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Research

Comparison of Cognitive-Executive Functions of the Frontal Lobe of the Brain and Lifestyle Self-Efficacy in Persons with Different Body Mass Indices

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ABSTRACT

Nowadays, obesity is a major problem in societies globally which not only causes complications and disorders in physiologic health of obese persons, but also affects psychologic health and self-confidence adversely. In this research, we intended to compare cognitive-executive functions of the frontal lobe of the brain and lifestyle self-efficacy in persons with different body mass indices (BMI). Three-hundred subjects with different BMI values were recruited via convenience sampling method. The questionnaires used included the Wisconsin Card Sorting Test, and the questionnaires for executive function disorder, lifestyle self-efficacy, and the general health. For data analysis, descriptive indices (mean, frequency) were used and for inferential indices, analysis of variance (ANOVA) was applied. The results showed that there is significant (P= 0.05) difference regarding attention shifting between persons with different BMI values. In subjects with different BMI values, cognitive functions are different, and reduced cognitive function was higher in those with higher BMI. Also, lifestyle self-efficacy was lower significantly (P = 0.05) in obese subjects compared to those with normal weight. Persons with different BMI values had different cognitive functions.

Key words: Cognitive-executive function, the frontal lobe of the brain, body mass index (BMI), lifestyle self-efficacy

1. INTRODUCTION

Obesity is a major problem for societies nowadays. It is a metabolic disorder which results in 1.5-2 times more morbidity and mortality rates compared to persons with normal weight. This new condition is related to technology and becomes more obvious everyday with changes in lifestyle, decreased physical activity, and changes in food tastes of people in societies. The warnings made by medical societies about obesity demonstrate the detrimental effects of obesity on health and its contribution to sudden death (1). The prevalence of overweight state and obesity in Iran is estimated to be 62.2% and 28%, respectively. This epidemic reflects the changes in lifestyle and behavioral patterns in the society. Overweight state and obesity are assessed using body mass index (BMI) calculation. The slope of BMI distribution is increasing in many countries as well as in Iran. The overall prevalence of obesity in Iranian population is higher than the US, the UK, France, the Netherlands, and Italy (2). Several studies have noted that there is relationship between obesity in children and attention-deficit hyperactivity disorder (ADHD) (3, 4). Some researchers believe that decreased level of cognitive functions is the result of obesity (5). Some studies have shown that low level of intellectual and cognitive functions is a risk factor for overweight and obesity (5-7). The World Health Organization (WHO) has reported that there are more than 300 million adult individuals with obesity worldwide. About 115 million people living in developed countries, Europe and the US have some degrees (15-25%) of obesity (8). Obesity is rapidly developing to an epidemic in the US (9, 10). With increasing rate of obesity, research studies are carried out concurrently to prevent obesity and to promote health maintenance techniques. This study highlights the assessment of different aspects of obesity. Another importance of this study is that it studies a simple and cost-effective method, which if applied in an accurate and correct way in screening programs to identify high risk individuals, has a considerable efficiency. Undesirable habits in lifestyle of children and adolescents, in par-

ticular sedentary lifestyle, not only is a threat to the health of this age group, but also endanger the society for increased rates of non-communicable disease such as cardiovascular diseases, diabetes, osteoporosis, psychologic disorders, and even some malignancies (10, 11). One of the causes responsible in increased rates of diseases mentioned earlier is obesity. Obesity is the result of a wide range of factors such as poor dietary habits and decreased physical activity (12). Therefore, identification of related factors to obesity and making policy about how to confront to this problem can have a significant effect in decreasing chronic diseases burden as well as costs resulted from treatments of obesity (13). Azizi et al, in 2009 in a study titled "the brain structure of the elderly with obesity" showed that the frontal lobe of the brain in overweight patients is decreased in size by 4% in comparison to peer-aged normal weight subjects. This reduced brain sized was doubled (8% reduction in brain tissue) in those with obesity. The frontal lobe of the brain has an important role in attention and planning (13). In addition, evidence demonstrates that higher levels of ADHD, Alzheimer's disease, cortical atrophy, and white matter disease exist in obese patients. Medical conditions associated with obesity (e.g., brain pathology, hypertension, and diabetes) are likely to cause poor cognitive functions of the brain. This information also demonstrates the harmful effect of high BMI on cognitive functions in healthy persons and shows that high BMI may damage cognition (especially executive function), (14). The relationship between vascular and metabolic diseases is the result of central (abdominal) obesity measured by WHR (waist-to-hip ratio). Higher WHR and older age have negative relationship with hippocampal size. In addition, increased WHR is associated with decreased hippocampal size and increased white matter density. Therefore, obesity causes brain aging. A concept which has gained much attention in weight reduction programs is the Albert Bandura self-efficacy concept. He believes that someone's estimation of his/her own ability in a particular situation affects his/her decision in making actions and insistence on doing them. This estimation is a silent and forgotten variable in behavioral weight reduction programs (15). Self-efficacy, which is increased during treatment, is a predictor index for weight reduction as well as a predictor of successful weight control programs. Those who experience fluctuations in their weight usually have lower levels of self-efficacy (16).

