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Extent and Management of Cardiovascular Risk Factors in Patients With Type 2 Diabetes and Serious Mental Illness

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Abstract

Cardiovascular disease is the leading cause of death in Type 2 diabetes, which commonly occurs in patients with serious mental illnesses (SMIs). We determined the extent to which patients with diabetes and SMI, relative to diabetes patients without SMI, met American Diabetes Association goals for cholesterol and blood pressure, met criteria for the metabolic syndrome, and were prescribed medications known to reduce cardiovascular events. We found that less than half of diabetes patients, both with and without SMI, met recommended goals for cholesterol levels; even fewer had adequate blood pressure control. In addition, a substantial proportion of all diabetes patients met metabolic syndrome criteria. However, diabetes patients with SMI were less likely to be prescribed cholesterol-lowering statin medications, angiotensin-converting enzyme inhibitors, and angiotensin receptor blocking agents than diabetes patients without SMI. Patients with both diabetes and SMI are treated less aggressively for high cardiovascular risk than diabetes patients without mental disorders.

Keywords

Type 2 diabetes; serious mental illness; cardiovascular risk; metabolic syndrome

In 2002, Type 2 diabetes affected approximately 6.3% of the US population at an estimated cost of $132 billion (American Diabetes Association, 2003; Engelgau et al., 2004). Type 2 diabetes is associated with a twofold to fourfold increased risk for major cardiovascular events and is considered a coronary heart disease risk equivalent that confers a level of risk equal to that in patients with pre-existing cardiovascular disease (CVD; Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults, 2001). Cardiovascular and cerebrovascular complications of Type 2 diabetes account for 60% to 75% of deaths from this disease (Stamler et al., 1993). Metabolic abnormalities characteristic of Type 2 diabetes including insulin resistance and dyslipidemias contribute in part to the increased CVD risk, with emerging evidence suggesting that persistent hyperglycemia may also play a role (Nathan et al., 2003; Selvin et al., 2004). Further, the

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frequent co-occurrence of hypertension, overweight and obesity, smoking, and reduced physical activity in patients with diabetes confers an additive CVD risk that exceeds the sum of their risks individually (Wilson et al., 1998). There is also mounting evidence that the cluster of risk factors that comprise the metabolic syndrome increases the risk for cardiovascular mortality (Lakka et al., 2002), and by definition, would be expected to occur disproportionately in people with Type 2 diabetes.

Persons with serious mental illnesses such as schizophrenia have an increased risk for Type 2 diabetes (Dixon et al., 2000) and other co-occurring medical conditions. Life expectancy in people with schizophrenia is 20% shorter than that of the general population (Newman and Bland, 1991), with the excess mortality largely attributed to higher rates of CVD (Brown et al., 2000; Osby et al., 2000). People with schizophrenia have a more than twofold higher risk of death from CVD relative to the general population (Osby et al., 2000). The increased cardiovascular risk may be related to the higher prevalence of Type 2 diabetes combined with multiple additional risk factors that are common in this population, including obesity (Daumit et al., 2003), physical inactivity (Daumit et al., 2005), poor diet (McCreadie, 2003), and high rates of smoking (de Leon et al., 1995), as well as treatment with psychotropic medications that promote weight gain and hyperglycemia (Allison et al., 1999; Lindenmayer et al., 2003).

Robust evidence suggests that control of blood pressure and cholesterol levels leads to fewer cardiovascular events and reduced mortality in patients with Type 2 diabetes (American Diabetes Association, 2004). The American Diabetes Association (ADA; 2004) has established standards of medical care that recommend target goals for both blood pressure and cholesterol levels in these patients. Further, among patients with both diabetes and hypertension (with and without evidence of renal disease), the ADA recommends treatment with ACE inhibitors (ACEIs) or angiotensin receptor blockers (ARBs), which improve cardiovascular outcomes and reduce the progression to diabetic nephropathy (Brenner et al., 2001). However, since these agents have been shown to reduce cardiovascular events in high-risk patients both with and without hypertension and appear to improve insulin sensitivity and glucose metabolism (Kurtz and Pravenec, 2004), it is likely that most patients with Type 2 diabetes would benefit from treatment with ACEIs and ARBs. The ADA also recommends lifestyle modifications or treatment with cholesterol lowering medications such as 3-hydroxy-3-methylglutaryl coenzyme A (HMG-CoA) reductase inhibitors (statins) to reach target cholesterol goals. Findings from the Heart Protection Study (Collins et al., 2003) and others (Colhoun et al., 2004; Sever et al., 2005) have led some experts to recommend that treatment with statins be routinely considered for all patients with Type 2 diabetes (American Diabetes Association, 2004; Armitage and Bowman, 2004).

Recent studies have found that a small proportion of individuals with Type 2 diabetes in the United States are achieving the target goals for blood pressure and cholesterol levels recommended by the ADA (Kerr et al., 2004; Saydah et al., 2004). To our knowledge, there are no similar reports of the extent of CVD risk or its management in patients with both Type 2 diabetes and SMI, which serves as the focus of this report.

