

Association Between the Number of Remaining Teeth and Body Mass Index in Japanese Inpatients with Schizophrenia

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Purpose: There is little evidence regarding the effects of dental status on body mass index (BMI) in inpatients with schizophrenia. Thus, we performed a cross-sectional study to explore the associations between the number of remaining teeth and BMI in Japanese inpatients with schizophrenia.

Patients and Methods: We performed multiple regression analysis to assess the effects of potential predictors (age, sex, number of remaining teeth, number of antipsychotics prescribed, chlorpromazine equivalent dose, and antipsychotic type) on BMI in 212 inpatients with schizophrenia. We then compared the number of remaining teeth between inpatients with schizophrenia and the Japanese general population (3283 individuals) from the Japan Dental Diseases Survey 2016, using an analysis of covariance with age and sex as covariates.

Results: Multiple regression analysis showed that the number of remaining teeth and the number of antipsychotics prescribed were significantly correlated with BMI (standardized regression coefficient = 0.201 and 0.235, respectively). In the analysis of covariance, inpatients with schizophrenia had significantly fewer remaining teeth compared with the Japanese general population (mean 14.8 [standard deviation: 10.9] vs mean 23.0 [standard deviation: 8.1]).

Conclusion: These results suggested that tooth loss and antipsychotic polypharmacy affect BMI in inpatients with schizophrenia, and that inpatients with schizophrenia lose more teeth compared with the general population.

Keywords: antipsychotic polypharmacy, body mass index, oral health, tooth loss

Introduction

There is cumulative evidence for an increased mortality rate in patients with schizophrenia.^{1,2} Life expectancy among patients with schizophrenia is 10–20 years shorter than that in the general population.³ Longitudinal studies suggest that the mortality gap between patients with schizophrenia and the general population has widened over time.⁴ Overweight/obesity and underweight are reported to be associated with increased mortality in European populations,⁵ whereas underweight is more strongly associated with the risk of mortality than overweight/obesity in East Asian populations, including Chinese, Japanese, and Korean populations.⁶ Therefore, it is important to investigate factors associated with body mass index (BMI) in patients with schizophrenia.

Previous studies have reported that the number of remaining teeth is associated with BMI in East Asian populations, including Taiwanese,⁷ Korean,⁸ and Japanese populations.⁹ Oral health is reported to be poor in patients with schizophrenia.¹ A meta-analysis revealed that patients with schizophrenia have more dental caries, missing teeth, and decayed teeth, but have fewer filled teeth compared with the general population.¹⁰ Taken together, these findings suggest that dental status may affect BMI in patients with schizophrenia. However, few studies have assessed the effects of dental status on BMI in patients with schizophrenia, producing conflicting results. The Decayed-Missing-Filled Teeth score was

associated with BMI in 878 Taiwanese inpatients with schizophrenia,¹¹ but not in 425 Chinese inpatients with schizophrenia.¹²

Here, we performed a cross-sectional study to examine the effects of the number of remaining teeth and relevant variables (eg, age, sex, and the number of antipsychotics prescribed)¹³ on BMI in Japanese inpatients with schizophrenia. Our recent study has shown that age, sex, type of care (outpatient/inpatient), the number of antipsychotics prescribed, aripiprazole, and olanzapine were correlated with BMI in 19,675 patients with schizophrenia.¹³ Among these variables, being an outpatient was the most strongly correlated with BMI. To control the effects of type of care, we included inpatients with schizophrenia in the current study. Moreover, we compared the number of remaining teeth between inpatients with schizophrenia and the Japanese general population. The current findings provide provisional evidence that poor oral health adversely affects nutritional status in inpatients with schizophrenia, which could be useful for informing the development of oral health care and nutritional programs.

Materials and Methods

Ethics Statement

This study was approved by the Ethics Committee of Niigata University and was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

Participants

We recruited patients with schizophrenia aged 20 years and older who were admitted for more than 1 year from six psychiatric hospitals in Niigata Prefecture. We excluded patients who were considered to be unable to give adequate informed consent by their physician. Of all remaining eligible candidates, we included patients from whom one of the authors (M Otake, SO, KK, KM, HK, or M Ootake) obtained adequate written informed consent.

