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The Impact of Substance Abuse on Osteoporosis Screening and Risk of Osteoporosis in Women with Psychotic Disorders

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Abstract

Osteoporosis is a major public health concern. Substance abuse and psychosis may be risk factors, however frequency of screening and disease risk in women with psychotic disorders and substance use disorder (SUD) remains unknown.

Methods—This study examined rates (FY 2005) of osteoporosis screening and disease risk in Medicaid enrolled women aged 50 to 64 (N=18,953). Four diagnostic groups were characterized: 1) Psychosis; 2) SUD; 3) Major mood disorder and 4) Controls. The interaction of psychosis and SUD on screening and disease prevalence of osteoporosis was tested.

Results—The prevalence of osteoporosis across the entire population was 6.7%. Four percent of those without an osteoporosis diagnosis received osteoporosis screening with no notable differences between psychosis and controls. Those with SUD, however, had a significant reduction in screening compared to controls (OR=0.61, 95% CI 0.40–0.91, p=0.016). Women with a major mood disorder were more likely to have osteoporosis in their administrative record (OR=1.32, 95% CI=1.03–1.70, p=0.028) compared to controls. Those who were dually diagnosed (SUD and psychosis) in the oldest ages (55–64 years) had a markedly higher prevalence of osteoporosis compared to controls (OR=6.4 CI 1.51–27.6, p=0.012), whereas this interaction (SUD and psychosis) was not significant in the entire population over age 49.

Conclusions—Osteoporosis screening in the Medicaid population is significantly lower for women with SUD, after adjusting for age, race and Medicaid enrollment category. The prevalence of osteoporosis appears markedly elevated in those with major mood disorders and those over age 55 dually diagnosed with schizophrenia and SUD.

Keywords

schizophrenia; osteoporosis; screening; bone mineral density; substance abuse; Medicaid; psychosis

Introduction

People who suffer from schizophrenia and other psychotic disorders have higher co-occurring physical disorders than the general population, with approximately 70% of people with psychosis having at least one medical comorbidity and 33% having three or more comorbid health disorders (1). Dixon et al (2) also reported that in people with schizophrenia, a greater number of current medical problems contributed to worse perceived physical health status, more severe psychiatric symptoms and greater likelihood of a history of a suicide attempt. People with psychotic disorders who abuse substances are at an even greater risk of general physical health problems (3). Approximately 50% of people with schizophrenia have substance abuse disorders (4) and Mackell et al (5) reported that substance abuse was one of the most significant predictors of poor physical health in people with schizophrenia. They found that preventive care for physical health is suboptimal in psychotic disorders and that those who receive less physical health care and substance abuse treatment reported the lowest scores on quality of life measures.

Women with schizophrenia and other psychotic disorders represent an underserved population with different treatment and physical health needs than men with these disorders. For example, women generally present with psychiatric symptoms at an older age, may have differences in metabolism of some medications (6), have more depressive symptoms, and often have different side effects with pharmacologic treatment as compared to men such as increased prolactin from dopamine antagonists (7). Additionally, compared to men, women have distinct physical health needs, including gynecologic, fertility and reproductive health care, hormonal changes associated with menopause and higher rates of breast cancer and osteoporosis (6). In a medical system in which general physical health care, care for health issues specific to women, mental health care, and substance abuse treatment have remained fragmented, physical health treatment for persons with schizophrenia--particularly gender specific care for women-- is often overlooked.

Osteoporosis and bone mineral density loss are significant physical health issues whose prevalence is highest in postmenopausal women. Osteoporosis and associated fractures are a significant public health concern because of related mortality, morbidity, disability and diminished quality of life (8–10). According to the National Osteoporosis Risk Assessment survey, 5–20% of women aged 50 years and older have osteoporosis (8). Osteoporosis is about 4 times more prevalent in women as compared to men (9–11). People with schizophrenia are considered a high-risk group for developing bone loss and osteoporosis, due in part to the illness itself and to multiple associated risk factors such as poor diet, low exercise, early menopause, and antipsychotic associated hyperprolactinemia (12–16). There is also evidence that osteoporosis and bone loss is greater in people who are smokers and who are substance abusing, both common in persons with psychotic disorders (17). Despite the many risk factors for osteoporosis present in women with psychosis, the frequency of osteoporosis screening in this population has not been studied; nor have there been studies of how the comorbidity of substance abuse effects screening and the risk of osteoporosis in this population (15).

This study was carried out using administrative Medicaid data from the State of Maryland to assess the impact of psychotic disorders and/or substance abuse on the rate of screening for osteoporosis or bone mineral density changes and the prevalence of osteoporosis in women with schizophrenia and other psychotic disorders compared to women without such disorders.

