ORIGINAL RESEARCH

Relationship Between Emotional Eating and Weight Loss Effect of the 211 Diet Body Weight Management Method in Obese Women of Childbearing Age

Dixian Cai, MM; Da Zou, MM; Pingxia Xie, MM; Xiaojing Lin, MM; Liang Yi, MD; Hualei Cai, BM

ABSTRACT

Purpose • To explore the relationship between emotional eating behavior and the weight loss effect of the 211 Diet body weight management method in obese women of childbearing age.

Methods • From March 2021 to November 2021, 33 obese women of childbearing age who were recommended by gynecologists to achieve weight management were selected from the gynecological outpatient department of The Affiliated Hospital of Guizhou Medical University via the target sampling method. The participants who met all the study inclusion criteria and did not meet any of the exclusion criteria underwent a 40-day 211 Diet body weight management program. Body mass index (BMI) was collected on the day before the formal start and the first day after 40 days of weight loss. The 7-item Generalized Anxiety Disorder Scale (GAD-7), 9-item Patient Health Questionnaire (PHQ-9) and Weight Efficacy Lifestyle Questionnaire-Short Form (WEL-SF) were employed to evaluate participants' anxiety, depression and dietary self-efficacy before and after weight loss. On the day before the formal start of the program, the Dutch Eating Behaviour Questionnaire (DEBQ) was used to investigate the causes of previous induced eating.

Results • The weight of the participants before weight loss was positively correlated with the previous emotional eating scores (r = 0.37; $P < .05$); after 40 days of weight loss, body weight and BMI were significantly lower than before weight loss ($P < .05$); BMI reduction value = 1.97 + 0.16*PHQ9 D-value ($R^2 = 0.35$, $B = 0.16$; $P < .001$); there was no correlation between WEL-SF scores before and after weight loss ($P > .05$); WEL-SF scores D-value was positively correlated with previous emotional eating scores ($r = 0.41$; $P < .05$), WEL-SF D-value = -22.09 + 1.13*emotional eating (R^2=0.16, B=1.13; $P < .05$); there was no difference among WEL-SF, GAD-7 and PHQ-9 scores before and after weight loss ($P > .05$).

Conclusion • The participants' relatively higher body weight before weight loss was related to their previous relatively more significant emotional eating behaviors. In obese women of childbearing age with more obvious previous emotional eating behaviors, the 211 Diet body weight management method may be more beneficial for weight loss. (*Altern Ther Health Med.* 2023;29(5):327-333).

Dixian Cai, MM; Da Zou, MM; Pingxia Xie, MM; Department of Psychiatry, The Affiliated Hospital of Guizhou Medical University, Guiyang, China. **Xiaojing Lin, MM; Hualei Cai, BM;** Department of Gynecology; The Affiliated Hospital of Guizhou Medical University, Guiyang, China. **Liang Yi, MD;** Department of Nutrition;The Affiliated, Hospital of Guizhou Medical University, Guiyang, China.

Corresponding author: Pingxia Xie, MM
E-mail: 1057384338@qq.com
Corresponding author: Hualei Cai, BM
E-mail: caihualei_dr@163.com

INTRODUCTION

According to the *Report on Nutrition and Chronic Disease Status of Chinese Residents* (2020), the overweight and obesity rate of Chinese adult residents exceeds 50%. Obesity contributes to increased risk for cardiovascular disease, diabetes, mood disorders[1] and bulimia. The increase in body mass index (BMI) in women would decrease the pregnancy rate;[2] obesity may also increase the incidence of miscarriage and preeclampsia,[3] and reduce the live birth rate.[4] What's more, it may even negatively affect the outcomes of assisted reproductive technology,[4] thus influencing the health of the offspring. Therefore, in clinical work, the weight management of women of childbearing age—generally between the age of 15 and 50 years—should not be ignored.

In addition, it has been demonstrated that some of the psychological basis for overeating would cause some people

to eat more and become more overweight than others. In the past few decades, scholars have put forward 3 psychological theories for overeating, and 3 different eating behaviors have been identified based on these theories. That is, (1) emotional eating caused by the reaction to negative emotions, (2) external eating caused by seeing or smelling delicious food and (3) restrictive eating, which may lead to more compensatory eating in order to reduce or maintain body weight.[5] These eating patterns may lead people to eat more. Also, in previous studies, social cognitive theory and self-regulation theory, as well as their extensions in the field of body weight management,[6] indicate the interaction between self-regulation and emotion in predicting major weight loss behaviors such as exercise and diet control. Studies suggest that improving dietary self-efficacy in obese people ("self-efficacy" refers to an individual's belief and self-control regarding whether they can successfully cope with certain difficulties[7]) was related to its weight loss effect.[8] Therefore, evaluation of dietary self-efficacy is frequently employed as a predictor of weight loss behavior through diet control, and is also the basis for conducting dietary intervention studies.

