ABSTRACT

Objectives: Empirical evidence is growing that addictive-like tendencies toward foods may contribute to obesity. This pilot study evaluated interventions used to treat addictive disorders for the treatment of obesity in individuals with and without food addiction (FA). FA and depression were common in the study population at baseline, with greater prevalence and severity of depression in those with FA. This secondary analysis evaluated whether prevalence and/or severity of FA and depression changed with intervention.

Methods: Participants within each obesity phenotype (FA+, FA-) were randomly assigned to treatment groups [motivational interviewing, pharmacotherapy (naltrexone-bupropion), motivational interviewing with pharmacotherapy, information control]. Interventions were delivered following data collection at baseline, 1, 2, 3, and 4 weeks and 2, 3, 4, 5, and 6 months. FA and depression were assessed at baseline and 6 months using the Yale Food Addiction Scale and Patient Health Questionnaire-9, respectively.

Results: Prevalence and severity of FA declined between baseline and 6 months (P < .001). The decline in symptoms was greater among those who were FA+ than among those who were FA- (P < .001), reflecting that those who were FA+ had higher symptom totals at baseline. Depression scores and severity also declined between baseline and 6 months in both obesity phenotypes (P < .001).

Conclusion: Both FA and depression were common in this study population and may contribute to obesity and/or complicate its treatment. That interventions used to treat addictive disorders lessened the prevalence and severity of both FA and depression is promising for the treatment of obesity.

Keywords
Obesity, Food addiction, Depression, Motivational interviewing, Naltrexone-bupropion.

Introduction
Obesity is a major health issue and is associated with increased risk of comorbidities and higher medical costs. Understanding the complexities of obesity is critical for developing effective treatments. Exploring eating behavior from an addiction perspective is an emerging field, though the term “food addiction” (FA) has been used since the 19th century [1]. Empirical evidence is growing that addictive-like tendencies toward foods (particularly highly processed foods) may contribute to obesity [2,3] and there is increasing interest in the implications of FA for treating obesity [4].
If addiction-like processes contribute to obesity in some individuals, then interventions used to treat addictive disorders may be effective in treating obesity in those with FA. Therefore, we conducted a pilot study to evaluate four such interventions, motivational interviewing (MI), pharmacotherapy (P), motivational interviewing with pharmacotherapy (MI+P), and an information control (IC) (diet and physical activity instruction) in individuals of both obesity phenotypes (FA+, FA-). Our goal is to develop effective obesity treatments for each phenotype. As part of this study, participants completed a set of baseline screening questionnaires, including the Yale Food Addiction Scale (YFAS) 2.0 [5], a validated and psychometrically sound instrument that adapts the 11 DSM-5 diagnostic indicators of substance use disorders to the consumption of highly processed foods (used to assess FA), and the Patient Health Questionnaire-9 (PHQ-9) [6] (used to assess depression).

Analysis of baseline responses revealed that 37% of individuals screened were FA+, 82% of participants experienced depression, and prevalence and severity of depression was greater in those who were FA+ [7]. The high incidence of depression suggests that depression may contribute to obesity and/or complicate its treatment. To further explore these relationships in both phenotypes, we re-administered the YFAS 2.0 and PHQ-9 instruments at participants’ final appointment to evaluate whether there were changes in the prevalence and/or severity of FA and depression over the 6-month intervention period. We report these findings here.

**Methods**

This study was conducted in accordance with IRB protocol 763-16-FB. Potential participants were informed about the study and those choosing to participate were consented.

**Participants**

We recruited 83 participants from adults (age 19-65 years) with obesity referred by providers at the Regional West Physicians Clinic (RWPC) in Scottsbluff, Nebraska and through snowballing. Most were Caucasian (71%, Hispanics 28%, black 1%) women (89%, men 11%) [7].

**Interventions**

Participants within each obesity phenotype (FA+, FA-) were randomly assigned to treatment groups. Interventions were delivered following data collection at baseline, 1, 2, 3, and 4 weeks and 2, 3, 4, 5, and 6 months.

**MI Intervention:** MI, an evidence-based client-centered approach for behavioral change, was developed and is still used to treat addictions [8,4]. Our intervention focused on educating/supporting individuals in reducing their intake of highly processed foods and increasing their intake of whole or minimally processed foods. A written MI algorithm was used to ensure fidelity.

**Pharmacotherapy Intervention:** Sustained release naltrexone-bupropion (Contrave®, Nalpropion Pharmaceuticals, Inc., La Jolla, CA) was used because these drugs have been used to treat addictions (naltrexone – alcohol and opioid addictions, bupropion – smoking cessation) [9]. Naltrexone-bupropion produces weight loss by reducing appetite/cravings and is more effective in combination than either drug in monotherapy [10].

**IC Condition:** Participants in this control group received information about improving their diet and physical activity. All intervention groups received this same information during their baseline visit.

**Data analysis**

Analyses only included participants with YFAS 2.0 and PHQ-9 data at both baseline and 6 months (n = 40). Participants’ FA phenotype was defined by their status at baseline. Differences were evaluated using independent and paired t-tests, ANOVAs, and Bonferroni multiple comparisons (α = 0.05). Analyses were performed using IBM® SPSS® Statistics (Version 25) software.

**Results**

**Food Addiction (FA)**

The number of participants who were FA+ and the severity of FA declined between baseline and 6 months (P < .001). At baseline 43% (n = 17) were FA+ (2 mildly, 2 moderately, 13 severely), whereas at 6 months 5% (n = 2) were FA+ (1 mildly, 1 severely).

