Effects of Electroconvulsive Therapy on Functional Outcomes Among Medicare Patients With Comorbid Depression and Dementia:

A Nationwide 1-Year Follow-Up Study

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ABSTRACT

Objective: Current treatments for behavioral and psychological symptoms of dementia (BPSD) are of limited efficacy. Electroconvulsive therapy (ECT) is an effective and safe treatment for a range of psychiatric disorders, with some limited data suggesting a role in treating BPSD. We sought to expand this growing literature by examining—in a rigorous way with a larger sample size than in previous reports—the potential of ECT as a treatment for comorbid depression and dementia.

Methods: Drawing on nationally representative 2014–2015 Medicare claims data, propensity score methods were used to create two comparable cohorts consisting of ECT-treated patients (n = 147) and controls (n = 415) who were hospitalized with a principal psychiatric diagnosis. Functional outcomes were compared before and after hospitalization (when ECT was initiated for the ECT cohort).

Results: Both cohorts generally declined in all functional outcomes over the time period observed. The ECT cohort had a slower rate of functional decline in bathing (Cohen $d = -0.05$ vs 0.38; $P < .001$) and transferring ($d = 0.18$ vs 0.45; $P = .031$) compared to matched controls. In multivariate analysis, ECT patients also fared better in the overall activities of daily living summary score at 180 days (coefficient = –0.10; 95% CI, –0.19 to 0.01), though these effects were small. No difference was seen in cognition or ambulation.

Discussion: Receiving ECT does not worsen the trajectory of functional outcomes compared to not receiving ECT in older adults with comorbid depression. Randomized clinical trials are needed to more definitively examine the causal effect of ECT on functional outcomes of individuals with dementia.

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Alzheimer's disease and related dementias (hereafter referred to as *dementia*) are the most prevalent and debilitating neurodegenerative diseases of aging, affecting about 5.8 million individuals in the US.[1] This number is expected to increase to 13.8 million by 2050.[1] Behavioral and psychological symptoms of dementia (BPSD) represent a heterogeneous group of symptoms and behaviors (ie, agitation, aberrant motor behavior, anxiety, elation, irritability, depression, apathy, disinhibition, delusions, hallucinations, and sleep/appetite changes) in dementia. BPSD are common and increase morbidity and mortality rates, intensifying the public health burden of dementia significantly.[2–6]

Current treatments for BPSD are mixed. While non-pharmacologic behavioral interventions are recommended as first-line treatments for BPSD, they require substantial time and resources and may be less effective for severely agitated, aggressive, or depressed patients. Pharmacologic interventions (eg, antipsychotics for agitation and antidepressants for depression) are widely used in older patients with BPSD, but efficacy is modest for severe agitation[7] or depression[8,9] and tolerability for the antipsychotic medications is of concern, including a US Food and Drug Administration (FDA) boxed warning for increased mortality.[10]

Electroconvulsive therapy (ECT) is an effective and safe treatment for a range of psychiatric disorders, including treatment-resistant depression, schizoaffective disorder, and bipolar disorder.[11] ECT has been shown to be associated with lower risks of all-cause mortality and a short-lived but significant reduction in suicide risk in older adults.[12] ECT has also been found to be very effective when urgent treatment is needed for catatonia, depression with suicidal thoughts, or psychotic depression.[11] Recently, interest has arisen in the off-label use of ECT to treat severe agitation, depression, or other behavioral symptoms of dementia.[13,14]

Approximately a dozen case reports or case series have suggested that BPSD can improve following ECT (reviewed by Tampi and colleagues[14]). Acharya and colleagues[15] conducted a prospective cohort study of 23 patients suffering from dementia (primarily Alzheimer's type) who were exhibiting agitation or aggression. Most (21/23) demonstrated improvement in symptom severity following a course of ECT. In another of 23 patients with BPSD treated with ECT, Zhang and colleagues[16] reported partial

Clinical Points

- Among Medicare beneficiaries with comorbid depression and dementia, both electroconvulsive therapy (ECT) and control cohorts generally declined in all functional outcomes over the time period observed.
- The ECT cohort had a slower rate of functional decline in bathing and transferring compared to matched controls.
- Receiving ECT does not worsen the trajectory of functional outcomes compared to not receiving ECT in older adults with comorbid depression.

or full symptomatic response in most (21/23) patients. Additionally, at least three retrospective analyses[17–19] have suggested that ECT may play a promising role in the treatment of BPSD. The largest of these was an analysis of 60 older patients by Hermida et al.[19] In that report, patients demonstrated a substantial reduction in agitation following an index course of ECT. Notably, multiple large reports[20,21] suggest that ECT does not worsen cognition among individuals with dementia or increase the risk of the development of dementia.