211 Diet Law

The 211 Diet Law was established on the basis of scientific diet principles promoted by the World Health Organization (WHO) and the Chinese Nutrition Society, and it combines a lot of theoretical bases and life experiences. "211 Diet" refers to the fact that the volume ratio of vegetables, protein and staple foods consumed at each meal or every day should be 2:1:1, and the specific ratio of the 3 types of food can be measured by a handful, a palm and a fist. This efficient and convenient diet method—food in accordance with a certain proportion and scientific and reasonable nutritional structure—can ensure sufficient intake of basic nutrients, and help maintain health.

Specifically, the "2" in the 211 Diet represents 2 servings of vegetables, excluding the starchy potato category; 100 to 160 g of lettuce per meal should be a handful. Vegetables should be dark green, purple, orange and other dark colors; the best half should be green leafy vegetables and the other half fungi, fresh beans and cruciferous vegetables, followed by melon and nightshade vegetables. The first "1" in the 211 Diet represents a serving of high-quality protein, namely meat, eggs and milk: 300 ml milk or 1 egg, or tofu, fish or meat. The volume is 1 hand. The second "1" represents a healthy staple food such as whole grains, mainly cereals, supplemented by beans and potatoes, each serving weighing 80g to 130g or the volume of a fist. This diet is not only suitable for ordinary people, but also for people wanting or needing to lose weight as well as people with diabetes.

Based on these studies, obese women of childbearing age were selected as the participants in our study to explore the relationship between their previous emotional eating behaviors and body weight, and the weight loss effect of the 211 Diet for body weight management, so as to provide a beneficial reference for women's clinical health management.

Study Participants

From March 2021 to November 2021, 33 obese women of childbearing age who were recommended by gynecologists to achieve weight management were selected from the gynecological outpatient department of The Affiliated Hospital of Guizhou Medical University in China by the target sampling method.

Inclusion criteria. The inclusion criteria for this study were patients: (1) who were age 18 to 45 years; (2) had a BMI ≥25.0 kg/m^2;[9] (3) whose minimum education level was junior high school; could understand and complete the study-related questionnaires; (4) who could cook/make the items in the daily diet by themselves; (5) who could employ the Internet to send pictures of their daily body weight and 3 meals, and follow the doctor's guidance about improving these meals; (6) who voluntarily participated in this study and signed an informed consent form.

Exclusion criteria. Patients who (1) had severe physical diseases; (2) had mental illness such as depression or anxiety; (3) were unable to return to the hospital for follow-up on time (the study required participants to return to the hospital for follow-up after a minimum of 40 days of weight loss; (4) were pregnant.

All patients enrolled in this study were assigned to follow the 211 Diet body weight management method. All patients enrolled in this study signed written informed consent forms, and this study was approved by the Ethics Committee of The Affiliated Hospital of Guizhou Medical University in China (No .J2023548).

METHODS

Research

This study was conducted in the outpatient department of The Affiliated Hospital of Guizhou Medical University, China, which provided special consulting rooms and wards to ensure the smooth progress of the study. After the participants who met the enrollment criteria of this study signed the informed consent form and received health education, the guiding physician taught them the principles of the 211 Diet body weight management method. The recruited individuals were required to complete the online feedback tasks for the guiding physician via the cloud every day (including daily body weight and pictures of 3 meals, etc.), the physicians supervised and guided their diet control behavior in a timely manner. The related clinical data (including body weight and BMI) of the participants were collected on the day before the formal start of weight loss and the first day after 40 days of weight loss (if the body weight of the participants decreased by 8% of the original body weight before the 40-day arrival, the weight loss at this stage would be terminated in advance; the observation after weight loss and the collection of relevant data would be started). Moreover, the participants were assessed using the Generalized Anxiety Disorder Scale (GAD-7), 9-item Patient Health Questionnaire (PHQ-9) and Weight Efficacy Lifestyle Questionnaire-Short Form (WEL-SF) scales. The contents included anxiety and depression, dietary self-efficacy before and after weight loss. In this study, we developed a detailed questionnaire based on the

evaluation criteria of the 3 scales, and patients were surveyed before and after weight loss, and scored according to the 3 scale scoring criteria (GAD-7, PHQ-9 and WEL-SF scales), and finally the score of patients was statistically analyzed and compared. Furthermore, the Dutch Eating Behaviour Questionnaire (DEBQ) questionnaire was employed to investigate the causes of previous induced eating 1 day before the formal start of weight loss. All the scales in this study were evaluated by professional psychiatrists using unified guidelines, distributed through the cloud, and immediately recovered and evaluated after the anonymous responses.