2. MATERIALS AND METHODS

Three-hundred adult subjects with age range of 19-57 years who were literate, right-handed and healthy without past brain injury history or metabolic diseases (e.g., diabetes) participated at the study. Demographic data and medical history taking were done using a questionnaire. In addition, data regarding physical status and cognitive function of the subjects were gathered via the General Health questionnaire and the Executive Function Disorder Questionnaire as well as the Wisconsin Card Sorting Test, respectively. The independent variable was BMI and the dependent variable was attention shifting (the ability of change in attention sources from one stimulus to another stimulus (17). The data analysis was done using variance analysis to compare the data. The samples were recruited via convenience sampling method. The eligible samples were tested during 10 weeks in Ibn-e- Sina doctors building in a room which was suitable for the test. To calculate the sample size, standard variation in a similar study was determined and 90 subjects were entered to each group. BMI measurement was done according to its standard definition as dividing the body weight in kilograms by the square of the height in meters using a computer (17). The samples, based on their BMI, were divided into three groups including normal weight (BMI= 18.5-24.9), overweight (BMI= 25-29.9), and obese (BMI ≥30), (18).

2.1. Exclusion criteria

1. If a person had depression or social function disorder (according to the General Health questionnaire, considering cut-off point= 7.5)
2. Having severe depression based on the General Health questionnaire (the 28-question form).
3. Having chronic neuro-cognitive diseases which affected cognitive ability of the patient. Also stroke, brain injury, epilepsy, and psychosis were among exclusion criteria (19).
4. Having neuro-cognitive and musculoskeletal disorders and vascular diseases (uncontrolled hypertension and diabetes) during the last year (19).

After we assured that the samples learned the Wisconsin Card Sorting Test, data documentation was done by software and cognitive function of the frontal lobe of the brain in three groups was studied. The Wisconsin Card Sorting Test: This test has 64 cards, labeled with four figures (triangle, circle, star and cross). The number of figures on each card varies from 1 to 4. This test has three principles: shape (4 types), number (4 states), and color (four colors). The combination of these three principles forms 64 states. In fact, each card represents a state and does not repeat. In this test, if the test taker continues categorization based on former principle, despite principle change by computer, or categorize the cards on a false assumption, he/she will develop preservative error. Preservative error, in overall, is repetition of a previously learned response against a new stimulus. Preservative error occurs in patients with the frontal lobe injury (20). Cluster score varies between 0 and 6. Zero refers to patients who do not understand the overall principle of the test at all. The Wisconsin Card Sorting Test is a standard neuropsychological test used to measure problem-solving skills, categorization, abstract thinking, the ability to maintain concepts, and cognitive flexibility which are related to the function of the frontal lobe of the brain (21). The Wisconsin Card Sorting Test, as a criterion for executive functions, is used when an external phenomenon is used to guide the behavior. In addition, this test is used to assess attention shifting (22, 23). In the current study, the computer version of the Wisconsin Card Sorting Test was used. This test was designed by Weber (according to Fallgatter and Strik in 1998) for abstract behavior and executive functions (24, 25). To evaluate lifestyle self-efficacy, the Weight Efficacy Life-Style (WEL) questionnaire was used. This questionnaire which has been designed by Clark, has 20 items about eating behavior self-efficacy in which the examinees state their confidence and reliability in controlling and avoidance of eating behavior in various tempting situations based on a 5-score Likert scale (no confidence to very confident) (26). All items are scored directly and

the score range varies from 0 to 80. This 20-item questionnaire has 5 subscales and each subscale contains 4 items. Therefore, this test has an overall score as well as 5 additional scores related to each subscale. Cronbach's alpha coefficient for 5 subscales and the whole test has been reported between 0.7 and 0.9. The validity of this test has been verified by confirmatory factor analysis (27). In addition, reliability of this test was verified by test-retest method with 2-week interval on 30 subjects and alpha values for subscales and the whole test varied from 0.73 to 0.92.

