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Mental Illness, Traumatic Brain Injury, and Medicaid Expenditures

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Abstract

Objective— To estimate the rates of mental illness among Medicaid beneficiaries with traumatic brain injury (TBI) and associated Medicaid-paid expenditures.

Design— Retrospective claims-based calendar year data.

Setting— Claims data.

Participants— Medicaid recipients with diagnosed TBI and mental illness who received Medicaid services in 4 states in 1995.

Interventions— Not applicable.

Main Outcome Measures— Annual expenditures for total, inpatient, and noninpatient services, as derived from Medicaid personal summary files. Mental illness and TBI were identified by using *International Classification of Diseases, 9th Revision, Clinical Modification* codes recorded in Medicaid claims.

Results— Of a total of 493,663 Medicaid recipients, 3641 (0.7%) were diagnosed with TBI in the 4 states. Significant demographic and racial differences were found in the rates of TBI; 18% of patients with TBI were diagnosed with serious mental illness. People with TBI in the age group 40 to 49 years were more likely to have a mental disorder. There were significant differences in estimated total, inpatient, and noninpatient expenditures between those with and without mental illness. In general, those with serious mental illness had higher Medicaid-paid expenditures than those without any mental illness.

Conclusions— Psychiatric comorbidity in TBI increases the overall expenditures in this population. This increased cost is an important consideration in programming for those with TBI.

Keywords

Brain injuries; Comorbidity; Medicaid; Mental Health; Rehabilitation

Traumatic Brain Injury (TBI) is a significant rehabilitation and public health issue; it results in significantly reduced independence levels among affected persons and in increased costs of care for society. Each year, approximately 2 million people experience brain injuries[1]; 75,000 sustain significant and persisting disability.[2] In 1991, Max et al[3] estimated total national annual

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TBI-related costs at $37.8 billion, with 12% of expenditures going toward acute hospitalization, inpatient rehabilitation, and medical services.

A consensus of TBI outcome studies shows that patients usually recover a proportion of their initial functional and cognitive losses over time, although the degree of recovery is often not adequate to return to a premorbid lifestyle.[4] Persons with TBI often show considerable emotional and motivational disturbances.[5] These problems result from the injury itself, as well as from difficulties in coping with the residual deficits.[5,6]

Psychiatric comorbidity is an additional burden that complicates recovery beyond the cognitive dysfunction that is typical in TBI and challenges the coordination of care for these patients. Psychiatric illness after TBI is prevalent in both inpatient and outpatient settings, with both moderate to severe and mild TBI being associated with an increased risk of subsequent psychiatric illness.[7] The frequency of major depression after TBI has been reported to be 13% at 1 year postinjury,[8] 38% at 3 years postinjury,[9] 50% at 5 years, and 61% at 8 years.[10] Likewise, the incidence of anxiety disorders has been reported to range from 18% to 60%.[11–13] For anxiety disorders, where generalized anxiety disorder (GAD) was the most frequently diagnosed disorder, 1 study reported a 22% incidence[14] and another a 24% incidence of GAD in those with TBI.[9] Incidence rates reported in studies addressing substance abuse and TBI range from 28% to 32%.[15–17]

Mooney and Speed[18] concluded that although most patients with brain injury recover relatively quickly and return to pre-injury levels of function, recovery in a large group of such patients is much longer, more complicated, and frequently incomplete. The underlying factor in the prolonged recovery, that study argued, is related to psychiatric conditions that developed after the injury. Hibbard et al[10] have found that TBI is a risk factor for subsequent psychiatric comorbidities. Malaspina et al[19] completed a study that supports this assertion and reported that subjects with brain injury have higher rates of schizophrenia and other forms of mental illness, including schizoaffective disorder, bipolar disorder, depression, and substance abuse, than those without brain injury.

