

Incidence, Prevalence, and Surveillance for Diabetes in New York State Psychiatric Hospitals, 1997–2004

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Objective: The purpose of the study was to describe the incidence of newly treated diabetes mellitus, the prevalence of identified cases, and surveillance for new cases between 1997 and 2004 among inpatients in a large state psychiatric hospital system. **Methods:** Prevalence was determined by ascertaining the number of individuals who received antidiabetic medication or had a diagnosis of diabetes mellitus for each calendar year in inpatient facilities operated by the New York State Office of Mental Health. Yearly incidence was calculated by identifying unique patients who received new prescriptions of antidiabetic medication among patients with no known history of receiving such medication and no recorded diagnosis of diabetes mellitus. Surveillance for abnormal plasma glucose levels was measured by calculating the number of plasma glucose tests completed per 100 patient-days among patients without diabetes mellitus. **Results:** Prevalence of identified cases of diabetes increased from 6.9 percent of 10,091 patients in 1997 to 14.5 percent of 7,420 patients in 2004 (risk ratio [RR]=2.11, 95 percent confidence interval [CI]=1.93–2.31). Incidence of newly treated diabetes increased from .9 percent in 1997 to 1.8 percent in 2004 (RR=2.03, CI=1.51–2.73). The increase in incidence and prevalence was only partially explained by the increase in surveillance for new cases, which increased from 1.23 plasma glucose tests per 100 patient-days in 1997 to 1.80 in 2002 (RR=1.46, CI=1.43–1.50). **Conclusions:** The doubling of the treated incidence rate and the rise in prevalence of identified cases of diabetes among psychiatric inpatients mirrors the rise observed in the general population but with higher absolute rates. (*Psychiatric Services* 57:1132–1139, 2006)

Type 2 diabetes mellitus is a common disease, with a prevalence rate that is increasing globally (1,2). In the United States, the prevalence of diabetes rose from 4.9 percent in 1990 to 7.9 percent in

2001 and is highly correlated with the prevalence of obesity (3–5).

Evidence suggests that patients with major mental disorders, such as schizophrenia, may have even higher prevalence rates (6–12). For exam-

ple, in a cohort of 436 outpatients with schizophrenia in New York State where data were gathered from 2001 to 2002, the prevalence of diabetes was 14.2 percent (12), almost double the reported prevalence of 7.7 percent of diagnosed diabetes among New York State adults at large in 2001 (5).

Many explanations have been proffered to explain the higher risk of type 2 diabetes mellitus among patients with schizophrenia (the most common disorder found among the patients in our study population) compared with the general population, including a biological link between these two disorders (13) and the unhealthy lifestyles practiced by patients, such as a high-fat diet, smoking, and lack of exercise (14). Within the past several years, much attention has also been placed on the metabolic consequences of using second-generation antipsychotics (15), particularly because these newer antipsychotics have generally replaced the use of older agents, such as haloperidol (16).

Although prevalence rates of diabetes mellitus have been documented among patients with severe mental illness, little is known about the incidence of diabetes mellitus in this population and even less is known about how these incidence rates may have changed over time. In a previous report, we evaluated new cases of diabetes from 2000 to 2002 and found that between 1.3 and 1.5 percent of patients hospitalized in New York

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State psychiatric centers developed diabetes each year, as measured by a new prescription for an antidiabetic agent (11). These figures are lower than the annualized incidence rate of 4.4 percent reported in a retrospective study of patients with schizophrenia receiving care through the U.S. Department of Veterans Affairs for the period from 1999 to 2001 (17) and the rate of 4.7 percent in a retrospective study of privately insured patients receiving antipsychotics for any three-month period from 1999 to 2000 (18). The latter two attempts to calculate incidence of new cases may have overestimated actual rates because they did not consider a history of treatment of diabetes mellitus beyond the previous six months (17) or prior to the study period (18).