METHODS

Sample and Setting

The present study was conducted within a larger investigation in which we recruited individuals with Type 2 diabetes including 100 patients with schizophrenia, 101 with a major mood disorder, and 99 without a serious mental illness (SMI). These participants were recruited between September 1, 1999, and September 30, 2002, and met the following inclusion criteria: (1) age 18 to 65 years, (2) current medical record diagnosis of Type 2

diabetes, (3) English-speaking, and (4) ability to provide informed consent. In addition, participants with both diabetes and SMI had either a diagnosis of a schizophrenia-spectrum disorder (schizophrenia or schizoaffective disorder) or a major mood disorder (bipolar disorder or recurrent major depressive disorder) recorded in their medical chart. Participants with diabetes but without SMI had not received treatment of a major psychiatric disorder within the last year as indicated in their medical record or in their screening interview.

Persons with diabetes and SMI were recruited from six public and private outpatient mental health clinics in urban and suburban communities across the Baltimore, Maryland, metropolitan area to represent the broad range of individuals receiving psychiatric treatment. One fourth of the entire sample consisted of VA patients recruited from the Baltimore VA Medical Center. Participants with diabetes but without SMI were recruited from three primary care clinics proximal to the psychiatric clinics as well as the VA to identify primary care clinic patients with a reasonable demographic match to the participants with schizophrenia. A more detailed description of the recruitment strategies for the mentally ill and nonmentally ill samples in the parent study is provided elsewhere (Dixon et al., 2004). The Institutional Review Boards of the University of Maryland School of Medicine and of each participating facility approved the study.

For the present study, we recruited a convenience sample of 50 diabetes patients with schizophrenia, 45 diabetes patients with a major mood disorder, and 48 diabetes patients without a mental illness who had participated in the parent study. We recruited participants from the parent study who agreed to be contacted for future related studies. Age, gender, race, and glycosylated hemoglobin (HbA1c) values did not differ between those who participated in this study and the original samples from the parent study. In the non-SMI group, participants in the current study had a shorter duration of diabetes (6.2 ± 6.9 years) compared with the original sample (8.5 ± 7.5 years; $p = 0.03$).

Assessments and Measures

The data used in this study were obtained from two assessments, one conducted as a part of the initial parent study (Dixon et al., 2004) and a second assessment conducted only for the participants in the current study. Participants provided written informed consent for all assessments. Data obtained as a part of the initial parent assessment included a patient interview in which we obtained information on demographic characteristics, diabetes-related factors (history, treatments, knowledge, beliefs, behaviors/self-care activities, service use), presence of and services or treatments used for co-occurring medical conditions (e.g., hypertension) and psychiatric disorders (SMI samples only), smoking status, and quality of life.

We also measured nonfasting HbA1c during this initial assessment. We obtained information on all medications prescribed at the time of this interview from medical records. Of particular interest for this study was whether participants were prescribed cholesterol-lowering HMG-CoA reductase inhibitors (statins), ACEIs, or ARB agents, all known to reduce cardiovascular events in diabetes patients.

Participants were also weighed and measured at the time of their initial assessment. Since the majority of the interviews occurred in clinical settings, on-site scales were used. In limited cases (<5%) in which a scale was not available, height and weight were obtained from the medical chart. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters. We classified subjects with a BMI ≤24.9 as normal weight, 25 to 29.9 as overweight, and ≥30 as obese.

We measured patients' blood pressure once during the initial evaluation with a portable, digital, self-inflating blood pressure cuff (a Sun Mark oscillometric sphygmomanometer with LCD digital display, automatic deflation, pulse calculation, and an accuracy of ±3 mm Hg or 2% for blood pressure and ±5% for pulse). Standards of medical care established by the ADA recommend a target blood pressure goal <130/80 mm Hg in patients with Type 2 diabetes (American Diabetes Association, 2004).

Measures of serum lipids and glucose for participants in the current study were collected by intravenous blood draw in the fasting state at a separate assessment following the initial evaluation, on average, 13.5 (±7.9) months after the initial assessment. The lipid profile (total, HDL, and LDL cholesterol, triglycerides) was measured using automated enzymatic spectrophotometry. The ADA recommends levels of LDL cholesterol below 100 mg/dl, HDL cholesterol levels above 40 mg/dl in men and above 50 mg/dl in women, and levels of triglycerides below 150 mg/dl (American Diabetes Association, 2004). Serum glucose measures were determined by using mass spectrophotometry.

