Body Mass Index Identified as an Independent Predictor of Psychiatric Readmission

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ABSTRACT

Background: Psychiatric hospital readmissions correlate with illness severity, drug selection, and compliance with treatment in the outpatient setting. The risk factors for psychiatric rehospitalization have been mainly assessed in databases lacking information regarding somatic comorbidity and anthropometric variables, such as body mass index (BMI), which are known to predict readmissions in nonpsychiatric settings.

Objective: To determine independent predictors of 1-year readmission occurring among unselected adults consecutively admitted for treatment of severe mental illness to an academic, freestanding psychiatric hospital in New York City from August 2010 through January 2011.

Method: After identifying univariate correlates of readmission, we used logistic regression with backward elimination to identify independent predictors of readmissions within 1 year after the index psychiatric hospitalization.

Results: Among 224 (23.7%) of 945 readmitted patients, psychiatric readmission was significantly associated with age ($P = .0029$), length of stay ($P = .036$), schizophrenia/schizoaffective disorder ($P < .0001$), dementia ($P = .027$), major depressive disorder ($P = .0006$), treatment with atypical antipsychotic drugs ($P = .0054$), electroconvulsive therapy ($P < .0001$), and BMI ($P = .0079$), but not with physical comorbidities and routine laboratory data. The independent predictors of readmission were higher BMI (median = 28.5 kg/m^2; odds ratio [OR] = 3.6; CI, 1.2–10.6), a diagnosis of schizophrenia/schizoaffective disorder (OR = 2.2; CI, 1.5–3.4), clozapine treatment (OR = 2.8; CI, 1.1–6.9), no electroconvulsive therapy (OR = 0.13; CI, 0.02–0.45), and shorter length of stay (median = 18 days; OR = 0.08; CI, 0.01–0.42).

Conclusions: Body mass index was identified, for the first time, as an independent predictor of psychiatric rehospitalization. Enhanced outpatient treatment programs for overweight and obese psychiatric patients might influence readmission rates and should be explored in prospective studies.

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The Hospital Readmissions Reduction Program (HRRP), established by the US Affordable Care Act, has been in effect since October 1, 2012 and penalizes hospitals whose readmission rates are higher than predicted by their case mix. The law stimulated intense research to understand contribution of illness severity, patient behaviors, socioeconomic status, post–acute care communication, and facilities/quality of care indicators to deteriorations requiring rehospitalizations. Financial penalties have been imposed on 2,189 (66.7%) of 3,282 hospitals included in the HRRP Data File, and the largest payment cuts have affected major teaching institutions and safety net hospitals.[1] However, general hospitals continue to face difficult challenges in finding effective solutions, in great part due to lack of solid evidence regarding reversible risk factors for readmissions. Available data have enabled the development of 26 unique risk prediction models for readmissions to general hospitals designed for clinical use or comparative purposes, but they perform poorly, because few include indicators of overall health and function.[2]

Psychiatric readmission rates depend on the time frame used for follow-up and range from 10% for 30-day readmissions to 86% over 7 years.[3] The nonmodifiable risk factors for readmissions identified in adults with severe mental illnesses include younger age[3–5]; male gender[3,4]; onset of illness at an early age[4]; multiple previous hospitalizations[4–6]; a diagnosis of schizophrenia, panic disorder, obsessive-compulsive disorder, or personality disorder[3,7]; and risk to others at the time of the index admission.[6] The potentially reversible correlates of readmissions to psychiatric hospitals include shorter length of stay,[3–5] modest changes from admission to discharge in scores on patient-reported symptoms,[8] lack of employment, homelessness and poverty,[3,9,10] substance use,[6–9] negative attitude toward treatment adherence,[10] absence of treatment with second-generation antipsychotics,[10] and nonassertive treatment in the community.[6]

Comorbid medical conditions contribute significantly to the risk of readmissions to general hospitals,[11–14] and the role of obesity as a predictor of medical rehospitalization has also been highlighted.[15,16] Psychiatric patients have, on average, at least 2 comorbid somatic disorders, which may lead to biological frailty and influence the outcome of psychiatric hospitalizations.[17] A majority of patients with severe mental illness are also overweight or obese,[18] and weight gain is a common adverse effect of treatment with psychotropic drugs, particularly certain second-generation antipsychotics and mood stabilizers. Weight gain correlates with poor food choices, unhealthy lifestyle, and low self-esteem and is known to contribute to poor compliance with pharmacologic interventions in outpatient settings.[19,20] However, neither somatic disorders nor anthropometric features, such as body mass index (BMI), have been evaluated for their possible influence on readmission rates.