3. RESULTS AND DISCUSSION

Demographic data and medical history taking were done using a questionnaire. In addition, data regarding physical status and cognitive function of the subjects were gathered via the General Health questionnaire and the Executive Function Disorder Questionnaire as well as the neuropsychologic Wisconsin Card Sorting Test, respectively. As depicted in Table 1, the study was done on 260 adult subjects with a mean age of 35.11 years and mean educational level equal to 12.41 years.

Table 1. Demographic data and sample description in three studied groups

	*Normal weight, mean (SD)**	*Overweight, mean (SD)**	*Obese, mean (SD)**	*Overall mean*
Number	96	96	68	260
Percent	36.9%	36.9%	26.2%	100%
Age	33.58 (8.6)	35.83 (8.3)	36.24± (9.1)	35.11
Education	12.5 (2.4)	12.68 (1.6)	11.91± (3.2)	12.41
Body mass index (BMI)	24.41 (3.1)	27.31 (3.4)	32.71± (4.2)	27.65
Waist-to-hip ratio	0.87 (0.08)	0.89 (0.06)	0.87± (0.07)	0.879

*SD= standard deviation

The subjects were divided into three groups as normal weight (96 cases), overweight (96 cases) and obese ones (68 cases). According to Table 1, mean BMI was 27.65 and mean waist-to-hip ratio was 0.879. As presented in Table 2, according to one-way analysis of variance (ANOVA) test, significant difference (P= 0.05) is observed in terms of cognitive functions between the three studied groups; those with higher BMI had more deficits in executive functions.

Table 2. One-way analysis of variance (ANOVA) in the Executive Functions Disorder Test

	*df**	*Normal weight, mean (SD)***	*Overweight, mean (SD)***	*Obese, mean (SD)***	*F*	*P value*
the Executive Functions Disorder Test	2	4.69 (3.496)	5.78 (4.211)	6.97± (4.071)	3.29	0.04

*df= degree of freedom ; ** SD= standard deviation

To determine attention-shifting functions in persons with different BMI values, the difference in completed clusters of the Wisconsin Card Sorting Test in the three studied groups was determined. To achieve this, comparison of the BMI data (normal weight, overweight, and obese) was done with one-way ANOVA. According to the results of this test presented in Table 3, a significant difference (p=0.04) exists between the studied groups. Attention shifting function was better significantly in normal weight subjects compared to overweight and obese cases. This function was better in overweight subjects than in obese cases. With increasing BMI, the score of attention shifting function decreased; in other words, the number of completed clusters was less. To determine difference in correct responses to the Wisconsin Card Sorting Test in the three studied groups, Wisconsin software test was used. As seen in Table 3, regarding the results of this test, a significant difference (P= 0.05) was observed regarding number of correct answers in the Wisconsin Card Sorting Test between the studied groups. In other words, those who had normal weight had more correct answers compared to those who were overweight.

Table 3. Analysis of variance (ANOVA) test to compare the completed clusters of correct and incorrect answers to The Wisconsin Card Sorting Test (WCST) in the three studied groups

Group	*Normal weight*	*Overweight*	*Obese*	*F*	*P value**
	Mean ±SD	Mean ±SD	mean±SD		
Completed clusters	3.90 ±0.69	3.44 ±0.94	3.32± 1.22	4.465	0.05
Correct answers to WCST	43.73 ±6.09	39.42 ±8.42	35.56± 10.11	10.661	0.04
Incorrect answers to WCST	15.96± 6.47	20.58 ±8.42	23.94± 9.79	9.899	0.05

* P value < 0.05

Overweight subjects also had more correct answers compared to obese cases. There was a significant difference (P= 0.05) regarding incorrect answers in the Wisconsin Card Sorting Test. Those with normal weight had less incorrect answers compared to those who were overweight. Similarly, overweight subjects had less incorrect answers in comparison to obese individuals. To assess lifestyle self-efficacy in persons with different BMI values, mean scores of eating behavior self-efficacy dimensions were compared between the three studied groups. As shown in Table 4, mean scores of self-efficacy in social pressure dimension in normal weight, overweight, and obese persons were 11.6, 10.8, and 9.4, respectively.

