Prevalence and Costs of Major Depression Among Elderly Claimants With Diabetes

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Finkelstein, E. A., Bray, J. W., Chen, H., Larson, M. J., Miller, K., Tompkins, C., Keme, A., & Manderscheid, R. (2003, February). Prevalence and costs of major depression among elderly claimants with diabetes. *Diabetes Care*, 26(2), 415–420.

Made available courtesy of American Diabetes Association:
http://dx.doi.org/10.2337/diacare.26.2.415

Abstract:

OBJECTIVE—To compare the odds of major depression among Medicare claimants with and without diabetes and to test whether annual medical payments are greater for those with both diabetes and major depression than for those with diabetes alone.

RESEARCH DESIGN AND METHODS—This retrospective analysis relies on claims data from the 1997 Medicare 5% Standard Analytic Files. Using these data, we statistically determined whether the odds of major depression are greater among elderly claimants with diabetes after controlling for age, race/ethnicity, and sex. We then used regression analysis on a sample of over 220,000 elderly claimants with diabetes to test whether payments for non-mental health-related services are greater for those with both diabetes and major depression (n = 4,203) than for those with diabetes alone.

RESULTS—Our findings indicate that the odds of major depression are significantly greater among elderly Medicare claimants with diabetes than among those without diabetes (OR 1.58 ± 0.05). We also found that elderly claimants with both diabetes and major depression seek treatment for more services and spend more time in inpatient facilities, and as a result incur higher medical costs than claimants with diabetes but without major depression. These results hold even after excluding services related to mental health treatment.

CONCLUSIONS—This analysis suggests that treatment for major depression among claimants with diabetes may reduce total medical costs if treatment results in a decrease in utilization for general medical services in the future.

Keywords: depression | Medicare | diabetes | cost | elderly

Article:

Diabetes and major depression are two costly chronic conditions of which prevalence continues to increase among Medicare claimants. The percentage of Medicare claimants with evidence of diabetes increased 41% between 1992 and 2000 and now exceeds 13% of claimants (unpublished data from the Centers for Medicare and Medicaid Services). Due to either heightened awareness or increased prevalence, the percentage of Medicare claimants with at least one claim with a diagnosis of major depression in any given year has also increased and now exceeds 2% (1). Moreover, annual Medicare payments for those with diabetes average $9,580 per claimant (in 1997 U.S. dollars), and annual payments for those with major depression average over $17,662 (1). These figures compare with an average of $5,057 for those without these conditions (1).

There are several reasons to suspect that the increasing prevalence rates of diabetes and major depression among Medicare claimants are related. It may be that individuals coping with any serious medical condition, including diabetes, are more likely to become clinically depressed. Because complications often increase with age, older individuals with diabetes may be even more likely to become depressed. It is also possible that the causality runs from depression to diabetes. Those with major depression may have less healthy diets and engage in limited physical activity, making them more susceptible to diabetes (2). This effect may also be attenuated with age. Major depression is also highly correlated with alcohol abuse, a presumed risk factor for diabetes (3).

Anderson et al. (4) conducted a meta-analysis on 42 studies comparing the prevalence of major depression among individuals with and without diabetes. They report that the odds of major depression among those with diabetes are roughly twice that of those without diabetes. Although none of the included studies focused specifically on the elderly, their results suggest that the increased prevalence of diabetes among Medicare claimants could be at least partly responsible for the increased prevalence of major depression.

Irrespective of causality, the costs associated with treating diabetes may be substantially greater for those with major depression. Major depression has been linked to hyperglycemia and poor blood glucose control (5), which may lead to physical complications that increase the cost of treating those with diabetes. DiMatteo, Lepper, and Croghan (6) note that individuals with major depression are less likely to follow prescribed treatment regimens. This noncompliance may take a variety of forms, including failure to follow dietary restrictions or take medication as indicated. Those with major depression are also more likely to abuse alcohol and drugs. Repercussions associated with each of these behaviors are more likely to occur later in life and may be especially evident among those with diabetes because of the adverse health consequences associated with noncompliance.

We have identified only two papers that quantify the increase in costs for those with both diabetes and major depression compared with those with diabetes alone. Ciechanowski et al. (7) rely on a sample of several hundred individuals with diabetes in a single health plan and show that those with greater depressive symptoms have between 51 and 86% higher costs. Egede et al. (8) use data from 825 individuals with diabetes who participated in the Medical Expenditure Panel Survey (MEPS) (85 of which report having major depression) and show that those with

both major depression and diabetes have 4.5 times greater annual health care expenditures than those with diabetes alone. Both studies rely on small samples and self-reported data, and neither focuses specifically on the elderly. Moreover, these studies compare total costs, which include the costs for mental health treatment. Regardless of whether major depression adversely affects an individual's physical health, total costs are expected to be higher for those with major depression due to the costs associated with mental health treatment.