Mean number of FA symptoms declined between baseline and 6 months. The decline was greater among those who were FA+ (8.24 ± 3.13 to 1.53 ± 2.43) than among those who were FA- (2.00 ± 1.60 to 1.26 ± 2.12) (P < .001), reflecting that those who were FA+ had higher symptom totals at baseline.

The change in total number of symptoms between baseline and 6 months differed among FA phenotype-treatment groups (P < .001). The change was greater for those in the FA+ IC, P, and P+MI treatment groups than for those in all FA- treatment groups (P < .001 to .030) except the FA+ and FA- P groups (P = .060). Change in total symptoms did not differ between the FA+ MI group and any other FA phenotype-treatment group (P = .079 to 1.000).

**Depression**

Overall, PHQ-9 scores declined between baseline (11.58 ± 6.47) and 6 months (4.35 ± 3.85) (P < .001). The same pattern was observed among those who were FA+ (15.71 ± 7.02 to 4.82 ± 4.57, n = 17) and FA- (8.52 ± 3.94 to 4.00 ± 3.28, n = 23) (P < .001). Severity of depression also declined between baseline (6 none/minimal, 10 mild, 13 moderate, 5 moderately severe, 6 severe) and 6 months (24 none/minimal, 11 mild, 5 moderate) (P < .001).

The change in PHQ-9 scores differed among FA phenotype-treatment groups (P = .004) and was greater in the FA+ IC group than in all FA- treatment groups (P = 0.002 to P = 0.010) except the P treatment group (P = 0.064), largely because the FA+ IC group had higher baseline PHQ-9 scores.

**Discussion**
There is growing interest in identifying subtypes of obesity [11,12] and tailoring treatments for those with different vulnerabilities [4,13,14]. Though presently not a clinical diagnosis, the FA construct identifies distinctive obesity phenotypes [14,7]. Previous analyses from this pilot study revealed that those who were FA+ may require more intensive intervention to achieve biometric results [15] and that prevalence/severity of depression was greater in those who were FA+ [7]. These secondary analyses demonstrated that prevalence and/or severity of FA and depression declined with intervention, particularly in those who were FA+ at baseline. Lessening FA and depression may improve the success of efforts to address obesity.

**Conclusion**

Both FA and depression were common in this study population and both conditions may contribute to obesity and/or complicate its treatment. That interventions used to treat addictive disorders lessened the prevalence and severity of both FA and depression is promising for the treatment of obesity and will be explored further in a fully powered study.

**Acknowledgments**

We thank the RWPC for clinic space and referrals, Dr. Gearhardt for use of the YFAS 2.0, and Don Graham, our consulting pharmacist. A Research & Engagement Competitive Award from the Rural Futures Institute, University of Nebraska supported this work.

**References**

1. Meule A. Focus: Addiction: Back by popular demand: A narrative review on the history of food addiction research. Yale J Biol Med. 2015; 88: 295-302.
2. Ifland JR, Preuss HG, Marcus MT, et al. Refined food addiction: a classic substance use disorder. Med Hypotheses. 2009; 72: 518-526.
3. Schulte EM, Avena NM, Gearhardt AN. Which foods may be addictive? The roles of processing, fat content, and glycemic load. PLoS One. 2015; 10: e0117959.
4. Vella SL, Pai NB. A narrative review of potential treatment strategies for food addiction. Eat Weight Disord-Stud on Anorexia, Bulimia and Obes. 2017; 22: 387-393.
5. Gearhardt AN, Corbin WR, Brownell KD. Development of the Yale Food Addiction Scale version 2.0. Psychol Addict Behav. 2016; 30: 113-121.
6. Kroenke K, Spitzer RL. The PHQ-9: a new depression diagnostic and severity measure. Psychiatr Ann. 2002; 32: 509-515.
7. Aguirre T, Bowman RB, Kreman R, et al. Pre-intervention characteristics in weight loss participants scoring positive and negative for food addiction. Clin Nutr Metab. 2018; 1: 1-3.
8. Miller WR. Motivational interviewing with problem drinkers. Behav Cogn Psychother. 1983; 11: 147-172.
9. Christou GA, Kiortsis DN. The efficacy and safety of the naltrexone/bupropion combination for the treatment of obesity: an update. Hormones (Athens). 2015; 14: 370-375.
10. Caixàs A, Albert L, Capel I, et al. Naltrexone sustained-release/bupropion sustained-release for the management of obesity: review of the data to date. Drug Des Devel Ther. 2014; 8: 1419-1427.
11. Field AE, Camargo CA, Ogino S. The merits of subtyping obesity: one size does not fit all. JAMA 2013; 310: 2147-2148.
12. Gupta A, Mayer EA, Labus JS, et al. Sex Commonalities and Differences in Obesity-Related Alterations in Intrinsic Brain Activity and Connectivity. Obesity. 2018; 26: 340-350.
13. Burmeister JM, Hinman N, Koball A, et al. Food addiction in adults seeking weight loss treatment. Implications for psychosocial health and weight loss. Appetite. 2013; 60: 103-110.
14. Davis C, Curtis C, Levitan RD, et al. Evidence that ‘food addiction’ is a valid phenotype of obesity. Appetite. 2011; 57: 711-717.
15. Aguirre T, Struwe L, Koehler A, et al. Impact of four obesity interventions on biometric measures of individuals positive and negative for food addiction. Arch Psychiatr Ment Health. 2018; 2: 1-5.