Despite the substantial impact of psychiatric and substance abuse comorbidity on care needs, there has been little work done on the economic impact of these diagnosed comorbidities in the TBI population on Medicaid or on the extent to which appropriate treatment is received for these conditions. By 1997, Medicaid was a major payer of mental health services across all states.[20] Medicaid covers the costs of inpatient psychiatric care[21] and, most important, Medicaid covers prescribed medication, a key component of mental health services.[20] A recent publication from the New York Traumatic Brain Injury Model System (TBIMS) points to the need for further work with patients with these dual diagnoses. However, this report does not discuss the financial impact that these patients exert on the health care system overall.[22] Gaining an understanding of the economic burden of TBI in the Medicaid population, where rates of Medicaid participation as high as 56.3% were found in a TBI population,[23] can assist in the program planning for this lifelong and potentially very costly disability, particularly when it is compounded with concomitant psychiatric disability. This is especially crucial because the literature shows that the rates of TBI are highest among those people with the lowest incomes.[24] Our study seeks to examine the effects of psychiatric comorbidity on those with TBI across 4 states by studying Medicaid expenditures.

State Medicaid Research Files (SMRF) that are based on Medicaid claims were used to examine patterns of diagnosed mental illness and annual Medicaid-paid expenditures among Medicaid recipients diagnosed with TBI in the states of Alabama, Georgia, New Jersey, and Wisconsin. In this article, we investigated whether there are sociodemographic or insurance differences in

the rates of mental illness, and we explored the relationship between mental illness and annual Medicaid expenditures among individuals with TBI.

METHODS

We used the following criteria to define our study population: aged 21 to 64 years, alive by the end of 1995, and enrolled for the full-year period in Medicaid. We excluded people who participated in managed care programs because these claims are not recorded in the SMRF files. We selected 4 states based on geographic diversity and limited penetration of Medicaid managed care. We identified 493,663 beneficiaries, of whom 96,866 were in Alabama, 186,875 were in Georgia, 128,887 were in New Jersey, and 81,035 were in Wisconsin. Across all 4 states, 0.7% (N = 3641) were diagnosed with TBI.

Measures

Traumatic brain injury—TBI was identified by using *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM) codes recorded in Medicaid claims and was defined according to the classification system used by the US Center for Disease Control and Prevention. As the most frequently used system for identifying TBI in Medicaid programming,[25] this classification system included the following ICD-9-CM diagnostic codes: 800.0 to 801.9 (fracture of vault of skull), 803.0 (other unqualified skull fractures) through 804.9 (multiple fractures involving skull or face with other bones), 850 (concussion), 851 (cerebral laceration and contusion), 852 (subarachnoid, subdural, and extradural hemorrhage after injury), 853 (other and unspecified intracranial hemorrhage after injury), 854.1 (intracranial injury of other unspecified nature with open intracranial wound), 950.1 to . 3 (injury to optic chiasm, pathways, and visual cortex), and 959.01 (head injury, unspecified).

Mental illness—Mental illness was classified into 3 categories: (1) those with serious mental illness (SMI), which included schizophrenia, schizoaffective disorder, manic depressive disorder, posttraumatic shock syndrome, panic disorder, severe forms of depression, and obsessive compulsive disorder; (2) those with other mental illnesses; and (3) those without any mental illness, following the system used by Kessler et al.[26] Substance abuse disorders were considered a separate category, rather than combining them with mental illness in this analysis.

Physical comorbidity—Physical comorbidity was assessed with the Charlson comorbidity index (CCI). The CCI is a risk-adjustment measure that is primarily based on ICD-9-CM diagnosis codes. It is a weighted index of 19 selected disease categories that are associated with mortality and other important health outcomes, with higher index representing more severe burden of comorbidity.[27,28] We classified comorbidity as absent (CCI score, 0), low (CCI score, 1–2), or severe (CCI score, > 2).

Annual expenditures by Medicaid—Annual expenditures by Medicaid were based on the actual amount reimbursed by each state's Medicaid program and were recorded in the personal summary files.