In this analysis, we rely on an extremely large sample of nationally representative Medicare claimants to test whether the odds of having major depression are greater among elderly claimants with diabetes than among those without diabetes (1) and whether annual payments for general medical services (i.e., non-mental health-related services) are greater for those with both diabetes and major depression than for those with diabetes alone (2), suggesting that major depression adversely affects both the mental and physical health of elderly Medicare claimants. We then explored the causes of payment differences between the two groups.

RESEARCH DESIGN AND METHODS

Data

We used data from the 1997 Medicare 5% Standard Analytic Files (SAF), which include data for all covered services for over 2 million Medicare claimants. Because our focus is on the elderly, we limit the sample to claimants aged 65 and older. We also exclude claimants who at any point in the year were enrolled in a Medicare health maintenance organization or who did not have complete coverage for both physician and hospital services for all 12 months. These exclusions ensure that we have complete claims for the remaining 1.3 million claimants eligible to be included in the analyses.

Methods

Based on the diagnosis codes recorded on each claim, we identified three subsamples from the Medicare 5% files: claimants with evidence of diabetes and no evidence of major depression, claimants with evidence of major depression and no evidence of diabetes, and claimants with evidence of both diabetes and major depression.

Based on the algorithm presented by Hebert et al. (9), the following diagnosis codes are used to identify diabetes:

- 250: Diabetes Mellitus
- 357.2: Neuropathy in Diabetes
- 362.01: Diabetic Retinopathy NOS
- 362.02: Proliferative Diabetic Retinopathy
- 366.41: Diabetic Cataract

Claimants with at least one of the included codes for diabetes on any claim, whether as a primary or secondary diagnosis, are assumed to have diabetes. Similarly, we identify major depression by International Classification of Diseases (ICD)-9 diagnosis codes 296.2 and 296.3, which define either single or multiple episodes of major depressive disorder.

We computed the diagnosed annual prevalence of major depression among claimants with diabetes by determining the percentage of claimants with diabetes with at least one diagnosis for major depression. We similarly compute the diagnosed annual prevalence of major depression among claimants without diabetes by determining the percentage of all claimants without diabetes with at least one diagnosis for major depression. We then use a Cochran-Mantel Haenszel $\chi 2$ test to statistically determine whether the odds of major depression are greater among elderly claimants with diabetes after controlling for age, race/ethnicity, and sex. For a variety of reasons (e.g., misclassification and underreporting), the diagnosed annual prevalence rates are likely to be biased downward; however, as long as the bias is similar among those with and without diabetes, then the ratio of these rates represents an unbiased estimate of the odds of major depression among those with and without diabetes.

Total annual payments, which include Medicare payments, individual co-payments, and other third-party payments, for claimants with both diabetes and major depression are expected to be higher solely because of payments for services associated with treating the mental health condition. To account for this, the cost analysis focuses solely on payments for non-mental health-related services. Each claim is determined to be mental health related or non-mental health related based on the primary diagnosis on the claim.

Because differences in payments may be because of differences between samples, aside from the presence or absence of major depression, we compute payment differences via the following ordinary least squares (OLS) regression equation:

$$\ln(\text{payment}) = \beta_0 + \beta_1\ \text{MD} + \beta'\ \text{X} + \epsilon$$

where MD represents an indicator variable for major depression, and X represents a vector of variables indicating the presence of select comorbid conditions and demographic characteristics. We include three separate measures of payment: total annual payments for all non-mental health-related services, total annual payments for non-mental health-related physician services, and total annual payments for non-mental health-related inpatient services.

The comorbid conditions are a slightly condensed version of the set of comorbidity measures recommended for use with administrative data by Elixhauser et al. (10). Because everyone in the sample has positive annual payments by construction (i.e., they all have at least one claim indicating diabetes), and a small percentage of individuals have extremely large payments, the regressions are estimated using the natural logarithm of annual payments to minimize the undesirable skewness in the expenditure distribution (11). This approach minimizes the undesirable skewness in the expenditure distribution and also allows us to interpret the coefficients as the percentage change in payments associated with a one unit increase in each

independent variable. [The actual percentage change is equal to $\exp(\beta) - 1$, which is roughly equal to β when β is small.]

The coefficient on the major depression variable, $\beta 1$, measures the percentage change in average annual non-mental health-related payments for claimants with both diabetes and major depression compared with claimants with diabetes alone, after controlling for other demographic and comorbid conditions that might affect payments. Because major depression may be at least partly responsible for the presence of the comorbid conditions, we ran the regressions both including and excluding these variables.