Outcome Index

General information questionnaire. The questionnaire was designed by the researchers and includes age, education level, ethnicity, occupation, reproductive history, body weight, height and BMI.

PHQ-9. This scale is the Chinese version of the Depression Module of the Patient Health Questionnaire compiled by Spitzer, et al., which was introduced by Bian Cuidong and Li Chunbo and is widely recommended in China. In this study, the questionnaire was used to assess the severity of depression in the study participants. It contains 9 items that are each scored from 0 to 3. The higher the total score, the more severe the depressive symptoms are. This scale has been verified to be highly reliable and valid in outpatient clinics in Chinese general hospitals.[10]

GAD-7. The Chinese version of the Anxiety Module of the Patient Health Questionnaire compiled by Spitzer, et al., which was introduced by He Xiaoyan and Li Chunbo. In this study, this scale was employed to assess the severity of the participants' anxiety. It contains 7 items that are each scored from 0 to 3. The higher the total score, the more severe the anxiety symptoms are. The reliability and validity of this scale have been verified in the outpatient population of the psychology department of a Chinese general hospital.[10]

WEL-SF. This scale was translated and culturally adjusted by Zhang Tianzi, Yang Ningli, et al. to the English version of WEL-SF, and it was verified to possess good reliability and validity by psychometrics in Chinese clinical practice. In this study, the questionnaire was used to evaluate participants' dietary self-efficacy. The scale consists of 8 items, each scored from 0 (have no confidence at all) to 10 (very confident). The higher the score, the higher the individual's dietary self-efficacy is.[11]

DEBQ. This is the Chinese version of the DEBQ, which was translated and revised by Li Yongnan, Liu Yong, et al. based on the English version of the DEBQ, and has been verified in the Chinese population as being an effective tool for measuring eating behaviors. The scale consists of 33 items with a 5-point scoring method, ranging from 1 – never to 5 – always. The standardized measurement of an individual's eating behavior is carried out from the 3 dimensions of exogenous eating, restrictive eating and emotional eating. The higher the scores of each dimension, the more obvious the corresponding tendency of exogenous, restricted or emotional eating is.

211 Diet body weight management method. Health education and a structured calorie-restricted diet was adopted in combination with dietary behavior supervision. This method was a phased and individualized weight loss strategy, and the total weight loss time of different participants was calculated according to the initial weight before weight loss and the weight loss effect at each stage. Generally, 40 days was regarded as the weight loss phase. This study only investigated the early period (40 days) of weight loss using this weight management method.

Health education. Women participating in weight management received pre-enrollment health education from the gynecologists, including the impact of weight control on fertility and long-term health, the necessity for weight loss, and what the structured calorie-restricted diet was.

Structured calorie-restricted diet. The participants' food preferences were included in this approach. The participants were instructed to control their food portions according to physical health and weight management needs, and to learn to purchase and prepare meals over time to properly manage food ratios, quantities and energy intake. Women involved in weight loss should standardize their diet plans with pictures and words to facilitate sharing and dissemination.

The main content of the structured calorie-restricted diet plan was to require the participants to learn the classification of 4 categories of food: staple foods, protein, vegetables and fatty food. The amount of food for their 3 meals was based on the size of their own fist. Each meal should contain 2 fists of vegetables, 1 fist of protein and 1 fist of staple food (participants could choose to appropriately reduce or not reduce the amount of staple food according to their own situation during meals). In addition, this diet control program required the participants to drink 1500 to 2000 ml of water per day, consume no more than 6 g of salt and no more than 6 g of oil per day, and avoid other oils and fats, as well as extra sugars, snacks, cakes and sugar-containing drinks and any other food.