The primary aims of this study were: 1) to examine the rates of screening for osteoporosis in a Medicaid population among women with psychotic disorders, substance use disorders non-

psychotic major mood disorders, compared to controls without substance use disorder; and 2) to assess the prevalence of osteoporosis among the same groups of women.

Methods

Sample Selection

This study included a cross sectional sample from State of Maryland Medicaid database records for fiscal year (FY) 2005 (July 2004-June 2005), a recent representative year prior to the initiation of Medicare Part D. This administrative sample included Children's Health Insurance Program (CHIP) data from the State of Maryland. Medicaid/CHIP (hereafter: Medicaid) is an important context in which to evaluate somatic and coordination of care issues for women and persons with severe mental illness because the program covers disproportionate shares of both populations compared to other insurance plans (18).

This study included women between the ages of 50–64 years with 12 months of continuous Medicaid enrollment, and excluded women who were receiving Medicaid benefits for pregnancy and family planning services alone. Selection of the main study population from Medicaid records is summarized in Table 1. For this study, the presence of psychosis was defined by International Classification of Diseases (ICD) 9 codes 295, 297 or 298, and the presence of substance use disorder (SUD) was defined by the following codes: ICD-9 codes 291-2, 303-5 (except 305.1), 760.7, 965.0, 967, 968.5, 970.0, 980 or Diagnosis Related Group (DRG) codes 433–437 and procedural codes (local and national) for identifying methadone treatment or other outpatient substance abuse therapy. Major mood disorder was defined by ICD-9 codes 296 or 300.4 without the occurrence of psychosis or SUD; and finally, controls were identified as having no psychotic or major mood disorder and no record of SUD. From these definitions, each woman in the study could be assigned to one or both of the following diagnoses: Psychosis or SUD; or in the absence of those major diagnostic labels, the remaining subjects were placed either in a Major Mood Disorder category or a control group (i.e., a group without Psychosis, SUD, or Major Mood Disorders). These diagnostic labels (and all of the other variables reviewed for this study) were assigned using FY2005 Medicaid records only, no other years or other sources of administrative or clinical data were reviewed.

Screening and Diagnostic Definitions for Osteoporosis

Screening events for osteoporosis were defined by the presence of Healthcare Common Procedure Coding System (HCPCS), Current Procedural Terminology (CPT), or ICD-9 procedure codes specific to dual energy x-ray absorptiometry (DXA), or other bone density assessment procedures or osteoporosis screening specifically (code lists appear as footnote to Table 2). The diagnosis for osteoporosis is based on the presence of at least one claim during the year with the ICD-9 code (733.0) for that disease. That claim could occur anywhere in the person's administrative medical record, and need not be the incident diagnosis, e.g., it may alternatively represent a secondary report by a primary care physician delivering follow-up or other care. To increase sensitivity to unlabeled osteoporosis, we further isolated persons who during the year had experienced a bone fracture of pathologic origin (ICD-9 Code= 733.1) suggesting possible bone disease that could include osteoporosis. Because the latter may not be specific to osteoporosis, this proxy indicator is used only in sensitivity analyses.

Statistical Analysis

Regression Modeling—Logistic regressions (19, 20) were used to examine the odds of osteoporosis screening (or of the disease itself in separate modeling) during Maryland's fiscal year 2005 (July 2004 through June 2005) as a function of diagnostic grouping,

controlling for age, race and Medicaid eligibility category. The main statistical model used for this investigation was as follows:

$$\text{Ln (odds of screening or disease)} = \beta_0 + \beta_1 * \text{Psychosis} + \beta_2 * \text{SUD} + \beta_3 * \text{Mood} + \beta_4 * \text{Control} + \beta_5 * \text{Age} + \beta_6 * \text{Race} + \beta_7 * \text{Elig} + \varepsilon \quad (\text{equation 1})$$

Beta coefficients 1 through 4 captured the individual diagnostic effects using binary flags for the presence or absence of each diagnosis with potential overlap (simultaneity) between Psychosis and SUD. Equation 1 presumes that the effects of co-occurring Psychosis and SUD are additive, an assumption evaluated by testing whether adding a Psychosis*SUD interaction term contributes significance to model fit. Use of the interaction term allowed direct assessment of how the common co-morbidity between Psychosis and SUD altered the prevalence of screening (or osteoporosis). The presence of a significant interaction term in the regression modeling conducted here is consistent with a synergistic (i.e., more than just additive) effect between co-morbid psychosis and SUD. Absence of such a significant interaction term is instead consistent with individual Psychosis and SUD effects that are simply additive when they co-occur. An alternative model specification was also tested as follows:

$$\text{Ln (odds of screening or disease)} = \beta_0 + \beta_1 * \text{Diagnosis Category} + \beta_2 * \text{Age} + \beta_3 * \text{Race} + \beta_4 * \text{Elig} + \varepsilon \quad (\text{equation 2})$$

