Food Addiction Is More Prevalent in Women with Metabolic Syndrome

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Citation

Abstract
Obesity and related illnesses like metabolic syndrome (MS) may be symptoms of food addiction. In accordance, food addiction was defined following the DSM-IV diagnostic criteria for substance dependence. The aim of this pilot study was to compare a subgroup of women suffering from MS with healthy subjects. We hypothesized that women with MS would be different from healthy women in terms of food addiction and its related diagnostic criteria. Twenty-four female adults with MS and 25 healthy individuals completed Yale Food Addiction Scale (YFAS) questionnaires to assess food addiction. Six food addiction diagnostic criteria and continuous version scores means were more in MS than healthy group. More than 70% of female with MS and only 12% of healthy subjects fulfilled the criteria for diagnosis of substance dependence. These findings suggest the higher prevalence of food addiction in female with MS.

1. Introduction

One of the most common documented hazards of obesity is metabolic syndrome (MS) in adulthood (1, 2). Metabolic syndrome refers to a constellation of three or more of the following components: abdominal obesity, hypertriglyceridemia, low HDL-C, high blood pressure, and high fasting glucose (3). The prevalence of MS is widespread through the world. It differs between populations and ethnic groups and increases with age (4, 5). The global prevalence of MS has been reported in a very wide range from 15% to 86% (3, 6-10). In addition, 7 to 46.5 % of adult women in the world are diagnosed with MS. Differences in genetic background, nutritional status, physical activity status, age and sex composition of the populations, malnutrition, obesity, and using different definitions have resulted in a wide range prevalence rate of MS in the world. The prevalence of MS in the US which is a developed country is about 20 to 30 %, while in some Asian countries like India and Iran higher prevalence rates have been reported. An early study showed the prevalence of MS among residents of Kurdistan Province aged 25 to 64 year. Results showed that the prevalence is 29.1% with the more prevalent among women than men (11). Moreover, a study designed to assess the prevalence of MS and its risk factors in an urban population in Ahvaz (South West of Iran) showed that women are at higher risk for MS than men (12). The prevalence increased with age in both genders (13). Different criteria have been proposed by the World Health Organization (WHO), the Adult...
Treatment Panel III (ATP III) and the International Diabetes Federation (IDF) for the diagnosis of the metabolic syndrome (14). MS is expected to become increasingly common as a consequence of sedentary lifestyles, excessive calorie intake and dramatic increase in obesity (15).

One of the new hypotheses for obesity epidemic is “food addiction”, which is associated with both substance-related disorder and eating disorder (16). In humans, increasing evidence suggests that individuals with obesity, experience behavioral symptoms and neurochemical changes that are highly comparable to other addictive behaviors (17-20). Moreover, there is now considerable evidence that food addictive exploits pathways in the brain, namely the dopamine and opiate systems. Dopamine has been associated with the perceived value of reward of food substances. Positron emission tomographic (PET) imaging studies have also shown that obese individuals have significantly lower dopamine receptor levels. Similarly, the opiate system has been implicated in food consumption. Consumption of food, especially high fat sweets, can cause endogenous opiates to be released in the brain. These findings suggest that opioid system plays a role in the regulation of ingestive behavior and μ-opioid receptor signaling in the nucleus accumbens significantly contributes to the hyperphagia, body weight gain, and body fat accretion observed when rodents are exposed to a palatable diet (21). Thus, food and opiate withdrawal stimulate appetite, increases calorie consumption, augments the incidence of overeating, overweight, obesity and related illnesses (22) including MS (23). In addition, it has been found that the prevalence of food addiction is higher in obese participations (24). Thus, obesity and related illnesses such as MS may be symptoms of food Addiction (22). Current cross-sectional study aims to compare the food addiction score between adult with metabolic syndrome and healthy subjects.

2. Materials and Methods

This was a cross-sectional study on a 49 randomly selected representative sub-sample (24 with MS and 25 healthy female adults) from available information in the “Adult Metabolic Syndrome research project” approved by Jundishapur University of Medical Sciences, Diabetes Research Center designed to assess the prevalence of MS and its risk factors in an urban population in Ahvaz. Sampling performed with random cluster method in 6 health center in Ahvaz conducted on October 2009 to February 2011. In each selected center, 55 households were randomly selected. Finally, 912 participants were included in the study (12).

At the base line, a written informed consent was obtained from all participants. Participants completed a written questionnaire in their home for evaluating food addiction (17). The diagnostic criteria score of food addiction extracted from the questionnaire was comprised between two groups (MS and healthy). The study protocol was approved by the research ethics committee of Ahvaz Jondi-Shapour University of Medical Sciences (AJUMS).