Dietary behavior supervision. The participants' dietary behavior guiding physicians managed the daily dietary behavior of weight loss participants via the cloud every day under the full supervision of a clinical nutritionist. Moreover, the physicians would give guidance and encouragement according to the participants' daily diet and answer relevant questions.

The study was to be terminated if a participant was assessed to possess obvious physiological or psychological abnormalities.

The questionnaire scales involved in this study (including GAD-7, PHQ-9, WEL-SF and DEBQ scales) were formulated by 4 professional clinicians in our hospital (including 2 endocrinologists and 2 obstetricians/gynecologists) according to the scale scoring criteria. Then, 2 postgraduate students assisted the enrolled patients in filling out the questionnaire survey, and finally, a professional statistician conducted a statistical analysis of the scale data.

Table 1. Pearson Correlation of Body Weight Before Weight Loss, Emotional Eating Scores, Restrictive Eating Scores and Exogenous Eating Scores

	Emotional eating score	Body weight before weight loss	Exogenous eating	Restrictive eating
Emotional eating score	1	0.37[a]	0.29	0.09
Body weight before weight loss	0.37[a]	1	-0.08	-0.02
Exogenous eating	0.29	-0.08	1	-0.03
Restrictive eating	0.09	-0.02	-0.03	1

[a]At the .05 level (two-tailed), the correlation was significant

Table 2. Paired Sample *t* test of Body Weight and BMI Before and After Weight Loss

Index	Before weight loss	After weight loss	*t*	*P* value
Body weight (kg)	73.39 ± 7.73	69.16 ± 8.04[a]	10.00	<.001
BMI (kg/m^2)	28.83 ± 2.22	27.31 ± 2.75[a]	6.04	<.001

[a]At the 0.001 level (two-tailed), the correlation was significant

Abbreviations: BMI, body mass index.

Table 3. Linear Regression Analysis of BMI Reduction and PHQ-9 Score Difference Before and After Weight Loss

Model	*B*	*F*	R^2	*P* value
BMI reduction = 1.97 + 0.16* PHQ-9 difference	0.16	17.01	0.35	<.001

Notes: The dependent variable was BMI reduction. BMI reduction = BMI before weight loss minus BMI after weight loss; PHQ-9 D-value = PHQ-9 after weight loss minus PHQ-9 before weight loss.

Abbreviations: BMI, body mass index; PHQ-9, 9-item Patient Health Questionnaire.

Statistical Analysis

The IBM, SPSS 26.0 system was employed for statistics. The clinical data and scale scoring data of the 2 groups before and after weight loss were all measurement data, expressed as mean ± standard deviation ($\bar{x} \pm s$). Moreover, paired sample *t* test (test level α = 0. 05), Pearson correlation analysis, and single factor linear regression analysis were employed to analyze the data, and $P < .05$ was considered statistically significant.

RESULTS

Participant Dem1ographics

A total of 33 people completed the 40-day body weight management program, and their general data, clinical data and various scale scores before and after weight loss were included in the analysis. The participants were all Han women; 17 age 18 ≤ age ≤ 31 years, 16 age 32 ≤ age ≤ 49 years; there were 5 civil servants, 9 employees, 6 full-time housewives, 9 self-employed and 4 teachers; 4 people were junior high school graduates, 6 people were high school graduates, 9 people were college graduates, 12 people had undergraduate diplomas; 2 people had master's degrees; 11 people had past birth history, 22 people had no past birth history; 21 persons with 25.00 ≤ BMI ≤ 29.9, and 12 patients with 30.00 ≤ BMI ≤ 33.90.

Relationship Between Body Weight Before Weight Loss and Previous Eating Incentives

In our study, the participants' weight before weight loss was positively correlated with previous emotional eating scores ($r = 0.37$; $P < .05$), but not related to the previous exogenous and restrictive eating scores ($P > .05$) (see Table 1). It can be seen that if the previous emotional eating scores were higher, the weight before weight loss might be higher.

Comparison of Body Weight and BMI Before and After Weight Loss

In our study, the body weight and BMI of the participants after 40 days of weight loss were significantly lower than before weight loss (the body weight and BMI data before and after weight loss were statistically analyzed by paired sample *t* test, $P < .001$) (see Table 2).