Types of expenditures were identified through the category of service recorded in the personal summary file. The mix of expenditures included the following categories: inpatient, out-patient and clinic, physician, institutional care, prescription drugs, home health, and other. Institutional care included skilled nursing facility (SNF) and intermediate care facility (ICF) mental health services for the aged (eg, people > 60y), ICF for the mentally retarded, ICF for all others (only applicable), and all other nursing facility services. Other services included charges for other dental practitioners; family planning; laboratory and radiography; Medicaid's Early and Periodic Screening, Diagnosis, and Treatment Program; rural health services; other services;

premium payment; durable medical equipment (DME) and supplies; case management fees; and transportation.

Sociodemographic characteristics—Sociodemographic characteristics, including sex, race and ethnicity, age, and geographic region, were derived from the personal summary files. Because of state variations in Medicaid policies, we included state as a covariate in all our analyses and contrasted utilization patterns in high TBI-prevalent states with others.

Dual eligibility—Because dually enrolled participants may have better access to providers and services that are not available to Medicaid-only enrollees,[29,30] we derived indicator variables for participation in Medicare and private insurance.

Reason for Medicare eligibility was also used as a control variable because of differences in pathways to Medicaid enrollment.

Statistical Techniques

We used a combination of bivariate statistical methods and multivariate models in addressing our research questions. We tested for subgroup differences in the proportion of people with TBI and mental illness by using chi-square statistics. We also examined average annual expenditures for different types of services in each of the 4 states and tested the statistical significance of bivariate subgroup differences in average annual expenditures by using *t* tests.

To determine the impact of differences in mental illness on Medicaid expenditures among subjects with TBI, we performed 3 ordinary least square (OLS) multivariate analyses on (1) total annual Medicaid expenditures; (2) inpatient Medicaid expenditures; and (3) noninpatient Medicaid expenditures, respectively, while controlling for sex, racial composition, geographic region, and other variables. These expenditures were transformed into a logarithmic scale to reduce skewness or the asymmetry of the distribution.

Sensitivity analysis—Because nearly 15% of those in the population with TBI were not enrolled throughout the entire year because of either death or dropout (ie, lost eligibility or left Medicaid enrollment), we analyzed the annual cost with survival analysis techniques. In the descriptive analyses, we applied product-limit (Kaplan-Meier) estimation. The log rank statistic was used to assess the significance of group differences in the Kaplan-Meier estimated mean of annual Medicaid expenditures. We visually examined the survival plots to check for any violation of the assumption of proportional hazards. Multivariate techniques included Cox proportional hazards regressions. The findings were consistent with the reported results from the analyses on full-year enrollees only.

RESULTS

Characteristics of Study Population

Table 1 describes the combined study population from all 4 states. The overall population was 64% female, 38% white, 30% African American, 2% Hispanic, and 30% other races. (The category of “other” included the unknown and the missing responses, making interpretation of the “other” response difficult.) Thirty-three percent of the combined population lived in Georgia, followed by New Jersey (31%). Eighty-three percent had qualified for Medicaid because of permanent disability. Almost two thirds of the population had Medicare or private insurance coverage, in addition to Medicaid.

Rates of TBI

Overall, the rate of diagnosed TBI (n = 3641) was less than 1% (0.7%). We found significant subgroup differences in the estimated rates. Those with TBI were more likely to be male, younger than 50 years, substance abusers, and to have a physical comorbidity or mental illness. Wisconsin had a significantly higher rate of diagnosed TBI than any of the other 3 states.

Rates of Mental Illness Among People Diagnosed With TBI

Overall, of the 3641 people diagnosed with TBI, 18.6% were diagnosed with SMI and 16.5% with other mental illness (table 2). We found significant differences in the demographic makeup of the populations with and without mental illness. The rate of mental illness was significantly higher among the group aged 40 to 49 years and among those who enrolled because they were blind and/or permanently disabled, were known substance abusers, or had a physical comorbidity. We also found significant differences in rates of SMI by region of the country. For example, residents of the south had lower rates of diagnosed SMI (11.2% in Alabama, 18.2% in Georgia) than those living in other regions of the country (> 20% in New Jersey and Wisconsin).