We determined whether participants met the criteria for the metabolic syndrome established by the National Cholesterol Education Program (NCEP; Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults, 2001). Persons with the metabolic syndrome met three or more of the following criteria: (1) fasting plasma glucose ≥110 mg/dl, (2) serum triglycerides ≥150 mg/dl, (3) serum HDL cholesterol less than 40 mg/dl, (4) blood pressure ≥130/85 mm Hg, and (5) waist circumference >102 cm. Since we did not measure waist girth in this study, we substituted BMI ≥30 for this criterion, which is used in the World Health Organization's definition of the metabolic syndrome (Alberti and Zimmet, 1998) and has been validated for use in epidemiologic studies (Laaksonen et al., 2002).

Analytic Plan

We first compared the three patient groups on demographic characteristics and selected diabetes-related characteristics and treatments using an overall test of difference among the three groups. One-way ANOVAs were used for continuous items, and two-way χ^2 tests were used for categorical items. Significant overall tests were followed by either Tukey multiple comparisons for pairwise group differences or 2 × 2 χ^2 tests.

We then constructed dichotomous measures indicating whether each patient did or did not meet the ADA target goals for cholesterol (LDL, HDL, triglycerides) and blood pressure as described above. We used multiple logistic regression to test whether there were significant differences between diagnostic groups (schizophrenia versus no SMI; major mood disorder versus no SMI) in meeting ADA goals for cholesterol and blood pressure while controlling for demographic characteristics (age, gender, race). We used a similar analytic strategy to test for group differences on meeting criteria for the metabolic syndrome, as well as for prescription of statin medications and ACEIs or ARBs. Since we had data from the initial assessment on use of prescription medications and demographic characteristics on the original samples of diabetes patients with schizophrenia (N = 100), major mood disorders (N = 101), and no SMI (N = 99), we also report the results of the regression analyses of statins and ACEIs/ARBs using the larger samples from the parent study.

RESULTS

Description of the Study Samples

Table 1 displays and compares the demographic, diabetes, and other clinical characteristics of the diabetes patients with schizophrenia, a major mood disorder, and no SMI who participated in the current study. The diabetes patients with schizophrenia were younger than

those without a mental illness (49 ± 8 vs. 53 ± 9 years; $p = 0.015$), and the sample with both diabetes and schizophrenia consisted of fewer Caucasians relative to those with diabetes and mood disorders (24% vs. 58%; $p = 0.0017$). The three groups were similar in terms of gender and educational attainment. The three groups did not differ on duration of illness, treatment with oral hypoglycemic medications or insulin, hospitalization for diabetes in the past 6 months, or number of outpatient visits in the past 6 months for diabetes or other medical conditions (Table 1). All three groups were also similar in terms of their extent of blood glucose control as assessed by HbA1c and fasting plasma glucose measures. Notably, on average, all three groups did not achieve the ADA recommended target goals for blood glucose control (HbA1c: <7%, fasting glucose: ≤110 mg/dl). Table 1 also shows that the majority of each patient group was classified as obese, with mean (±*SD*) BMI values of 33 ± 7 for diabetes patients with schizophrenia and mood disorders and 36 ± 7 for those without a mental illness. A significantly larger proportion of diabetes patients with schizophrenia smoked (68%) relative to those with no mental illness (31%; $p = 0.0006$). Compared with those with diabetes and mood disorders, a larger proportion of patients with both diabetes and schizophrenia were prescribed any antipsychotic medication (98% vs. 38%; $p = 0.0001$).

Cholesterol and Blood Pressure Goals

Table 2 displays the proportions of each sample that achieved the ADA's target goals for cholesterol and blood pressure values and the mean (±*SD*) values for each measure. On average, about one half of the patients in each group had levels of LDL cholesterol, HDL cholesterol, and triglycerides that conformed to those recommended by the ADA. The adjusted odds of meeting ADA recommended goals for any measure of cholesterol was similar for diabetes patients with schizophrenia and mood disorders compared with diabetes patients without SMI (see Table 2 for odds ratios adjusted for age, gender, and race). Table 2 also shows the proportion of diabetes patients with schizophrenia (37%), a mood disorder (27%), and no mental illness (22%) who had a current blood pressure reading within ADA recommended standards. The adjusted odds of achieving the ADA recommended blood pressure goal were similar for diabetes patients with schizophrenia and mood disorders compared with diabetes patients without SMI (Table 2).

Metabolic Syndrome

We found that 54% of diabetes patients with schizophrenia, 64% with a mood disorder, and 71% of nonmentally ill diabetes patients met the NCEP definition of the metabolic syndrome. Compared with diabetes patients without mental illnesses, diabetes patients with schizophrenia (adjusted odds ratio [AOR]: 0.47 [0.19–1.16]; $p = 0.10$) and mood disorders (AOR: 0.62 [0.24–1.59]; $p = 0.32$) had similar odds of meeting criteria for the metabolic syndrome. Among the five possible criteria for the metabolic syndrome, the following proportions of diabetes patients with schizophrenia, mood disorders, and no SMI, respectively, met zero to one (12%, 20%, 8%), two (34%, 15%, 21%), three (26%, 27%, 33%), or four to five (28%, 38%, 38%) of the criteria.