Relationship Between BMI Reduction and PHQ-9 Score D-value

In this study, the model was obtained via single factor linear regression analysis of the difference between the BMI reduction and PHQ-9 score D-value of participants: BMI reduction = 1.97 + 0.16 *; PHQ-9 D-value ($R^2 = 0.35$; $B = 0.16$; $P < .001$) (see Table 3). We observed that approximately 35% of the BMI reduction in this study was affected by the D-value in depressive mood before and after weight loss; the participants with more obvious depression after weight loss compared with before weight loss had a relatively greater reduction in BMI during the 40-day weight loss period.

Relationship Between Dietary Self-Efficacy Before/After Weight Loss and Between Dietary Self-Efficacy and Previous Eating Incentives

In this study, there was no correlation between WEL-SF scores of participants before and after weight loss ($P > .05$), as shown in Table 4. We found that dietary self-efficacy before weight loss did not affect dietary self-efficacy after weight loss. The difference between WEL-SF scores before and after weight loss was positively correlated with the previous emotional eating score ($r = 0.41$; $P < .05$) but exhibited no correlation with the previous restrictive and exogenous eating scores ($P > .05$) (see Table 4). The model was obtained via single factor linear regression analysis: WEL-SF D-value = -22.09 + 1.13* emotional eating; $R^2 = 0.16$, $B = 1.13$; $P < .05$ (see Table 5). Approximately 16% of the WEL-SF score

Table 4. Pearson Correlation Analysis Between WEL-SF Scores and Emotional Eating Scores, Restrictive Eating Scores and Exogenous Eating Scores Before and After Weight Loss

	WEL-SF after weight loss	WEL-SF before weight loss	Emotional eating	Exogenous eating	Restrictive eating	WEL-SF D-value
WEL-SF after weight loss	1	0.17	-0.18	0.22	0.32	0.56[b]
WEL-SF before weight loss	0.17	1	-0.55[c]	-0.10	0.02	-0.73[b]
Emotional eating	-0.18	-0.55[c]	1	0.29	0.09	0.41[a]
Exogenous eating	0.22	-0.10	0.29	1	-0.03	0.23
Restrictive eating	0.32	0.02	0.09	-0.03	1	0.20
WEL-SF D-value	0.56[b]	-0.73[b]	0.41*	0.23	0.20	1

[a]At the .05 level (two-tailed), the correlation was significant
[b]At the .01 level (two-tailed), the correlation was significant
[c]At the .001 level (two-tailed), the correlation was significant

WEL-SF difference value = WEL-SF after weight loss minus WEL-SF before weight loss

Abbreviations: WEL-SF, Weight Efficacy Lifestyle Questionnaire-Short Form.

D-values in our study was affected by the previous emotional eating scores; the more significant previous emotional eating, the higher the dietary self-efficacy after weight loss.

Differences in WEL-SF, GAD-7 and PHQ-9 Scale Scores of the Participants Before and After Weight Loss

In this study, there was no significant difference in dietary self-efficacy, anxiety or depression scores of the participants before and after weight loss (statistical analysis of WEL-SF scale score, GAD-7 scale score and PHQ-9 scale score before and after weight loss was performed by paired sample *t*-test; $P > .05$), as shown in Table 6.

DISCUSSION

A large number of previous studies indicated that obesity would directly or indirectly induce many serious diseases. However, although exercise was the best predictor of maintaining weight loss,[13] its effect may mainly come from the derived psychological skills of exercise that help control the diet, not the heat consumption brought about by exercise.[14] In addition, increasing the amount of exercise may lead to aggravation of existing joint damage in obese individuals, which would adversely affect their health. Therefore, many studies related to weight control in recent years have tended to adopt diet control to manage body weight. We found in our study that the 211 Diet body weight management method was effective in reducing the BMI of participants in the early stage of weight loss (first 40 days). The possible reason for this is that such a diet pattern, while ensuring adequate intake of nutrients, also increases satiety via protein and vegetable intake, thus controlling carbohydrate intake and reducing participants' BMI.

Body Weight Before Weight Loss and Previous Emotional Eating

This study found that the participants with more significant previous emotional eating might have higher body weight before weight loss, and the body weight before weight loss was not correlated with their previous exogenous or restrictive eating. Our conclusion was similar to those of previous studies on emotional eating behaviors.[15-16] Previous studies also found that individuals with relatively higher emotional eating scale scores tended to eat more high-energy foods after inducing negative emotions in the laboratory compared with emotionally neutral situations,[17] which may also suggest the reason for the positive correlation between the participants' body weight before weight loss and the severity of previous emotional eating. Nevertheless, this eating habit had negative effects on individuals' short- and long-term health.[18-21]

Table 5. Linear Regression Analysis of the Difference Between WEL-SF scores and previous emotional eating scores before and after weight loss

Model	B	*F*	R^2	*P* value
WEL-SF difference value = -22.09 + 1.13 * emotional eating	1.13	6.07	0.16	<.05

Notes: Dependent variable was WEL-SF D-value; WEL-SF D-value = WEL-SF after weight loss minus WEL-SF before weight loss

Abbreviations: WEL-SF, Weight Efficacy Lifestyle Questionnaire-Short Form.