Finally, because of differences uncovered in the initial regressions, we included three additional regressions, each with the same set of independent variables. The first is an OLS regression that uses the total number of non-mental health-related physician services received as the dependent variable. The second focuses on the probability of a non-mental health-related inpatient visit and is estimated using a logistic regression. The third is a negative binomial regression that uses the total number of non-mental health-related inpatient days as the dependent variable and is restricted to those individuals who had an inpatient visit. The negative binomial model is appropriate for count data models of this sort (12).

The first specification allows for assessing whether individuals with both diabetes and major depression have more non-mental health-related physician services than those with diabetes alone. The second and third specifications allow for assessing (1) whether those with both diabetes and major depression are more likely to have an inpatient visit and (2), if admitted, whether their length of stay is likely to be longer than those with diabetes alone.

RESULTS

Table 1 presents mean and median payments for non-mental health-related services, and demographic characteristics and comorbid conditions associated with the three subgroups. As shown in the table, mean payments are roughly twice as great and median payments are over three times greater for those with both diabetes and major depression. Although there are not major differences in average age or race, there are other differences that may be at least partly responsible for the payment differentials. Claimants with diabetes and major depression have, on average, more comorbidities than those in the other two subgroups, and they consistently have the highest rates for all of the included comorbidities.

Table 1—*Demographic characteristics by sample*

Variables	Claimants with diabetes (no major depression)	Claimants with major depression (no diabetes)	Claimants with diabetes and major depression
Number of claimants	218,245	19,619	4,203
Unadjusted annual non–mental health-related payments updated to 2001 dollars			
Mean	$10,358	$13,153	$25,360
Median	$2,453	$3,956	$11,445
Age (mean in years)	75.69	77.19	76.51
Initial reason for eligibility (%)			
Other than aged (disability or end-stage renal disease)	10.72	11.72	17.17
Sex (% male)	41.22	26.29	29.83
Race/ethnicity (%)			
White	82.95	92.98	85.87
Black	11.55	4.09	8.27
Hispanic	3.02	1.89	4.07
Other	2.48	1.04	1.78
Number of comorbidities (mean)	1.72	2.46	3.05
Comorbidities (%)			
Alzheimer's disease	5.84	22.08	24.24
Anemia	22.19	28.01	38.70
Asthma	5.68	7.36	9.41
Cancer	16.17	17.77	18.89
Cardiovascular disease	80.40	74.34	89.15
HIV/AIDS	0.07	0.05	0.16
Liver disease	0.45	0.37	0.78
Mental retardation or developmental disabilities	0.23	0.56	0.70
Neurological disorders	7.49	17.31	23.82
Nutritional disorders	18.19	25.21	38.87
Other mental health/substance abuse	18.45	71.27	75.46
Renal failure	5.44	3.42	9.66

The diagnosed annual prevalence of major depression among claimants with diabetes is 2.85% compared with 1.88% among claimants without diabetes (Table 2). The corresponding OR suggests that elderly claimants with diabetes are 1.58 times more likely to have major depression. A Cochran-Mantel Haenszel $\chi 2$ test (not reported) reveals that this difference is statistically significant after controlling for age, race/ethnicity, and sex ($P < 0.0001$).

Table 2—*Prevalence rates of major depression*

	Diagnosed annual prevalence rates of major depression		
	Claimants with diabetes (%)	Claimants without diabetes (%)	Adjusted OR
Overall	2.85	1.88	1.58 (95% CI 1.53–1.63)
By sex			
Male	2.08	1.26	1.65
Female	3.39	2.29	1.48
By race/ethnicity			
Black	2.06	1.18	1.75
Hispanic	3.81	2.36	1.61
White	2.95	1.94	1.52
Other	2.06	1.01	2.04
By age category (years)			
65–74	2.55	1.58	1.61
75–84	3.03	2.01	1.51
85+	3.51	2.61	1.34

In fact, major depression is consistently higher among claimants with diabetes than among claimants without diabetes in select age, race/ethnicity, and sex strata. Results also reveal that major depression is more common among women than men and Hispanics than whites, blacks, or claimants of other races, and the diagnosed annual prevalence rate of major depression increases with age.

