ORIGINAL ARTICLE

Comparison of Body Composition and Lifestyle of Patients with Schizophrenia and Healthy Controls: A Cross-Sectional Study

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ABSTRACT

Objective: **The objective of the present study was to clarify characteristics of body composition and lifestyle of patients with schizophrenia through comparison with a healthy control population.**

Methods: **The body composition and lifestyle of inpatients with schizophrenia at a psychiatric hospital and the healthy controls by matching the age and gender were compared. The body composition and Health-Promoting Lifestyle Profile □(HPLP□) of the male and female groups using the t-test or Mann-Whitney U-test was also compared.**

Results: **In the comparison of body composition and HPLP II of patients with schizophrenia and the healthy controls, a significant difference was confirmed in the fat-free mass index (p = 0.005), visceral fat rating (*p* = 0.038), body mass index (*p* = 0.020), trunk fat-free mass (p = 0.015), and trunk muscle mass (*p* = 0.012) for men. A significant difference in waist circumference (p = 0.041) and HPLP□ nutrition score (p = 0.018) was observed in women.**

Conclusions: **Male inpatients with schizophrenia experienced a decrease in the trunk muscle mass while female inpatients with schizophrenia experienced an increase in the waist circumference. The nutrition in their lifestyle can have an impact on their body composition.**

KEY WORDS

schizophrenia, inpatient, body composition, lifestyle

INTRODUCTION

The mortality of patients with schizophrenia is higher than that of the general public, and the average life expectancy is approximately 20% shorter[1,2]. The main causes of death in patients with schizophrenia are suicide, cancer, vascular diseases, and respiratory diseases[3]. Recently, the average age at death of patients with schizophrenia has increased in a similar way to that of the general public, where suicide is decreasing but cancer and vascular diseases are increasing[4]. The main risk factors for cancer and vascular diseases include obesity and metabolic syndrome. Patients with schizophrenia tend to have irregular lifestyle habits (smoking, inadequate physical activities, and unbalanced diet) and experience side effects of antipsychotics (hyperlipidemia and dyslipidemia), which are closely related to obesity and metabolic syndrome[5].

In previous studies, it has been reported that patients with schizophrenia tend to experience other mental illnesses and obesity compared with the healthy controls with lower fat-free mass and muscle mass[6-8]. Furthermore, among patients with schizophrenia, outpatients have a higher prevalence of obesity and metabolic syndrome compared with inpatients[9]. In contrast, the percentage of those who are underweight among patients with schizophrenia in Japan is similar to that of patients with obesity, which is higher than that of the general public and outpatients of schizophrenia[10,11]. A recent meta-analysis has reported that the percentage of patients who are underweight is higher than that in other countries[12]. Mortality is higher for patients who are obese and underweight compared with patients of average weight[13], where being underweight is associated with mortality from respiratory diseases other than cancer and vascular diseases[14]. Additionally, low skeletal muscle mass is associated with mortality[15,16]; therefore, patients with schizophrenia may experience problems with obesity, underweight, and low muscle mass. Despite these risks, patients with mental illnesses tend to not be interested in activities that pose a high risk for their physical health[17]. Going forward, support is needed for people with schizophrenia to acquire the capacity to manage their health in order to maintain and promote health in their community.

Therefore, the present study aimed to clarify the body composition and lifestyle characteristics of patients with schizophrenia through a comparison with healthy controls. Results of the present study will aid in effective intervention so that patients with schizophrenia acquire the ability to manage their health.

MATERIALS AND METHODS

Participants

The target of the present study was inpatients with schizophrenia of a psychiatric hospital; consent for participation was obtained from the patients and permission to participate was obtained from the attending physician. In addition, we recruited staff of the psychiatric hospital as healthy controls. Furthermore, the age and gender of patients in the schizophrenia group and the healthy control group were matched.

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Table 1: Comparison of body composition and HPLP II for male patients with schizophrenia and the healthy controls.