Table 6. Variations in WEL-SF, PHO9 and GAD7 Scale Scores Before/After Weight Loss

Scale scores	Before weight loss	After weight loss	*t*	*P* value
WEL-SF	49.12 ± 21.51	55.18 ± 17.81	-1.37	.18
PHQ-9	8.09 ± 4.28	7.21 ± 4.01	1.31	.20
GAD-7	5.67 ± 4.39	4.94 ± 3.40	1.26	.22

First, the immediate sense of relief from negative emotions obtained from eating would interfere with the individual's ability to learn and implement long-term adaptive strategies to cope with negative emotions. Individuals would form a conditioned reflex to eating because of negative emotions and might further maintain this eating cycle through negative reinforcement,[18-20] making it difficult to resolve negative emotions. And the accumulated negative emotions may eventually lead to mental illness. Second, it has been reported that although the negative emotional state would be improved immediately after eating delicious food, this effect is often short-term, and then other negative emotions such as guilt appear.[22] This feeling of guilt about overeating may further aggravate an individual's negative emotions, and they would rely more on emotional eating, making the eating behavior more chaotic. This may eventually lead to continuous obesity, and is not conducive to physical health.

Individuals with More Obvious Previous Emotional Eating May Benefit More From Early Weight Management

The weight management method employed in this study could not only effectively reduce the participants' BMI in the early stage of weight loss (first 40 days), but also change their original eating habits during the period of weight loss. All participants' emotional eating behaviors of would be forced to stop, which would allow them to completely eliminate the excessive intake of a large amount of unnecessary calories caused by emotional eating during the weight loss period, and therefore thus them control body weight and decrease BMI.

In addition, our study found that there was no statistically significant increase in anxiety or depression after weight loss compared with before weight loss. The probable reason may be that participants with relatively more obvious previous emotional eating may not be able to quickly find other powerful new ways to improve negative emotions in a short time. This was manifested by the relatively more obvious increase of negative emotions such as anxiety and depression after weight loss than before weight loss. And we found that the participants with more pronounced depression after weight loss than before weight loss also had a more pronounced decrease in BMI. This may be due to the relatively decreased appetite caused by the relatively more obvious depression of participants after weight loss,[22] resulting in women with more pronounced depression during weight loss eating less and consuming less calories than other participants and achieving relatively better weight loss effects over the same period. These results suggest that with the weight management method of this study, women with relatively more significant previous emotional eating behaviors may benefit more in the early stage of weight loss.

Individuals with More Obvious Previous Emotional Eating May Benefit More From Further Weight Management in the Future

We also found that participants who had relatively more pronounced previous emotional eating also experienced a relatively greater increase in dietary self-efficacy after weight loss. This may be due to fact that self-efficacy was often affected by personal experience.[23] The 211 Diet may allow the participants to effectively reduce their BMI after changing their original poor eating behavior and cultivating healthy eating habits, so that participants can improve their dietary self-efficacy in weight management.

In previous studies, it has been proposed that self-efficacy is an important predictor of weight loss.[23-24] In general, the higher the self-efficacy, the more conducive it was to the implementation of the weight management plan. Therefore, we deduced that the participants who had completed the early 211 program who had previous emotional eating behaviors may obtain relatively better body weight management results in further body weight management. Furthermore, this study also found that there was no correlation between participants' dietary self-efficacy before and after weight loss. It also suggests that whether the participants had firm willpower to control diet or self-control before the weight management program did not necessarily affect the improvement in their dietary self-efficacy in follow-up body weight management.

In addition, our results also showed that there was no significant difference in dietary self-efficacy, anxiety and depression scores of the participants before and after weight loss (statistical analysis of WEL-SF scale, GAD-7 scale and PHQ-9 scale scores before and after weight loss was evaluated via paired sample t test; $P > .05$) . The possible reason is that the participants included in this study had a very low sense of dietary self-efficacy and significant anxiety and depression before weight loss. Therefore, for them, 40 days of weight management on the 211 Diet was a relatively short period of time. Although it can reduce their BMI, participants may not be able to quickly find other powerful new ways to improve negative emotions in a short time. Some participants even had worse negative emotions such as anxiety and depression after losing weight. Therefore, it is necessary to extend the study length and increase the number of participants so that the results can be more reliable.