Medicaid Expenditures and Mental Illness

Table 3 shows the average annual Medicaid expenditures for those people with TBI and mental illness within the overall Medicaid population for each of the 4 states. New Jersey and Wisconsin Medicaid beneficiaries had the highest annual total expenditures; inpatient care accounted for the highest percentage of total expenditures in Georgia and New Jersey, and the second highest in Alabama and Wisconsin.

Across all 4 states, those with SMI had significantly higher inpatient expenditures than those with no mental illness. In Georgia and New Jersey, their total annual expenditures were significantly higher. In all states except Alabama, those with SMI also had significantly higher expenditures for outpatient and clinic services, physician services, and prescription drugs. Those with SMI were also found to spend significantly more on inpatient care than on any other services. For example, in Alabama, among those with SMI, inpatient expenditures comprised half their total expenditures. In Georgia, New Jersey, and Wisconsin, the rates were 39%, 40%, and 46%, respectively. The corresponding percentages for those without mental illness in the 4 states were 22%, 38%, 32%, and 22%, respectively.

Bivariate analysis of Medicaid expenditures—Table 4 shows bivariate comparisons of average total, inpatient, and noninpatient annual expenditures across subgroups, combining all 4 states. The average annual expenditures were $12,298 for all services, $4048 for inpatient services, and $8250 for non-inpatient services. Medicaid recipients with mental illness, both serious and other, had significantly higher total, inpatient, and noninpatient expenditures than those without mental illness.

Also in table 4, we report socioeconomic differences in expenditures. In general, women had lower expenditures than did men. Being white was associated with higher total and noninpatient expenditures. For example, the average total expenditure was $14,008 for whites and $9753 for African Americans. We also found significant differences by the reason for eligibility. Those who qualified for Medicaid because they had a permanent disability constituted the group with highest total expenditures. Those aged 40 years or more were associated with higher expenditures. Those who were also covered by Medicare had significantly higher expenditures in total and noninpatient but not in inpatient services. Substance abuse was associated with higher inpatient, but lower noninpatient expenditures. People with physical comorbidity had higher expenditures in both inpatient and noninpatient services.

Multivariate analysis of Medicaid expenditures—Table 4 also presents the results of the multivariate analysis of the effects of sex, race and ethnicity, age, substance abuse, geographic region, basis of disability, and mental illness. These analyses used ordinary least squares regressions on total, inpatient, and noninpatient annual expenditures, respectively; the results were consistent with the bivariate analyses. We found that mental illness was associated with higher expected cost, even after controlling for other factors. Those with severe mental illness were more likely to incur higher total, inpatient, and noninpatient expenditures than those without mental illness. Similar patterns were found among people with other mental illness, except in inpatient expenditures, in which the expenditures were lower.

For each type of service, expenditures also varied by other subgroups. For example, the multivariate results suggest that, in this population, being female was associated with significantly lower noninpatient expenditures. Although being African American was associated with lower total expenditures compared with being white, inpatient expenditures of African Americans were not significantly different. Medicaid beneficiaries aged 40 years or more had higher expenditures than younger beneficiaries. Having Medicare or private insurance significantly reduced the expected inpatient Medicaid expenditures. Being a substance abuser significantly increased the expected inpatient expenditures and, not surprisingly, the presence of a physical comorbidity increased the expected expenditures in all types of services.