Despite multiple pharmacoepidemiological reports in the literature describing possible associations between exposure to second-generation antipsychotics and the development of diabetes mellitus, there is a lack of published information on changes over time in the annual incidence and prevalence of diabetes mellitus among inpatients with serious and persistent mental illness. This study aimed to determine the incidence of newly treated diabetes mellitus and the prevalence of identified diabetes mellitus among all patients hospitalized in adult civil facilities operated by the New York State Office of Mental Health for the period 1997 through 2004. A secondary aim was to determine the change in surveillance for abnormal plasma glucose levels among patients who had not been identified as having diabetes mellitus and the impact surveillance may have had on the identification of new cases of diabetes mellitus—and thus on prevalence and incidence. Information about the possibility of an association between exposure to second-generation antipsychotics and the development of diabetes mellitus in this New York inpatient population can be found elsewhere (11).

Methods

Database

Data were obtained from the Integrated Research Database (IRDB) created by the Information Sciences

Division of the Nathan S. Kline Institute for Psychiatric Research. The IRDB contains patient information (demographic characteristics; dates of admission, transfer, and discharge; and diagnosis) and drug prescription information for every inpatient in the 17 adult civil facilities of the New York State psychiatric hospital system. These psychiatric centers provide intermediate and long-term care to patients with severe and persistent mental illness. Patients admitted to these facilities have usually been receiving inpatient care for several weeks in community-based hospitals before their transfer. Approximately half of the patients in the state-operated facilities have a length of stay of one year or more. Institutional review board approval was obtained, along with a waiver for written informed consent. Personal identifiers were removed from the data, and the study (retrospective review of existing data) presented no more than minimal risk to participants.

Ascertainment procedures

Patients were included in the study if they were inpatients at any time during the period January 1, 1997, through December 31, 2004. Cases were defined as those who had received prescriptions of antidiabetic medication as documented in the IRDB (insulin, glyburide, glipizide, glimepiride, tolbutamide, chlorpropamide, tolazamide, repaglinide, metformin, troglitazone, acetohexamide, acarbose, miglitol, rosiglitazone maleate, pioglitazone hydrochloride, and nateglinide) or those who had a recorded diagnosis of diabetes mellitus (*ICD-9* code 250.xx) in the IRDB. Incident cases were defined as those with a new prescription for an antidiabetic medication; that is, we excluded patients from being considered as an incident case if an antidiabetic medication had been prescribed at any time since January 1, 1994 (the earliest date for which such data were available), as documented in the IRDB. Patients were also excluded from the calculation of incident cases if they ever had a recorded diagnosis of diabetes mellitus.

To reduce the possibility that a pre-

scription of an antidiabetic medication was a renewal of a medication received before hospitalization, for incident cases patients were required to have at least a 30-day period of hospitalization before the start of the prescription of the antidiabetic medication. Patients who received a new diagnosis of diabetes mellitus in the absence of a new prescription of an antidiabetic medication were not counted as a new incident case, because the coding of a diagnosis of diabetes may have occurred immediately after admission in response to the medical history obtained at that time and thus may not have represented a true incident case.

Because the risk of developing diabetes may be related to demographic and diagnostic variables, prevalence and incidence were categorized by gender, race or ethnicity (white, black, Hispanic, and other), and age group (18 to 44, 45 to 64, and 65 years and older). Three diagnostic categories were used: schizophrenia or schizoaffective disorder and other nonmood nonorganic psychotic disorders (*DSM-IV-TR* code 295.x, 297.1, 297.3, 298.8, or 298.9), major mood disorders (*DSM-IV-TR* code 296.x), and other diagnoses.

Relative risk ratios (RR) for incidence and prevalence were calculated from 2×2 tables. When comparing rates from the year 2004 to those of 1997, we also stratified by gender, age, race or ethnicity, and diagnosis (19). When comparing rates between the subgroups (men versus women, nonwhite race or ethnicity versus white, age 45 years or older versus younger than 45 years, diagnosis of schizophrenia or schizoaffective disorder versus mood disorders or others), we stratified by calendar year.

We compared our prevalence rates with those observed in the population at large in New York State, as estimated by the Behavioral Risk Factor Surveillance System study, which measured, by telephone survey, self-reported diabetes among noninstitutionalized adults aged 18 years or older (3,20,21).