Use of Medications

We observed that 20% of diabetes patients with schizophrenia, 16% with mood disorders, and 48% of nonmentally ill diabetes patients in the current study were prescribed cholesterol-lowering statin medications. Logistic regression analysis showed that diabetes patients with schizophrenia were only 29% as likely (AOR: 0.29 [0.11–0.77]; $p = 0.01$) and diabetes patients with mood disorders were only 14% as likely (AOR: 0.14 [0.05–0.44]; $p = 0.0007$) as those without SMI to receive a statin medication. When we repeated these analyses using the original sample of 300 diabetes patients, we observed results similar to those from the samples in the current study.

We also examined the proportion of each patient group prescribed ACEIs or ARBs. Whereas 44% of the non-SMI diabetes patients received treatment with ACEIs or ARBs, only 24% of diabetes patients with schizophrenia and only 22% of those with a mood disorder received these medications. Regression analyses did not reveal significant differences in the use of these medications in diabetes patients with schizophrenia (AOR: 0.43 [0.17–1.10]; $p = 0.08$) or mood disorders (AOR: 0.46 [0.18–1.19]; $p = 0.11$) relative to diabetes patients without SMI in the current study. Repeating the analyses in the original samples, we observed that 19% of diabetes patients with schizophrenia, 20% with a mood disorder, and 56% without a mental illness were prescribed these medications. Logistic regression analyses showed that diabetes patients with schizophrenia (AOR: 0.23 [0.12–0.44]; $p < 0.001$) and mood disorders (AOR: 0.39 [0.21–0.74]; $p = 0.004$) were significantly less likely than non-SMI diabetes patients to receive ACEIs or ARBs.

DISCUSSION

Despite convincing evidence that management of cardiovascular risk factors can reduce morbidity and mortality in patients with Type 2 diabetes, we found that cardiovascular risk is treated less aggressively in patients with both Type 2 diabetes and serious mental illnesses compared with nonmentally ill patients with Type 2 diabetes. Specifically, we found that less than one quarter of diabetes patients with schizophrenia and mood disorders were prescribed lipid-lowering statins and angiotensin-blocking medications compared with approximately half of diabetes patients without SMI. Recent large population-based studies of diabetes (Nau et al., 2004; Nau and Mallya 2005; Safford et al., 2003; Timpe et al., 2004) show the frequency of use of both cholesterol-lowering medications (approximately 40%) and ACEIs/ARBs (approximately 50%) to be generally comparable to that which we observed in our nonmentally ill sample with diabetes.

Although the rationale for treatment with both statins and ACEIs/ARBs is the attenuation of cardiovascular risk, emerging evidence suggests that cardiovascular events are reduced by these agents regardless of lipid levels or the presence of hypertension (Colhoun et al., 2004; Collins et al., 2003; Kurtz and Pravenec, 2004). Therefore, although the benefits of such treatments might be greatest in diabetes patients with more risk factors for CVD, current evidence suggests that extent of cardiovascular risk need not factor heavily into the prescribing decision. However, if clinicians' prescribing choices were based on patients' cardiovascular risk profiles, we would have expected patients with both diabetes and SMI to have fewer cardiovascular risk factors than those without SMI and diabetes, a hypothesis that was not realized in this study.

In contrast, we found that few diabetes patients, both with and without SMI, are achieving target goals for cholesterol and blood pressure recommended by the ADA. Our observations are consistent with other population-based (Kerr et al., 2004; Saydah et al., 2004) and clinic-based studies (Grant et al., 2005; Kennedy et al., 2005; Wexler et al., 2005) of the general population with Type 2 diabetes. Second, we found that similar and substantial numbers of diabetes patients with and without SMI in this study met criteria for the metabolic syndrome, a cluster of risk factors including elevated cholesterol and blood pressure along with obesity and hyperglycemia that has been associated with increased mortality overall and from CVD in men and heightened risk of CVD in women (Lakka et al., 2002). A third important consideration is that more diabetes patients with SMI smoked and were prescribed antipsychotics and other psychotropic medications with known metabolic adverse effects. These findings suggest that many diabetes patients with SMI may be at very high risk for cardiovascular events according to a recent classification established by the NCEP (Grundy et al., 2004). Very high-risk patients are those who have established CVD together with multiple risk factors (e.g., diabetes), severe and poorly controlled risk factors (e.g.,

smoking), or the metabolic syndrome, or who are hospitalized for acute coronary syndromes. Even more aggressive LDL lowering (<70 mg/dl) than that suggested by the ADA (<100 mg/dl) is recommended in these patients, but is unlikely to be achieved given the infrequent use of cholesterol-lowering medications that we observed in diabetes patients with SMI in our study.

Our data do not support the notion that inadequate management of cardiovascular risk in diabetes patients with SMI results from a lack of access to medical care services. Diabetes patients both with and without SMI had similar numbers of hospitalizations and outpatient visits related to diabetes over the preceding 6 months in our study. This finding is consistent with our previous work (Dickerson et al., 2003) and the work of Druss and Rosenheck (1998), who observed that patients with mental illnesses make relatively frequent use of general medical services.