DISCUSSION

Our study used a dataset of Medicaid claims from 4 states. Such a dataset is uniquely suited to examine patterns of expenditures for those with TBI and mental illness, in an effort to gain better understanding of the impact of a psychiatric comorbidity on the care and the related costs, for these people. Use of claims data allows the tracking of claims across time without the active participation of the patient to provide information. This style of data collection is well suited for those with TBI, given the typical impairments in memory that are characteristic of this diagnosis.[31] In studies in which active participation is required by a subject, particularly someone with a TBI, a systematic bias can emerge because of loss to follow-up.[32] Finally, many studies addressing expenditure patterns of those with TBI generally use the National Institute of Disability Rehabilitation and Research TBIMS as a data source.[33–36] Data collected by these facilities are limited to those within their hospital system network and would not include the breadth of data available within the SMRF data (eg, prescriptions, DME, SNF claims). Given that the analyses used secondary data, the results must be interpreted cautiously; however, some findings are worth noting.

There is some evidence that Medicaid patients with TBI differ somewhat from the general population. Care of people with TBI shows some racial disparities; however, the category designated as “other” also includes the unknown response as well, making this difficult to interpret. TBI in the general population is typically characterized by 20- to 30-year-old men[1]; however, our findings show more men diagnosed with TBI in the 30- to 39-year-old age group. This may reflect a delayed period of application and waiting period for Medicaid enrollment. For example, this may be because someone with a TBI required assistance in the completion of the Medicaid application process, but such assistance was not readily available. This delay may also be related to the fact that people with TBI are not usually eligible for timely Medicaid coverage (ie, TBI is not a “presumptive eligibility” diagnosis like spinal cord injury, in which disability is immediately assumed for the Medicaid application process), and it may take more than 90 days to even review a case[24]; hence, some people may go without necessary services for some time. The delays in eligibility may reach beyond the point where rehabilitation care is typically provided, thereby reducing the possibility of receiving such services (ie, not appearing in this claims data set), thus reducing functional outcomes and

perhaps increasing the length of stay in the most costly level of care, the inpatient acute care hospital.[24]

We found that the presence of concomitant mental illness increased the cost of care for those with TBI. A natural question arises whether the higher expenditures for those with TBI and SMI are primarily caused by SMI or their physical injury. Therefore, we examined costs for SMI with and without TBI. Our analysis of expenditures among subjects with SMI and without TBI suggests that, for every state, the total expenditures for those with SMI and without TBI were substantially lower than for those with TBI and SMI. Total expenditures in Alabama for those without TBI and SMI were $6093, compared with $8723 among people with SMI and TBI. Respectively for Georgia, New Jersey, and Wisconsin, the total expenditures among those without TBI and SMI were $6919, $21,924, and $7154, compared with $13,688, $10,907, and $19,986 for people with SMI and TBI. We found similar differences in inpatient expenditures as well. Taken together, these findings suggest that higher costs for people with mental illness and TBI are because of the high expenditures incurred for the care of their TBI.

We also found that the mix of services and expenditures varied by the type of mental illness. Generally, the higher charges are related to SMI, where the greater needs would reflect higher expenditures. Those with other mental illness did not incur significantly higher inpatient expenditures than those without mental illness. This is not unexpected, given the overall decreased use of inpatient hospitalization as the treatment method for those with mental illness because of issues related to funding.[37] With respect to physician services, Georgia and New Jersey showed higher expenditures for those with SMI than for those with other mental illness. In Alabama and Wisconsin, those with other mental illness generally did not have significantly higher expenditures on noninpatient services than did those without mental illness. Care for the mental illness group may also be spread across the categories into home health and outpatient care, rather than the inpatient hospitalization, to match their care needs. (Medicaid does allow use of home-based care for personal assistance and outpatient care for therapy services simultaneously.) Finally, consistent with existing findings, a racial gap was found in total and outpatient expenditures, which suggests access to care issues.

Our study does have several limitations that need to be considered. Most critically, we did not have information on severity and duration of TBI or the mental illness. We did not have access to information concerning the diagnosis on which Medicaid eligibility was based. Therefore, we are not able to capture the temporal sequence of the 2 events; we do not know whether the mental illness was the result of TBI or if the mental illness occurred before TBI.