Shirone Midorigaoka Hospital, Suehirohashi Hospital, Minamihama Hospital, and Kohdo Hospital are in Niigata City, the prefectural capital of Niigata. Niigata Psychiatric Center is in Nagaoka City, the second largest city in Niigata Prefecture. Kurokawa Hospital is in Tainai City located in a rural area in Niigata Prefecture.

All patients were diagnosed in accordance with the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition criteria for schizophrenia.

Measurements

We measured height, weight, and the number of remaining teeth. The number of remaining teeth was measured by psychiatrists or nurses. BMI was calculated as weight in kilograms divided by the square of the height in meters. We obtained information about prescribed antipsychotics and calculated chlorpromazine equivalent doses using conversion formulas.¹⁴

We obtained data on age, sex, and the number of remaining teeth in the Japanese general population from the Japan Dental Diseases Survey 2016 conducted by the Ministry of Health, Labour and Welfare (ghdx.healthdata.org/record/japan-dental-diseases-survey-2016).

Statistical Analysis

We performed correlation analysis between variables (age, sex, number of remaining teeth, number of antipsychotics prescribed, chlorpromazine equivalent dose, and BMI). In the correlation analysis, the level of significance was set at $p < 0.003$ according to the Bonferroni correction for 15 statistical tests. Controlling for potentially confounding variables, we performed multiple regression analysis to assess the effects of potential predictors (age, sex, number of remaining teeth, number of antipsychotics prescribed, chlorpromazine equivalent dose, and antipsychotic type [ie, aripiprazole, olanzapine, and risperidone]) on BMI.

We compared the number of remaining teeth between inpatients with schizophrenia and the Japanese general population using an analysis of covariance with age and sex as covariates.

We conducted statistical analyses using the Statistical Package for the Social Sciences (SPSS) version 25 (IBM Japan, Tokyo, Japan).

Results

The study participants comprised 212 inpatients with schizophrenia (117 men and 95 women) aged 22–90 (mean 62.3 [standard deviation; SD: 13.6]) years (Table 1). The correlation analysis revealed that age was significantly negatively correlated with the number of remaining teeth, chlorpromazine equivalent dose, and BMI ($r = -0.627$, -0.292 , and -0.211 , $p < 0.001$, < 0.001 , and $= 0.002$, respectively; Table 2). There were also significant correlations between the number of remaining teeth and BMI ($r = 0.261$, $p < 0.001$), and between the number of antipsychotics prescribed and chlorpromazine equivalent dose ($r = 0.627$, $p < 0.001$; Table 2). The multiple regression analysis revealed that the number of remaining teeth and the number of antipsychotics prescribed were significantly correlated with BMI (standardized regression coefficient = 0.201 and 0.235, $p = 0.020$ and 0.009, respectively; Table 3). In the regression model, the adjusted R^2 and residual sum of squares values were 0.071 and 2064, respectively.

We obtained data on age, sex, and the number of remaining teeth of the Japanese general population (1396 men and 1887 women) aged 22–90 (mean 59.9 [SD: 16.2]) years from the Japan Dental Diseases Survey 2016. Table 4 shows the number of remaining teeth in inpatients with schizophrenia and the Japanese general population stratified by age and sex. In the analysis of covariance with age and sex as covariates, the number of remaining teeth was significantly lower in inpatients with schizophrenia compared with the Japanese general population (mean 14.8 [SD: 10.9] vs mean 23.0 [SD: 8.1], $p < 0.001$).