Table 3—*Regression analysis to assess the impact of major depression on total payments, payments for physician services, and number of physician services received*

	Model 1 (dependent variable: non–mental health-related total payments)		Model 2 (dependent variable: non–mental health-related physician payments)		Model 3 (dependent variable: non–mental health-related physician services)	
Variables	Parameter estimate	*t* statistic	Parameter estimate	*t* statistic	Parameter estimate	*t* statistic
Intercept	6.22	617.87*	5.92	780.03*	12.48	42.39*
Major depression	0.19	10.98*	0.21	15.87*	14.38	28.32*
Other eligibility (disability or end-stage renal disease)	0.25	27.33*	0.09	12.25*	3.65	13.48*
Age 65 years	0.03	21.78*	0.02	24.10*	0.56	14.14*
(Age 65 years)^2	−0.001	−14.08*	−0.001	−26.02*	−0.03	−18.52*
Male	0.06	10.39*	0.08	17.19*	1.57	9.20*
Black	−0.05	−5.23*	−0.21	−30.69*	−5.61	−21.44*
Hispanic	0.05	2.94*	0.05	4.24*	2.27	4.75*
Alzheimer's disease	0.12	9.45*	−0.03	−2.77*	0.68	1.85
Anemia	0.59	82.95*	0.53	97.90*	24.86	119.31*
Asthma	0.55	45.21*	0.41	45.26*	16.24	46.05*
Cancer	0.70	91.13*	0.62	107.84*	18.60	82.90*
Cardiovascular disease	0.81	111.29*	0.56	101.58*	12.96	60.84*
HIV/AIDS	0.68	6.54*	0.44	5.60*	38.61	12.72*
Liver disease	0.57	13.65*	0.39	12.32*	15.88	13.08*
Mental retardation/developmental disabilities	0.05	0.90	−0.03	−0.78	3.48	2.10†
Neurological disorders	0.91	83.43*	0.46	55.87*	19.90	62.81*
Nutritional disorders	1.03	132.38*	0.54	92.22*	21.92	96.93*
Other mental health and substance abuse	0.60	76.66*	0.32	53.76*	11.42	49.68*
Renal disease	0.87	67.81*	0.58	60.36*	39.15	104.38*
Observations	224,639		222,655		222,655	
R^2	0.37		0.30		0.32	

*Significant at the 0.01 level; †significant at the 0.05 level.

In fact, major depression is consistently higher among claimants with diabetes than among claimants without diabetes in select age, race/ethnicity, and sex strata. Results also reveal that major depression is more common among women than men and Hispanics than whites, blacks, or claimants of other races, and the diagnosed annual prevalence rate of major depression increases with age.

Model 1 in Table 3 shows the regression results for non-mental health-related total payments. The coefficient associated with major depression (0.19) suggests that claimants with diabetes who also have major depression are associated with 21% ([exp(0.19) − 1]*100 = 21%) greater annual non-mental health-related payments. The coefficient increases to 1.13 when the comorbidity variables are excluded (results not reported); however, the fit of the model is reduced substantially with the exclusion of these variables, making these results suspect. The regression also reveals that a 1-year increase in age is associated with an average 3% increase in payments. Men are associated with larger payments, as are Hispanics and those whose initial reason for eligibility is not "age." As expected, all of the comorbidities positively impact payments.

The second specification focuses specifically on non-mental health-related payments for physician services. Among claimants with diabetes, major depression is associated with 23% greater payments for non-mental health-related physician services.

Model 3 focuses specifically on the total number of non-mental health-related physician services provided. Claimants with diabetes and major depression experienced an average of 14 additional non-mental health-related physician services in 1997. To put this result into perspective, a 65-year-old white female claimant with diabetes who aged into the system and had no evidence of the included comorbidities received ∼12 non-mental health-related physician services; this number jumps to 26 if there is also evidence of major depression. Table 4 presents results of the inpatient regressions. The statistically insignificant coefficient on the major depression variable in model 4 suggests that claimants with both diabetes and major depression are no more likely to have an inpatient non-mental health-related visit than claimants with diabetes without major depression. Model 5 includes only those claimants who had at least one inpatient non-mental health-related stay in 1997. The major depression coefficient reveals that total payments increase by 7% if the claimant also has evidence of major depression.