The lack of clinical information is also a significant limitation. Without the clinical record, we were not able to verify dates of incidence or duration or to consider comorbid conditions. This also impacted our ability to address outcomes with respect to cognitive or physical functioning or living situation in terms of whether there was a caregiver within the home; therefore, our analyses do not include such covariates. In addition, it should be noted that the results of this research may not necessarily be generalizable to other TBI populations. For example, with respect to the use of Medicaid, our study population had more women than men because women account for 70% of covered Medicaid beneficiaries.[38]

There is a paucity of research in this area of the dual diagnosis of TBI and mental illness, particularly in the examination of health care expenditures for the treatment and care of these people. Although we are able to make some assertions relating to expenditures, further work should include a prospective study whereby patients, or their designees reporting for them, could be followed over time from point of injury, to discern actual expenditures for costs of both the care for the TBI and for the mental illness. Such a study should allow for an examination of the clinical record, to secure information on incidence, severity, and functional

outcomes and to eliminate many limitations on the use of administrative data posed in this particular study. Furthermore, Appelbaum[37] reports on the "quiet crisis" occurring in mental health services and shows the need for more adequate reimbursement to sustain mental health providers in general. This leaves an already vulnerable population—those with TBI and mental illness—in an ever more vulnerable position, if mental health services are more difficult or even impossible to find.

Despite the noted limitations, our study has highlighted the importance of considering the impact of mental illness on TBI. It is known that no 2 people with a brain injury are alike, nor do they require the same type of care, or use the same types of programming[25]; however, the results of this study demonstrate that expenditures are increased in the Medicaid population for people with TBI and mental illness. Therefore, it behooves programs, particularly state-level programs such as Medicaid waivers and other specialty brain injury programs, to account for the additional costs and related special care needs of this subpopulation. It is interesting to note that TBI Medicaid waivers do not specifically consider SMI in their programming or budget allocation.[25,39] These programs may include a mental health advisory role, but the additional costs added to the programming for individuals in their waiver because of mental illness needs special attention.

CONCLUSIONS

This study found that expenditures, although variable across service types, are generally higher for those with TBI and SMI. This suggests the overall need for general awareness that the expenditures for the dual diagnosis are higher than for TBI alone, and that this be considered in programming and budget planning, particularly for tightly budgeted programs like the state Medicaid programs.

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Table 1

Characteristics of Medicaid Recipients With SMI and TBI SMRF, 1995

Characteristics	Study Population		Recipients With TBI	
	N	% of Total	N	% of Total
All	56,652	100.0	678	100.0
Medicaid program				
Alabama	6883	12.2	74	10.9
Georgia	18,611	32.9	230	33.9
New Jersey	17,639	31.1	208	30.7
Wisconsin	13,519	23.9	166	24.5
Sex*				
Female	36,385	64.2	400	59.0
Male	20,267	35.8	278	41.0
Race and ethnicity				
White	21,538	38.0	269	39.7
African American	16,979	30.0	180	26.6
Latino	1014	1.8	13	1.9
Other/unknown	17,121	30.2	216	31.9
Age at end of 1995 (y)				
21–29	9037	16.0	112	16.5
30–39	19,262	34.0	236	34.8
40–49	15,348	27.1	199	29.4
50–64	13,005	23.0	131	19.3
Reason for eligibility				
Blind/disabled	47,066	83.1	559	82.5
AFDC	5965	10.5	79	11.7
Poverty	2302	4.1	24	3.5
Other	1319	2.3	16	2.4
Medicare				
Yes	35,394	62.5	491	72.4
No	21,258	37.5	187	27.6
Private insurance				
Yes	1576	2.8	18	2.7
No	55,076	97.2	660	97.4
Substance abuse*				
Yes	7042	12.4	198	29.2
No	49,610	87.6	480	70.8
Physical comorbidity*				
Absent	40,404	71.3	383	56.5
Low	13,570	24.0	224	33.0
Severe	2678	4.7	71	10.5

NOTE. Based on fee-for-service (FFS) Medicaid beneficiaries in Alabama, Georgia, New Jersey, and Wisconsin, who were full-year enrolled, aged 21 to 64 years, alive by the end of 1995, and diagnosed with SMI or TBI.

