Original Article

Contingency Management for the Treatment of Antipsychotic-Induced Weight Gain: A Randomized Controlled Pilot Study

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Key Words

Obesity management • Schizophrenia • Weight gain

Abstract

Objective: Weight gain is common for individuals with serious mental illness (SMI) receiving antipsychotic drug therapy. Contingency management (CM) is a behavioral intervention that rewards positive performance and has demonstrated effectiveness in reducing drug use in SMI populations. This study evaluated the feasibility of using CM to promote weight loss in individuals with SMI over 8 weeks. **Method:** 30 individuals ($BMI \geq 28 \text{ kg/m}^2$) were randomized to one of three conditions: i) The combination of a standardized lifestyle modification (LM) program for individuals with SMI and payment for group attendance ($CM_{\text{attendance}}$), ii) The combination of LM and payment for weight loss (CM_{weight}), and iii) waitlist control (CON). After the waitlist period, those participants joined a LM group and received payment for behavioral change (CM_{behavior}). **Results:** Subjects in the $CM_{\text{attendance}}$ and in the CM_{weight} group lost a mean of 1.16 kg and 1.23 kg, respectively, while subjects in the CON gained a mean of 0.68 kg. Subjects receiving CM_{behavior} lost a mean of 2.54 kg, which was a significant weight loss compared to the control period. **Conclusion:** LM supplemented with CM may facilitate weight loss in patients taking antipsychotic medications; financial reimbursement for behavioral change may be particularly effective in this population.

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Introduction

Individuals with severe mental illness (SMI) have a life expectancy that is 2 decades shorter than that of the general population [1]. SMI is associated with increased prevalence rates of obesity [2], type 2 diabetes [3], and cardiovascular disease [4]. Poor nutritional

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choices, sedentary lifestyle, and antipsychotic medications (particularly some 2nd-generation antipsychotic medications) contribute to the increased obesity rates observed in SMI populations [5, 6]. Lifestyle modification (LM) interventions can be utilized as a first-line treatment for obesity and produce approximately 0.5 kg/week of weight loss in the general population [7]. LM and cognitive behavioral therapy have been shown to reduce weight or prevent weight gain in SMI populations [8–11]; a review of randomized controlled studies reported that these techniques average approximately 0.2 kg/week of weight loss over 15 weeks in this population [12]. There is a critical need to develop strategies to augment the effectiveness of LM interventions in SMI populations.

Contingency management (CM) is based on the behavioral principle that reinforcement of a targeted behavior will increase its frequency. CM has been used extensively to facilitate behavior change in individuals with substance abuse disorders [13]. CM is applied to situations in which an outcome is easily detected (e.g., abstinence from substances), and individuals are rewarded, usually financially, for objective evidence of success [14, 15].

Applications of CM have included rewards for both attendance (adherence to treatment) and treatment outcomes (negative urine samples) [16, 17]. Nearly one third of all clinical appointments are missed [18], leading to lost opportunities for therapy and attrition from treatment. The effectiveness for CM for improving substance abuse outcomes has been demonstrated among individuals with SMI [16, 18]. In one study, the provision of take-home doses of methadone significantly improved attendance at therapy sessions [19]. In a different study of CM, monetary incentives increased the number of negative urine samples in a sample of SMI patients that abused marijuana [16].

As CM has been used to increase gym attendance [20] and to reinforce healthy eating habits [21] and financial incentives have been shown to promote weight loss in obese individuals [22–24], the combination of LM with CM may be particularly effective in promoting weight loss. In a previous study, we demonstrated the effectiveness of CM for behavioral change (in the form of food reimbursement) in promoting weight loss among overweight and obese persons with SMI [12]. This intervention allowed participants to shop for healthy foods according to their own tastes, which made individuals more receptive to dietary change by incorporating their own preferences while also providing a counseling opportunity to guide them on making better food choices. Food reimbursement resulted in significant weight loss compared to that of the control group, and participants continued to lose weight 6 months after the intervention. LM in conjunction with financial incentives as a reward contingent on weight loss or other behavior change represents a novel treatment for antipsychotic-induced weight gain [25, 26].