Depression is the most common comorbid psychiatric condition in dementia, affecting 20%–25% of all individuals with dementia.[22] Depression is also the most common clinical indication for ECT. Taking advantage of an existing database of almost one million patients with depression, we sought to examine the potential of ECT to be used as a treatment for BPSD in older adults with comorbid depression. In this report, we sought to expand the existing literature on ECT use in dementia by using a larger sample size than in previous reports and by utilizing a control cohort to allow for between-group comparisons.

METHODS

Data Sources

The data were drawn from the 2014–2015 Medicare fee-for-service claims database(https://resdac.org/), the most recently available data at the time the study was initiated. The Medicare claims data are administered by the Centers for Medicare and Medicaid Services (CMS) and derived from multiple claims records, including the Master Beneficiary Summary File (MBSF), outpatient and inpatient files, and carrier files.

We also linked these Medicare claims data with the 2014–2015 Outcome and Assessment Information Set (OASIS) assessments, which were collected by the CMS. Since 1999, the CMS has required Medicare-certified home health agencies to collect quarterly assessments related to patients' bio-psycho-social health statuses.[23] Because these measures are collected every quarter, we were able to investigate the long-term effects of ECT on behavioral symptoms and functional outcomes among community-dwelling older adults with comorbid depression and dementia in home health settings.

Analytic Sample

Using a partial sample of patients covered by Medicare, we defined an analytic population with the following inclusion and exclusion criteria:

1. aged 65 years or older (not dually enrolled),
2. continuous Medicare coverage throughout the study period,
3. a diagnosis of major depressive disorder[24] (*ICD-9-CM*: 296.2x, 296.3x, 296.5x, 296.6x 298.0, 300.4, 309.1, 311; *ICD-10-CM*: F31.x, F32.x, F33.x, F34.1, F43.21, and F43.23),
4. a diagnosis of Alzheimer's disease or related dementias[24] (*ICD-9-CM*: 331.0, 331.11, 331.19, 331.2, 331.7, 290.0, 290.10, 290.11, 290.12, 290.13, 290.20, 290.21, 290.3, 290.40, 290.41, 290.42, 290.43, 294.0, 294.10, 294.11, 294.20, 294.21, 294.8, 797 ; *ICD-10-CM*: F01.50, F01.51, F02.80, F02.81, F03.90, F03.91, F04, F05, F06.1, F06.8, G13.8, G30.0, G30.1, G30.8, G30.9, G31.01, G31.09, G31.1, G31.2, G94, R41.81, R54); and
5. those who were hospitalized between January 1, 2014, and September 30, 2015.

The ECT cohort was identified by CPT codes 90870 or 90871, *ICD-9-CM* code 94.27, or *ICD-10* codes GZB0ZZZ–GZB4ZZZ. When applying the propensity score matching (see the next paragraph for further information), our final analytic sample included 147 patients in the ECT cohort and 415 patients in the control group, totaling 562 patients with comorbid depression and dementia (Figure 1). We focused on patients with comorbid depression and dementia to take advantage of an existing database of almost one million patients with depression.