Abbreviation: AFDC, Aid to Family and Dependent Children.

* Significant group differences (χ^2 test, $P < .05$) in TBI.

Table 2

Rates of Mental Illness Among Medicaid Beneficiaries With TBI SMRF, 1995

Characteristics	SMI		Other Mental Illness		No Mental Illness	
	N	%	N	%	N	%
All	678	18.6	601	16.5	2362	64.9
Medicaid program*						
Alabama	74	11.2	56	8.5	529	80.3
Georgia	230	18.2	211	16.7	825	65.2
New Jersey	208	22.4	165	17.8	554	59.8
Wisconsin	166	21.0	169	21.4	454	57.5
Sex						
Female	400	18.2	373	16.9	1429	64.9
Male	278	19.3	228	15.8	933	64.8
Race and ethnicity*						
White	269	18.9	268	18.9	885	62.2
African American	180	14.7	157	12.9	885	72.4
Latino	13	13.1	21	21.2	65	65.7
Other/unknown	216	24.1	155	17.3	527	58.7
Age at end of 1995 (y)*						
21–29	112	11.1	158	15.7	738	73.2
30–39	236	19.8	224	18.8	733	61.4
40–49	199	26.7	120	16.1	426	57.2
50–64	131	18.9	99	14.2	465	66.9
Reason for eligibility*						
Blind/disabled	559	22.1	422	16.7	1547	61.2
AFDC	79	9.5	142	17.0	615	73.6
Poverty	24	24.2	14	14.1	61	61.6
Other	16	9.0	23	12.9	139	78.1
Medicare						
Yes	187	20.8	151	16.8	560	62.4
No	491	17.9	450	16.4	1802	65.7
Private insurance						
Yes	18	14.0	24	18.6	87	67.4
No	660	18.8	577	16.4	2275	64.8
Substance abuse*						
Yes	198	35.0	110	19.4	258	45.6
No	480	15.6	491	16.0	2104	68.4
Physical comorbidity*						
Absent	383	16.4	349	14.9	1608	68.7
Low	224	21.9	204	19.9	597	58.2
Severe	71	25.7	48	17.4	157	56.9

NOTE. Based on FFS Medicaid beneficiaries in Alabama, Georgia, New Jersey, and Wisconsin, who were diagnosed with TBI, full-year enrolled, aged 18 to 64 years, and alive by the end of 1995.

*Significant group differences (χ^2 test, $P < .05$) in mental illness.

Table 3

Statewide Annual Medicaid Expenditures by Type of Service Among People With TBI by Mental Illness SMRF, 1995

Type of Service	All	SMI	Other Mental Illness	No Mental Illness
Alabama				
Total	7710	8723	7402	7600
Inpatient*	2018	4389	2416	1644
Outpatient/clinic	103	196	68	93
Physician	636	825	825	590
Institutional care	2435	0	1074	2919
Drugs	1274	1583	1595	1196
Home health*	484	144	551	525
Other services*	761	1587	871	633
Georgia				
Total*†	9389	13,688	11,288	7705
Inpatient*	3601	5396	4129	2965
Outpatient/clinic*†	943	1730	1258	643
Physician*†‡	1377	2234	1554	1094
Institutional care	1050	843	1492	995
Drugs*†	731	1155	889	572
Home health	224	346	136	212
Other services*†	1464	1984	1830	1225
New Jersey				
Total*	16,812	21,924	20,245	13,871
Inpatient*	5524	8761	5091	4437
Outpatient/clinic*†	4360	6776	7,068	2647
Physician*‡	450	679	449	365
Institutional care	1151	390	511	1628
Drugs*†	1422	2385	1667	987
Home health‡	2716	1619	4136	2704
Other services	1189	1313	1322	1103
Wisconsin				
Total	15,493	19,986	17,997	12,918
Inpatient*	4728	9174	5364	2865
Outpatient/clinic*†	1416	2389	1831	905
Physician*	339	563	366	247
Institutional care	5412	3529	6171	5817
Drugs*	1091	1478	2004	609
Home health	978	559	749	1216
Other services	1530	2295	1513	1258

NOTE. Based on FFS Medicaid beneficiaries in Alabama, Georgia, New Jersey, and Wisconsin, who were diagnosed with TBI, full-year enrolled, aged 18 to 64 years, and alive by the end of 1995.