	Male								
	Patients with schizophrenia (n = 13)				Healthy controls (n = 13)				P value
	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	
Age (year)	49.2	9.7	22.0	58.0	49.5	10.1	22.0	59.0	0.797 [b]
Height (cm)	170.6	6.1	163.3	183.6	169.0	7.5	153.3	180.6	0.548 [a]
Weight (kg)	63.5	12.4	48.8	96.0	72.4	14.8	49.1	111.5	0.110 [a]
WC (cm)	82.9	7.3	71.7	96.5	89.2	10.6	68.4	113.5	0.065 [b]
FM (kg)	12.6	6.6	2.0	24.3	17.6	9.6	4.0	44.4	0.138 [a]
FMI (kg/m^2)	4.3	2.2	0.7	7.6	6.1	3.2	1.5	15.2	0.158 [b]
FMM (kg)	50.9	7.9	43.5	71.7	54.8	6.0	45.1	67.1	0.165 [a]
FFMI (kg/m^2)	**17.4**	**1.9**	**15.4**	**22.5**	**19.2**	**1.7**	**16.2**	**23.0**	**0.005 [b]**
MM (kg)	48.3	7.5	41.2	68.0	52.0	5.7	42.7	63.6	0.077 [b]
VFR	**8.5**	**4.0**	**3.0**	**16.0**	**12.0**	**4.1**	**4.0**	**21.0**	**0.038 [a]**
BMI (kg/m2)	**21.7**	**3.3**	**17.8**	**30.1**	**25.3**	**4.6**	**18.7**	**38.1**	**0.020 [b]**
Limb fat mass (kg)	5.1	2.6	1.3	11.5	7.1	3.2	2.3	16.0	0.051 [b]
Trunk fat mass (kg)	7.5	4.3	0.7	14.2	10.5	6.5	1.7	28.4	0.281 [b]
Limb fat-free mass (kg)	24.3	5.0	19.4	36.7	26.0	3.5	19.6	31.2	0.151 [b]
Trunk fat-free mass (kg)	**26.6**	**3.0**	**24.0**	**35.0**	**28.9**	**2.8**	**24.0**	**36.0**	**0.015 [b]**
SMM (kg)	22.9	4.8	18.2	34.7	24.4	3.2	18.4	29.3	0.347 [a]
Trunk muscle mass (kg)	**25.4**	**2.9**	**22.7**	**33.3**	**27.6**	**2.7**	**22.8**	**34.3**	**0.012 [b]**
SMI (kg/m^2)	7.8	1.2	6.5	10.9	8.5	0.8	7.2	10.0	0.085 [a]
Total HPLP	124.8	17.6	95.0	151.0	125.2	17.8	101.0	151.0	0.947 [a]
Health responsibility	20.7	4.8	13.0	28.0	20.4	5.0	15.0	29.0	0.874 [a]
Spiritual growth	24.1	4.5	17.0	32.0	22.7	2.8	18.0	29.0	0.356 [a]
Physical activity	13.8	4.0	8.0	20.0	16.5	5.5	8.0	27.0	0.167 [a]
Interpersonal relations	22.1	4.4	14.0	30.0	23.6	3.6	17.0	28.0	0.335 [a]
Nutrition	23.5	3.5	17.0	29.0	22.2	3.8	17.0	28.0	0.367 [a]
Stress management	20.6	3.3	13.0	25.0	19.8	4.9	9.0	28.0	0.645 [a]

a) Unpaired t-test.

b) Mann-Whitney U-test

Measurement

Clinical characteristics

As clinical characteristics of patients with schizophrenia, information was collected on age (years), gender, duration of hospitalization (days).

Body composition

Body composition was measured using multi-frequency body composition monitor (MC-780A-N, TANITA, Tokyo, Japan). Measured items were body weight, fat mass (FM), fat mass index (FMI), fat-free mass (FFM), fat-free mass index (FFMI), muscle mass (MM), visceral fat rating (VFR), body mass index (BMI), limb fat mass, trunk fat mass, limb fat-free mass, trunk fat-free mass, skeletal muscle mass (SMM), trunk muscle mass, and skeletal muscle index (SMI). VFR ranged from 1 (the lowest) to 59 (the highest). Researchers had participants in a standing position to measure the waist circumference (WC) down to 0.1 cm at the navel.

Health-Promoting Lifestyle Profile □ (HPLP □)

Health-promoting behavior was measured using the Japanese version of Health-Promoting Lifestyle Profile □ (JLV-HPLP □)[18]. JLV-HPLP □ measures health-promoting behavior related to a healthy lifestyle. This scale consists of 52 questions in six areas: health responsibility, spiritual growth, physical activity, interpersonal relationships, nutrition, and stress management. Participants use a four-point scale, ranging from "not at all" to "always," to answer the questions.

Statistical analysis

The clinical characteristics of patients with schizophrenia, age, gender, hospitalization duration were tabulated. In addition, the normality of age, height, gender, weight, body composition, total HPLP □ score, and each area was tested. For male and female participants in the schizophrenia patient group and the healthy control group, body composition and HPLP II between the groups were examined using the t-test or Mann-Whitney U-test. For all tests, the P-value was two-sided where $p < 0.05$ was considered statistically significant. We used IBM Statistical Package for the Social Sciences (SPSS v.27.0 J for Windows) for all statistical analyses.