3. Participants

A total of 61 female adults with MS and 78 healthy subjects were selected randomly from data bank of “Adult Metabolic Syndrome research project” and were included in this study. A total of 90 subjects were not present in the household during the period of the survey, giving a response rate of 35.3%. The final sample contained 24 with MS and 25 healthy females.

After obtaining informed consent by volunteers, they were invited to participate in this study. The MS was defined as the presence of ≥ 3 of the following components according to the American Heart Association/National Heart, Lung, and Blood Institute (AHA/NHLBI) criteria for diagnosis of metabolic syndrome: 1) waist circumference (WC) > 102 cm in males or > 88 cm in females; 2) systolic blood pressure ≥ 130 mm Hg or diastolic blood pressure ≥ 85 mm Hg or on antihypertensive drug treatment in a patient with a history of hypertension, 3) serum triglycerides (TG) ≥ 150 mg/dl or on treatment; 4) serum high density lipoproteins (HDL) < 40 mg/dl (1.03 mmol/L) in men and <50 mg/dl (1.3 mmol/L) in women on or drug treatment for reduced HDL-C; 5) Fasting glucose ≥ 100 mg/dl or on drug treatment for elevated blood glucose levels (14). Inclusion criteria were having MS according to AHA/NHLBI criteria, age ≥ 20 years for metabolic syndrome.

Twenty five subjects from the data bank of “Metabolic Syndrome” research project was selected randomly as Healthy subjects. Inclusion criteria were having no MS based on AHA/NHLBI criteria and aged 20 years and over. Exclusion criteria were having MS based on AHA/NHLBI criteria and aged less than 20 years.

4. Methods Summery

4.1. Measurements

Initial validation of Yale Food Addiction Scale (YFAS) questionnaire as a food addiction scale has been confirmed by the previous studies. Results were strongly supportive of the food addiction construct and validation of the YFAS (17, 19). This scale was translated to Persian language. A written standard questionnaire was completed by participants at their homes in the present of a trained nutritionist.

4.2. Yale Food Addiction Scale (YFAS)

YFAS is a 25-item measure to assess food addiction and examine the severity and frequency with which participants experienced symptoms of dependence in relation to their food consumption by assessing signs of substance-dependence symptoms (17) including tolerance, withdrawal, loss of control, a desire or repeated failed attempts to reduce or stop consumption, a great deal of time spent in activities
necessary to obtain, use, or recover, giving up other important activities, and continued use despite physical or psychological problems in eating behavior (18). For the diagnostic version, which resembles a diagnosis of substance dependence, criteria were considered met if participants endorsed three or more criteria as well as at least one of the two clinical significance items (impairment or distress). The symptom count score was a simple sum of the seven diagnostic criteria. Two different summary scores were created based on the diagnostic criteria; a symptom count (0–7) or the continuous version and a dichotomous diagnosis (yes/no). To score the continuous version of the scale, which resembles a symptom count without diagnosis, all of the scores for each of the criterion (but not clinical significance) were added up to the score. This score should range from 0 to 7 (0 symptoms to 7 symptoms). To score the dichotomous version, which resembles a diagnosis of substance dependence, each of the seven diagnostic criteria was considered to have been met if one or more item representing the criteria was endorsed. This should be either a 0 or 1 score (no diagnosis or diagnosis met). The version of the YFAS used in the current study measures all items on a Likert scale (17).

4.3. Reliability Measurement

Reliability was evaluated by a pilot study on 40 participants with MS and Cronbach’s alfa-Coefficient was calculated for primary sample.

4.4. Validity Measurement

Validity was evaluated by getting the viewpoint of the psychology and nutrition professors.

4.5. Demographic Characteristics

Demographic characteristics of the participants including age, marriage statues, highest educational degree, and occupation were recorded according to available information of “Metabolic Syndrome” research project.

4.6. Statistical Analyses

Chi square test was used to compare differences in categorical variables. Independent samples T test was used to compare differences in continuous variables between MS and healthy groups. The Mantel–Haenszel test controlled for age, highest educational levels, and occupation categories was applied. Statistical significance is considered when P < 0.05 (two sided). All the analyses were performed using SPSS software (version 21).

5. Results

5.1. Independent Sample T- Test Analyses

In general, the MS patients were likely to be older, under diploma, and unemployed, as compared with healthy participants (Table 1). No difference in marriage statues was found between MS and healthy subjects.

Table 2 shows that participants with MS had a higher score mean of food addiction criteria and continuous version score. In addition, diagnosis of substance dependence was more prevalence in participants with MS than healthy subjects. No difference in criterion “Continued use despite physical or psychological problems in eating behavior” score mean was found between the two study groups.