*Significant differences ($P < .05$) in the average expenditures between subjects with SMI and subjects with no mental illness,

†between subjects with other mental illness and subjects with no mental illness, and

‡between subjects with SMI and subjects with other mental illness, respectively.

Table 4

Annual Expenditures Among Medicaid Recipients With TBI SMRF, 1995

Characteristics	Total Expenditures		Inpatient Expenditures		Noninpatient Expenditures	
	Mean $	OLS on Log($)	Mean $	OLS on Log($)	Mean $	OLS on Log($)
All	12,298	NA	4048	NA	8250	NA
Medicaid program						
Alabama	7710*	−0.65†	2018*	0.05	5692*	−0.67†
Georgia	9389*	−0.11	3601	0.18	5788*	−0.10
New Jersey	16,812	0.12	5524	−0.01	11,289	0.08
Wisconsin	15,493	Ref	4728	Ref	10,765	Ref
Sex						
Female	9881*	0.04	3375*	−0.11	6505*	0.12†
Male	15,996	Ref	5077	Ref	10,919	Ref
Race and ethnicity						
White	14,008	Ref	3847	Ref	10,161	Ref
African American	9753*	−0.26†	3729	0.06	6024*	−0.35†
Latino	9358*	−0.20	4186	0.60	5172*	−0.23
Other/unknown	13,376	−0.46†	4785	−0.10	8591	−0.49†
Age at end of 1995 (y)						
21–29	10,569	Ref	3581	Ref	6987	Ref
30–39	10,963	0.01	3295	−0.14	7668	0.03
40–49	14,997*	0.25†	5452*	0.41†	9545*	0.25†
50–64	14,203*	0.19†	4513	0.26	9690*	0.21†
Reason for eligibility						
Blind/disabled	15,308	Ref	4877	Ref	10,431	Ref
AFDC	5315*	−0.61†	2197*	−0.51†	3118*	−0.61†
Poverty	10,038*	−0.60†	3313	0.85†	6725*	−0.75†
Other	3597*	−0.87†	1376*	−1.07†	2221*	−0.76†
Medicare						
Yes	16,146*	−0.12†	3494	−0.41†	12,652*	0.01
No	11,038	Ref	4229	Ref	6808	Ref
Private insurance						
Yes	14,257	0.03	2673	−0.68†	11,584	0.08
No	12,226	Ref	4099	Ref	8127	Ref
Substance abuse						
Yes	13,433	0.38†	6829*	2.84†	6603*	0.01
No	12,089	Ref	3536	Ref	8553	Ref
Physical comorbidity						
Absent	9773	Ref	2844	Ref	6929	Ref
Low	13,988*	0.58†	4492*	1.23†	9496*	0.53†
Severe	27,422*	1.30†	12,605*	3.74†	14,817*	1.09†
Mental illness						
Serious	17,215*	0.68†	7244*	1.67†	9971*	0.58†
Other	15,272*	0.46†	4581	0.14	10,691*	0.50†
No	10,130	Ref	2995	Ref	7134	Ref

NOTE. Based on FFS Medicaid beneficiaries in Alabama, Georgia, New Jersey, and Wisconsin who were diagnosed with TBI, aged 18 to 64 years, full-year enrolled, and alive as of the end of 1994.

Abbreviations: NA, not applicable; Ref, reference group.

* Significant difference (*t* test, $P \leq .05$) in mean dollars of expenditure relative to the reference group.

† Significant effect in the OLS regression on natural log of expenditure.