Parameters in equation 2 are as they are in equation 1 except that Beta 1 represents the effect of categorical changes among five mutually exclusive diagnostic groupings (i.e., psychosis only, psychosis and SUD together, SUD alone, and Mood disorder; with Controls as the referent). For this alternative specification, the psychosis and SUD together group is analogous to the interaction term for model, but this latter model has the disadvantage of not consider an of the dual diagnosis cases with regards to their individual effects.

Both of the dependent variables (odds of osteoporosis screening or disease) were analyzed with separate regression models. Both were dichotomous, i.e., they reflect either their presence or absence of the variable of interest. Modeling for both dependent variables used the same populations except for the fact that persons with osteoporosis (n=1,218), or those with osteoporosis or idiopathic bone fracture (n=1,264), were excluded from the screening analyses so as to focus on primary prevention. These models assumed a linear effect of age in years, which was treated as a continuous variable; models incorporating a quadratic (age-squared) term for age were also evaluated to test whether the estimated effects of diagnostic grouping were potentially altered by how the adjustment for age was specified.

Additional Modeling

Post Menopausal (Age 55–64): Similar follow-up analyses examined the age group of 55–64 years -- the oldest decade in which large numbers of women rely on Medicaid (rather than Medicare) as their principal source of health care coverage-- in order to focus upon a slightly more homogenous sample in which the percentage of menopausal women will be increased (compared to the full sample ages 50–64 years).

Pathologic Bone Fracture: Similar follow-up analyses also were carried out by altering our definition of osteoporosis to include pathologic bone fracture in the absence of any diagnostic record of osteoporosis. Though such inclusion decreases specificity (i.e., it may mistakenly capture other disease such as bone cancer), it simultaneously may increase our sensitivity to cases of osteoporosis that otherwise may not be visible in the Medicaid record. This expanded definition of osteoporosis increased our osteoporosis case counts by 4.6% (increased n by 56 cases).

Defining Race and Medicaid Eligibility—Subject race as recorded in the administrative record was grouped in three mutually exclusive categories (Black, White, or “Other”, the latter group including those whose race was unrecorded). White was used as the reference category for logistic regression modeling.

The eligibility variable was composed of five mutually exclusive groups: Families & Children (temporary cash assistance or medically needy categories), Dually Eligible (enrolled dually in Medicaid and Medicare), Long-term Care (LTC) (extended facility-based care for aged, blind, disabled groups), Disabled (as determined by state or federal programs), and all other enrollment categories (Other). The Families and Children category was used as the reference for the regression models. The Other category was small (N=160), but of potential importance as it is composed mostly (89%) of women enrolled in Medicaid because they have a history of breast or cervical cancer, conditions with treatments that increase the risk for osteoporosis (22). The Medicaid eligibility variable is an important co-variate in these analyses as a proxy of general health status: for example, individuals are classified as Disabled due to severe morbidity (often from mental illness). The status of dual eligibility for Medicare and Medicaid is distinctive from the other eligibility categories because in addition to marking disability, it further marks limited Medicaid coverage levels. Specifically, Part B of the Medicare program is likely to cover the majority of preventative screening for osteoporosis and thus the Medicaid record (the source of data for this review) would not reveal such screening.

All analyses were carried out using SAS® 9.1 (Cary, North Carolina). P-values <0.05 were considered significant. This study was submitted to the National Institute on Drug Abuse Institutional Review Board (IRB), the University of Maryland IRB and the Department of Health and Mental Hygiene (DHMH) IRBs and determined exempt due to the nature of the existing and deidentified data.

Results

Descriptive data

The sample is presented and described in Table 2. The overall observed prevalence of psychosis is 11.3% (2,143/18,953), higher than the general population (23), but not unexpected for an older Medicaid population with continuous enrollment (24). The fact that the population has continuous enrollment likely correlates with chronic disability status that can result from a serious mental disorder. The fact that they are older also means they are more likely to be engaged in Medicaid because of chronic disability since the program otherwise favors enrollment for pregnant women and children. The prevalence of a major mood disorder (3.7%, 704/18,953) is likely lower because it, per se, does not carry the same level of morbidity and inability to work as severe psychoses. Overall SUD prevalence in the population was 7.2% (1,366/18,953). If limited to those with psychotic disorders only the prevalence of SUD was 11.4% (245/2,143), and for those without psychosis or major mood disorder the prevalence was 6.9% (1,121/16,106).