Table 4. Comparison of mean scores of eating behavior self-efficacy dimensions in the three studied groups (normal weight, overweight, and obese)

Group	*Normal weight*	*Overweight*	*Obese*	*P value**
Self-efficacy in situation	Mean ±SD	Mean ±SD)*	Mean ±SD	
Social pressure	11.6 ±4.3	10.8 ±4	9.4± 5.5	0.04
Access to food	10.1 ±3.9	10.4± 3.9	8.3 ± 4.6	0.02
Positive excitements	12.5 ±4.4	11.8 ±3.9	10.2± 4.5	0.02
Negative excitements	12.4± 3.6	12.5± 4.2	11.4± 4.5	0.2
Physical discomfort	12.8± 3.3	13.2± 3.5	12.0 ± 4.01	0.4
Eating behavior as a whole	59.5± 15.6	54.8± 15.1	52.3± 18.2	0.01

*P< 0.05

Mean score of this dimension was higher in obese cases compared to other two groups, and the difference was significant (P= 0.04) based on ANOVA test. The Tukey post-hoc test showed that mean score of self-efficacy in situations with social pressure is different in obese cases compared to other two groups. Mean score of self-efficacy in access to food was lower in obese subjects compared to other two groups (P= 0.02). The Tukey post-hoc test showed that mean score of self-efficacy in access to food is significantly different in obese cases compared to other two groups. Mean score of self-efficacy in positive excitement, similar to previous dimension, was lower in obese cases than in other two groups (P= 0.02). The Tukey post-hoc test showed that mean score of self-efficacy in positive excitements is significantly different in obese cases compared to those with normal weight. Mean score of self-efficacy in negative excitements dimension was lower in obese cases compared to other two groups and less self-efficacy was reported in this group, but the difference was not statistically significant (P= 0.2). The results of self-efficacy in physical discomfort showed that mean score of self-efficacy in this dimension was lower in obese cases. But, this difference was not statistically significant (P= 0.4, ANOVA test). Regarding the total score of behavior self-efficacy, the results showed that mean scores in the three studied groups were 59.5, 54.8, and 52.3, respectively. Mean total score was lower in obese cases in comparison to other two groups (P= 0.01). Post-hoc test also demonstrated that total score of self-efficacy in obese cases showed significant difference with those with normal weight, but the difference was not significant when comparing with two groups. Logistic regression analysis to determine predictive value of five dimensions of weight efficacy lifestyle was done. The results showed that only two factors (i.e., access to food and positive excitements) could predict overweight state and obesity. Correlation coefficient value between variables showed that 26% variance of dependent variable is related to these two variables. Evaluation of the overall model showed that fitness was acceptable (P= 0.02). The results of the current study showed that attention-shifting function, which is determined by the Wisconsin Card Sorting Test, was significantly better in normal weight subjects compared to overweight ones. In addition, this function was better in overweight group than in obese cases. There was a specific trend, as with increasing BMI the score of attention shifting function decreased, correct answers decreased, and incorrect answers increased. These results are comparable to former studies. For example, Liou noted that there is a reciprocal relationship between BMI and basic metabolism in pre-frontal areas of the brain and a positive relationship between metabolism of pre-frontal areas and cognitive function as well as memory. These findings were also observed in the current research (28). The results of Azizi et al, study showed that harmful effects of obesity were only observed in males. However, in our study attention shifting function was significantly better in normal-weight subjects compared to overweight and obese cases in both genders (29). Liou showed that BMI of greater than 30 is associated with cognitive function deficit including executive function, attention, and memory (28). Considering significant lower score of self-efficacy in access to food and social pressure dimensions in obese cases, there is relationship between weight self-efficacy lifestyle and obesity in the mentioned dimensions, but no significant difference was seen regarding negative excitements and physical discomfort. In agreement with these findings, the results of Burke et al. study showed that access to food (13.9%), eating in response to positive excitements (13%0, and familial and social situations (13%) were the most important causes of difficulty in achieving successful outcomes in weight reduction programs. This implies lack of behavior control and low efficacy in these situations (30). In another study carried out in Turkey on obese individuals, it was observed that high score in eating behavior self-efficacy was associated with more weight loss and low self-efficacy of positive excitements was associated with discontinuing dietary regimens and experiencing weight gain (31). Hoy et al. study showed that general self-efficacy score increased from 16.7 to 26.7 and eating behavior self-efficacy score increased from 45.6 to 76.5 from pre-intention stage to behavior preservation state (32, 33).