Even if access to treatment is equitable for diabetes patients with SMI, our results suggest there are disparities with respect to the quality and appropriateness of diabetes care provided to these patients. Previous work provides support for this hypothesis, although the data are not completely consistent. For example, in a study of patients receiving care at VA centers, Druss et al. (2002) observed that patients with mental disorders, and particularly those with substance use diagnoses, were less likely to receive recommended preventive services (e.g., immunization and cancer screenings) than patients without psychiatric conditions. Similarly, Druss et al. (2000) found that patients with psychiatric disorders were less likely than patients without these conditions to receive specialized cardiac procedures following hospitalization for acute myocardial infarction in nongovernmental acute care facilities. However, a comparable study conducted in the VA revealed that patients with mental illnesses were equally as likely as other patients to receive cardiac revascularization procedures or beneficial medications (e.g., thrombolytic therapy, β-blockers, ACEIs, aspirin) following acute myocardial infarction (Petersen et al., 2003). More work is needed to understand if and how the quality of care for persons with SMI is deficient, as well as the role of particular care systems (e.g., VA) in reducing or exacerbating potential quality problems.

Other possible explanations for the observed disparities include clinicians' hesitance to prescribe additional medications to patients who may have difficulty adhering to complex treatment regimens. It may also be that patients' mental health needs take precedence over their medical needs or that there is an overemphasis on short-term diabetes outcomes such as controlling blood glucose that overshadow more long-term treatment goals such as reducing cardiovascular risk. We were not able to examine these possible explanations in the current study, but further investigation is warranted. The next steps in research in this area should also address some of the limitations of our study, including a relatively small sample size that precluded any efforts to examine the influence of antipsychotic medications or treatment setting on extent and management of cardiovascular risk. Further, we did not investigate whether any of the diabetes patients in our study possessed contraindications to treatment with statins or ACEIs/ARBs such as drug-drug or drug-disease interactions, although we know of no significant interactions between these agents and the primary treatments for schizophrenia or major mood disorders.

CONCLUSION

In summary, our findings suggest that enhanced efforts to improve control of blood pressure and cholesterol levels are warranted in all patients with Type 2 diabetes. However, since patients with SMI appear to be at higher risk for developing Type 2 diabetes, possess multiple risk factors for CVD and frequently develop the metabolic syndrome, and have

higher mortality rates from CVD relative to the general population, interventions to improve modifiable CVD risk factors that occur at disproportionately higher rates in these patients are sorely needed. Such efforts should be combined with education for both clinicians and patients regarding the availability of specific treatments known to reduce the risk of potentially debilitating cardiovascular events associated with Type 2 diabetes.

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References

Alberti KG, Zimmet PZ. Definition, diagnosis and classification of diabetes mellitus and its complications, part 1: Diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. Diabet Med. 1998; 15:539–553. [PubMed: 9686693]

Allison DB, Mentore JL, Heo M, Chandler LP, Cappelleri JC, Infante MC, Weiden PJ. Antipsychotic-induced weight gain: A comprehensive research synthesis. Am J Psychiatry. 1999; 156:1686–1696. [PubMed: 10553730]

American Diabetes Association. Economic costs of diabetes in the U.S. in 2002. Diabetes Care. 2003; 6:917–932.

American Diabetes Association. Standards of medical care in diabetes. Diabetes Care. 2004; 27(suppl 1):S15–S35. [PubMed: 14693923]

Armitage J, Bowman L. Cardiovascular outcomes among participants with diabetes in the recent large statin trials. Curr Opin Lipidol. 2004; 15:439–446. [PubMed: 15243217]

Brenner BM, Cooper ME, de Zeeuw D, Keane WF, Mitch WE, Parving HH, Remuzzi G, Snapinn SM, Zhang Z, Shahinfar S. RENAAL Study Investigators. Effects of losartan on renal and cardiovascular outcomes in patients with Type 2 diabetes and nephropathy. N Engl J Med. 2001; 345:861–869. [PubMed: 11565518]

Brown S, Inskip H, Barraclough B. Causes of the excess mortality of schizophrenia. Br J Psychiatry. 2000; 177:212–217. [PubMed: 11040880]

Colhoun HM, Betteridge DJ, Durrington PN, Hitman GA, Neil HA, Livingstone SJ, Thomason MJ, Mackness MI, Charlton-Menys V, Fuller JH. Investigators CARDS. Primary prevention of cardiovascular disease with atorvastatin in Type 2 diabetes in the Collaborative Atorva-statin Diabetes Study (CARDS): Multicentre randomized placebo-controlled trial. Lancet. 2004; 364:685–696. [PubMed: 15325833]