Screening Rates for Osteoporosis

Overall 6.7% of the full sample of 18,953 was screened for osteoporosis during FY 2005, but only 4.0% of the sample without an osteoporosis diagnosis or a pathologic bone fracture (N=17,679) was screened during this time period. To focus upon true primary prevention (e.g., asymptomatic) screening rates, the sample without osteoporosis is the principal one reviewed with regard to screening. Logistic regression modeling for osteoporosis screening (see Table 3) demonstrated significant results ($p < 0.0001$), but fit statistics indicated only slightly above 1 percent of the variance was characterized by this modeling. This model

found that the prevalence of screening was not lower in those with psychosis ($p=0.60$) or major mood disorders ($p=0.86$) compared to the control group, and no significant interaction was observed between psychosis and SUD ($p=0.50$). However, people who have a SUD (with or without co-occurring psychosis) were 39% less likely than controls to be screened for osteoporosis ($OR=0.61$, 95% CI 0.40–0.91, $p=0.016$) after adjusting for the covariates in this model. Those who are Black were less likely to be screened than White subjects ($OR=0.67$, 95% CI=0.57–0.79, $p<0.0001$). Patients enrolled in Medicaid eligibility as Dually Eligible, Disabled or “Other” were likely to be screened at higher rates than those in the Families and Children categories. The effect of age (or Age²) was not statistically significant, possibly because of the restricted age range included in the sample; whether age was modeled with a linear or quadratic term did not substantially alter the results regarding relative risks (OR) comparing the diagnostic groups. Excluding the 56 persons with pathologic bone fracture from the models for osteoporosis screening did not change the results in any remarkable way.

Mutually Exclusive Modeling—The mutually exclusive diagnostic group analysis (equation 2 in the methods) was similar regarding overall fit and individual effect sizes and probabilities to the analyses presented in Table 3, showing that the only diagnostic group different from the controls was the SUD group alone, for whom the odds of screening were decreased ($OR=0.58$, 95% CI: 0.36–0.88, $p=0.011$). The group with both psychosis and SUD did not demonstrate significantly reduced screening rates, though the point estimate was consistent with reduced odds compared to controls ($OR=0.82$, 95% CI: 0.38–1.75, $p=0.61$).

Analysis of Ages 55–64 (Post Menopausal)—For the subset of women with ages 55–64 years old ($n=11,237$), odds ratios for diagnosis group were similar to those in the full 50–64 year old sample, but none of the diagnostic group effects, including that for SUD ($OR=0.65$, CI=0.37–1.15, $p=0.14$), were statistically significant. Other findings were analogous to previously describe models except that the Disabled and Dual eligibility categories did not differ significantly from other eligibility groups ($p>0.27$).

Prevalence of Osteoporosis

Overall osteoporosis/pathologic bone fracture prevalence was 6.7% during FY 2005, whereas the diagnosis of osteoporosis alone was found in a slightly smaller proportion of women included in this study (6.4%). Table 4 summarizes the logistic regression results using the osteoporosis diagnosis alone as the binary outcome of interest. The overall model was significant ($p<0.0001$), but fit statistics indicated that only slightly above 4 percent of the variance was accounted for by this main model. This modeling revealed similar rates of osteoporosis between those with psychosis in the absence of SUD compared to controls ($OR=0.90$, 95% CI 0.73–1.12, $p=0.35$) after adjustment for the other covariates. However, women with major mood disorders were significantly more likely to have osteoporosis compared to the control group ($OR=1.37$, 95% CI=1.070–1.76, $p=0.013$). Compared to the Families and Children eligibility category, all other eligibility categories were associated with significantly heightened risk for osteoporosis— a finding that likely reflects fact that overall morbidity is, by eligibility definition, heightened in these categories of Medicaid enrollees compared to the women who compose the vast majority of the Families and Children category. Increasing age was associated with increased risk of osteoporosis ($OR=1.040$, 95% CI= 1.025–1.054, $p<0.0001$), and Black race was associated with markedly decreased risk ($OR=0.40$, 95% CI: 0.35–0.45, $p<0.0001$). No significant interaction between psychosis and SUD for this modeling was apparent ($OR=1.66$, 95% CI: 0.57–4.89, $p=0.35$). Choice of linear or quadratic terms when adjusting for age did not substantially alter relative risk (odds ratios) of osteoporosis among diagnostic groups. An

age² specification was significant, but no more so than the linear form of this variable (OR=1.00034, 95% CI=1.00021–1.00046, chi-square= 29.5, p<0.0001). Pathologic bone fracture as an indicator of osteoporosis (i.e., as an indicator for the dependent variable for this analysis) did not alter the results in any remarkable way

