# Weight control in schizophrenic patients through Sakata's Charting of Daily Weight Pattern and its associations with temperament and character

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Abstract

**Aim:** This study examined whether daily self-monitoring of weight and monthly interviews with a doctor improved eating habits and led to weight loss, and whether temperament and character traits affect weight change in persons with schizophrenia.

**Methods:** Participants used Sakata's Charting of Daily Weight Pattern to monitor their weight daily. In addition, Sakata's Eating Behavior Questionnaire was administered to evaluate eating-behavior awareness. The Temperament and Character Inventory (TCI) was used to assess participants' temperament and character. Fifty patients were divided into two groups: the intervention group (n = 25) filled in Sakata's Charting of Daily Weight Pattern every day; was interviewed monthly by a doctor about weight management; was weighed monthly. The non-intervention group (n = 25) was only weighed monthly.

**Results:** The body mass index (mean ± standard error: 0.59 ± 0.10 kg/m$^2$, $p < 0.001$) of the intervention group decreased significantly while their scores on Sakata's Eating Behavior Questionnaire significantly improved albeit marginally. Conversely, body mass index increased significantly (0.66 ± 0.18 kg/m$^2$, $p < 0.001$) in the non-intervention group, whose scores on Sakata's Eating Behavior Questionnaire did not change significantly. Weight change and TCI scores were not correlated for the intervention group, but scores for "self-directedness" and weight gain in the non-intervention group had a marginally significant negative correlation ($r$ = -0.33, $p < 0.10$).

**Conclusion:** Our results suggest that monitoring one's weight daily on Sakata's Charting of Daily Weight Pattern led to improvements in eating behavior and a decrease in BMI of patients with schizophrenia.

Key words: Sakata's Charting of Daily Weight Pattern, Sakata's Eating Behavior Questionnaire, schizophrenia, temperament and character inventory, weight control

## 1. Introduction

Multiple factors contribute to the risk of obesity in patients with schizophrenia, including a decrease in daily activity, a lack of concern about personal health, and an increased appetite and excess ingestion due to the side effects of antipsychotics. Weight gain has been known to increase mortality and risk for numerous health conditions such as glucose intolerance, hypertension, and cardiovascular disease. In recent years, although the use of atypical antipsychotics has decreased side effects, such as tardive dyskinesia and extrapyramidal symptoms, remarkable weight gain has become a significant problem in this patient population (Lieberman et al., 2005). Up to now, dietetic treatment and exercise therapy have been used to reduce weight gain in patients with schizophrenia. However, although improvements in weight and body mass index (BMI) have been reported (Alvarez-Jiménez et al., 2006; Menza et al., 2004), null results have been reported as well (Scocco et al, 2005).

Eating-behavior adjustment occurs through the cooperation between two regulatory systems around the hypothalamus. The first is metabolic regulation, which is driven by humoral information, such as leptin, and neural information derived from viscera, such as the stomach and liver. The second is cognitive regulation that involves higher brain functions such as taste, memory, and motivation (Chiba and Yoshimatsu, 2004). Sakata's Charting of Daily Weight Pattern and Sakata's Eating Behavior Questionnaire use the cognitive behavior therapeutic approach, which works on cognitive regulation as a treatment for obese patients, and using these has been shown to have a constant positive effect on weight loss (Ookuma, 2001; Sakata, 1996; Yoshimatsu, 2009). In this study, we examined whether using Sakata's Charting of Daily Weight Pattern would change distortions and habits in eating behavior and improve the BMI of patients with schizophrenia. We also examined whether temperament and character would affect weight change in patients with schizophrenia by using the Temperament and Character Inventory (TCI), which identifies neurobiological bases related to each temperament and

character (Kijima et al., 2000).