Discussion

We found associations between the number of remaining teeth and the number of antipsychotics prescribed and BMI in 212 inpatients with schizophrenia. Previous studies compared the Decayed-Missing-Filled Teeth score among BMI groups in inpatients with schizophrenia. This score significantly differed in 878 Taiwanese inpatients with schizophrenia,¹¹ but not in 425 Chinese inpatients with schizophrenia.¹² Although the Decayed-Missing-Filled

Table 1 Characteristics of Inpatients with Schizophrenia

Characteristics	Patients
Age (years)	62.3 ± 13.6 ^a
Sex (men/women)	117/95
Number of remaining teeth	14.8 ± 10.9 ^a
Number of antipsychotics	
0	1 (0.5%)
1	96 (45.3%)
2	79 (37.3%)
3	23 (10.8%)
4	11 (5.2%)
5	1 (0.5%)
Chlorpromazine equivalent dose (mg/day)	874.7 ± 594.1 ^a
Type of antipsychotics	
Aripiprazole	24 (11.3%)
Olanzapine	63 (29.7%)
Risperidone	69 (32.5%)
Body mass index (kg/m ²)	21.3 ± 3.3 ^a

Note: ^aData are expressed as mean ± standard deviation.

Table 2 Correlation Coefficients and p values Between Variables in Inpatients with Schizophrenia

Variable	1	2	3	4	5	6
1. Age	–	0.073	–0.627	–0.168	–0.292	–0.211
2. Sex	0.289	–	–0.035	–0.083	–0.102	0.024
3. Number of remaining teeth	< 0.001	0.614	–	0.097	0.156	0.261
4. Number of antipsychotics	0.014	0.229	0.158	–	0.627	0.157
5. Chlorpromazine equivalent dose	< 0.001	0.138	0.023	< 0.001	–	0.057
6. Body mass index	0.002	0.728	< 0.001	0.023	0.408	–

Notes: Correlation coefficients and p values were provided above and below the diagonal line, respectively. The level of significance was set at $p < 0.003$ according to the Bonferroni correction for 15 statistical tests.

Table 3 Multiple Regression Analysis of the Effects of the Independent Variables on Body Mass Index

Independent Variables	SRC	P
Age	–0.079	0.372
Sex ^a	0.039	0.558
Number of remaining teeth	0.201	0.020
Number of antipsychotics	0.235	0.009
Chlorpromazine equivalent dose	–0.117	0.196
Aripiprazole ^b	–0.028	0.690
Olanzapine ^b	–0.021	0.765
Risperidone ^b	–0.099	0.171

Notes: ^aReference was male. ^bReference was not taking the antipsychotic.

Abbreviation: SRC, standardized regression coefficient.

Table 4 Number of Remaining Teeth in Inpatients with Schizophrenia and the Japanese General Population Stratified by Age and Sex

Age	Patients		General Population	
	Men	Women	Men	Women
22–29	26.0 ± 2.6 (n = 3)	30.5 ± 2.1 (n = 2)	29.2 ± 1.9 (n = 60)	28.6 ± 1.7 (n = 75)
30–39	28.4 ± 2.7 (n = 5)	25.7 ± 3.2 (n = 3)	28.8 ± 1.5 (n = 110)	28.5 ± 1.7 (n = 219)
40–49	24.1 ± 6.5 (n = 15)	25.6 ± 6.8 (n = 10)	27.8 ± 3.1 (n = 174)	27.8 ± 1.9 (n = 282)
50–59	19.6 ± 8.0 (n = 30)	20.8 ± 8.9 (n = 21)	25.1 ± 5.4 (n = 181)	26.3 ± 3.3 (n = 294)
60–69	10.4 ± 10.0 (n = 23)	11.9 ± 9.1 (n = 20)	22.3 ± 7.6 (n = 383)	22.7 ± 6.6 (n = 471)
70–79	9.7 ± 9.8 (n = 34)	8.4 ± 8.8 (n = 30)	18.6 ± 9.3 (n = 339)	19.3 ± 8.9 (n = 360)
80–90	4.4 ± 9.6 (n = 7)	4.9 ± 8.1 (n = 9)	14.3 ± 10.5 (n = 149)	13.7 ± 10.2 (n = 186)

Note: Data are expressed as mean ± standard deviation.