Collins R, Armitage J, Parish S, Sleigh P, Peto R. Heart Protection Study Collaborative Group. MRC/BHF Heart Protection Study of cholesterol-lowering with simvastatin in 5963 people with diabetes: A randomised placebo-controlled trial. Lancet. 2003; 361:2005–2016. [PubMed: 12814710]

Daumit GL, Clark JM, Steinwachs DM, Graham CM, Lehman A, Ford DE. Prevalence and correlates of obesity in a community sample of individuals with severe and persistent mental illness. J Nerv Ment Dis. 2003; 191:799–805. [PubMed: 14671456]

Daumit GL, Goldberg RW, Anthony C, Dickerson FB, Brown CH, Kreyenbuhl J, Wohlheiter K, Dixon LB. Physical activity patterns in adults with severe mental illness. J Nerv Ment Dis. 2005; 193:641–646. [PubMed: 16208158]

de Leon J, Dadvand M, Canuso C, White AO, Stanilla JK, Simpson GM. Schizophrenia and smoking: An epidemiological survey in a state hospital. Am J Psychiatry. 1995; 152:453–455. [PubMed: 7864277]

Dickerson FB, McNary SW, Brown CH, Kreyenbuhl J, Goldberg RW, Dixon LB. Somatic healthcare utilization among adults with serious mental illness who are receiving community psychiatric services. Med Care. 2003; 41:560–570. [PubMed: 12665719]

Dixon LB, Kreyenbuhl JA, Dickerson FB, Donner TW, Brown CH, Wohlheiter K, Postrado L, Goldberg RW, Fang L, Marano C, Messias E. A comparison of Type 2 diabetes outcomes among

persons with and without severe mental illness. Psychiatr Serv. 2004; 55:892–900. [PubMed: 15292539]

Dixon LB, Weiden P, Delahanty J, Goldberg R, Postrado L, Lucksted A, Lehman A. Prevalence and correlates of diabetes in national schizophrenia samples. Schizophr Bull. 2000; 26:903–912. [PubMed: 11087022]

Druss BG, Bradford DW, Rosenheck RA, Radford MJ, Krumholz HM. Mental disorders and use of cardiovascular procedures after myocardial infarction. JAMA. 2000; 283:506–511. [PubMed: 10659877]

Druss BG, Rosenheck RA. Mental disorders and access to medical care in the United States. Am J Psychiatry. 1998; 155:1775–1777. [PubMed: 9842793]

Druss BG, Rosenheck RA, Desai MM, Perlin JB. Quality of preventive medical care for patients with mental disorders. Med Care. 2002; 40:129–136. [PubMed: 11802085]

Engelgau MM, Geiss LS, Saaddine JB, Boyle JP, Benjamin SM, Gregg EW, Tierney EF, Rios-Burrows N, Mokdad AH, Ford ES, Imperatore G, Narayan KM. The evolving diabetes burden in the United States. Ann Intern Med. 2004; 140:945–950. [PubMed: 15172919]

Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). JAMA. 2001; 285:2486–2497. [PubMed: 11368702]

Grant RW, Buse JB, Meigs JB. Quality of diabetes care in US academic medical centers. Diabetes Care. 2005; 28:337–442. [PubMed: 15677789]

Grundy SM, Cleeman JI, Merz CN, Brewer HB Jr, Clark LT, Hunninghake DB, Pasternak RC, Smith SC Jr, Stone NJ. National Heart, Lung and Blood Institute, American College of Cardiology Foundation, American Heart Association. Implications of recent clinical trials for the National Cholesterol Education Program Adult Treatment Panel III Guidelines. Circulation. 2004; 110:227–239. [PubMed: 15249516]

Kennedy AG, Maclean CD, Littenberg B, Ades PA, Pinckney RG. The challenge of achieving national cholesterol goals in patients with diabetes. Diabetes Care. 2005; 28:1029–1034. [PubMed: 15855562]

Kerr EA, Gerzoff RB, Krein SL, Selby JV, Piette JD, Curb JD, Herman WH, Marrero DG, Narayan KM, Safford MM, Thompson T, Mangione CM. Diabetes care quality in the Veterans Affairs health care system and commercial managed care: The TRAID study. Ann Intern Med. 2004; 141:272–281. [PubMed: 15313743]

Kurtz TW, Pravenec M. Antidiabetic mechanisms of angiotensin-converting enzyme inhibitors and angiotensin II receptor antagonists: Beyond the renin-angiotensin system. J Hypertens. 2004; 22:2253–2261. [PubMed: 15614015]

Lakka HM, Laaksonen DE, Lakka TA, Niskanen LK, Kumpusalo E, Tuomilehto J, Salonen JT. The metabolic syndrome and total and cardiovascular disease mortality in middle-aged men. JAMA. 2002; 288:2709–2716. [PubMed: 12460094]