RESULTS

There were 26 participants in the schizophrenia patient group and 26 participants in the healthy control group (13 men and 13 women each). The mean length of hospital stay for schizophrenia patients was 1147.9 ± 996.6 days for males and 1734.5 ± 1757.2 days for females. Comparison of body composition and HPLP II of male patients with schizophrenia and the healthy controls confirmed a significant difference in FFMI ($p = 0.005$), VFR ($p = 0.038$), BMI ($p = 0.020$), trunk fat-free mass ($p = 0.015$), and trunk MM ($p = 0.012$) (Table 1). Furthermore, a comparison of body composition and HPLP II of female patients with schizophrenia and the healthy controls confirmed a significant difference in WC ($p = 0.041$) and HPLP □ nutrition ($p = 0.018$) (Table 2).

DISCUSSION

The present study clarified the body composition and lifestyle char-

Table 2: Comparison of body composition and HPLP II between female patients with schizophrenia and the healthy controls.

	Female								
	Patients with schizophrenia (n = 13)				Healthy controls (n = 13)				P value
	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	
Age (years)	49.6	11.5	26.0	64.0	49.8	11.7	26.0	65.0	0.960 a)
Height (cm)	155.0	5.3	145.0	164.5	156.9	4.7	148.3	163.0	0.347 a)
Weight (kg)	56.1	7.7	48.2	75.0	54.9	6.7	45.1	64.9	0.858 b)
WC (cm)	**85.9**	**10.6**	**70.3**	**106.2**	**77.9**	**8.1**	**61.4**	**86.2**	**0.041 a)**
FM (kg)	18.6	7.0	9.1	36.6	16.9	6.0	6.1	24.6	0.515 a)
FMI (kg/m2)	7.8	3.1	3.8	15.7	6.9	2.5	2.8	11.2	0.415 a)
FMM (kg)	37.6	3.7	30.0	41.6	38.0	2.5	33.5	42.6	0.817 b)
FFMI (kg/m2)	15.6	1.4	13.7	17.8	15.5	1.1	14.3	18.1	0.745 a)
MM (kg)	35.4	3.4	28.5	39.1	35.8	2.3	31.7	40.0	0.817 b)
VFR	5.8	3.2	1.0	14.0	5.2	2.5	1.0	9.0	0.594 a)
BMI (kg/m2)	23.4	3.4	19.6	32.1	22.3	2.9	17.8	28.2	0.387 a)
Limb fat mass (kg)	8.6	2.5	5.9	14.5	8.2	2.2	4.3	11.1	0.685 a)
Trunk fat mass (kg)	10.0	4.8	3.2	22.1	8.7	3.8	1.8	13.5	0.447 a)
Limb fat-free mass (kg)	17.2	2.5	11.6	20.2	17.8	1.7	14.9	20.8	0.500 a)
Trunk fat-free mass (kg)	20.4	1.3	17.7	22.4	20.2	1.0	18.6	21.9	0.792 a)
SMM (kg)	16.2	2.3	11.0	18.6	16.7	1.5	14.1	19.6	0.918 b)
Trunk muscle mass (kg)	19.2	1.1	17.0	21.0	19.1	0.9	17.6	20.5	0.832 a)
SMI (kg/m2)	6.7	0.9	5.2	7.9	6.8	0.7	6.1	8.5	0.980 b)
Total HPLP	133.5	29.6	58.0	173.0	129.4	14.7	110.0	155.0	0.655 a)
Health responsibility	21.5	5.6	10.0	28.0	21.9	3.1	19.0	29.0	0.679 b)
Spiritual growth	24.5	6.5	9.0	31.0	22.2	3.6	15.0	27.0	0.257 a)
Physical activity	14.9	5.2	8.0	27.0	14.2	4.5	9.0	22.0	0.691 a)
Interpersonal relations	22.8	6.7	11.0	34.0	26.4	2.8	22.0	31.0	0.092 a)
Nutrition	**27.7**	**9.5**	**11.0**	**54.0**	**22.9**	**3.4**	**19.0**	**30.0**	**0.018 b)**
Stress management	22.2	5.1	9.0	30.0	21.8	4.3	15.0	29.0	0.870 a)

a) Unpaired t-test.

b) Mann-Whitney U-test

acteristics of schizophrenia inpatients through a comparison with healthy controls. The BMI consists of FMI and FFMI. For male inpatients with schizophrenia in the present study, FFMI was significantly lower than that in the healthy controls, where the main parts were FFM and MM of the trunk. In another previous study[19], only men in the range of normal body weight were compared. The result showed that patients with schizophrenia had a significantly lower FFM compared with the healthy controls. FFM is the total mass of muscle, bone, and organs excluding the fat, which is dominated by MM; therefore, male inpatients with schizophrenia might have a notable decrease in trunk muscle mass. In the present study, the age and gender of participants were matched, but comparison was not made based on BMI distribution. In the future, considering the age, gender, and BMI of participants, examination of the cause of MM loss and an intervention method to increase MM for male inpatients with schizophrenia are needed.