Table 4—*Regression analysis to assess the impact of major depression on the probability of an inpatient visit, inpatient payments, and inpatient length of stay*

	Model 4 (probability of inpatient non–mental health-related admission)		Model 5 (inpatient non–mental health-related payments)		Model 6 (inpatient non–mental health-related days)	
Variables	Parameter estimate	χ^2 statistic	Parameter estimate	*t* statistic	Parameter estimate	χ^2 statistic
Intercept	−3.25	18,478.47*	8.50	541.72*	1.34	6,286.32*
Major depression	−0.03	0.84	0.07	4.75*	0.16	119.14*
Other eligibility	0.29	294.03*	−0.02	−2.51*	0.08	70.52*
Age 65 years	0.03	125.61*	−0.006	−4.22*	0.01	51.96*
(Age 65 years)^2	−0.001	49.90*	0.0002	−3.16*	−0.0004	56.93*
Male	0.19	269.88*	0.13	20.29*	0.03	25.35*
Black	−0.18	107.05*	0.003	0.32	0.05	28.47*
Hispanic	−0.06	3.82	−0.10	−5.26	0.08	15.19*
Alzheimer's disease	0.04	2.83*	−0.06	−5.92*	0.03	6.23
Anemia	0.56	1,954.92*	0.26	38.94*	0.30	1,837.41*
Asthma	0.80	1,383.94*	0.10	9.73*	0.22	404.83*
Cancer	0.61	1,918.12*	0.13	17.52*	0.10	172.93*
Cardiovascular disease	1.26	4,790.36*	0.33	25.41*	0.39	748.86*
HIV/AIDS	0.39	3.59	0.21	2.60*	0.31	14.70
Liver disease	0.94	134.61*	0.11	3.42*	0.05	2.89
Mental retardation/developmental disabilities	0.11	1.18	−0.04	−0.74	0.06	1.31
Neurological disorders	1.17	3,612.10*	0.20	23.37*	0.38	1,919.49*
Nutrition	1.67	15,895.78*	0.26	39.03*	0.43	3,863.46*
Other mental health and substance abuse	0.84	3,676.41*	0.15	21.33*	0.24	1,056.72
Renal disease	0.87	1,350.71*	0.27	27.27*	0.33	1,054.04*
Observations	224,651		67,847		67,847	

*Significant at the 0.01 level.

The final model in Table 4 offers one explanation for the additional inpatient payments. The dependent variable in this regression is annual non-mental health-related inpatient days. Those with major depression have an average of 17% more non-mental health-related inpatient days.

CONCLUSIONS

Results indicate that the odds of major depression are roughly 1.6 times greater among elderly Medicare claimants with diabetes than among those without diabetes. In deriving this estimate, we assume that the probability that a person with major depression has a claim indicating this diagnosis is the same regardless of whether the claimant has diabetes. However, claimants with diabetes have substantially more contact with the health care system, which may increase the likelihood of a diagnosis of major depression. Under this scenario, the OR would be biased upward. However, our estimate is actually smaller than that reported by Anderson et al. (4).

We also test whether claimants with both diabetes and major depression are associated with greater non-mental health-related payments than claimants with diabetes without evidence of major depression. Unlike previous studies, we focus on payments for non-mental health-related services because these services are more likely to be associated with diabetes and are less likely to be associated with treatment for major depression.

We find that claimants with both diabetes and major depression have greater costs and utilization than claimants with diabetes without major depression. They seek treatment for more services, and, when admitted, spend more time in inpatient facilities than claimants with diabetes without

major depression. We also find that both the diagnosed annual prevalence of major depression and payments vary systematically by race/ethnicity. Hispanics had the highest rates of major depression, and blacks had the lowest rates. Hispanics were also associated with higher non-mental health-related payments than whites, and blacks were associated with lower payments. The motivation behind these differences is unclear.

Although Medicare data allow us to construct nationally representative estimates, we are limited to the information available on the Medicare claims data. Therefore, we cannot assess the causal relationship between diabetes and depression, nor can we identify individuals with diabetes and/or major depression who do not have a claim for these conditions. Because of the stigma and historically low reimbursement rates associated with mental illness, it is likely that the underreporting of major depression is greater than that of other health conditions. Additionally, a significant portion of health care utilization and costs for Medicare eligible claimants does not generate a Medicare claim under any circumstances (e.g., prescription drugs and other noncovered services); therefore, that information is not included in this analysis. We are also unable to compare long-term outcomes or costs for those who receive treatment for major depression with those who do not.

Even with these limitations, the results of this study are important. This analysis suggests a possible link between major depression and diabetes and that treatment for major depression may actually reduce costs if treatment results in a decrease in utilization for general medical services in the future. An obvious next step is to use panel data to try to assess the causal relationship between diabetes and depression and to compare long-term costs between claimants with both diabetes and major depression who do or do not receive mental health treatment. Future research should also focus on understanding racial and ethnic differences in the prevalence and costs of both major depression and diabetes.

ACKNOWLEDGEMENTS

Funding for this work was provided by the Substance Abuse and Mental Health Services Administration (SAMHSA) under contract number 280-99-0701. The views expressed in this paper are not necessarily those of SAMHSA or RTI.

The authors thank Susan Murchie for editorial review.

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