We evaluated a consecutive cohort of adults admitted to a psychiatric teaching hospital to determine predictors of 1-year rehospitalizations

Clinical Points

- The independent predictors of 1-year readmissions to a self-standing psychiatric hospital were body mass index ≥ 28.5 kg/m2, a diagnosis of schizophrenia or schizoaffective disorder, treatment with clozapine, and shorter length of stay during the previous hospitalization.
- The increased risk of readmission in overweight and obese psychiatric patients suggests decreased compliance with treatment, but may also reflect inflammatory patterns common to obesity and schizophrenia.
- Enhanced outpatient monitoring and therapeutic interventions for overweight and obese psychiatric patients might influence readmission rates.

from among the anthropometric, medical, and psychiatric features recorded at the time of initial hospital stay. We hypothesized that a higher burden of somatic pathology (number of active medical conditions) and a greater BMI would be independent correlates of readmissions in adult psychiatric patients.

METHOD

Setting and Patients

The study was performed using data generated by 1,000 adult patients consecutively admitted to a 208-bed, freestanding, not-for-profit teaching psychiatric hospital located in New York City from August 2010 through January 2011, adjacent to a 480-bed full-service general hospital. The psychiatric hospital admits approximately 4,000 adult patients annually without restrictions regarding ability to pay, citizenship status, and location of residence. Schizophrenia spectrum disorders, bipolar disorder, and major depressive disorder are the most common admitting diagnoses, and the length of stay averages 19 days (Table 1). The therapeutic interventions provided include medications, electroconvulsive therapy, and individual and group psychotherapy. The data extraction was performed according to a protocol approved by the Institutional Review Board, North Shore–Long Island Jewish Health System, Manhasset, New York.

Hospital policy requires that all consenting patients receive a medical evaluation on the day of admission. The evaluation includes a history and physical examination and laboratory testing, consisting of a comprehensive metabolic panel, complete blood count, and thyroid-stimulating hormone. Patients are "medically cleared" for admission if they are clinically stable and do not require intravenous administration of drugs or fluids. Medical and neurologic consultation is provided by onsite, salaried, board-certified physicians. The patients with medical conditions who cannot be managed in the psychiatric setting are transferred to the general hospital.

Data Collection

Data for the initial hospitalization were collected from electronic hospital records of the psychiatric hospital. Data extracted included psychiatric and medical diagnoses, medications, results of mandatory admission laboratory testing, and reason for transfer to the general hospital. Readmissions during the year after the index hospitalization were recorded prospectively. For those patients with multiple readmissions during the 1-year follow-up period, the first readmission was used to gather data. Patients transferred to a general hospital for medical deterioration during the index admission who "bounced back" to continue inpatient psychiatric care were excluded from the cases requiring readmission.

Statistical Analyses

We compared demographic characteristics, psychiatric diagnoses, active medical conditions, BMI, and discharge medications of the readmitted patients with those of the rest of the cohort who were not readmitted. Items statistically different in univariate comparisons with $P < .1$ were then entered in a logistic regression model to determine the independent predictors of readmission.

RESULTS

Within the first year after discharge, 224 of 945 patients (23.7%) with data were readmitted. Fifty-nine patients (6.3%) were readmitted within 30 days of discharge, and 165 patients (17.4%) were readmitted between 31 and 365 days after the initial hospitalization.

Readmitted patients were younger ($P = .0029$), had a shorter length of stay during the initial admission ($P = .036$), had a higher BMI (29.7 ± 8.6 kg/m^2 vs 28.0 ± 7.0 kg/m^2, $P = .0079$), were more likely to have a diagnosis of schizophrenia or schizoaffective disorder ($P < .0001$), and were less likely to have major depressive disorder/depression not otherwise specified ($P = .0006$) or dementia ($P = .027$) (Table 1). The groups were similar with regard to number of active medical disorders ($P = .68$) and type of active medical disorders ($P = .13$–$.67$) (Table 2). There were no intergroup differences in any of the mandatory admission laboratory parameters (complete blood count, basic metabolic panel, and thyroid-stimulating hormone levels).

The proportion of patients discharged on second-generation antipsychotics was greater in the readmitted group ($P = .0054$). Within this class of drugs, the only significant difference was recorded for clozapine, which was the antipsychotic prescribed for outpatient care more often in the readmitted group ($P = .0024$) (Table 3). In addition, readmitted patients also received more first-generation antipsychotics ($P = .042$), as well as less electroconvulsive therapy treatment ($P < .001$).