Teeth score is a standard index for assessing dental status, it is difficult for psychiatrists and nurses to measure this score in real-world practice. Therefore, we used the number of remaining teeth as a measure in this study. We classified inpatients with schizophrenia into three groups: underweight (BMI < 18.5 kg/m²; 17.0%), standard weight (BMI ≥ 18.5 to < 25 kg/m²; 69.8%), and overweight/obesity (BMI ≥ 25 kg/m²; 13.2%), which revealed significant differences in the number of remaining teeth among the three groups (mean 11.3 [SD: 9.6], mean 14.5 [SD: 11.0], and mean 19.7 [SD: 10.6], respectively). The prevalence of underweight was higher among our Japanese inpatients with schizophrenia (17.0%) compared with the prevalence reported in previous studies of Taiwanese (4.3%)¹¹ and Chinese (6.6%) samples.¹² Previous large-scale studies reported that the prevalence rates of underweight were 20.2% and 17.4% in 15,171 and 14,237 Japanese inpatients with schizophrenia, respectively.^{15,16} Additionally, a meta-analysis indicated an odds ratio of 4.4 for underweight in Japanese inpatients with schizophrenia.¹⁷ Tooth loss is a potential risk factor for the high prevalence of underweight in Japanese inpatients with schizophrenia. To clarify this issue, however, further studies should be performed in various ethnic populations.

The mechanism by which the number of remaining teeth affects BMI is unclear. However, one possibility is that tooth loss causes masticatory dysfunction, resulting in lower BMI. Notably, one study reported that the number of teeth was associated with masticatory performance in 1288 Japanese individuals aged 60–84 years.¹⁸ Moreover, masticatory performance was correlated with BMI in 365 Japanese individuals aged 20–70 years.¹⁹ Although we did not evaluate masticatory performance in the current study, we plan to investigate the effects of masticatory performance on BMI in inpatients with schizophrenia.

The current results replicated the finding in our previous study, which revealed an association between the number of antipsychotics prescribed and BMI in 19,675 patients with schizophrenia.¹³ In the current study, 115 of 212 (54.2%) inpatients with schizophrenia received antipsychotic polypharmacy. Notably, 35 (16.5%) inpatients were treated with three or more antipsychotics. In our previous study, 52.3% and 19.5% of 14,234 Japanese inpatients with schizophrenia received antipsychotic polypharmacy and three or more antipsychotics, respectively.¹³ Moreover, another recent study reported that 42.9% and 24.1% of 2177 Japanese inpatients with schizophrenia received antipsychotic polypharmacy and three or more antipsychotics, respectively, at discharge.²⁰ To minimize adverse effects of antipsychotics on BMI, psychiatrists should avoid inappropriate antipsychotic polypharmacy, especially polypharmacy involving three or more antipsychotics.

In the current study, the number of remaining teeth was lower in inpatients with schizophrenia compared with the Japanese general population. The current findings are in line with those of previous studies reporting that patients with schizophrenia have more missing teeth than the general population.¹⁰ Notably, a meta-analysis reported that tooth loss is associated with increased risk of mortality in the general population.²¹ These findings suggest that tooth loss may contribute to an increased mortality rate in patients with schizophrenia. Poor oral health is a critical issue for patients with schizophrenia. Psychiatrists should be aware of this issue and help patients with schizophrenia to access dental care to improve their oral health.¹

A major strength of the current study is that we included inpatients with schizophrenia, and thus were able to control for diet, current smoking status (ie, non-smoker), and adherence to prescribed antipsychotics. However, our study involved several limitations. First, the nature of a cross-sectional design did not allow us to determine causal relationships. Second, data regarding previous smoking status were not available. Third, participants were recruited from six psychiatric hospitals in Niigata Prefecture, Japan. The study population may not be representative of inpatients with schizophrenia in Japan. Fourth, we did not assess symptom severity of patients with schizophrenia. We cannot exclude the possibility that our results were influenced by symptom severity affecting the quality of oral health care. Fifth, the independent variables explained only a small amount of the variance in the multiple regression analysis. Therefore, our results should be interpreted with caution. Further studies should be performed to investigate other factors associated with BMI.

Conclusion

Our results suggest that tooth loss and antipsychotic polypharmacy affect BMI in inpatients with schizophrenia and that inpatients with schizophrenia lose more teeth compared with the general population.

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