The objective of this study was to determine the feasibility and efficacy of an 8-week LM program utilizing CM for the treatment of antipsychotic-induced weight gain in individuals with SMI. We aimed to determine whether there would be any difference in weight loss across groups which were rewarded either for attendance, weight loss, or behavioral change. We hypothesized that rewarding for behavioral change would be the most effective based on our previous experience with food reimbursement.

Subjects and Methods

Subjects

30 individuals (BMI ≥ 28 kg/m²) aged 18 to 70 years with SMI who were on a stable dose of antipsychotics for at least 1 month and self-reported weight gain $\geq 5\%$ over the past 5 years were recruited via advertisement or referral. Individuals who were pregnant, had a history of dementia or of mental retardation, or were not fluent in English were excluded from the study.

This study was conducted from October 2010 through March 2011 at the Connecticut Mental Health Center, in New Haven, CT. The protocol was approved by the Institutional Review Board of Yale University. After complete description of the study to the participants, written informed consent was obtained.

Lifestyle Modification

All subjects received an 8-week, randomized, group-based LM weight loss intervention coupled with CM in the form of financial reimbursement. Initially, participants were randomly assigned by a blinded research assistant using randomization software to one of three groups; i) contingency for weight (CM_{weight}), ii) contingency for attendance ($CM_{attendance}$), or iii) waitlist control (CON). After 8 weeks, participants from CON joined a group that had a contingency for behavioral change ($CM_{behavior}$) in the form of reimbursement for healthy food purchases. This was chosen to follow CON because we have demonstrated the effectiveness of rewarding behavioral change with food reimbursement in a SMI population previously [12].

The LM program was the Simplified Intervention to Modify Physical Activity, Lifestyle and, Eating Behavior (SIMPLE) program, a standardized lifestyle program based on social cognitive theory. SIMPLE was specifically designed to be used with SMI populations, assumed no prior nutritional knowledge, and all concepts were presented in basic terms with cultural sensitivity [12]. The format consisted of weekly, hour-long group sessions with 8–10 individuals. Topics focused broadly on nutrition and physical activity and included changing attitudes to support weight loss and implementing social support to aid in weight loss. The main focus of the nutritional component of SIMPLE was to help participants choose healthy options from each food group while reducing total calorie consumption. The physical activity component focused on helping participants identify ways to increase daily physical activity (e.g., walking more and choosing stairs rather than elevators).

Contingencies for Weight and Attendance

All participants were paid USD 20.00 for each of the baseline and week 8 assessments. The total maximum dollar amount (USD 140.00) that individuals could potentially earn for contingencies was the same across the three different types of CM groups; however, the interventions differed with respect to the way money was earned. Individuals ($n = 10$) in the $CM_{attendance}$ group received USD 17.50 for each of the 8 weight loss groups they attended. Individuals ($n = 10$) in the CM_{weight} group received monetary reward for weight loss. Starting in the 2nd week of group, if a group member lost at least 1 lb since the previous week, a USD 5.00 reward was given. At week 3, if the group member lost at least another pound, the payment was USD 10.00. Payments continued to escalate in USD 5.00 increments for each week that the group member lost at least 1 lb. If a group member was unable to lose at least 1 lb, no payment was disbursed, and payments would reset back to the USD 5.00 level.

Waitlist Control and Contingency for Behavior

Individuals ($n = 10$) randomized to the CON group received no specific dietary or physical activity intervention for 8 weeks and were instructed to continue with their habitual patterns of eating and activity. After the 8-week period was over, subjects entered a LM group with a contingency for behavior ($CM_{behavior}$). During the $CM_{behavior}$ group intervention, participants received financial reimbursement for healthy foods that were purchased from a shopping list that was handed out the first week of group. Starting in the 2nd week, group members brought their grocery receipts to group and were reimbursed up to USD 20.00 a week for healthy items purchased. All intervention groups received the healthy food list during the first session, but only the $CM_{behavior}$ group was reimbursed for healthy food purchases.

Outcome Measures and Other Assessments

Weight was measured weekly before group sessions. All other ratings were performed at baseline and after 8 weeks. The primary outcome measure was change in weight after 8 weeks.