Mutually Exclusive Modeling—The mutually exclusive diagnostic group analysis (equation 2 in methods) was similar regarding the overall fit and individual effect sizes and probabilities to the results presented in Table 4. Again, only the mood disorder diagnosis was significantly increased compared to controls with regards to the odds of osteoporosis after adjusting for the covariates in the model (OR= 1.44, 95% CI: 1.11–1.86, p<0.0001). The group defined as those with both psychosis and SUD was not different from the control group (p>0.28). Age² specification did not add to the overall fit or individual effect significance levels for that variable or other variables in the model.

Analysis of Age 55–64 (Post Menopausal)—Results of analyses restricted to those age 55–64 years were distinctive enough from the broader sample to comment about them in some detail. This older sample, despite the reduced size of 12,100 observations and only a slightly increased osteoporosis prevalence of 7.1% led to a significant interaction term demonstrating that those with psychosis and SUD together are more likely to have a diagnosis of osteoporosis than controls (OR=6.4, 95% CI: 1.51–27.6, p=0.012). Such an interaction effect was not apparent in the full population studied suggesting that it may be unique to the slightly older subgroup, which presumably would include a higher proportion of post- or peri-menopausal women. Other diagnostic effects in the age 55–64 sample were not significant except for the mood disorder group (OR=1.42, 95% CI: 1.023–1.96, p=0.036)- a finding that was consistent in magnitude and direction with results from the larger population (see Table 4). The prevalence of elevated osteoporosis risk in the dually diagnoses population is consistent across race and eligibility categories (data not shown). Other point estimates in the age 55–64 group were not remarkably different from the full population modeling.

Discussion

To our knowledge this is the first report to examine the impact of SUD on screening for osteoporosis and the frequency of osteoporosis diagnosis in women with schizophrenia and other psychotic disorders. Osteoporosis screening and treatment is essential as bone fracture is a significant clinical and economic concern. Twenty percent of people in the US sustaining an osteoporotic hip fracture die within 1 year, another 20% become permanently disabled, and 50% can no longer walk without assistance after the event (11). These associated costs of osteoporosis-related fractures and repair are estimated to cost 17 billion dollars in the US alone (25).

Overall, we found a low rate of osteoporosis screening in the Medicaid population as a whole. Just 4% of our Medicaid sample of women aged 50 years and older without any record of osteoporosis received osteoporosis screening within a one-year period. It should be noted that such screening is not necessarily indicated for all women who are peri- or even post-menopausal. Instead the clinical focus for such screening is placed upon women with various risk factors especially including atraumatic fractures, but others such as smoking or the presence of diabetes (26). From our administrative data, we could not accurately define the subset of women who had these clinical indicators. Many people do not begin screening until the age of 60 or 65; however, people with severe mental illness or substance abuse have many risk factors that indicate earlier screening age targets (11). In one study of women over the age of 66 years, population screening rates were reported on the order of 9 to 20% (depending upon Medicaid or Medicare engagement, and the presence or absence of

diabetes) (27). Such population screening rates seem consistent with the observations in our study given the fact that our population is younger and thus less likely to require or be referred for screening, and additionally given the fact that the rates for the study just cited were based on a 2-year follow-up whereas ours were based on a single year follow-up.

In this study we found that, in the absence of substance use disorder, rates of screening for osteoporosis were comparable among women with schizophrenia and other psychosis, women with major mood disorders, and the control population (Table 3). One small study (N=46 schizophrenia and N=46 controls) in a VA population aged 45–64 found similar rates of screening in the two groups, but that people with schizophrenia had significantly lower rates than controls of medication prescription for prevention and treatment of osteoporosis (28). In our study, people with SUD in the absence of other major psychiatric conditions had a 39% lower likelihood of receiving screening. From the administrative data we assembled, we could not determine whether this reduction in screening occurs because clinicians fail to recommend the test to this population, fail to follow-up on that recommendation, or due to other factors. Nevertheless, our data indicate that SUD per se appears to correlate with reduced utilization of screening.