From what has been stated above, the participants' relatively higher body weight before weight loss was associated with their previous relatively more significant emotional eating behaviors. Although some participants may feel more depressed in the early stage of weight loss, in general, the 211 Diet would not exert a significant adverse effect on the participants' mood. And this body weight management program may be more beneficial for weight loss in obese women of childbearing age who have relatively more obvious previous emotional eating behavior, which provides a new idea for body weight management in this population.

Study Limitations

This study involved a small number of participants, and only the early stage of the weight management program (first 40 days) was observed. The long-term psychological variations in the participants and the effect of weight

management remains to be clarified. As a result, more research participants should be included in future investigations. And we should continue to regularly conduct related psychological assessments and weight management effect evaluations in future research. Moreover, after the participant's future weight management plan is completed, their eating behaviors should be evaluated again at a selected time to observe whether the participant completely improved their previous poor eating behaviors via this weight management method.

CONCLUSION

The participants' relatively higher body weight before weight loss was related to their previous relatively more significant emotional eating behaviors. In obese women of childbearing age with more obvious previous emotional eating behaviors, the 211 Diet body weight management method may be more beneficial for weight loss.

AUTHOR CONTRIBUTIONS

Dixian Cai: propose a research question, design a research plan, implement the research process, collect and collate data, statistical analysis, research and collate literature, design a thesis framework, draft a thesis and complete a thesis. DaZou: provide technical and material support for the research. Xiaojing Lin: helping to recruit subjects for the study. Pingxia Xie: revising the thesis, teaching support and recruiting subjects for the study. Liang Yi: provision of research funding,and teaching support Hualei Cai: provision of research funding, teaching support and recruitment of subjects for the study.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

I confirm that I have read the Editorial Policy pages. This study was conducted with approval from the Ethics Committee of Guizhou Medical University (2022-006) . This study was conducted in accordance with the declaration of Helsinki. Written informed consent was obtained from all participants.

COMPETING INTERESTS

The authors declare that they have no competing interests.

DATA AVAILABILITY

The data used to support this study is available from the corresponding author upon request.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

FUNDING

This work was supported by the Research Foundation of Affiliated Hospital of Guizhou Medical University, China (No. gzwjkj2020-1-146) , and Effect of macronutrients during differentperiods of pregnancy on the risk of gestational diabetes in Miao pregnant women(No. gyfybsky-2021-22).