Laboratory and Anthropometric Measurements

Weight was measured in light clothing, without shoes, to the nearest 0.1 kg, and height was measured to the nearest 0.1 cm on a calibrated, portable scale (Pelstar LLC, Alsip, IL, USA). BMI was calculated as kg/m^2 . Waist circumference was the average of two measurements at the midpoint between the iliac crest and the lowest rib to the nearest 0.1 cm. Blood pressure was measured using a calibrated wrist monitor (Oregon Scientific, Portland, OR, USA) after participants sat quietly for 5 min.

Plasma glucose levels (YSI, Yellow Springs, OH, USA), plasma insulin concentrations (Diagnostic, Webster, TX, USA), glycosylated hemoglobin (HbA1c) (Miles, Inc., Elkhart, IN, USA), and lipid profile (Sigma, St. Louis, MO, USA) were measured using standard enzymatic procedures.

Questionnaires

A 24-hour diet recall [27] was used to gather information about food and beverage consumption. Recalls were semi-structured interviews conducted with trained research staff. The Godin Leisure Time Exercise Questionnaire (GLTEQ) [28] was used to assess self-reported frequency of mild, moderate, and vigorous exercise.

Statistical Analysis

A preliminary sample size calculation determined that 8 members in each group would provide 80% power to detect a significant weight loss difference based on subjects in the CM_{behavior} group losing 1 lb/week, subjects in the CM_{attendance} and CM_{weight} groups losing 0.5 lb/week, and no weight change for CON. Subjects who completed baseline and 8-week assessments were included in the outcome analyses. Analysis of Covariance (ANCOVA) was conducted with CM_{attendance}, CM_{weight}, and CON groups for the 8-week intervention. A repeated measures analysis of variance (ANOVA) was used to assess results for the CON group that became the CM_{behavior} group. Finally, the three CM groups were compared using ANCOVA with chlorpromazine equivalent, sessions attended, and contingencies earned as covariates. Bivariate correlations were calculated using Spearman's correlation coefficient to assess the relationship between session attendance, body weight, physical activity, eating behaviors, and quality of life. All analyses were performed using SPSS, version 17.0 for Windows (SPSS Inc., Chicago, IL, USA).

Results

Participant Characteristics

26 individuals (CM_{attendance} = 9, CM_{weight} = 9, CON = 8) completed the first 8 weeks of the study, and 9 individuals from the CON group completed CM_{behavior} after the waitlist period. The flow of study participants is presented in figure 1. Subjects primarily had schizophrenia or schizoaffective disorder diagnoses (60%). Three individuals (CM_{attendance}, CM_{weight}, CON) dropped out of the study after randomization. One subject in the CON group was excluded from CON analyses because a weight was not available after the waitlist period; however, this individual was allowed to join CM_{behavior} as scheduled. Baseline antipsychotic medication dose was statistically different between groups based on calculated chlorpromazine equivalencies [29] and was therefore controlled for during subsequent analyses. The average length of illness was 23 ± 13 years. There were no differences in age, gender, ethnicity, length of illness, or psychiatric diagnosis between any of the groups, and there were no differences between dropouts and those that completed the study. Demographic characteristics are presented in table 1.

Anthropometric Values

There were no differences in weight or BMI between groups at baseline. After 8 weeks, subjects in both the CM_{attendance} (-1.16 ± 2.34 kg) and the CM_{weight} (-1.23 ± 2.01 kg) groups lost weight, while CON subjects, on average, gained weight (0.68 ± 2.66 kg), although these differences did not reach statistical significance. CM also reduced waist circumference, while this measure increased among CON subjects, but these differences were also not statistically significant. A repeated measures ANOVA showed that CM_{behavior} resulted in a significant weight loss (-2.54 ± 2.49 kg) compared to the 8-week waitlist control period ($F(1, 8) = 9.63, p = .02$, table 2). Similar analyses also showed that BMI was significantly improved for subjects after the CM_{behavior} intervention (-0.92 ± 0.92 kg/m²) compared with the control period (0.34 ± 0.87 kg/m²; $F(1, 8) = 11.08, p = 0.01$). There

Fig. 1. CONSORT flow diagram.