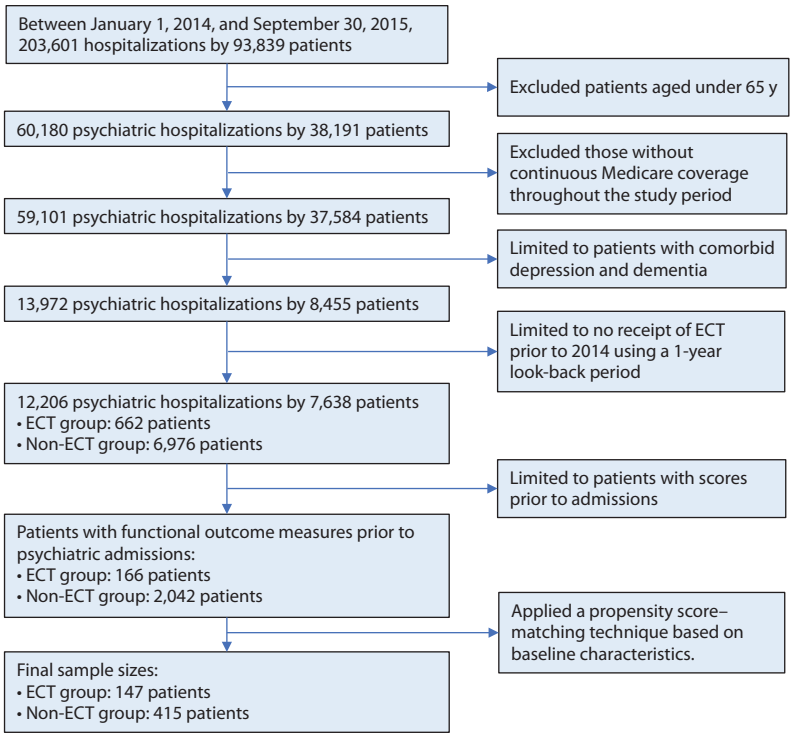
Matching

Exact matching was used to obtain an ECT cohort comparable to the controls with regards to demographic and clinically relevant factors.[25–27] These factors included age, sex, principal diagnosis at admission, modified Elixhauser comorbidity index score,[27] and summary score of activities of daily living (ADLs) at baseline (ie, 180 days prior to hospitalizations). Other variables such as rural-urban continuum code, US Census region, and median income of zip code were controlled for in multivariable-adjusted analyses.

Outcomes of Interest

The cognitive functioning and ADL items were obtained from the OASIS assessments. Cognitive functioning was rated from 0 to 4 with 0 as "alert/oriented, able to focus and shift attention, comprehends and recalls task directions independently" and 4 as "totally dependent due to disturbances such as constant disorientation, coma, persistent vegetative state, or delirium." The 9 ADL items (feeding, bathing, grooming, dressing [lower], dressing [upper], toileting, ambulation, transportation, and

Figure 1. Inclusion and Exclusion Criteria of the Study Sample[a]



[a]Data are from Medicare claims from 2013 to 2015.
Abbreviation: ECT = electroconvulsive therapy.

housekeeping) were included with scores ranging from 0 as independent to 4 as dependent. The ADL summary score was calculated as the sum of the 9 ADL items.

Analytic Plan

First, we compared matched ECT and non-ECT cohorts on measured characteristics prior to index date. Covariate balance was compared using standardized differences for all baseline covariates between ECT and non-ECT patient groups.

Differences in functioning. In the bivariate analyses, we estimated the functional changes that were based on the assessments closest to hospitalization up to 180 days prior to hospitalization and up to 365 days after hospitalization. We estimated effect sizes of the functional changes before and after hospitalization as measured by Cohen *d*,[28] which was calculated as the differences in scores divided by the standard deviation of the respective pre- and post-hospitalization scores and tested using a 2-sample *t* test.

Linear mixed model. In the multivariable-adjusted model, we fitted linear mixed models for the following 4 outcomes of interest: cognitive function, ambulation, disruptive behavior, and the overall summary score. These outcomes were chosen based on the sample sizes, bivariate analyses, and concepts (ie, measures that are most relevant for functional independence in older adults[29]). In each linear mixed model, we estimated the functional changes at 30, 90, 180, and 365 days from hospitalization. A linear time effect prior to hospitalization and after hospitalization (as per 30-day change) was adjusted, and we also controlled for age, sex, race/ethnicity, principal diagnosis of the index hospitalization, number of prior hospitalizations, number of prior attempts, modified Elixhauser score, and geographic region.

All analyses were performed with SAS version 9.4 (SAS Institute; Cary, North Carolina), R (R Foundation for Statistical Computing; Vienna, Austria), and Stata version 16 (College Station, Texas). All *P* values were 2-sided with a P value $< .05$ indicating statistical significance. The study used deidentified data and was approved with a waiver of informed consent by the Yale School of Medicine Institutional Review Board (#2000024893).

RESULTS

Characteristics of the Study Sample

Following application of inclusion and exclusion criteria, our analytic sample consisted of 147 patients in the ECT cohort and 415 patients in the control cohort (Figure 1). Overall, a little more than one-third of the sample (37.0%) was aged 65–74 years, with almost half (46.6%) aged 75–84 years and 16.4% at least 85 years old (Table 1). Most were female (74.6%), non-Hispanic White (84.0%), and residing in an urban location (87.0%). The most common principal diagnosis for index hospitalization was a major depressive disorder (64.6%), followed by bipolar disorder (19.6%) and a psychotic disorder (13.3%).