A subanalysis comparing patients readmitted within 30 days with those rehospitalized after 2–12 months revealed only a few differences, ie, lower frequency of substance use disorders (15.3% vs 31.7%, $P = .015$), higher frequency of hypothyroidism (13.6% vs 5.6%, $P = .049$), and more likely to have been treated with mood stabilizers (45.8% vs 30.0%, $P = .031$).

Table 1. Demographic and Clinical Characteristics of Patients at the Time of the Initial Psychiatric Admission

Characteristic	Total (n = 945)	Patients Readmitted Within 1 Year (n = 224)	Patients Not Readmitted (n = 721)	*P* Value
Age, mean ± SD, y	41.5 ± 19.4	41.1 ± 16.4	45.5 ± 19.8	.0029*
Male, n (%)	502 (53.1)	129 (57.6)	373 (51.7)	.15
Length of stay, mean ± SD, d	19.2 ± 21.3	16.6 ± 14.7	20.0 ± 23.1	.036*
Body mass index, mean ± SD, kg/m^2	28.5 ± 7.5	29.7 ± 8.6	28.0 ± 7.0	.0079*
Schizophrenia/schizoaffective disorder, n (%)	269 (28.5)	88 (39.3)	181 (25.1)	< .0001*
Bipolar disorder, n (%)	180 (19.0)	39 (17.4)	141 (19.5)	.56
Major depressive disorder/depression not otherwise specified, n (%)	290 (30.7)	48 (21.4)	242 (33.6)	.0006*
Psychosis not otherwise specified, n (%)	69 (7.3)	16 (7.1)	53 (7.4)	1.0
Anxiety disorder, n (%)	58 (6.1)	13 (5.8)	45 (6.2)	.87
Substance use disorder, n (%)	235 (24.9)	60 (26.8)	175 (24.3)	.48
Dementia, n (%)	59 (6.2)	7 (3.1)	52 (7.2)	.027*

*Indicates statistical significance at $P < .05$.

Table 2. Active Medical Conditions at the Time of the Initial Psychiatric Admission

Characteristic	Total (n = 945)	Patients Readmitted Within 1 Year (n = 224)	Patients Not Readmitted (n = 721)	*P* Value
Arterial hypertension, n (%)	267 (28.3)	66 (29.5)	201 (27.9)	.67
Dyslipidemia, n (%)	185 (19.6)	48 (21.4)	137 (19.0)	.44
Diabetes mellitus, n (%)	111 (11.7)	31 (13.8)	80 (11.1)	.29
Asthma/chronic obstructive pulmonary disease, n (%)	93 (9.8)	28 (12.5)	65 (9.0)	.13
Hypothyroidism, n (%)	55 (5.8)	17 (7.6)	38 (5.3)	.19
Coronary artery disease, n (%)	946 (4.9)	7 (3.1)	39 (5.4)	.21
No. of active medical disorders, mean ± SD	2.9 ± 1.9	3.0 ± 1.9	2.9 ± 1.9	.68

Logistic regression analyses identified the following dependent predictors of readmission: higher BMI (median = 28.5 kg/m^2; odds ratio [OR] = 3.6; 95% CI, 1.2–10.6), schizophrenia/schizoaffective disorder (OR = 2.2; 95% CI, 1.5–3.4), clozapine treatment (OR = 2.8; 95% CI, 1.1–6.9), no electroconvulsive therapy (OR = 0.13; 95% CI, 0.02–0.45), and shorter length of stay (median = 18 days; OR = 0.08; 95% CI, 0.01–0.42) (Table 4).

DISCUSSION

This analysis of a consecutive cohort of 945 patients admitted to a large psychiatric hospital in New York City indicated that almost a quarter of subjects had a relapse requiring readmission within 1 year of admission for treatment of severe mental illness. Independent predictors correlated with readmission included higher BMI, a diagnosis of schizophrenia or schizoaffective disorder, treatment with clozapine, shorter length of stay, and no electroconvulsive therapy during the index admission. The type and total number of somatic disorders and routine laboratory values did not appear to influence the risk of readmission.