5.2. Mantel–Haenszel Analyses

Mantel–Haenszel analyses were conducted for adjusting the dichotomous version results for demographic variables. After the adjustment for age and occupation, diagnosis of substance dependence was more prevalence among females with MS than healthy participations. The Mantel-Haenszel common odds ratios estimate (Asymptomatic 95% CI) of diagnosis of substance dependence associated with MS after the adjustment for age and occupation were (0.008- 0.486) (p=0.013) and (-4.4-(-0.48)) (p=0.031), respectively. Further adjustment for education levels attenuated the association, and the association became marginally significant (p=0.065). Confidence interval became wide due to the small sample size.

6. Discussion

This study used YFAS food addiction questionnaire to examine differences in substance dependence diagnosis between female adults with and healthy. Our data extends the food addiction literature by providing evidence of the higher prevalence of substance dependence among female adult with MS in comparison to healthy individuals.

In this study among Iranian female adults, we observed that MS was positively associated with substance dependence risk. This association persisted after adjusting for known risk factors of MS, including socio-demographic characteristics.

“Food addiction” is a new hypothesis. Very limited and inconsistent data are available on substance dependence and MS risk. Most of studies have examined the effect of opiate systems on intake of a palatable diet, food addiction and the development of diet-induced obesity in human and rats. The positive association between the prevalence of MS and diagnosis of substance dependence in the present study was in accordance with findings in a case- control study (19) using a sample of obese adults that focused their assessments on three domains relevant to the characterization of conventional substance-dependence disorders: clinical co-morbidities, psychological risk factors, and abnormal motivation for the addictive substance.

Those who met the diagnostic criteria for food addiction had a significantly greater co-morbidity with Binge Eating Disorder, depression, and attention-deficit/hyperactivity disorder compared to their age- and weight-equivalent counterparts. Those with food addiction were also more impulsive and displayed greater emotional reactivity than obese controls. They also displayed greater food cravings and the tendency to 'self-soothe' with food. These findings
advances the quest to identify clinically relevant subtypes of obesity that may possess different vulnerabilities to environmental risk factors, and thereby could inform more personalized treatment approaches for those who struggle with overeating and weight gain (19). Another study in Germany on young students showed that 37% of obese participants diagnosed with food addiction. The prevalence was higher in women and obese patients (25).

Recent research has also shown the nature of “food addiction” as assessed by the YFAS in obese patients with binge eating disorder (BED). Classification of “food addiction” was met by 57% of BED patients. Patients classified as meeting YFAS “food addiction” criteria had significantly higher levels of depression, negative effect, emotion dysregulation, eating disorder psychopathology, and lower self-esteem. YFAS scores were also significant predictors of binge eating frequency above and beyond other measures (20).

Research has also shown that opiate dependent subjects during consuming salted food develop an increase in weight during opiate withdrawal, concluded that salted food may be an addictive substance that stimulates opiate and dopamine receptors in the brain’s reward. Salted food and opiate withdrawal stimulate appetite, increases calorie consumption, augments the incidence of overeating, overweight, obesity and related illnesses. (22).

Table 1. Characteristics of study participants with and without metabolic syndrome

<table>
<thead>
<tr>
<th>Demographic variables</th>
<th>Healthy subjects (n=25)</th>
<th>Subjects with metabolic syndrome (n=24)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22-32</td>
<td>14 (56)</td>
<td>1 (4.2)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>33-40</td>
<td>7 (28)</td>
<td>3 (12.5)</td>
<td></td>
</tr>
<tr>
<td>≥ 41</td>
<td>4 (16)</td>
<td>20 (83.3)</td>
<td></td>
</tr>
<tr>
<td>Married statuses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>0 (0)</td>
<td>6 (25)</td>
<td>0.269</td>
</tr>
<tr>
<td>Married</td>
<td>25 (100)</td>
<td>18 (75)</td>
<td></td>
</tr>
<tr>
<td>Highest educational degree</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under diploma</td>
<td>3 (12)</td>
<td>18 (75)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Diploma and upper</td>
<td>22 (88)</td>
<td>6 (25)</td>
<td></td>
</tr>
<tr>
<td>Occupation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>20 (80)</td>
<td>2 (8.3)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Unemployed</td>
<td>5 (20)</td>
<td>22 (91.7)</td>
<td></td>
</tr>
</tbody>
</table>

*Chi square test was conducted to analyze data.

