (15.9)	26.5 (67.6)	26.7 (53.0)
Women	08.9 (12.8)	07.6 (07.9)	08.7 (12.1)	08.3 (14.6)	08.3 (14.6)	07.8 (13.3)	08.5 (12.4)
All	12.1 (18.5)	16.3 (32.4)	12.9 (22.0)	18.7 (55.1)	10.2 (13.2)	16.2 (47.1)	13.9 (31.8)
ND Men – 26.4 (56.1) Women – 08.8 (13.3) D Men – 27.7 (42.8) Women – 07.4 (08.5) All ND - M = 13.9 (33.1); D - M = 13.8 (26.7)							
Sugar							
Men	34.8 (40.7)	38.9 (28.9)	35.6 (38.3)	26.1 (23.4)	26.9 (23.7)	26.3 (23.3)	31.4 (32.6)
Women	19.7(20.2)	26.6 (29.7)	21.0 (22.5)	17.4 (18.9)	30.8 (58.7)	21.4 (35.7)	21.1 (26.2)
All	23.2 (27.0)	29.6 (29.8)	24.4 (27.6)	21.4 (21.0)	29.1 (46.3)	23.6 (30.8)	24.2 (28.6)

Key: ND = Non Depressed; D = Depressed

Table 2: ANOVA F Values for the Craved Micro-Nutrients: Obesity x Depression x Sex.

Variable	Obesity (A) F _{2,433}	Depression (B) F _{1,433}	Sex (C) F _{1,433}	A x B F _{2,433}	A x C F _{2,434}	B x C F _{1,434}	A x B x C F _{2,434}
Carbohydrates	4.19*	5.43*	12.33**	1.79	0.83	0.01	0.35
Fats	1.03	0.33	19.84**	1.08	8.71**	0.00	2.35
Proteins	1.83	0.01	26.01**	5.60*	1.35	0.15	5.52*
Sugars	1.72	3.08	5.05*	0.05	2.50	1.17	0.47

Level of Significant: *p< .05; **p< .01

Significant main effects of Obesity ($F_{2,432} = 4.19$, $p=.041$), Depression ($F_{1,432} = 5.43$, $p=.02$), and Sex ($F_{1,432} = 12.33$, $p=.0001$) were noted on Carbohydrate. None of the interactions were significant. Snacks with more grams of carbohydrate were preferred by Men ($M = 55.32$) as compared to Women ($M = 40.56$); by Lean participants (M

$= 45.27$) as compared to Overweight/Obese ($M = 44.26$); and by Depressed participants ($M = 53.32$) as compared to Non-Depressed ($M = 42.50$). The first two results about Men and Overweight/Obese participants were opposite to what we expected. However, the results about depressed participants were as expected.

On Fat, one significant main effect of Sex ($F_{2,432} = 19.84, p = .0001$) and one significant interaction effect of Obesity x Sex ($F_{1,432} = 8.71, p = .003$) were found. Overall Men preferred snacks with more grams of fat ($M = 25.12$) than did Women ($M = 12.92$) as expected. Further analysis revealed that Overweight/Obese Women ($M = 16.23$) preferred snacks with higher grams of fat than did the Lean Women ($M = 11.88$). However, the direction changed for the Lean Men ($M = 28.13$) who preferred snacks with higher grams of fat than Lean Women ($M = 11.88$).

As expected, a main effect of Sex ($F_{1,432} = 26.01, p = .0001$) was observed on Protein. Men ($M = 26.72$) preferred snacks with higher grams of protein than did Women ($M = 8.49$). Two interaction effects on Proteins were also significant: Obesity x Depression ($F_{1,432} = 5.6, p = .02$) and Obesity x Depression x Sex ($F_{1,432} = 5.52, p = .02$). Further analyses revealed that Lean Depressed participants ($M = 16.28$) preferred snacks with higher grams of protein than did Lean Non-Depressed ($M = 12.07$). For the three way interaction effect, the significant results were noted for Lean Depressed Men ($M = 42.67$) with highest grams of protein in their preferred snacks as compared to all other subgroups. There were no significant differences in any of the women's pair wise comparisons.

As expected, a main effect of Sex ($F_{1,432} = 5.05, p = .03$) was also found on Sugar. Men ($M = 31.40$) preferred snacks with higher grams of sugar than did women ($M = 21.13$). No other results were significant.