On the other hand, Waist circumference can be an indicator of visceral fat accumulation, but there was no significant difference in VFR and FM of female patients with schizophrenia in the present study. Men tend to accumulate visceral fat while women tend to accumulate subcutaneous fat[20]. Female inpatients with schizophrenia in the present study might have accumulated more subcutaneous fat than visceral fat. The result of the previous study[19] that compared women in the normal weight range showed that patients with schizophrenia had significantly more visceral fat tissues compared with the healthy controls, and there was no significant difference in subcutaneous fat tissues. Asian women reportedly have more visceral fat than Caucasian women[21]. Therefore, waist circumference alone might not be adequate to evaluate the distribution of visceral fat and subcutaneous fat. An increase in visceral fat and subcutaneous fat can lead to heart and orthopedic diseases. In the future, in addition to measurements of BMI and body composition, it might be necessary to evaluate obesity type (visceral fat or subcutaneous fat) based on the waist-to-hip ratio, and subcutaneous fat tissues using computed tomography and ultrasound.

Furthermore, in terms of lifestyle, patients with mental illness tend to show less interest in physical health; therefore, patients with schizophrenia in the present study were assumed to show the same result. However, female patients with schizophrenia had significantly higher HPLP II nutrition scores compared with the healthy controls. Although the waist circumference of the female patients with schizophrenia in the present study was higher than that of the healthy controls, there were no significant differences in other items of body composition. This could be because more attention was paid to their physical health with the support of physicians, nurses, and nutritionists because these female patients with schizophrenia were in a hospital environment. An earlier report showed that the diet of patients with schizophrenia tends to be high in calories and saturated fat, which tends to increase the amount of visceral fat. Meanwhile, their intake of dietary fiber and fruits is low. As such, their diet is unhealthy[22]. Another study showed that male patients with schizophrenia had lower calories, protein, glucose, and dietary fiber compared with the healthy controls, whereas female patients with schizophrenia had a higher intake of saturated fatty acids[19]. Eating behavior was related to gender, where women have a stronger belief in healthy diets, such as food selection and weight management, compared with men[23,24]. Therefore, female patients with schizophrenia might have a stronger awareness of nutrition in lifestyle. As such, male inpatients with schizophrenia in the present study showed a decrease in trunk MM, whereas female inpatients showed an increase in waist circumference. The components and volume of food intake might be different, causing a difference in body composition. In the future, the intervention of dietary ingredients and nutrition should be examined considering the gender differences in inpatients with schizophrenia.

CONCLUSION

The present study clarified the body composition and lifestyle characteristics of schizophrenia inpatients through a comparison with healthy controls. Male patients with schizophrenia had significantly lower BMI, VFR, trunk FFM, and MM compared with the healthy con-

trols. Female patients with schizophrenia had significantly higher waist circumference and HPLP II compared with the healthy controls. The present result indicates a link between body composition, lifestyle, and nutrition. In the future, a dietary intervention that considers the gender differences in patients with schizophrenia should be examined.

ETHICAL STATEMENT

The objective of the present study was explained to all participants, and written consent was obtained at the beginning of the study (research ethics committee approval number: 21MH007).

INFORMED CONSENT

All participants of the study provided informed consent.