Table 1. Demographic information^a

Variable	CM _{weight} (n = 10)	CON (n = 10)	CM _{attendance} (n = 10)	F or χ^2	P value
Female, %	60	70	70	1.82	0.178
Age, years	50.1 ± 10.6	47.3 ± 8.0	49.0 ± 8.1	0.19	0.829
C/AA/H, n	6/3/1	3/4/3	6/4/0	2.67	0.264
BMI, kg/m ²	41.6 ± 9.9	38.1 ± 5.7	36.0 ± 8.9	1.02	0.376
Chlorpromazine equivalent antipsychotic dosage, mg	481 ± 414	269 ± 180	833.33 ± 617	3.75	0.038

C = Caucasian; AA = African American; H = Hispanic.

^aAge, BMI, and antipsychotic dosage are reported as mean ± SD.

were no differences in blood pressure between groups or over time. There were no significant differences between changes in outcome variables for the three CM groups after the intervention.

Table 2. Changes in outcome variables between waitlist period and active intervention^a

Variable	CON	CM _{behavior}	F ^b	P
Δ Weight, kg	0.68 ± 2.66	−2.54 ± 2.49	9.63	0.02
Δ BMI, kg/m ²	0.4 ± 0.9	−0.9 ± 0.9	11.08	0.01
Δ Waist, cm	3.4 ± 7.0	−3.5 ± 5.6	0.93	0.39
Δ Glucose, mg/dl	8.4 ± 30.4	−15.6 ± 57.9	0.95	0.76
Δ HbA1c, %	0.7 ± 1.6	−0.2 ± 0.9	0.80	0.41
Δ Insulin, uU/l	−4.6 ± 5.9	4.3 ± 6.7	4.42	0.07
Δ TC, mg/dl	−4.3 ± 20.8	−0.6 ± 24.9	0.09	0.77
Δ Trig, mg/dl	7.1 ± 38.8	0.0 ± 31.4	0.12	0.74
Δ HDL, mg/dl	−2.9 ± 7.3	4.3 ± 4.4	4.42	0.06
Δ LDL, mg/dl	−16.3 ± 31.1	3.7 ± 24.8	2.03	0.21
Δ Calories	44 ± 973	−414 ± 679	0.54	0.50
Δ GLTEQ	−5.5 ± 35.0	12.1 ± 19.4	0.41	0.55

HbA1c = Glycosylated hemoglobin; TC = total cholesterol; Trig = triglycerides

^aValues are reported as means ± SD.

^bRepeated measures ANOVA.

Laboratory Values

There were no differences in laboratory values at any time point between any groups. CM tended to improve HDL cholesterol values, whereas this measurement worsened among CON subjects.

Caloric Intake and Physical Activity

There were no significant differences in caloric intake or physical activity between any groups at any time point; however, CM_{behavior} was the only group to improve both facets of energy balance.

Contingencies and Sessions Attended

The percentage of sessions attended were 81% for CM_{attendance}, 78% for CM_{behavior}, and 60% for the CM_{weight} group. Contingencies earned for the CM_{attendance} (USD 112.78 / subject) and CM_{behavior} (USD 93.80 / subject) groups were significantly greater than those earned in the CM_{weight} group (USD 12.22 / subject) ($F(2, 27) = 40, p \leq 0.001$). Percentage of sessions attended was positively correlated with baseline emotional health ($r = 0.407, p \leq 0.05$) and total GLTEQ score after treatment ($r = 0.452, p \leq 0.05$).

Discussion

Our study demonstrates the feasibility of combining CM with LM for weight loss among an overweight and obese SMI population. The study evaluated three different CM interventions (rewarding either attendance, weight loss, or the behavior of purchasing healthy foods). Mean weight was reduced in all of the intervention groups, regardless of the form of CM used. The magnitude of mean weight loss after 8 weeks (approximately 4 lb) was similar to results from other behavioral weight management studies on SMI populations and those from currently available pharmacological treatment studies using orlistat or phentermine [30].