REFERENCE

1. Barry D, Petry NM. Associations between body mass index and substance use disorders differ by gender: results from the National Epidemiologic Survey on Alcohol and Related Conditions. [J]. *Addict Behav*. 2009;34(1):51-60. doi:10.1016/j.addbeh.2008.08.008
2. Ramlau-Hansen CH, Thulstrup AM, Nohr EA, Bonde JP, Sørensen TI, Olsen J. Subfecundity in overweight and obese couples. [J]. *Hum Reprod*. 2007;22(6):1634-1637. doi:10.1093/humrep/dem035
3. Güngör NK. Overweight and obesity in children and adolescents. [J]. *J Clin Res Pediatr Endocrinol*. 2014;6(3):129-143. doi:10.4274/jcrpe.1471
4. Luke B, Brown MB, Stern JE, Missmer SA, Fujimoto VY, Leach R; SART Writing Group. Female obesity adversely affects assisted reproductive technology (ART) pregnancy and live birth rates. [J]. *Hum Reprod*. 2011;26(1):245-252. doi:10.1093/humrep/deq306
5. van Strien T, Oosterveld P. The children's DEBQ for assessment of restrained, emotional, and external eating in 7- to 12-year-old children. [J]. *Int J Eat Disord*. 2008;41(1):72-81. doi:10.1002/eat.20424
6. Baker CW, Brownell KD. BOUCHARD C.Physical activity and maintenance of weight loss: physiological and psychological mechanisms [J]. *Physical Activity and Obesity*. 2000;2000(3):311-328.
7. Rudolph A, Hilbert A. Post-operative behavioural management in bariatric surgery: a systematic review and meta-analysis of randomized controlled trials. [J]. *Obes Rev*. 2013;14(4):292-302. doi:10.1111/obr.12013
8. Batsis JA, Clark MM, Grothe K, et al. Self-efficacy after bariatric surgery for obesity. A population-based cohort study. [J]. *Appetite*. 2009;52(3):637-645. doi:10.1016/j.appet.2009.02.017
9. Kim BY, Kang SM, Kang JH, et al; Committee of Clinical Practice Guidelines, Korean Society for the Study of Obesity (KSSO). 2020 Korean Society for the Study of Obesity Guidelines for the Management of Obesity in Korea. [J]. *J Obes Metab Syndr*. 2021;30(2):81-92. doi:10.7570/jomes21022
10. Zhang MY, He YL. Psychiatric Rating Scale Manual [M]. Changsha: Hunan Science and Technology Press, 2015:172-174; 200-203.
11. Zhang TQ, Yang NL, Liang H, et al. Confidence validity study of the Weight Effectiveness Lifestyle Questionnaire in patients before weight loss metabolism [J]. *Chinese Modern Nursing Journal*. 2018;24(20):2418-2422.
12. Li YN, Liu Y, Bao J. The Application of the Dutch Eating Behavior Questionnaire in Chinese College Students [J]. *Chin J Clin Psychol*. 2018;26(2):277-326.
13. Fogelholm M, Kukkonen-Harjula K. Does physical activity prevent weight gain--a systematic review. [J]. *Obes Rev*. 2000;1(2):95-111. doi:10.1046/j.1467-789x.2000.00016.x
14. Annesi JJ. Self-regulation foci and mood affect healthy and unhealthy eating behaviours differently in successful weight-loss treatment participants. [J]. *Int J Psychol*. 2020;55(3):398-404. doi:10.1002/ijop.12593
15. Allison DB, Heshka S. Emotion and eating in obesity? A critical analysis. [J]. *Int J Eat Disord*. 1993;13(3):289-295. doi:10.1002/1098-108X(199304)13:3<289::AID-EAT2260130307>3.0.CO;2-X
16. McElroy SL, Kotwal R, Malhotra S, Nelson EB, Keck PE, Nemeroff CB. Are mood disorders and obesity related? A review for the mental health professional. [J]. *J Clin Psychiatry*. 2004;65(5):634-651. doi:10.4088/JCP.v65n0507
17. Devonport TJ, Nicholls W, Fullerton C. A systematic review of the association between emotions and eating behaviour in normal and overweight adult populations. [J]. *J Health Psychol*. 2019;24(1):3-24. doi:10.1177/1359105317697813
18. Haedt-Matt AA, Keel PK, Racine SE, et al. Do emotional eating urges regulate affect? Concurrent and prospective associations and implications for risk models of binge eating. [J]. *Int J Eat Disord*. 2014;47(8):874-877. doi:10.1002/eat.22247
19. Polivy J, Herman CP. Etiology of binge eating: psychological mechanisms. In: Fairburn CG, Wilson GT (eds) Binge eating: nature, assessment, and treatment[J]. Guilford Press, New York, 1993,1993(1):173–205.
20. Hawkins RC, Clement PF. Binge eating: measurement problems and a conceptual model. In: Hawkins RC, Fremouw WJ, Clement PF (eds) The binge purge syndrome: diagnosis, treatment, and research[J]. Springer, New York,1984,1984(1):229–251.
21. van Strien T, Konttinen H, Homberg JR, Engels RC, Winkens LH. Emotional eating as a mediator between depression and weight gain. [J]. *Appetite*. 2016;100(100):216-224. doi:10.1016/j.appet.2016.02.034
22. Haedt-Matt AA, Keel PK, Racine SE, et al. Do emotional eating urges regulate affect? Concurrent and prospective associations and implications for risk models of binge eating. [J]. *Int J Eat Disord*. 2014;47(8):874-877. doi:10.1002/eat.22247
23. Shao J, Guo JB, Liao J. Pathway analysis of the effect of self-efficacy, medical adherence on pre-pregnancy weight loss in overweight / obese infertility participants [J]. *The PLA Nursing Journal*. 2021;38(04):37-40.
24. Teixeira PJ, Carraça EV, Marques MM, et al. Successful behavior change in obesity interventions in adults: a systematic review of self-regulation mediators. [J]. *BMC Med*. 2015;13(13):84. doi:10.1186/s12916-015-0323-6