## 2. Method

### 2.1. Participants

The participants were 50 patients in Taniguchi Hospital diagnosed with schizophrenia by psychiatrists through the International Classification of Diseases, version 10 (ICD-10). There were 18 inpatients (12 men and 6 women) and 32 outpatients (18 men and 14 women). We confirmed that these participants were free of endocrinological and metabolic diseases, including diabetic and Basedow's disease, kidney disease, neoplastic disease, and other diseases that could result in short-term weight change. We divided the participants into two groups: the intervention group and the non-intervention group, which were comparable in size, sex ratio, inpatient and outpatient ratio, IQ, chlorpromazine equivalent dose, average age, disease duration, and initial weight and BMI (see Table 1).

The intervention group recorded their weight every day for 16 weeks with Sakata's Charting of Daily Weight Pattern, had monthly interviews with a doctor about weight management, in addition to the usual examination, and measured their weight monthly. The non-intervention group only had to have their weight measured by medical staff monthly. None of the participants had any changes in medicine type or dose during the course of this study. This study was approved by the medical ethics committee of the Faculty of Medicine of the University of Miyazaki and conforms to the provisions of the Declaration of Helsinki. Participants gave their informed consent prior to participation, and patient anonymity was preserved.

## 2.2. Procedure

### 2.2.1 Sakata's Charting of Daily Weight Pattern

Sakata's Charting of Daily Weight Pattern was developed to facilitate weight loss in obese patients (Yoshimatsu, 2009). Patients are usually required to measure and record their weight in the provided graph four times daily; just after waking up, just after breakfast, just after dinner, and just before bedtime. This chart was developed based on the concept that visualizing fluctuations in their weight would help patients be more aware of their eating behavior, which they could then correct. In this study, the intervention group measured and recorded their weight once a day just after waking up. Patients were free to include additional notes, such as content of meals, exercise, and daily activities. If notes were included, they were used for reference on patient behavior, self–reflection, and self-estimation.

### 2.2.2 Interview

The monthly interviews focused on daily fluctuations in body weight rather than weight change over a month. The doctor neither pointed out specific causes of weight change nor gave specific instructions about meal contents and times. This was to allow patients to notice and correct problems about their eating behavior on their own. Patients who were aware of and regulated their weight were praised.

### 2.2.3 Weight measurement

Participants in the intervention group used their own weighing scales for daily recording. We used the OMRON Karada-Scan scale (HBF-357-A, Omron, Tokyo) to weigh

participants monthly and to calculate their BMIs.

### 2.2.4 Sakata's Eating Behavior Questionnaire

Sakata's Eating Behavior Questionnaire, whose reliability and validity have been verified by Ookuma and Yoshimatsu, was developed to grasp distortions and habits in eating behavior (Ookuma, 2001; Sakata, 1996; Yoshimatsu, 2009). It consists of 50 questions, including 30 items that could be used to distinguish obese patients. Each item is rated on a 4-point scale ranging from 1 (*there is no such thing*) to 4 (*absolutely*), with higher scores signifying a higher probability of obesity. These 30 questions are classified into seven areas: (1) cognition of constitution, such as "tend to gain weight more easily than others" and "gain weight just by drinking water," (2) reasons for eating more, such as "when eating out or getting home delivery, I always order a lot," (3) eating and drinking due to mood, such as "eat to get rid of irritability," (4) satiety, such as "if it is food I like, I can eat more after meals," (5) eating style, such as "eat fast" and "little chewing," (6) meal contents, such as "eat fast food often," and (7) irregular mealtimes, such as "eat at irregular times" and "snacking after dinner." Higher scores indicate more improper eating behavior and a larger area enclosed with the straight line on the diagram indicate a larger deviation. Treating obese patients with this chart and questionnaire helps them to notice distortions and habits in their eating behavior, which is a first step in behavior modification. This method has been used in some hospitals in Japan to treat obesity. Fujimoto *et al.* reported a mean weight loss of 15.2 ± 1.5 (mean ± SEM) kg after 6.5 ± 0.8 months of treatment in 48 patients of 55 participants (Fujimoto et al., 1992). In this study, we measured changes in distortions and habits in the eating behavior of patients with schizophrenia by administering this questionnaire before and after intervention.