4. CONCLUSION

According to the obtained results in the current study and comparison of these findings with other studies, it can be conferred that in persons with different BMI values, cognitive functions are different. Reduced cognitive function is seen in those with higher BMI values. Therefore, increase in weight and BMI, as an independent risk factor, can has considerable effect on memory decline and reduced cognitive function of people 9 the current study was done on those who aged less than 60 years). In addition, it is concluded that lifestyle self-efficacy is significantly lower in obese subjects compared to those with normal weight.

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AUTHORS CONTRIBUTION

This work was carried out in collaboration between all authors.

CONFLICT OF INTEREST

The authors declared no potential conflicts of interests with respect to the authorship and/or publication of this article.

REFERENCES

1. Bahrami H, Sadatsafavi M, Pourshams A, Kamangar F, Nouraei M, Semnani S, et al. Obesity and hypertension in an Iranian cohort study; Iranian women experience higher rates of obesity and hypertension than American women. BMC public health. 2006;6:158. Epub 2006/06/21.

2. McPherson CP SK, Pine DA, Leimer L. A nurse-based pilot program to reduce cardiovascular risk factors in a primary care setting. Am J Manag Care. 2002;8(6):543-55.

3. Lamounier JA, Cabral CM, Oliveira BC, Oliveira AB, Jr AM, Silva AP] .Does drug therapy in the postpartum period interfere with breastfeeding recommendations?]. Jornal de pediatria. 2002;78(1):57-61. Epub 2003/12/04. O uso de medicamentos em puerpuras interfere nas recomendacoes quanto ao aleitamen-