Our study did not find that the prevalence of diagnosed osteoporosis was elevated in the psychosis group compared to controls (Table 4). Other studies in similar populations have found higher rates of osteoporosis. For example, a recent study which used broadband ultrasound attenuation found that bone mass in women with schizophrenia under age 50 was significantly lower than healthy controls; however, broadband attenuation values were similar in groups in those over 50 years (15). A study by our group found that bone mineral density as measured by dual-energy x-ray absorptiometry (DXA) is also lower in middle-aged women with schizophrenia than in same-age healthy controls (14). However, substance use was not examined in these reports. Though not observed as a significant finding in our full population age 50–64, our post-hoc analysis of women age 55–64 found that SUD might significantly impact osteoporosis prevalence. For those oldest subjects, there was more than a 6-times increase (OR=6.7) in the observed prevalence of osteoporosis for the group with the diagnosis of psychosis and SUD together, although the psychosis or substance use diagnoses alone demonstrated no such increased prevalence.

Alcohol and drugs of abuse have been associated with an increased risk of osteoporosis and fracture (29, 30), particularly in the older population (31). In a Swedish study 20% of all patients with hip fracture during a two-year period were in people with alcohol and drug abuse (32). Furthermore, early menopause is associated with a greater risk of osteoporosis, and drug use has been found to be associated with a 2.6 fold increased risk for early menopause (33). Amenorrhea from prolactin elevating antipsychotics has also been suggested to increase osteoporosis risk in women with schizophrenia and long term cumulative exposure may explain the higher risk in the older ages. However, because we did not observe a significant risk of osteoporosis in the non-SUD psychotic disorders group, this may suggest that comorbid substance use plays a significant role and may partially explain the higher rates of bone loss seen in other studies where substance use was not reported (12, 16, 34). Whatever the explanation, the convergence of both the diagnosis of schizophrenia and substance use in our subpopulation of women age 55–64 correlates with elevated risk of osteoporosis. Consistent with this apparent life-stage finding, we have recently completed another study using dual-energy x-ray absorptiometry (DXA) in older (> 50 years) patients and found that those who smoke or are alcohol dependent had a significantly greater bone mass loss (17).

Other interesting findings of the current study include the following. First, women of Black race were significantly less likely to receive screening for osteoporosis, as has been reported

previously (35, 36), yet were also less likely to be diagnosed with this disorder. There is evidence to suggest that Black women are at a decreased risk for osteoporosis and our findings parallel these reports (37, 38). It is not clear however if the decreased prevalence noted in our study is an artifact of decreased screening or truly represents a lower risk in this population. Regarding race, it is noteworthy that the apparent prevalence of major mood disorder in Black women was substantially lower than in White women (209/9690, 2.2% versus 456/7968, 5.7%; Table 2). This project was not designed to evaluate diagnostic racial disparities, however this finding is interesting in view of previously observed disparities in treating and possibly diagnosing mood disorders in minority populations (39). Lastly, although prevalence of screening was similar among patients with mood disorders and controls (Tables 2 and 3), risk of osteoporosis was significantly elevated in those with mood disorders (see Table 4). People within this diagnostic category were 37% more likely to develop osteoporosis compared to the control group. This diagnostic group may be at increased risk of osteoporosis that may be related to other mechanisms than those associated with substance use or psychotic disorders (40). Osteoporosis in women with mood disorders might be elevated due in part to hypercortisolemia and maintaining a hyperadrenergic state (41, 42), or increases in interleukin 6, one of the most potent known bone resorption factors. Additionally, recent evidence suggests that antidepressants also may contribute to risk of osteoporosis (43). It should finally be noted here that reverse causality may be partially in play regarding this observed association, i.e., that osteoporosis may lead to depression because the disease is associated with deteriorating physical health.