### 2.2.5 Temperament and Character Inventory (TCI)

Cloninger *et al.* designed the TCI to evaluate personality structure with a 7-factor model of temperament and character with the assumption that personality structure is composed of temperament and character (Cloninger et al., 1993; Peirson et al., 1999). He proposed that temperament, which includes the four dimensions of "novelty seeking," "reward dependence," "harm avoidance," and "persistence," reflects variations in the dopaminergic, serotonergic, and noradrenergic systems in the central nervous system and is influenced by genes and contributes to behavioral decisions. On the other hand, character, which includes the three dimensions of "self-directedness," "cooperativeness," and "self-transcendence," matures in adulthood and influences personal and social effectiveness as people develop their self-concepts. In this study, we examined whether temperament and character are related to weight change in patients with schizophrenia by using the short Japanese version of the TCI (125 items), where each item is rated as "Yes" or "No" (Kijima et al., 2000).

2.2.6 Short form of the WAIS-R

In addition, we used the short forms of four-subtest of the Japanese version of Wechsler Adult Intelligence Scale-Revised (WAIS-R), namely, "information," "picture completion," "digit symbol coding," and "arithmetic," to evaluate the level of understanding in participants (Kaufman et al., 1991).

2.2.7 Statistical analysis

A two-way repeated measures analysis of variance (ANOVA) was used to compare changes in BMI and eating-behavior scores at the beginning and after 16 weeks in the intervention and non-intervention groups. Simple main effects tests were conducted if there was a significant interaction between two factors. Pearson's product-moment correlation coefficient was also used to calculate the relationship between the rate of weight change and the

subordinate items of the TCI in order to determine the type of temperament and character traits involved in weight change.

## 3. Results

### 3.1 Sakata's Charting of Daily Weight Pattern

Participants were generally diligent in recording their daily weight changes in the chart; although there were some days that were not recorded due to various circumstances, there were no instances where no measurements were made for two or more consecutive days. Some patients also voluntarily recorded events, meal contents, snacks, and exercise (see Figure 1).

### 3.2 Interview

Participants in the intervention group diligently attended the monthly interviews about weight management. Some patients revealed that they "began to eat less" and "began to reduce snacking," indicating changes in eating behavior.

### 3.3 Weight and BMI changes

Changes in BMI in the intervention and non-intervention groups are presented in Figure 2. After 16 weeks, the average BMI of the intervention group was found to decrease ($0.59 \pm 0.10$ kg/m$^2$). In contrast, the average BMI of the non-intervention group increased ($0.66 \pm 0.18$ kg/m$^2$). A two-way repeated measures ANOVA (measurement point: 0 week, 16 week × intervention) found no significant main effects of measurement point ($F(1, 48) = 0.16$) or intervention ($F(1, 48) = 0.71$) but there was a significant interaction between the two factors

($F(1, 48) = 48.36$, $p < 0.001$). Post hoc analysis found significant simple main effects of intervention (intervention: $F(1, 48) = 21.5$, $p < 0.001$; non-intervention: $F(1, 48) = 27.0$, $p < 0.001$). Therefore, BMI decrease in the intervention group and BMI increase in the non-intervention group after 16 weeks were both significant.

### 3.4 Sakata's Eating Behavior Questionnaire

Figure 3 displays score changes in the seven areas in the beginning and after 16 weeks in the questionnaire for both the intervention and non-intervention groups as well as the percentage of maximum score for each area. As the figure shows, scores decreased with time in the intervention group. A two-way repeated measures ANOVA (measurement point: 0 week, 16 week × intervention) on changes in questionnaire score was conducted. There were no significant main effects of measurement point ($F(1, 48) = 1.6$) or intervention ($F(1, 48) < 0.0$). However, there was a marginally significant interaction between measurement point and intervention ($F(1, 48) = 3.8$, $p < 0.10$). Post hoc analysis revealed a simple main effect for intervention ($F(1, 48) = 5.1$, $p < 0.05$) but not for non-intervention ($F(1, 48) = 0.2$). Thus, the decrease in questionnaire score in the intervention group was marginally significant but there were no significant changes in questionnaire score in the non-intervention group.