Because the likelihood of a person's being diagnosed or treated for diabetes is influenced by the rate at which plasma glucose tests are or-

Table 1

Population characteristics of patients hospitalized in the adult civil facilities operated by the New York State Office of Mental Health, 1997–2004^a

Characteristic	1997 (N=10,091)		1998 (N=9,424)		1999 (N=9,008)		2000 (N=8,621)		2001 (N=8,520)		2002 (N=8,269)		2003 (N=7,724)		2004 (N=7,420)	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Age (M±SD)	45.7± 14.6		45.1± 13.9		44.5± 13.6		44.3± 13.5		44.0± 13.8		44.0± 13.9		44.1± 13.7		44.2± 13.8	
Men, age group ^b																
18–44	3,867	59	3,628	59	3,512	59	3,340	59	3,261	58	3,114	57	2,872	56	2,684	54
45–64	2,141	32	2,060	34	2,061	35	2,038	36	2,011	36	2,040	37	2,014	39	1,998	41
65 and older	581	8.8	457	7.4	363	6.1	317	5.6	309	5.5	300	5.5	272	5.3	249	5.0
Total	6,589	65	6,145	65	5,936	66	5,695	66	5,581	66	5,454	66	5,158	67	4,931	67
Women, age group ^b																
18–44	1,478	42	1,427	44	1,386	45	1,344	46	1,337	46	1,260	45	1,151	45	1,074	43
45–64	1,350	39	1,325	40	1,243	40	1,186	41	1,225	42	1,196	43	1,112	43	1,108	45
65 and older	673	19	525	16	442	14	394	13	375	13	357	13	302	12	302	12
Total	3,501	35	3,277	35	3,071	34	2,924	34	2,937	34	2,813	34	2,565	33	2,484	34
Race or ethnicity																
White	5,362	53	4,779	51	4,493	50	4,191	49	4,136	49	3,904	47	3,672	48	3,465	47
Black	3,322	33	3,285	35	3,150	35	3,061	36	3,069	36	3,130	38	2,923	38	2,818	38
Hispanic	1,142	11	1,097	12	1,093	12	1,087	13	1,050	12	983	12	885	11	873	12
Other or missing	265	2.6	263	2.8	272	3.0	282	3.3	265	3.1	252	3.0	244	3.2	264	3.6
Diagnosis																
Schizophrenia ^c	7,691	76	7,302	77	7,022	78	6,819	79	6,628	78	6,533	79	6,145	80	5,926	80
Major mood	933	9.3	870	9.2	883	9.8	803	9.3	830	9.7	826	10	710	9.2	657	8.8
Other	1,467	15	1,252	13	1,103	12	999	12	1,062	12	910	11	869	11	837	11

^a Number and percentage of total by year

^b Percentages in the gender categories (except for the total) express the proportion for that gender only. Totals may differ because of missing gender information.

^c Includes schizoaffective disorder

dered, surveillance for diabetes mellitus was measured by calculating the frequency of plasma glucose testing performed during the relevant calendar year. These data were obtained from the administrative records maintained by the central laboratory that processes the bulk of these tests for the hospitals operated by the New York State Office of Mental Health. The records indicate if a test was done and its value, but they do not indicate if the sample was taken when the patient was fasting or not. A minority of patients were hospitalized at more remote facilities not served by the central laboratory. Laboratory data were available for nine facilities in 1997 and 1998 and for ten facilities in 1999 through 2002. To avoid counting laboratory tests done for patients with identified diabetes, patients who were identified as a case were excluded. We examined counts of plasma glucose tests per 100 patient-days. To estimate the number of potential cases of diabetes not

captured by a recording of a diagnosis of diabetes or the prescription of an antidiabetic medication, we counted the number of unique patients in this group of patients not identified as having diabetes but who nevertheless had plasma glucose levels of 200 mg/dL or greater.

Results

Description of population

Table 1 summarizes the basic demographic characteristics of the population by year, including age, gender, race or ethnicity, and principal psychiatric diagnosis. In all years, antipsychotic medication was prescribed for 92 to 93 percent of all patients. Comprehensive reports of the utilization and dosing patterns of antipsychotics in this population have been published elsewhere (16,22).