A limitation of our study is that our estimate of prevalence rates for osteoporosis comes from administrative records of treatment, rather than direct screening of the entire sample, and thus could potentially miss large numbers of undiagnosed cases. Thus, we would interpret the apparently similar prevalence of osteoporosis (Table 4) in women with SUD and controls, despite lower screening rates (Table 3), as a signal that osteoporosis is likely under-diagnosed in women with SUD. Prevalence of osteoporosis is higher in women with mood disorders compared with controls even while screening rates are comparable in both groups. This may reflect appropriate and targeted testing, or it might, again, suggest that the mood disorder group may have a true prevalence of osteoporosis that is even higher than reported, due to inadequate screening in this high risk group. Accordingly, Medicaid records are not as sensitive to prevalence as epidemiologic survey data that typically have higher potential to obtain untreated or otherwise undisclosed pathology. The apparent prevalence of substance use in this population of women age 50–64 was 7.2%, of whom 11% had co-morbid diagnoses of psychosis. While the overall population rate (7.2%) is on par with epidemiologic studies including younger adults, the rate of substance use as a co-morbidity to psychosis was only 11.4%—lower than the 50% lifetime prevalence anticipated (44). In Medicaid reporting, the principal disease (psychosis) and its treatment may eclipse reporting of comorbid substance abuse because it is not relevant to reimbursement expectations. In addition, formally diagnosed SUD is known to be lower than the actual rates of such illness (45). The Epidemiological Catchment Area (ECA) study reported a prevalence of 6.1% for drug/alcohol abuse and dependence in the general population (46) and the most recent National Comorbidity Survey reported 3.8% for drug/alcohol abuse or dependence (47) similar to what we have observed here. In evaluating our reported prevalence of the co-morbid substance abuse and psychosis, it is important to keep in mind that our derived rates are annual and not life-time prevalence figures. Our figures furthermore reflect late-life prevalence and therefore may seem lower than expected (42, 43). While lifetime alcohol use rates have been reported to be as high as 77% in schizophrenia, at any point in time, current prevalence of alcohol abuse or dependence is generally reported to be around 20% (48, 49). Occasional and lifetime use would not necessarily be included in administrative data as it, by design, emphasizes contemporary diagnostic and treatment events.

Another limitation to this study is the fact that the logistic regression model results predicted only 1 and 4 percent of the variance regarding screening or osteoporosis rates, respectively. Though significant, much remains unexplained regarding who received screening or who is at risk for disease. For example, we were unable to control for obesity, smoking status, diet, exercise and other unknown factors in this analysis, but this type of information is difficult to gather in even a prospective design. Medication use, particularly antipsychotic exposure and prescriptions for treatment (e.g., biphosphonates) were not analyzed. Future work would benefit from considering such ancillary and direct treatment variables. Lastly, although the majority of people with schizophrenia and psychotic disorders in the US are receiving Medicaid benefits (18), generalizability of these findings across groups is questionable because the sample size of the control group was considerably larger than the diagnostic groups, and some of the diagnostic groupings were quite small. Finally, it remains unclear if SUD leads to lower rates for all preventive health screening or if this is specific to DXA and other bone density scanning. There is little published literature on this topic in an SUD population and more research is needed in this area.

In conclusion, screening rates for osteoporosis in people with schizophrenia are low but do not differ from the general population of those on Medicaid. However, this population may be at greater risk if they are substance users/abusers, thereby increasing the potential need for screening for such persons. Additionally, screening rates for those with substance abuse problems in isolation also appear to be below those for most other Medicaid enrollees. Accordingly, it appears that efforts should be made to increase osteoporosis prevention and treatment in those with substance abuse problems and especially in those who also have comorbid psychosis (50, 51). The higher rates of diagnosed osteoporosis among older women with major mood disorders indicate that this group, also, may require more extensive screening.

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Table 1Medicaid Study Population For Fiscal Year 2005^a

Population	Count
All Medicaid enrollees	822,451
Women only	494,025
12 months of Medicaid enrollment	325,338
Age 19–64 years	130,462
Exclude pregnant women ^b	108,751
Exclude Pharmacy Assistance ^c	107,144
Exclude Family Planning ^c	66,520
Older adults: age 50 to 64 years	18,953
Those with no record of osteoporosis ^d in the study year	17,679

^aThe fiscal year runs from July '04 to June '05.

^bAny indication of pregnancy during the year led to an exclusion.

^cLimited Medicaid benefits

^dOsteoporosis exclusions = 1,218; and pathologic bone fracture in absence of an osteoporosis diagnoses (ICD-9= 733.1) exclusions = 56. Absence of an osteoporosis diagnostic record for women with such bone fractures may reflect osteoporosis-related or some other pathology, it is included here to increase sensitivity regarding the detection of osteoporosis, though it simultaneously decreases specificity for that disease.

Table 2

Characteristics and Prevalence of Osteoporosis Screening or Osteoporosis by Diagnosis Group^a, Medicaid Women Age 50–64 years (N=18,953)^b. Annual counts and rates reported for 2005.