### 3.5 TCI

There were no significant differences in TCI scores between the two groups. Results of the regression analysis on weight change rate and the seven dimensions of TCI are displayed in Table 2. Although there was no significant correlation between rate of weight gain and TCI score for the intervention group, there was a marginally significant negative correlation ($r = -0.33$, $p < 0.10$) between the score on "self-directedness" and weight gain for 23 participants in the non-intervention group; two participants were excluded because they gave incomplete or

inappropriate responses.

## 4. Discussion

This study found that the BMI of participants in the intervention group decreased significantly after 16 weeks. Some participants in the intervention group talked in the interview about noticing problems in their eating behavior and the changes that they have made, such as eating less and reducing snacking. Furthermore, the total scores on Sakata's Eating Behavior Questionnaire improved marginally significantly after 16 weeks for the intervention group. Taken together, these results suggest that monitoring one's weight daily on Sakata's Charting of Daily Weight Pattern led to both improvements in eating behavior and a decrease in BMI.

We have previously reported average weight loss and the awareness of eating style and meal content in 14 patients with schizophrenia who used Sakata's Charting of Daily Weight Pattern and were administered Sakata's Eating Behavior Questionnaire (Matsuo et al., 2007). The groups in the present study were formed based on the results of that study, and we were able to replicate BMI decrease and awareness of eating behavior in the intervention group. Many studies have suggested that psychoeducation and behavioral intervention are effective in managing the weight of patients with schizophrenia (Feeney et al., 2003; Vreeland et al., 2003). However, these methods require a lot of resources, such as staff, time, place, and effort, and may not be applicable for outpatients and short-term inpatients. Therefore, Sakata's Charting of Daily Weight Pattern could be a reliable, convenient, and cost-effective method of managing the weight of patients with schizophrenia.

Conversely, we found that the BMI of the non-intervention group increased significantly after 16 weeks. Vreeland *et al.* reported weight loss of 2.7 kg and BMI decrease of

0.98 kg/m$^2$ in the intervention group (n=31) with psychoeducation for 12 weeks, however there was weight gain of 2.9 kg and BMI increase of 1.2 kg/m$^2$ in the non-intervention group (n=15) in schizophrenia patients with atypical antipsychotics (Vreeland et al., 2003). Feeney *et al.* reported BMI decrease of 1.6 kg/m$^2$ in the intervention group (n=51) with psychoeducation for three years, however there was BMI increase of 0.2 kg/m$^2$ in the non-intervention group (n=38) in the schizophrenia outpatients (Feeney et al., 2003). Furthermore, Alvarez-Jimenez *et al.* reported weight loss of 4.1 ± 4.0 kg (average ± standard deviation) in the intervention group (n=35) with behavioral intervention for 3 months, however there was weight gain of 6.9 ± 4.5 kg in the non-intervention group (n=27) in the schizophrenia patients (Alvarez-Jiménez et al., 2006). Therefore, our results, and those of previous studies, show that patients with schizophrenia are likely to gain weight if they are not provided with intervention or guidance about weight management.

There were no significant differences in TCI scores between the two groups. However, we found a marginally significant negative correlation between the score of "self-directedness" and weight gain in the non-intervention group. High self-directedness indicates a high sense of responsibility, the ability to set targets and select actions toward a goal, and the ability to motivate oneself, while low self-directedness indicates a low sense of responsibility, low self-esteem, and the inability to take action toward a goal and to inspire oneself (Kijima et al., 2000), and is evident when psychiatric symptoms in patients with schizophrenia worsen (Eklund et al., 2004). It is thus logical that participants in the non-intervention group with low self-directedness would gain weight.