Prevalence of identified cases of diabetes mellitus

Table 2 provides the yearly period prevalence of identified cases of diabetes mellitus by gender, race or eth-

nicity, age, and diagnosis for the years 1997 to 2004. Annual period prevalence of diabetes increased from 696 of 10,091 patients (6.9 percent) in 1997 to 1,079 of 7,420 (14.5 percent) in 2004 (for the comparison between 2004 and 1997, risk ratio [RR]=2.11; 95 percent confidence interval [CI]=1.93–2.31). The difference remained statistically significant after stratification by age (RR=2.12, CI=1.99–2.26), race or ethnicity (RR=2.06, CI=1.94–2.18), gender (RR=2.13, CI=2.04–2.21), and diagnosis (RR=2.10, CI=2.01–2.19).

In all years, prevalence of diabetes was significantly higher for women than for men, for patients aged 45 years or older than for those younger than 45 years, and for patients of non-white race or ethnicity than for white patients (after stratification by year, RR=1.68, CI=1.65–1.71; RR=1.87, CI=1.83–1.91; and RR=1.49, CI=1.46–1.51, respectively).

Differences in prevalence of diabetes by psychiatric diagnosis were not consistent; no statistically signifi-

Table 2

Period prevalence of identified cases of diabetes mellitus among patients hospitalized in the adult civil facilities operated by the New York State Office of Mental Health, 1997–2004^a

Variable	1997 (N=10,091)		1998 (N=9,424)		1999 (N=9,008)		2000 (N=8,621)		2001 (N=8,520)		2002 (N=8,269)		2003 (N=7,724)		2004 (N=7,420)	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Prevalent cases	696	6.9	794	8.4	836	9.3	842	9.8	969	11.4	1,068	12.9	1,038	13.4	1,079	14.5
Age (M±SD)	51.9± 13.9		51.2± 13.5		50.2± 12.9		48.7± 12.8		48.5± 12.9		49.1± 12.7		48.5± 12.6		48.6± 12.2	
Men, age group																
18–44	126	3.2	151	4.2	175	5.0	191	5.7	236	7.2	256	8.2	244	8.5	265	9.9
45–64	143	6.7	164	8.0	212	10.3	216	10.6	247	12.3	291	14.3	311	15.4	327	16.4
65 and older	53	9.1	56	12.2	44	12.1	39	12.3	43	13.9	50	16.7	44	16.2	40	16.1
Total	322	4.9	371	6.0	431	7.3	446	7.8	526	9.4	597	10.9	599	11.6	632	12.8
Women, age group																
18–44	104	7.0	120	8.4	130	9.4	149	11.1	160	12.0	148	11.7	157	13.6	144	13.4
45–64	169	12.5	205	15.5	193	15.5	179	15.1	213	17.4	246	20.6	220	19.8	239	21.6
65 and older	101	15.0	98	18.7	82	18.6	68	17.2	70	18.7	77	21.6	62	20.5	64	21.2
Total	374	10.7	423	12.9	405	13.2	396	13.5	443	15.1	471	16.7	439	17.1	447	18.0
Race or ethnicity																
White	297	5.5	322	6.7	324	7.2	331	7.9	374	9.0	407	10.4	399	10.9	412	11.9
Black	304	9.2	364	11.1	396	12.6	365	11.9	424	13.8	464	14.8	466	15.9	506	18.0
Hispanic	80	7.0	93	8.5	97	8.9	126	11.6	140	13.3	157	16.0	136	15.4	131	15.0
Other or missing	15	5.7	15	5.7	19	7.0	21	7.4	31	11.7	40	15.9	37	15.2	30	11.4
Diagnosis																
Schizophrenia ^b	535	7.0	622	8.5	649	9.2	639	9.4	715	10.8	826	12.6	814	13.2	868	14.6
Major mood	74	7.9	87	10.0	104	11.8	97	12.1	115	13.9	116	14.0	105	14.8	106	16.1
Other	87	5.9	85	6.8	83	7.5	106	10.6	139	13.1	126	13.8	119	13.7	105	12.5

^a Percentages (period prevalence) are for the indicated groups. Figures presenting these data in a graphic format are available online at ps.psychiatryonline.org.