REFERENCES

1. Brown S, Inskip H, Barraclough B. Causes of the excess mortality of schizophrenia. Br J Psychiatry 2000; 177: 212-217.
2. Laursen TM, Nordentoft M, Mortensen PB. Excess Early Mortality in Schizophrenia. Annu Rev Clin Psychol 2014; 10: 425-48.
3. Bushe CJ, Taylor M, Haukka J. Mortality in schizophrenia: a measurable clinical endpoint. J Psychopharmacol. 2010; 24(4 Suppl): 17-25.
4. Tanskanen A, Tiihonen J, Taipale H. Mortality in schizophrenia: a 30-year nationwide follow-up study. Acta Psychiatr Scand. 2018; 138(6): 492-499.
5. Heald A, Pendlebury J, Anderson S, *et al*. Lifestyle factors and the metabolic syndrome in Schizophrenia: a cross-sectional study. Ann Gen Psychiatry. 2017; doi: 10.1186/s12991-017-0134-6.
6. Saarni SE, Saarni SI, Fogelholm M, Heliövaara M, Perälä J, *et al*. Body composition in psychotic disorders: a general population survey. Psychol Med. 2009; 39(5): 801-810.
7. Sugawara N, Yasui-Furukori N, Tsuchimine S, *et al*. Body composition in patients with schizophrenia: Comparison with healthy controls. Ann Gen Psychiatry. 2012; doi: 10.1186/1744-859X-11-11.
8. Loh SY, Yusof A, Bakar AKA. Visceral obesity in the normal-weight people-comparing chronic schizophrenia and healthy control subjects. Brain and Nerves 2017; 1(2): 1-6.
9. Sugawara N, Yasui-Furukori N, Sato Y, *et al*. Comparison of prevalence of metabolic syndrome in hospital and community-based Japanese patients with schizophrenia. Ann Gen Psychiatry. 2011; doi: 10.1186/1744-859X-10-21.
10. Inamura Y, Sagae T, Nakamachi K, Murayama N. Body mass index of inpatients with schizophrenia in Japan. Int J Psychiatry Med. 2012; 44(2): 171-81.
11. Sugai T, Suzuki Y, Yamazaki M, *et al*. High prevalence of underweight and undernutrition in Japanese inpatients with schizophrenia: a nationwide survey. BMJ Open 2015; 5(12): 1-8.
12. Sugawara N, Maruo K, Sugai T, *et al*. Prevalence of underweight in patients with schizophrenia: A meta-analysis. Schizophr Res. 2018; 195: 67-73.
13. Flegal KM, Graubard BI, Williamson DF, Gail MH. Excess Deaths Associated with Underweight, Overweight, and Obesity. JAMA. 2005; 293(15): 1861-1877.
14. Flegal KM, Graubard BI, Williamson DF, Gail MH. Cause-specific excess deaths associated with underweight, overweight, and obesity. JAMA 2007; 298(17): 2028-2037.
15. Chuang SY, Hsu YY, Chen RCY, Liu WL, Pan WH. Abdominal Obesity and Low Skeletal Muscle Mass Jointly Predict Total Mortality and Cardiovascular Mortality in an Elderly Asian Population. J Gerontol A Biol Sci Med Sci. 2016; 71(8): 1049-1055.
16. Abramowitz MK, Hall CB, Amodu A, *et al*. Muscle mass, BMI, and mortality among adults in the United States: A population-based cohort study. PLoS One 2018; doi: 10.1371/journal.pone.0194697.
17. Buhagiar K, Parsonage L, Osborn DP. Physical health behaviors and health locus of control in people with schizophrenia-spectrum disorder and bipolar disorder: a cross-sectional comparative study with people with non-psychotic mental illness. BMC Psychiatry 2011; doi: 10.1186/1471-244X-11-104.
18. Wei CN, Yonemitsu H, Harada K, *et al*. A Japanese Language Version of the Health-Promoting Lifestyle Profile. Japanese Journal of Hygiene. 2000; 54(4): 597-606 (in Japanese).
19. Konarzewska B, Stefańska E, Wendołowicz A, *et al*. Visceral obesity in normal-weight patients suffering from chronic schizophrenia. BMC Psychiatry. 2014; doi: 10.1186/1471-244X-14-35.
20. Karastergiou K, Smith SR, Greenberg AS, Fried SK. Sex differences in human adipose tissues – the biology of pear shape. Biol Sex Differ. 2012; 3(1): doi: 10.1186/2042-6410-3-13.
21. Lim U, Ernst T, Buchthal SD, *et al*. Asian women have greater abdominal and visceral adiposity than Caucasian women with similar body mass index. Nutr Diabetes. 2011; doi: 10.1038/nutd.2011.2.
22. Dipasquale S, Pariante CM, Dazzan P, *et al*. The dietary pattern of patients with schizophrenia: a systematic review. J Psychiatr Res. 2013; 47(2): 197-207.
23. Rolls BJ, Fedoroff CI, Guthrie JF: Gender differences in eating behavior and body weight regulation. Health Psychol. 1991; 10(2): 133-142.
24. Wardle J, Haase AM, Steptoe A, *et al*. Gender differences in food choice: the contribution of health beliefs and dieting. Ann Behav Med. 2004; 27(2): 107-116.