There was also no correlation between the rate of weight gain and TCI scores for the intervention group. We have previously found a significant negative correlation between "harm avoidance" and weight gain in 14 patients with schizophrenia, and have suggested that this is due to the inhibited and cautious characteristics of people with high harm avoidance (Matsuo et

al., 2007). However, we did not find any significant correlation between harm avoidance and weight change in this study. This may be because of differences in interview methods. In the previous study, we conducted our interviews through a harm avoidance perspective, informing participants of health damage associated with obesity. In this study, our interviews centered on praising patients when they took initiatives on managing their weight. We also observed behavioral changes and focused on the cognition and emotion in the interview. It is suggested that weight management could be improved by using Sakata's Charting of Daily Weight Pattern.

Although further research is necessary, we suggest it may be possible to manage weight in patients with schizophrenia.

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Contributors

Study concept and design: Ryoei Miyoshi, Hisae Matsuo, Keiko Nagatomo, and Yasushi Ishida. Clinical study: Ryoei Miyoshi, Kazuhiko Ozono, Ryuji Araki, Michiko Ishikawa, and Hiroshi Taniguchi. Analysis and interpretation of data: Ryoei Miyoshi and Hisae Matsuo. Drafting of the manuscript: Ryoei Miyoshi and Hisae Matsuo. Statistical analysis: Ryoei Miyoshi, Hisae Matsuo, and Hiroshi Abe. Study supervision: Yasushi Ishida. All authors contributed to and have approved the final manuscript.

Conflict of interest

None.

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Figure legends

Figure 1. Records on Sakata's Charting of Daily Weight Pattern (after 9-10 weeks) by a 35-year-old outpatient prescribed with an atypical antipsychotic in the intervention group.
He began to record events, meal contents, snacks, and exercise voluntarily.

Figure 2. Comparisons of participants' body mass indexes (BMIs) at Week 0 and Week 16.
The BMI of the intervention group decreased by 0.59 ± 0.10 kg/m$^2$ (mean ± standard deviation) but that of the non-intervention group increased by 0.66 ± 0.18 kg/m$^2$.

Figure 3. Changes in scores on Sakata's Eating Behavior Questionnaire in the intervention group (above) and the non- intervention group (bottom).