^b Includes schizoaffective disorder

cant differences were found between patients with a diagnosis of schizophrenia or schizoaffective disorder and those with a mood disorder or other psychiatric diagnosis for the years 1997 through 1999 and 2002 through 2004.

Incidence of newly treated diabetes mellitus

Table 3 provides the yearly incidence of newly treated diabetes mellitus by gender, race or ethnicity, age, and diagnosis for the years 1997 to 2004. Incidence increased from 74 of 8,468 patients (.9 percent) in 1997 to 106 of 5,982 (1.8 percent) in 2004 (for the comparison between 2004 and 1997, RR=2.03, CI=1.51–2.73). The difference remained statistically significant after stratification by age (RR=2.03, CI=1.51–2.73), race or ethnicity (RR=2.00, 95 CI=1.49–2.69), gender (RR=2.04, CI=1.52–2.74), and diagnosis (RR=2.01, CI=1.74–2.32).

In all years, incidence of diabetes was significantly higher for nonwhites than whites (after stratification by

year, RR=2.07, CI=1.79–2.39). No statistically significant differences were found in incidence of diabetes by gender for any specific year; however, for the comparison between women and men, after stratification by year the overall RR was 1.16 (CI=1.00–1.34). No statistically significant differences in incidence of diabetes were found between patients 45 years or older and younger patients or between patients with a diagnosis of schizophrenia or schizoaffective disorder and those with a mood disorder or other psychiatric diagnosis.

Comparison with the New York State general population

Prevalence data for diabetes mellitus are available for the general population of New York State through the Behavioral Risk Factor Surveillance System study (3,20,21). In that study, diagnosed diabetes was defined by an affirmative response to the question, “Have you ever been told by a doctor that you have diabetes?” (20). Reported prevalence rates of diabetes (ex-

cluding gestational diabetes) were 5.5 percent in 1998 and 6.0 percent in 1999 (20). In our population, corresponding prevalence rates calculated by using the same three-year moving-average technique were about 50 percent higher (8.2 and 9.2 percent, respectively). When our population in 2003 was compared with the general population in New York State for that year (21)—the latest information publicly available—the rates for the psychiatric inpatient population were higher (Table 4).

Surveillance for new cases of diabetes mellitus

Among patients who did not have a recorded diagnosis of diabetes mellitus or a prescription for an antidiabetic agent, the number of plasma glucose tests per 100 patient-days increased annually. In 1997, among the 4,353 patients who were not identified as having diabetes in the nine facilities for which laboratory data were available, the number of plasma glucose tests per 100 patient-days was

Table 3

Annual incidence of newly identified cases of diabetes mellitus among patients hospitalized in the adult civil facilities operated by the New York State Office of Mental Health, 1997–2004^a

Variable	1997 (N=8,468) ^b		1998 (N=7,909) ^b		1999 (N=7,424) ^b		2000 (N=7,124) ^b		2001 (N=6,906) ^b		2002 (N=6,740) ^b		2003 (N=6,307) ^b		2004 (N=5,982) ^b	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Prevalent cases	74	.9	92	1.2	109	1.5	107	1.5	118	1.7	108	1.6	98	1.6	106	1.8
Age (M±SD)	43.8± 12.6		45.1± 12.1		45.4± 11.4		44.8± 12.0		44.7± 12.2		45.9± 13.2		45.4± 13.1		45.1± 13.0	
Men, age group																
18–44	29	.9	27	.9	46	1.6	41	1.5	50	1.8	32	1.2	37	1.5	34	1.5
45–64	9	.5	27	1.5	23	1.3	23	1.3	31	1.8	26	1.6	27	1.6	29	1.8
65 and older	4	.8	3	.8	4	1.3	2	.7	2	.8	5	2.0	3	1.3	6	3.0
Total	42	.7	57	1.1	73	1.5	66	1.4	83	1.8	63	1.4	67	1.6	69	1.7
Women, age group																
18–44	17	1.4	18	1.5	17	1.6	20	1.9	18	1.7	17	1.7	13	1.4	16	1.9
45–64	12	1.1	13	1.2	15	1.5	16	1.7	12	1.3	23	2.5	14	1.6	17	2.0
65 and older	3	.6	4	1.0	4	1.2	5	1.6	5	1.7	5	1.8	4	1.7	4	1.7
Total	32	1.1	35	1.3	36	1.5	41	1.8	35	1.6	45	2.0	31	1.5	37	1.9
Race or ethnicity																
White	26	.6	35	.9	27	.7	34	1.0	42	1.2	37	1.1	23	.8	38	1.3
Black	39	1.4	44	1.6	64	2.5	48	1.9	50	2.0	49	1.9	55	2.3	57	2.6
Hispanic	8	.8	12	1.3	15	1.7	22	2.5	22	2.7	19	2.4	17	2.4	9	1.3
Other or missing	1	.5	1	.5	3	1.4	3	1.4	4	1.9	3	1.5	3	1.6	2	.9
Diagnosis																
Schizophrenia ^c	59	.8	77	1.2	83	1.4	81	1.4	91	1.7	88	1.6	83	1.6	84	1.7
Major mood	6	.8	5	.7	9	1.4	10	1.6	12	1.9	11	1.7	7	1.2	13	2.6
Other	9	.8	10	1.0	17	2.0	16	2.0	15	1.9	9	1.3	8	1.2	9	1.5