Table 2. Means, standard deviations, percent, and differences between groups on dependent variables

<table>
<thead>
<tr>
<th>Loss of control</th>
<th>0.4 (0.5)</th>
<th>0.79 (0.41)</th>
<th>0.005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed attempts</td>
<td>0.8 (0.41)</td>
<td>1.0 (0.0)</td>
<td>0.02</td>
</tr>
<tr>
<td>Much time/activity to obtain, use, recover</td>
<td>0.24 (0.44)</td>
<td>0.63 (0.49)</td>
<td>0.006</td>
</tr>
<tr>
<td>Giving up important activities</td>
<td>0.12 (0.33)</td>
<td>0.58 (0.5)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Continued use</td>
<td>0.44 (0.51)</td>
<td>0.67 (0.48)</td>
<td>0.115</td>
</tr>
<tr>
<td>Tolerance</td>
<td>0.12 (0.33)</td>
<td>0.75 (0.44)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Withdrawal</td>
<td>0.44 (0.51)</td>
<td>0.79 (0.41)</td>
<td>0.011</td>
</tr>
<tr>
<td>Use causes clinically significant impairment or distress</td>
<td>0.12 (0.33)</td>
<td>0.75 (0.44)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Continuous version score</td>
<td>2.6 (1.9)</td>
<td>5.2 (1.7)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Dichotomous version</td>
<td>22 (88)</td>
<td>7 (29.2)</td>
<td>0.013</td>
</tr>
<tr>
<td>Diagnosis of substance dependence</td>
<td>3 (12)</td>
<td>17 (70.8)</td>
<td></td>
</tr>
</tbody>
</table>

*Chi square test for categorical variables and independent sample T test for continuous variables

a Substance taken in larger amount and for longer period than intended. Values are presented as mean (SD).
b Desire or repeated failed attempts to reduce or stop consumption. Values are presented as mean (SD).
c A great deal of time spent in activities necessary to obtain, use, or recover. Values are presented as mean (SD).
d Giving up social, occupational, or recreational activities because of substance use. Values are presented as mean (SD).
e Continued use despite physical or psychological problems in eating behavior. Values are presented as mean (SD).
f Marked increase in amount; marked decrease in effect. Values are presented as mean (SD).
g Characteristic withdrawal symptoms; substance taken to relieve withdrawal. Values are presented as mean (SD).
h Values are presented as mean (SD).
i Values are presented as mean (SD).
j Adjusted for age. Values are presented as number (percent).
The chronic suppression of endogenous µ-opioid receptor signaling in the nucleus accumbens significantly attenuates development of diet-induced obesity by reducing intake of palatable preferred foods in Sprague-Dawley rats (21). µ-opioid receptor signaling, perhaps in peripheral organs, might also have suppressive effects on food intake and/or stimulatory effects on fat oxidation and energy expenditure, and demonstrate the need for more localized manipulations of µ-opioid receptor signaling (26). An experimental study shows that µ-opioid receptor-deficient mice would show an even greater, intake-dependent, resistance to high fat diet-induced obesity if the diet comprises a sweet component. This study found that µ-opioid receptor-deficient mice on a regular chow diet show increased body weight in adulthood and 2-fold higher adiposity than wild type mice (27).

This study just included female. Women are at higher risk for MS than men shown in an urban population in Ahvaz (12). Moreover, gender-related differences used to be more extreme in females, who exhibited eating disorders more often than males (28). In addition, eating disorders in a male population are more difficult to observe and define, as most available reference and psychometric tools concern mainly females (29). It should be noted that participants did not have a preference to a specific food type based on the food preference assessment; this may be a result of administering the task directly prior to the fasting scan, which may reflect increased palatability during hunger (30).

7. Conclusions

Our findings demonstrate that MS is positively associated with substance dependence risk. This association persists after adjusting for age and occupation.

This study has limitations. Due to the constraints on data collection as part of a larger project, higher than 70% of subjects that had been selected randomly, were not present in the household during the period of the survey, giving a low response rate and sample size given the demands of the larger project.

The strong point of this study was that the YFAS is a new questionnaire and it had not been used to assess food addiction in community patients. This study provides preliminary evidence for substance dependence among female adults with MS. It could be a strong point of our study that we controlled demographic variables; therefore, the results of the YFAS questionnaire were not possibly affected by these factors. Future work with larger sample size should expand on these findings by examining the food addiction in males with MS and subjects with other disease on other age group.

Acknowledgments

This work was supported by Vice-Chancellor for Research Affairs of Ahvaz Jundishapur University of Medical Sciences. The authors thank the personnel of Diabetes Research Center, Ahvaz Jundishapur University of Medical Sciences for their support for availability of “Metabolic Syndrome” research project information; to MS. Saideh Hajinajaf for her kind helps in data collections; and to all individuals who participated. There is no conflict of interest between the authors.

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