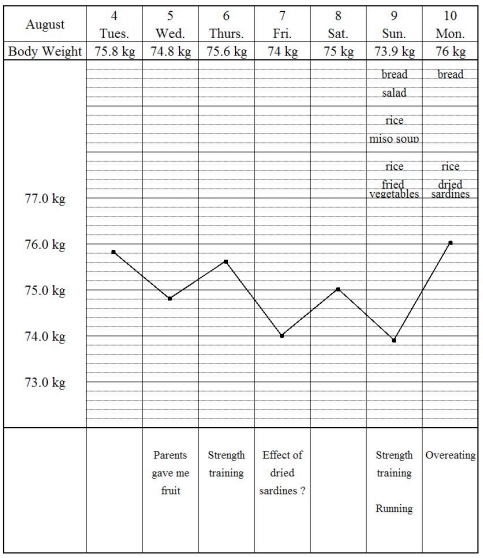


Figure 1

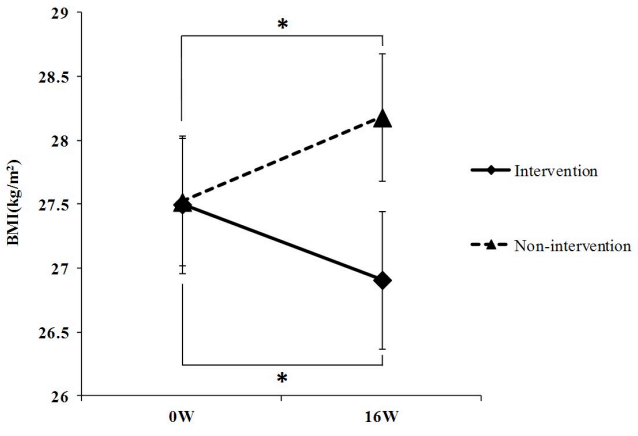


Figure 2

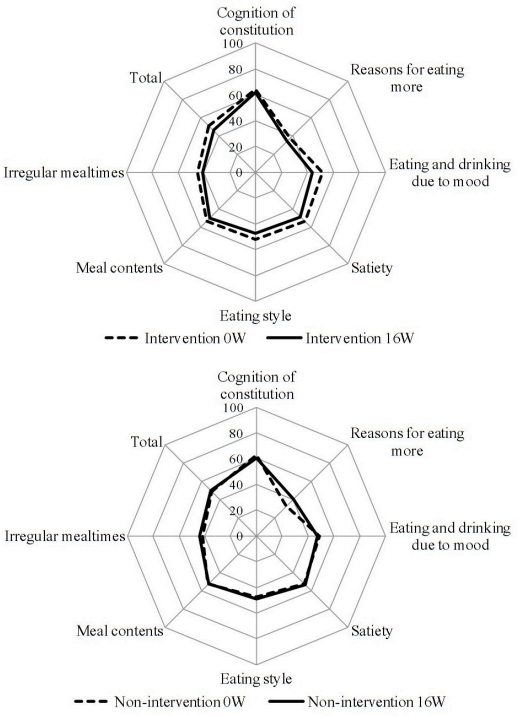


Figure 3

Table 1. Summary of the intervention group and the non- intervention group

| | Group | |
|---|---|---|
| | Intervention | Non-intervention |
| | N, mean | N, mean |
| Total, N | 25 | 25 |
| Gender, n | | |
| Male | 16 | 14 |
| Female | 9 | 11 |
| Out-patient, n | | |
| Male | 10 | 8 |
| Female | 6 | 8 |
| In-patient, n | | |
| Male | 6 | 6 |
| Female | 3 | 3 |
| Age, years (mean±S.E.M) | 53.2 ± 1.9 | 53.6 ± 2.3 |
| Disease duration, years (mean±S.E.M | 28.7 ± 2.0 | 25.7 ± 2.8 |
| WAIS-R (mean±S.E.M) | 77.8 ± 3.1 | 74.3 ± 3.1 |
| Chlorpromazine equivalent doses, mg/day (mean±S.E.M) | 572.6 ± 73.9 | 621.5 ± 110.5 |
| Weight, kg (mean±S.E.M) | 71.7 ± 1.9 | 70.8 ± 2.1 |
| BMI, $kg/m^2$ (mean±S.E.M) | 27.5 ± 0.6 | 27.5 ± 0.5 |

Table 2. Correlation between rate of weight change and the Temperament and Characteristic Inventory (TCI)

| TCI | Intervention group | | Non-intervention group | |
|---|---|---|---|---|
| | correlation coefficient (r) | probability | correlation coefficient (r) | probability |
| Novelty-Seeking | 0.188 | 0.184 | -0.032 | 0.443 |
| Harm Avoidance | -0.143 | 0.248 | -0.083 | 0.354 |
| Reward | 0.152 | 0.235 | -0.08 | 0.358 |
| Persistence | 0.243 | 0.121 | 0.093 | 0.337 |
| Self-Directedness | 0.021 | 0.461 | -0.33 | 0.062 † |
| Cooperativeness | -0.081 | 0.35 | 0.126 | 0.284 |
| Self-Transcendence | 0.076 | 0.359 | 0.076 | 0.365 |

Regression analysis on the rate of weight change and the seven dimensions of TCI (intervention group: n = 25, non- intervention group: n = 23, † $p < 0.1$)