^a Percentages (annual incidence) are for the indicated groups. Figures presenting these data in a graphic format are available online at ps.psychiatryonline.org.

^b The total is the number of unique patients in the calendar year who had a length of stay of 30 days or longer and who were not identified as a case in previous years (back to 1994). Incident cases are those who were prescribed an antidiabetic agent for the first time at least 30 days after the date of admission to the hospital.

^c Includes schizoaffective disorder

1.23 (12,501 tests for 1,013,848 patient-days). In 2002 for 4,426 patients from ten facilities who also were not identified as having diabetes, the rate of testing was 1.80 tests per 100 patient-days (16,371 tests for 908,216 patient-days) (for testing in 2002 compared with 1997, RR=1.46, CI=1.43–1.50). The number of patients (all presumed nondiabetic) with plasma glucose tests greater than or equal to 200 mg/dL ranged from a low of 19 in 1999 (.45 percent of 4,250 patients) to a high of 27 in 1998 (.66 percent of 4,111 patients). It is unknown how many of these plasma glucose levels were obtained in the fasting state.

Discussion

Rise in treated incidence and identified prevalence

The incidence of newly treated diabetes mellitus and the prevalence of identified cases of diabetes mellitus

in psychiatric patients hospitalized in the New York State Office of Mental Health system have increased markedly over the past decade. Although this rise is consistent with trends for the increased prevalence of diabetes in the general population, the absolute rise appears greater in the psychiatric population than in the general population.

The rise in incidence and prevalence of diabetes mellitus in our population corresponds in time with the continued adoption of second-generation antipsychotics as the preferred choice of antipsychotic medication (16). In the New York State Office of Mental Health system, prescription of a single oral first-generation agent dropped from 70.2 percent of prescribing episodes at the start of 1994 to 10.3 percent of prescribing episodes at the end of 2000, whereas over the same period, the use of second-generation antipsychotics, singly

or in combination with any other antipsychotic, rose dramatically from 8.6 percent to 78.7 percent of prescribing episodes (16). Second-generation antipsychotics have been associated with new-onset diabetes mellitus; however, quantifiable differences among the newer agents have been inconsistent in pharmacoepidemiological studies (15,23), including our own case-control study conducted with the same population (11).