Laaksonen DE, Lakka HM, Niskanen LK, Kaplan GA, Salonen JT, Lakka TA. Metabolic syndrome and development of diabetes mellitus: Application and validation of recently suggested definitions of the metabolic syndrome in a prospective cohort study. Am J Epidemiol. 2002; 156:1070–1077. [PubMed: 12446265]

Lindenmayer JP, Czobor P, Volavka J, Citrome L, Sheitman B, McEvoy JP, Cooper TB, Chakos M, Lieberman JA. Changes in glucose and cholesterol levels in patients with schizophrenia treated with typical or atypical antipsychotics. Am J Psychiatry. 2003; 160:290–296. [PubMed: 12562575]

McCreadie RG. Diet, smoking and cardiovascular risk in people with schizophrenia: Descriptive study. Br J Psychiatry. 2003; 183:534–539. [PubMed: 14645025]

Nathan DM, Lachin J, Cleary P, Orchard T, Brillon DJ, Backlund JY, O'Leary DH, Genuth S. Diabetes Control and Complications Trial, Epidemiology of Diabetes Interventions and Complications Research Group. Intensive diabetes therapy and carotid intima-media thickness in Type 1 diabetes mellitus. N Engl J Med. 2003; 348:2294–2303. [PubMed: 12788993]

Nau DP, Garber MC, Herman WH. The intensification of drug therapy for diabetes and its complications: Evidence from 2 HMOs. Am J Manag Care. 2004; 10:118–123. [PubMed: 15005503]

Nau DP, Mallya U. Sex disparity in the management of dyslipidemia among patients with type 2 diabetes mellitus in a managed care organization. Am J Manag Care. 2005; 11:69–73. [PubMed: 15726854]

Newman SC, Bland RC. Mortality in a cohort of patients with schizophrenia: A record linkage study. Can J Psychiatry. 1991; 36:239–245. [PubMed: 1868416]

Osby U, Correia N, Brandt L, Ekbom A, Sparen P. Mortality and causes of death in schizophrenia in Stockholm County, Sweden. Schizophr Res. 2000; 45:21–28. [PubMed: 10978869]

Petersen LA, Normand SL, Druss BG, Rosenheck RA. Process of care and outcome after acute myocardial infarction for patients with mental illness in the VA health care system: Are there disparities? Health Serv Res. 2003; 38:41–63. [PubMed: 12650380]

Safford M, Eaton L, Hawley G, Brimacombe M, Rajan M, Li H, Pogach L. Disparities in use of lipid-lowering medications among people with Type 2 diabetes mellitus. Arch Intern Med. 2003; 163:922–928. [PubMed: 12719201]

Saydah SH, Fradkin J, Cowie CC. Poor control of risk factors for vascular disease among adults with previously diagnosed diabetes. JAMA. 2004; 291:335–342. [PubMed: 14734596]

Selvin E, Marinopoulos S, Berkenblit G, Rami T, Brancati FL, Powe NR, Golden SH. Meta-analysis: Glycosylated hemoglobin and cardiovascular disease in diabetes mellitus. Ann Intern Med. 2004; 141:421–431. [PubMed: 15381515]

Sever PS, Poulter NR, Dahlof B, Wedel H, Collins R, Beevers G, Caulfield M, Kjeldsen SE, Kristinsson A, McInnes GT, Mehlsen J, Nieminen M, O'Brien E, Ostergren J. Reduction in cardiovascular events with atorvastatin in 2,532 patients with Type 2 diabetes: Anglo-Scandinavian Cardiac Outcomes Trial-Lipid-Lowering Arm (ASCOT-LLA). Diabetes Care. 2005; 28:1151–1157. [PubMed: 15855581]

Stamler J, Vaccaro O, Neaton JD, Wentworth D. Diabetes, other risk factors and 12-yr cardiovascular mortality for men screened in the Multiple Risk Factor Intervention Trial. Diabetes Care. 1993; 16:434–444. [PubMed: 8432214]

Timpe EM, Amarshi N, Reed P. Evaluation of angiotension-converting enzyme inhibitor use in patients with type 2 diabetes in a state managed care plan. Am J Manag Care. 2004; 10:124–129. [PubMed: 15005504]

Wexler DJ, Grant RW, Meigs JB, Nathan DM, Cagliero E. Sex disparities in treatment of cardiac risk factors in patients with type 2 diabetes. Diabetes Care. 2005; 28:514–520. [PubMed: 15735180]

Wilson PW, D'Agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB. Prediction of coronary heart disease using risk factor categories. Circulation. 1998; 97:1837–1847. [PubMed: 9603539]