Characteristic	PSY (N=1,898)		PSY/SUD ^c (N=245)		SUD (N=1,121)		MMD (N=704)		Control (N=14,985)	
Age, years (mean, s.d)	56	4.3	54	3.7	55	3.8	56	4.1	57	4.3
	n	%	n	%	n	%	n	%	n	%
RACE										
White	921	49	87	36	349	31	456	65	6,155	41
Black	887	47	151	62	740	66	209	30	7,703	51
Other	90	5	7	3	32	3	39	6	1,127	8
Eligibility										
Disabled	951	50	146	60	777	69	401	57	7,282	49
Long-Term Care	119	6	14	6	23	2	20	3	264	2
Dual eligible	816	43	81	33	248	22	263	37	6,669	45
Families & Children	11	1	4	2	72	6	13	2	620	4
Other ^d	1	0.05	0	0	1	0.09	7	1	150	0.9
Screening & Diagnoses										
Received osteoporosis screening ^e	131	7	13	5	41	4	58	8	1,041	7
Osteoporosis (ICD-9 = 733.0)	118	6	17	8	55	5	71	10	957	7
Pathologic bone fracture/ no record of osteoporosis (ICD-9 = 733.1)	4	0.2	2	0.8	5	0.4	1	0.1	44	0.3

^aPSY= psychosis only; SUD= substance use disorder; PSY/SUD= both psychosis and substance use disorder

^bExcludes women receiving pregnancy/Family planning services only

^cPSY/SUD group was not included as a primary group in the analysis but is shown separately here for descriptive purposes.

^dEighty-nine percent in this category are women with cervical or breast cancer, the remaining few are aliens with emergencies (4%), and persons receiving partial benefits from both Medicare and Medicaid (7%).

^eCurrent Procedure Terminology code in the following list: 76075, 76076, 77080, 77079, 76070, 76071, 76078, 76977, 77075, 77076, 77078, 77083, 78350, 78351, 77080–77083, or ICD-9 code is 88.98 or V82.81, or Healthcare Common Procedure Coding System Code = G0130.

Table 3

Logistic Model Results: Predictors of Osteoporosis Screening, Medicaid Women Age 50–64 Years *. (N=17,679), those with osteoporosis excluded from sample; screening rate = 4.2%.

Characteristic	OR	95% CI	chi-square (df=1)	P-value
Diagnosis (OR relative to controls)				
Psychosis	1.071	0.82–1.38	0.28	0.60
Substance Use Disorder	0.61	0.40–0.91	5.84	0.016
Major Mood Disorder	1.033	0.72–1.49	0.030	0.86
Race (OR relative to white)				
Black	0.67	0.57–0.79	24	<0.0001
Other	1.063	0.80–1.41	0.18	0.67
Eligibility (OR relative to Families & Children)				
Long-term Care	0.58	0.22–1.52	1.2	0.27
Dual eligible	1.70	1.00–2.88	3.80	0.051
Disabled	1.70	1.01–2.88	3.92	0.049
Other	3.89	1.82–8.31	12.0	0.00050
Age (OR per one year increase in age) **	1.012	0.99–1.030	1.81	0.18

* Excludes women receiving pregnancy/Family planning services only

** Using Age² did not change this result. Psychosis*SUD interaction vs. control (OR=1.75, 95% CI: 0.34-8.9, Chi-square: 0.46, $p=0.50$). Accordingly, the model presented here does not include this parameter.

Table 4

Logistic Model Results: Predictors of Osteoporosis, Medicaid Women Age 50–64 Years * (N=18,953, disease prevalence= 6.4%).

Characteristic	OR	95% CI	chi-square (df=1)	P-value
Diagnosis (OR relative to controls)				
Psychosis	0.90	0.73–1.12	0.89	0.35
Substance use disorder	0.96	0.72–1.27	0.079	0.78
Major Mood Disorder	1.37	1.070–1.76	6.2	0.013
Race (OR relative to white)				
Black	0.40	0.35–0.45	191.2	<0.0001
Other	0.98	0.80–1.21	0.016	0.90
Eligibility (OR relative to Families and Children)				
Long-term care	2.33	1.25–4.34	7.01	0.0081
Dual eligible	2.22	1.34–3.69	9.45	0.0021
SSI/Disabled	2.15	1.30–3.56	8.76	0.0031
Other	3.057	1.50–6.24	9.43	0.0021
Age (OR per one year increase in age) **	1.040	1.025–1.054	29.8	<0.0001

* Excludes women receiving pregnancy/Family planning services only

** Age² specification did not enhance the fit of the model or offer greater explanatory power regarding the dependent variable (OR=1.00034, 95% CI=1.00021–1.00046, chi-square= 29.5, p<0.0001).

Psychosis*SUD interaction vs. controls (OR=1.66, 95% CI: 0.57–4.89, Chi-square=0.85 p= 0.35). Accordingly, this parameter was dropped from the final modeling summarized above.