to materno?
4. Lam LT, L .Y. Overweight/obesity and attention deficit and hyperactivity disorder tendency among adolescents in China. Int J Obes (Lond). 2007;31(4):584-90.
5. Chandola T, Deary IJ, Blane D, Batty GD. Childhood IQ in relation to obesity and weight gain in adult life: the National Child Development (1958) Study. Int J Obes (Lond). 2006;30(9):1422-32. Epub 2006/03/08.
6. Halkjaer J, Holst C, Sorensen TI. Intelligence test score and educational level in relation to BMI changes and obesity. Obesity research. 2003;11(10 .45-1238:(Epub 2003/10/22.
7. Lawlor DA, Clark H, Davey Smith G, DA. L. Childhood intelligence, educational attainment and adult body mass index: findings from a prospective cohort and within sibling-pairs analysis. Int J Obes (Lond). 2006;30(12):1758-65.
8. Navarro V. World Health Report 2000: responses to Murray and Frenk. Lancet. 2001;357(9269):1701-2; discussion 2-3. Epub 2001/06/27.
9. Desai MN, Miller WC, Staples B, Bravender T. Risk factors associated with overweight and obesity in college students. Journal of American college health : J of ACH. 2008;57(1):109-14. Epub 2008/08/07.
10. Katzmarzyk PT, Baur LA, Blair SN, Lambert EV, Oppert JM, Riddoch C. International conference on physical activity and obesity in children: summary statement and recommendations. International journal of pediatric obesity : IJPO : an official journal of the International Association for the Study of Obesity. 2008;3(1):3-21. Epub 2008/01/01.
11. Eisenmann JC. Physical activity and cardiovascular disease risk factors in children and adolescents: an overview. The Canadian journal of cardiology. 2004;20(3):295-301. Epub 2004/04/01.
12. Greenland P, Knoll MD, Stamler J, Neaton JD, Dyer AR, Garside DB, et al. Major risk factors as antecedents of fatal and nonfatal coronary heart disease events. JAMA. 2003 Aug 20;290(7):891-7.
13. Kelishadi R, Hashemipour M, Sarraf-Zadegan N, al e. Obesity and associated modifiable risk factors in Iranian adolescents: IHHP-HHPC. . Inter Pediatr. 2003;45(4):435-42.
14. D L. Influence of Self efficacy on fat-related dietary behavior in Chinese-Americans. Int J Electron Healthc 2004;7(1):27-37.
15. Buckner JD, Schmidt NB. A randomized pilot study of motivation enhancement therapy to increase utilization of cognitive-behavioral therapy for social anxiety. Behaviour research and therapy. 2009;47(8):710-5. Epub 2009/05/27.
16. Toray T, Cooley E. Weight fluctuation, bulimic symptoms, and self-efficacy for control of eating. The Journal of psychology. 1997;131(4):383-92. Epub 1997/07/01.
17. Stuss DT, Levine B, Alexander MP, Hong J, Palumbo C, Hamer L, et al. Wisconsin Card Sorting Test performance in patients with focal frontal and posterior brain damage: effects of lesion location and test structure on separable cognitive processes. Neuropsychologia. 2000;38(4):388-402. Epub 2000/02/23.
18. Flegal KM CM, Ogden CL, Curtin LR. Prevalence and trends in obesity among US adults, 1999-2008. JAMA. 2010 Jan 20;303(3):235-41.
19. Deviterne D, Gauchard GC, Jamet M, Vancon G, Perrin PP. Added cognitive load through rotary auditory stimulation can improve the quality of postural control in the elderly. Brain research bulletin. 2005;64(6):487-92. Epub 2005/01/11.
20. Mattson AJ, Levin HS. Frontal lobe dysfunction following closed head injury. A review of the literature. The Journal of nervous and mental disease. 1990;178(5):282-91. Epub 1990/05/01.
21. Kaplan HL SB. Comprehensive text book of psychiatry. Ed t, editor: Baltimore: Willams & Wilkins 1999.
22. EA B. A simple objective technique for measuring flexibility in thinking. J Gen Psychol. 1948 Jul;39(1):15-22.
23. Goldstein FC, Green J, Presley R, Green RC. Dysnomia in Alzheimer's disease: an evaluation of neurobehavioral subtypes. Brain and language. 1992;43(2):308-22. Epub 1992/08/01.
24. MacLeod CM. Half a century of research on the Stroop effect: an integrative review. Psychological bulletin. 1991;109(2):163-203. Epub 1991/03/01.
25. Fallgatter AJ SN. Frontal brain activation during the Wisconsin Card Sorting Test assessed with two-channel near-infrared spectroscopy. European Archives of Psychiatry and Clinical Neuroscience. 1998;248(5):245-9.
26. Clark MM, King TK. Eating self-efficacy and weight cycling: a prospective clinical study. Eating behaviors. 2000;1(1):47-52. Epub 2004/03/06.
27. Navidian A AM, Bagheban I, Fatehizade M, Porsharifi H. Reliability and validity of questionnaire based lifestyle weight efficacy. Baghiyatallah Behav Sci J 2009;3(1):217-22.
28. D L. Influence of Self efficacy on fat-related dietary behavior in Chinese-Americans .Int J Electron Healthc 2004;7(1):27-37.
29. Azizi F MP, Azadbakht L. Predictors of cardiovascular risk factors in Tehranian adolescents: Tehran Lipid and Glucose Study. Int J Vitam Nutr Res 2004;74(5):307-12.
30. Burke LE, Steenkiste A, Music E, Styn MA. A descriptive study of past experiences with weight-loss treatment. Journal of the American Dietetic Association. 2008;108(4):640-7. Epub 2008/04/01.
31. Bas M, Donmez S. Self-efficacy and restrained eating in relation to weight loss among overweight men and women in Turkey. Appetite. 2009;52(1):209-16. Epub 2008/10/22.
32. Hoy MK LM, Grosvenor MB, Winters BL, Liu W, Wong WK. Development and use of a motivational action plan for ietary behavior change using a patient – centered counseling approach. Topics in Clinical Nutrition. 2005;20(1):118-26.
33. Jones N, Furlanetto DL, Jackson JA, Kinn S. An investigation of obese adults' views of the outcomes of dietary treatment. Journal of human nutrition and dietetics : the official journal of the British Dietetic Association. 2007;20(5):486-94. Epub 2007/09/12.