Our study confirmed that shorter length of stay and a diagnosis of schizophrenia or schizoaffective disorder are risk factors for relapse. These findings have been interpreted to suggest that patients with schizophrenia may be poorly stabilized and have a lower level of function after short hospital stays.[3] However, we could not confirm other characteristics of patients readmitted after shorter hospital stays, such as male gender and alcohol or substance use.[3,9] The notion that shorter hospitalizations are synonymous with poor service is not supported by empirical research,[8,21] which has suggested that disease characteristics and the success of therapeutic interventions are more important than length of stay for the risk of readmission. Our finding that patients receiving electroconvulsive therapy are 10 times less likely to be readmitted during the 1-year time frame might be seen as a contributing factor to the success of this hospital-based intervention, at least in patients without psychotic features, as suggested by previously published data.[22]

In our sample of patients with mixed psychiatric disorders, treatment with antipsychotics at discharge of the index admission, either first-generation or second-generation agents, was associated with a greater risk for readmission. The fact that patients discharged on second-generation antipsychotics were significantly more likely to be readmitted stands in contrast with the results of a German multicenter study, which concluded that patients treated with this class of drugs were at lower risk of relapse.[10] Their sample consisted of patients with schizophrenia only, and fewer patients were treated with second-generation antipsychotics than in our cohort, suggesting a difference in practice patterns with regard to patient selection and perhaps severity of illness. Clozapine was not specifically assessed by these investigators. As a risk factor for readmission, clozapine may be a proxy for

Table 3. Psychiatric Treatment During Initial Admission

Characteristic	Total (n = 945)	Patients Readmitted Within 1 Year (n = 224)	Patients Not Readmitted (n = 721)	*P* Value
Atypical antipsychotics, n (%)	550 (58.2)[a]	148 (66.1)[b]	402 (55.8)[c]	.0054*
Clozapine	37 (3.9)	17 (7.7)	20 (2.8)	.0024*
Olanzapine	79 (8.4)	17 (7.6)	62 (8.6)	.78
Quetiapine	170 (18.0)	47 (21.1)	123 (17.1)	.19
Risperidone	172 (18.2)	45 (20.1)	126 (17.5)	.37
Aripiprazole	122 (12.9)	35 (15.6)	87 (12.1)	.17
Ziprasidone	22 (2.3)	7 (3.1)	15 (2.1)	.44
Typical antipsychotics, n (%)	109 (11.5)	8 (13.6)	101 (14.0)	.042*
Mood stabilizers, n (%)	291 (30.8)[d]	76 (34.1)[e]	215 (29.8)[f]	.25
Lithium, n (%)	123 (13.0)	30 (13.4)	93 (12.9)	.82
Anticonvulsant, n (%)	196 (20.7)	53 (23.7)	143 (19.8)	.22
Sedative/anxiolytic, n (%)	371 (39.3)	85 (38.1)	286 (39.7)	.70
Electroconvulsive therapy, n (%)	57 (6.0)	2 (0.9)	55 (7.6)	< .001*

[a]56 patients were treated with 2 atypical antipsychotics.
[b]20 patients were treated with 2 atypical antipsychotics.
[c]36 patients were treated with 2 atypical antipsychotics.
[d]28 patients were treated with lithium and an anticonvulsant.
[e]7 patients were treated with lithium and an anticonvulsant.
[f]21 patients were treated with lithium and an anticonvulsant.
*Indicates statistical significance at $P < .05$.

Table 4. Independent Predictors of Psychiatric Readmission

Independent Predictor	Odds Ratio	95% CI	*P* Value
Body mass index	3.6	1.2–10.6	.0216*
Clozapine treatment	2.8	1.1–6.9	.0247*
Diagnosis of schizophrenia/ schizoaffective disorder	2.2	1.5–3.4	.0001*
Electroconvulsive therapy	0.13	0.02–0.45	.0064*
Length of stay	0.08	0.01–0.42	.0051*

*Indicates statistical significance at $P < .05$.

severity of illness in schizophrenia and suboptimal response to treatment, which has been documented in almost half of patients in which it has been used as a drug of last resort.[23]