Over the same period, the bed capacity of the New York State psychiatric hospital system has been reduced. It has been suggested that the patients who remain, or the new patients who require this intensity of tertiary psychiatric care, are substantially more ill than patients admitted to these hospitals in the past. This has been used as a possible explanation for the rise in the use of combination treatments with more than one antipsychotic (24) as well as the use of

Table 4

Prevalence of diabetes mellitus in 2003 among patients hospitalized in facilities operated by the New York State Office of Mental Health and estimates for the population of New York State^a

Variable	Study population			New York State general population ^b			Relative risk ratio	95% CI
	Cases	Total N	%	Cases	Total N	%		
Prevalence	1,038	7,724	13.4	1,874	24,185	7.7	1.73	1.61–1.86
Men	599	5,158	11.6	806	9,483	8.5	1.37	1.24–1.51
Women	439	2,565	17.1	1068	14702	7.3	2.36	2.13–2.61
Age								
18–44	401	4,023	10.0	239	10396	2.3	4.34	3.71–5.07
45–64	531	3126	17.0	796	8281	9.6	1.77	1.60–1.96
65 and older	106	574	18.5	812	5169	15.7	1.18	0.98–1.41
Race or ethnicity								
White	399	3672	10.9	1480	19892	7.4	1.46	1.32–1.62
Black	466	2923	15.9	169	1327	12.7	1.25	1.06–1.47
Hispanic	136	885	15.4	107	1412	7.6	2.03	1.60–2.58

^a A figure presenting these data in a graphic format is available online at ps.psychiatryonline.org.

^b Data source: Expanded Behavioral Risk Factor Surveillance System (21)

adjunctive anticonvulsants (25) in this population over the past decade. Thus the combination of more severe psychopathology and the use of additional medications that may also have an impact on the risk of diabetes could have contributed to the incidence and prevalence pattern reported here.

In terms of the specific demographic variables, our results are similar to those found for 1991 by Dixon and colleagues (6), before second-generation antipsychotics became generally available. Increasing age, being female, and being of nonwhite race or ethnicity increased the likelihood of having diabetes among patients with schizophrenia (6) then as well as now. We did not find that a diagnosis of schizophrenia was associated with a statistically significant higher prevalence of diabetes compared with other psychiatric disorders. However, this could be a reflection of the severity of psychiatric illness across all diagnoses in our population of state hospital inpatients.

The prevalence of diabetes mellitus appears higher for our study population than for the general population of New York State, according to data from the Behavioral Risk Factor Surveillance System study (3,20,21). Whether the higher prevalence is due to more careful vigilance for physical disorders among hospitalized inpatients than in the general population is unknown. Of note are the observed prevalence rates for persons aged 18

to 44 years. In our population, prevalence of diabetes in this age group was 10.0 percent in 2003, compared with 2.3 percent for the corresponding sample of the general New York State population (RR=4.34, CI=3.71–5.07). The rate for inpatients aged 65 years or older was not statistically different from that for the general population (18.5 percent compared with 15.7 percent). The difference in prevalence rates for younger adults may reflect a pathophysiological process that accelerates the onset of diabetes among patients with schizophrenia who may be genetically predisposed to develop abnormalities in glucose homeostasis. Our observation is consistent with data from Taiwan where the prevalence of diabetes among 246 hospitalized patients with schizophrenia was significantly higher than for the general population only among the younger patients between the ages of 20 and 49 years (26).

Factors affecting detection of diabetes

The definitions of diabetes have changed over the past several years. The American Diabetes Association in 1997 (27) and the World Health Organization in 1999 (28) revised their diagnostic criteria to include a lower threshold for a fasting plasma glucose level that would signal diabetes (126 mg/dL). Because we used treatment with an antidiabetic agent as a proxy for the diagnosis of dia-

betes mellitus, our estimates are sensitive to changes in the plasma glucose thresholds for the detection and subsequent treatment of diabetes mellitus. The lower thresholds may have contributed to the increases we observed in the incidence of newly treated diabetes mellitus and in the prevalence of identified cases.

We have demonstrated a higher degree of surveillance for abnormal plasma glucose in 2002 compared with 1997. The minimum requirement for periodic physical examination, including laboratory testing, is at the time of admission and annually thereafter. Unknown is the number of patients who may consistently refuse blood testing, which may contribute to a lower case rate (fewer patients being identified as having diabetes mellitus). Nevertheless, the number of plasma glucose tests performed for patients without known diabetes mellitus (as defined by not having any prescriptions for an antidiabetic medication or any recorded diagnosis of diabetes) increased from 1.23 per 100 patient-days in 1997 to 1.80 in 2002. The increased surveillance for diabetes mellitus likely resulted in the identification of additional cases, contributing to some, but not all, of the observed increase in incidence and prevalence of diabetes reported here.