TABLE 1

Characteristics of the Study Samples With Type 2 Diabetes

	Schizophrenia and Diabetes (*N* = 50)	Major Mood Disorder and Diabetes (*N* = 45)	No SMI and Diabetes (*N* = 48)	Overall Comparison
Demographic characteristics				
Mean age (*SD*), y	49 (8)	52 (8)	53 (9)	$F = 3.18$, $p = 0.045$[a]
% Male	60%	44%	52%	$\chi^2 = 2.3$, $p = 0.32$
% Caucasian	24%	58%	35%	$\chi^2 = 11.70$, $p = 0.0029$[b]
% ≥High school education	66%	69%	69%	$\chi^2 = 0.12$, $p = 0.94$
Diabetes and other clinical characteristics				
Mean duration of diabetes (*SD*), y	8 (8)	8 (9)	6 (7)	$F = 0.95$, $p = 0.39$
% Prescribed insulin	24%	24%	21%	$\chi^2 = 0.21$, $p = 0.90$
% Prescribed oral hypoglycemic medication	80%	91%	85%	$\chi^2 = 0.65$, $p = 0.72$
% Hospitalized for diabetes in past 6 mo	6%	4%	8%	$\chi^2 = 0.61$, $p = 0.74$[c]
Mean *N* outpatient visits for diabetes in past 6 mo (*SD*)	3.8 (8.0)	3.3 (4.3)	2.8 (2.0)	$\chi^2 = 3.72$, $p = 0.16$[d]
Mean *N* outpatient visits for nondiabetes medical conditions in past 6 mo (*SD*)	2.2 (2.2)	2.4 (3.3)	2.4 (1.9)	$\chi^2 = 2.84$, $p = 0.24$[d]
Mean HbA1c (*SD*), %	7.9 (2.2)	7.7 (2.0)	8.7 (2.5)	$F = 2.63$, $p = 0.076$
Mean fasting glucose (*SD*), mg/dl	160.2 (73)	165.3 (81)	180.0 (110)	$F = 0.63$, $p = 0.53$
BMI				
% Normal weight (BMI ≤24.9)	10%	9%	6%	$\chi^2 = 7.87$, $p = 0.096$
% Overweight (BMI 25–29.9)	28%	31%	10%	
% Obese (BMI ≥30)	62%	60%	83%	
% Current smoker	68%	47%	31%	$\chi^2 = 13.4$, $p = 0.0012$[e]
% Prescribed any antipsychotic medication	98%	38%	NA	$\chi^2 = 37.7$, $p = 0.0001$

[a] Pairwise results: schizophrenia < no SMI, $p = 0.015$.

[b] Pairwise results: schizophrenia < major mood disorder, $p = 0.0017$.

[c] Fisher exact test.

[d] Kruskal-Wallis test used for skewed data.

[e] Pairwise results: schizophrenia > major mood disorder, $p = 0.058$; and schizophrenia > no SMI, $p = 0.006$.

TABLE 2

Comparison of ADA-Recommended Goals for Cholesterol and Blood Pressure Met by Three Patient Groups With Type 2 Diabetes (*N* = 143)

	Schizophrenia and Diabetes (*N* = 50)	Major Mood Disorder and Diabetes (*N* = 45)	No SMI and Diabetes (*N* = 48)
LDL cholesterol			
Mean (±*SD*) value	110.8 mg/dl (36 mg/dl)	110.0 mg/dl (46 mg/dl)	111.3 mg/dl (34 mg/dl)
% LDL <100 mg/dl	38%	51%	44%
AOR [95% CI]; *p* value[a]	0.87 [0.38–2.02]; 0.74	1.22 [0.52–2.86]; 0.64	Reference
HDL cholesterol			
Mean (±*SD*) value (men)	44.2 mg/dl (17 mg/dl)	44.9 mg/dl (11 mg/dl)	45.9 mg/dl (13 mg/dl)
Mean (±*SD*) value (women)	46.8 mg/dl (15 mg/dl)	47.2 mg/dl (11.8 mg/dl)	53.6 mg/dl (19 mg/dl)
% HDL ≥40 mg/dl (men) or ≥50 mg/dl (women)	44%	53%	60%
AOR [95% CI]; *p* value	0.49 [0.20–1.18]; 0.11	0.87 [0.36–2.14]; 0.77	Reference
Triglycerides			
Mean (±*SD*) value	147.0 mg/dl (71 mg/dl)	196.2 mg/dl (131 mg/dl)	199.3 mg/dl (116 mg/dl)
% Triglycerides <150 mg/dl	64%	47%	42%
AOR [95% CI]; *p* value	2.23 [0.92–5.42]; 0.08	1.72 [0.69–4.32]; 0.25	Reference
Blood pressure			
Mean (±*SD*) value (systolic)	131.7 mm Hg (21 mm Hg)	137.9 mm Hg (22 mm Hg)	135.9 mm Hg (23 mm Hg)
Mean (±*SD*) value (diastolic)	82.1 mm Hg (14 mm Hg)	84.1 mm Hg (13 mm Hg)	81.6 mm Hg (13 mm Hg)
% Blood pressure <130/80 mm Hg	37%	27%	22%
AOR [95% CI]; *p* value	1.86 [0.72–4.78]; 0.20	1.14 [0.41–3.12]; 0.80	Reference

[a]AOR adjusted for age, gender, race.