Higher BMI is a novel risk factor for psychiatric readmission and deserves careful consideration. A BMI in the overweight (25–29.9 kg/m^2) and obese (> 30 kg/m^2) range is common in patients treated with antipsychotics,[24] and weight gain may be associated with nonadherence with antipsychotics.[25] Although an association between antipsychotic-induced weight gain and improved therapeutic outcomes has been reported in several studies of adults with schizophrenia,[26–30] the relevance and mechanisms of this association independent of greater adherence and longer treatment continuation in patients gaining weight in these studies have been questioned.[18,24,31] Moreover, in another study, 86% of patients who perceived themselves to be overweight attributed the excess adiposity to their antipsychotic treatment, and 72% with this explanatory model reduced their medication dose by themselves.[20] Importantly, in addition to engendering a negative attitude toward treatment, obesity may correlate directly with the severity of psychiatric disorders through dysregulations in shared biological pathways, such as hypothalamus-pituitary-adrenal activation, increased nitrosative and oxidative stress, mitochondrial disturbances, and neurotransmitter imbalances.[32] Abnormalities in inflammatory status and responses are also similar in obesity and patients with psychotic symptoms, primarily in patients with schizophrenia and bipolar disorder, in whom the levels of C-reactive protein,[33] interleukin-1 receptor antagonist, and soluble tumor necrosis factor receptor 1[34] were associated with the general severity of illness. The potential relationship between increased BMI and severity of psychiatric disorder leading to relapse and readmission is strengthened by the fact that the frequencies of somatic disorder associated with obesity (arterial hypertension, diabetes mellitus, dyslipidemia, and coronary artery disease) were similar in the readmitted and control patients.

Results from this study need to be interpreted within its limitations. These limitations include the retrospective study design, lack of information on treatment adherence, oxidative stress and inflammation, and inclusion of a mixed sample with regard to severe mental disorders. The single site design may limit the generalizability of our observations. Moreover, we cannot exclude that certain patients could have been readmitted to another inpatient facility. Confounding factors for BMI, such as poor socioeconomic status, high caloric diet, deconditioning due to decreased physical activity, inflammation, and lowered self-esteem, which have not been assessed in this study, may increase the risk of readmission. Nonetheless, this is a reasonably sized study of a consecutively hospitalized psychiatric inpatient sample from a semiurban location that has representative demographics for the United States. Moreover, this is the first attempt to include BMI and somatic disorders in models explaining readmission to a psychiatric hospital.

Readmissions to acute psychiatric units in English-speaking, developed countries such as Australia,[35] New Zealand,[36] the United Kingdom,[36] and the United States[4,37] have had many common denominators, such as severity of mental illness, lack of employment, suboptimal discharge planning, and poor global functioning. Research is needed to study the association between increased BMI and

psychiatric readmissions in these and other countries with high rates of obesity. Prospective studies are required, and the effect of weight reduction on psychiatric symptomatology, including the risk for relapse and rehospitalization, should be investigated. Furthermore, studies are needed to better understand the interplay between inflammation and oxidative stress and mental disorders, as well as the interaction of elevated BMI, which is a proinflammatory state, with lack of treatment response and relapse in patients with severe mental disorders.

Drug names: aripiprazole (Abilify), clozapine (Clozaril, FazaClo, and others), lithium (Lithobid and others), olanzapine (Zyprexa), quetiapine (Seroquel), risperidone (Risperdal and others), ziprasidone (Geodon).

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Potential conflicts of interest: **Dr Kane** has served as a consultant to Alkermes, Amgen, Astra-Zeneca, Bristol-Myers Squibb, Eli Lilly, Intra-Cellular Therapies, Janssen, Johnson & Johnson, Lundbeck, Merck, Novartis, Otsuka, Pfizer, Pierre Fabre, Proteus, Roche, and Sunovion; has received honoraria from Bristol-Myers Squibb, Merck, Novartis, and Otsuka; has served on the speakers' or advisory boards of Bristol-Myers Squibb, Eli Lilly, Janssen, and Otsuka; and is a stock shareholder in MedAvante. **Dr Correll** has served as a consultant to Alexza, AstraZeneca, Bristol-Myers Squibb, Eli Lilly, Genentech, Gerson Lehrman Group, Intra-Cellular Therapies, Lundbeck, MedAvante, Otsuka, Pfizer, Roche, Sunovion, Takeda, Teva, and Vanda; has received grant/research support from Bristol-Myers Squibb, Ortho-McNeill/Janssen/Johnson & Johnson, and Otsuka; has received honoraria from Bristol-Myers Squibb, Cephalon, Janssen/Johnson & Johnson, Medscape, Otsuka, ProPhase, Takeda, Teva, and Vanda; and has served on the speakers' or advisory boards for Actelion, Alexza, AstraZeneca, Bristol-Myers Squibb, Intra-Cellular Therapies, MedAvante, Merck, Novartis, Otsuka, Pfizer, and Sunovion. **Drs Manu**, **Khan**, **Radhakrishnan**, and **Russ** report no conflicts of interest related to the subject of this article.

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