Discussion

The results of the present study indicate that one's sex, mood, and weight tend to affect one's choice of snacks with carbohydrates. Men tend to prefer snacks with higher carbohydrate content than women. Lean persons prefer snacks with higher carbohydrate content than do the overweight/obese persons. And persons with depressed mood tend to prefer snacks with higher carbohydrate content than do the non-depressed persons. The results for men and lean participants were contrary to the findings of previous research which reported that women preferred foods with higher amount of carbohydrate and so did the obese persons [11, 12]. One possible explanation for our diverging results is that our findings might be reflecting women's cultural and educational changes in the modern society. Previous research has reported that women are more cognizant of what they eat than men because of their pursuit of achieving ideal body shape. They tend to prefer snacks with lower grams of carbohydrate which are linked

to obesity [21, 22]. Lean individuals on the other hand might feel less concerned about selecting a snack with higher carbohydrate content because they are not as concerned about their weight as overweight/obese individuals might be. The finding that depressed participants preferred snacks with higher grams of carbohydrate is explained by the evidence that carbohydrate can relieve depression and elevate mood [23, 24]. A snack high in carbohydrate increases the rate in which tryptophan enters the brain. This in turn leads to an increase in the level of serotonin which modulates mood and alleviates depression among other things [24]. This has led to the conclusion that depressed individuals might be using excessive carbohydrate to self-medicate [23].

In support of the previous research [12, 25, 26], our overall findings of men preferring higher fat snacks than women and overweight/obese women preferring higher fat snacks than lean women were as we expected. However, contrary to previous research, the overweight/obese men preferred snacks with lower grams of fat than did the lean men. As with carbohydrate, lean men might feel less concerned about selecting snacks with higher fat content than the overweight/obese men in the present study. Because fat has been implicated in obesity, overweight and obese persons might avoid it.

Protein results yielded some interesting findings. As expected, overall men preferred snacks with higher grams of protein than did women, supporting previous research [26, 27]. One explanation is that men obtain greater percentage of their energy intake from protein because they prefer to eat more meat-based products than women [27]. Further look into the data revealed that lean depressed participants preferred snacks with higher grams of protein than did the lean non-depressed participants. And the three way interaction results showed that lean depressed men had the highest mean grams of protein in their preferred snacks as compared to all other subgroups. This effect was not evident in subgroups of women. A detailed review [28] of sensory, physiological, and psychological mechanisms that underlie emotional effects on food choices has suggested that higher proportion of protein to carbohydrate intake might be related to depression. Synthesis of serotonin (low levels of which are involved in depression) is interfered by the intake of high amount of protein even if the food contains high amount of carbohydrate. This might explain the reason for our finding of lean depressed participants, especially men preferring snacks with the higher grams of protein than

any sub group. Our findings are only exploratory and do not suggest any cause and effect relationship; however, high protein and depression connection with regard to food preference should be investigated in future research.

Men preferred snacks with higher grams of sugar than did women in the present study. There are inconsistent findings about preference for sugary food by men and women. Some have reported that men prefer sugary food more than do women [29] and others have reported that obese women and women in general prefer sugary foods more than do men [25, 30, 31]. One explanation given for women preferring sugary snacks less than men is that women are more concerned with the health problems associated with sugary foods. They usually tend to be more interested in nutritional information than do men [32]. This explanation may apply to our findings as well.

Sex appears to be an important factor related to ones choice of snacks containing macronutrients and sugar which might have implications for obesity and depression. Controlled studies are needed to examine the sex diversities with regard to food preference. Another conclusion of this study is that overall men tend to prefer richer snacks with higher contents of carbohydrate, fat, protein and sugar than do women. This finding is a reflection of our current orientation of women who are more body shape and health conscious than men. Further, this finding coincides with the conclusion of a review of the studies on global sex disparities in obesity showing more men being overweight than women in developed countries [30].

The main limitation of this study is the sample of convenience which is non randomized. Other limitations are use of self-report measures and not controlling some possible confounding variables such as age, ethnicity, health conditions, and socioeconomic status. Notwithstanding, our findings have implications for weight reduction and management programs. Sex has been a variable that has been somewhat neglected while designing such programs. We feel that it should be an important variable to consider while devising any strategies for weight reduction and management. Men and women choose food differently partly due to physiological reasons and partly due to socio cultural reasons. It is important to understand these dynamics for successful interventions. Being overweight or obese (BMI 25.1 or more) is related to higher risk for atherosclerotic cardiovascular disease, coronary heart disease, cancer, hyper lipidemia, hypertension, metabolic syndrome, and diabetes mellitus and subsequently mortality [33]. More controlled studies and surveys are needed in

this area because many questions remain unanswered. The famous adage, “Let food be thy medicine and medicine be thy food” by Hippocrates is needing serious attention of our government, pharmaceutical companies, health professionals, parents, teachers, and researchers.

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