Limitations

The main limitation of our study is the retrospective collection of data.

The prevalence of cases of diabetes mellitus is probably an underestimate. Patients may have diabetes mellitus that remains undiagnosed.

Another limitation is that comorbid medical conditions are not always consistently recorded in our database. For example, among the 995 patients who received an antidiabetic medication in 2004, only 289 (29 percent) had a recorded diagnosis of diabetes. Also, patients may be treated with diet and exercise rather than with antidiabetic medication. If these patients do not have a recorded diagnosis of diabetes mellitus, they remain unidentifiable as a case.

A small number of patients who had elevated plasma glucose tests (greater than or equal to 200 mg/dL) did not have a recorded diagnosis of diabetes or a recorded prescription for an antidiabetic agent. In the sample of facilities for which these data were available, the percentage of patients in this category ranged from .41 to .66 percent depending on the calendar year. Even assuming that these patients would have met criteria for a diagnosis of diabetes mellitus, the impact on our prevalence estimates is negligible. Because we were unable to determine if a blood sample was drawn while the patient was fasting, we were not able to determine with any reasonable certainty the numbers of patients with mild hyperglycemia.

The incident rates we report here may be overestimates, because ascertainment of prior diagnosis of diabetes or prior treatment for diabetes is somewhat hampered by the incomplete nature of the history. If patients had received treatment for diabetes before 1994 or had received treatment outside the system, they would be incorrectly classified as having had no history of diabetes. The possibility of misclassification is mitigated in part by the fact that approximately 75 percent of our patients in any given year have had an episode of care in a previous year going back to 1994 (the first year for which diagnosis and medication history are available in the database) and approximately one-third of our patients have lengths of stay exceeding five years (one-half exceeding one year).

Another limitation of our study,

common in the pharmacoepidemiological literature on the association of antipsychotics and diabetes (23), is the lack of information on weight and body mass index and on family history of diabetes mellitus. Also unknown is the degree of physical activity that the patients engaged in. These are potentially important confounds. For example, if the use of second-generation antipsychotics results in greater weight gain than occurs with older agents, the resultant increases in obesity rates may have increased the observed rates of diabetes mellitus over time.

The comparison with data from the Behavioral Risk Factor Surveillance System study is somewhat speculative, because the Behavioral Risk Factor Surveillance System data were ascertained in a completely different manner. That system relied on self-report by telephone survey and hence was subject to underreporting. Participants in the telephone survey may not have received screening for diabetes mellitus. In our study population everyone generally received at least one plasma glucose test. This difference may have contributed to the gap in prevalence rates of diabetes mellitus that we observed between our population and that of the general population of New York State.

Generalizability of our results may be limited to inpatients with chronic mental illness. Outpatient psychiatric populations may differ significantly on parameters such as diet, level of activity, and disease severity. Not so different from our inpatient population may be outpatients with severe and persistent mental illness receiving services in other areas of the United States that do not have the extensive network of state-operated psychiatric inpatient facilities that New York State has and that rely more on community-based programs to provide care.

Management of the problem

The Canadian Diabetes Association has now included schizophrenia in the list of independent risk factors for the development of type 2 diabetes mellitus in its clinical practice guidelines for the prevention and manage-

ment of diabetes (29). This inclusion should result in more aggressive screening for hyperglycemia. A number of monitoring guidelines for metabolic problems among patients with schizophrenia have also been introduced in the United States (30–32). Continued education about appropriate monitoring is imperative for this major public health problem.

Conclusions

The doubling of the incidence rate of newly treated diabetes mellitus from .9 percent in 1997 to 1.8 percent in 2004 among the patients hospitalized in the 17-hospital system operated by the New York State Office of Mental Health underscores the need to address this major public health problem. The rise in prevalence of identified cases of diabetes mellitus among these psychiatric inpatients mirrors the rise observed in the general population of New York State but with higher absolute rates. Long-term prospective cohort studies with uniform ascertainment procedures to detect diabetes mellitus will be required to confirm the findings presented here.

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