In the present study, CM in the form of reimbursement for healthy food purchases resulted in the greatest weight loss, which is consistent with findings from a systematic review of studies using financial incentives for weight loss that reported a trend in favor of greater weight loss with reward for behavioral change rather than reward for weight loss outcome [31]. The increased cost of healthy foods is often cited as an impediment to appropriate food choices – especially for groups with low socioeconomic status [32, 33]. The combination of food provision and financial incentives may enhance weight loss because these strategies target both the antecedents and consequences of behavior, allowing participants to make better choices and learn from their past experiences.

In contrast, the CM interventions that rewarded either attendance or weight loss did not reduce weight more effectively when compared with the control group. Wing et al. [34] found no difference between the effects of financial incentives for weight loss and payment for group attendance in a group of overweight adults. It is possible that the method of payment for weight loss in this study limited its efficacy. Financial contracting, in which the participant deposits their own money, which is reimbursed contingent on weight loss, has been shown to substantially reduce weight in the general population [22]. Perhaps the threat of losing one's own money provides a greater incentive than receiving an external reward [35, 36], but this method would likely limit study volunteers for a population with limited socioeconomic means such as those with SMI. Another possibility is that the 1 lb/week weight loss goal may have been too ambitious for this population. Previous behavioral studies have reported that weight loss over time is associated with increased session attendance [37]; however, the current study found no such relation. One possible explanation could be that individuals who were rewarded for attendance became passive participants in the LM process without positive reinforcement for changing eating behaviors or achieving weight loss.

We were unable to observe significant changes in metabolic indices after this intervention, likely due to the small sample size along with the abbreviated timeframe. Even modest weight loss can significantly improve glucose and lipid metabolism in SMI populations [38], making the improvement in HDL cholesterol levels observed with LM in the current study encouraging.

Session attendance was significantly correlated with baseline emotional health and frequency of physical activity at week 8. Developing strategies to improve emotional wellness may make participants more receptive to the behavioral changes necessary for weight loss. The increase of physical activity observed with higher session attendance was a positive outcome. Regular physical activity can decrease triglyceride and insulin concentrations for individuals with SMI [39]. While the sample size was too small to detect significant changes in metabolic parameters, the largest weight loss was observed in the only group that improved both their dietary and exercise patterns.

The primary limitations of this study were the small sample size, the brief duration, and the lack of long-term follow-up of the intervention which might have limited the ability to find significant differences in some outcome variables. The small sample size also did not allow for a differential analysis of effects for individual antipsychotics on weight change. Another limitation was the control group crossing-over to a CM group; it would have been less confounding to have four separate groups of individuals running simultaneously, but the time necessary to recruit another group would have increased study attrition. The use of a group receiving LM without incentives would have provided a direct comparison for the efficacy of CM in this population. There was selection bias in the recruitment of participants because these individuals were motivated to lose weight; so these results may not be indicative of the SMI population. Another limitation is the use of one 24-hour dietary recall. Some patients may underestimate or overestimate their actual intake or consume a different

amount of food depending on whether it was a weekday or weekend. To minimize this variation, we provided measuring cups and food models to help patients visualize portion sizes, and dietary recalls were assessed on an equal number of weekdays and weekends. The use of self-reported physical activity frequency provides another limitation. Patients may have difficulty remembering duration and frequency of physical activity. Although objective measures like accelerometers may be more accurate, the GLTEQ provides clear examples to guide patients and is more suitable for a clinical setting. Another limitation was the lack of baseline cognitive testing. Perhaps limited cognitive functioning impaired some patients' ability to understand the LM information, or possibly there were differences in cognitive functioning between groups. Finally, the pilot was not designed to provide cost-effectiveness analyses. One criticism of CM that has reduced its implementation in community-based settings is cost [40]. Food reimbursement was associated with significant weight loss for less than USD 100.00 / patient over 8 weeks. Future research should try to determine the sustainability of CM and the lowest payment amount where benefits are still observed.

We found that an 8-week intervention that combined LM and CM for individuals with SMI reduced weight. Although rewarding participants for attendance, weight loss, or food purchasing behaviors were all associated with weight loss, food reimbursement (rewarding behavioral change) may be particularly effective in this population. CM may provide sufficient motivation to help SMI patients combat antipsychotic-induced weight gain.

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Disclosure Statement

The authors declare no conflicts of interest.

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