There was no statistically significant difference between cohorts with respect to age, sex, race/ethnicity, urban/rural

Table 1. Selected Demographic and Clinical Characteristics of the Study Sample at Baseline[a]

Characteristic	ECT	Control	Total	*P* Value
Sample size, n	147	415	562	
Age, mean ± SD, y				.971
65–74	36.7	37.1	37.0	
75–84	46.3	46.8	46.6	
≥ 85	17.0	16.1	16.4	
Sex				.567
Male	27.2	24.8	25.4	
Female	72.8	75.2	74.6	
Race/ethnicity				.235
Non-Hispanic White	87.1	82.9	84.0	
Other	12.9	17.1	16.0	
Income, $				.001
< 40,000	16.3	30.4	26.7	
40,000 to < 60,000	37.4	38.3	38.1	
≥ 60,000	44.9	29.2	33.3	
Unknown	1.4	2.2	2.0	
Urban residence				.755
Rural	13.3	12.2	13.0	
Urban	86.8	87.8	87.0	
Elixhauser comorbidity index score				.993
0	8.2	7.7	7.8	
1 to ≤ 5	9.5	8.9	9.1	
6 to ≤ 12	26.5	26.8	26.7	
> 12	55.8	56.6	56.4	
Principal diagnosis at admission				.969
Delirium, dementia, or catatonia	1.4	1.5	1.4	
Anxiety disorder	0.7	0.7	0.7	
Bipolar disorder	21.1	19.0	19.6	
Nonpsychotic depressive disorder	63.3	65.1	64.6	
Schizophrenia or psychosis	12.9	13.5	13.3	
Other	0.7	0.2	0.4	
No. of psychiatric hospitalizations in the past year				< .001
None	36.1	59.3	53.2	
1	32.0	21.5	24.2	
2	17.7	12.1	13.5	
≥ 3	14.3	7.2	9.1	
No. of suicide attempts in the past year				.104
None	90.5	93.5	92.7	
1	5.4	5.5	5.5	
2	3.4	0.7	1.4	
≥ 3	0.7	0.2	0.4	

[a]All values (except *P* values) are shown as column % unless otherwise noted. Data are from Medicare claims from 2013 to 2015. ECT and control cohorts were matched based on age, sex, Elixhauser comorbidity index score, and ADL summary scores at baseline.
Abbreviations: ADL = activities of daily living, ECT = electroconvulsive therapy.

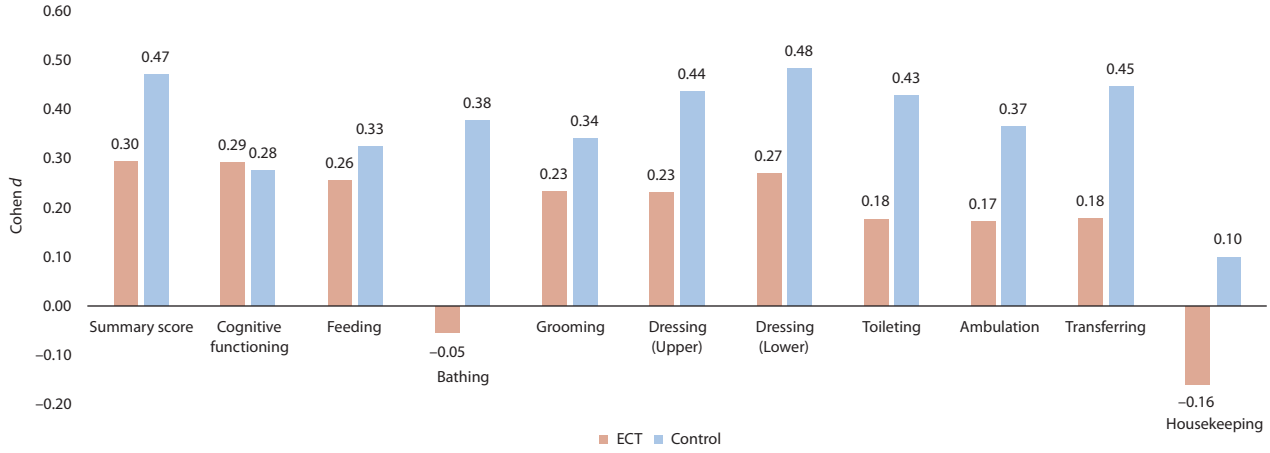
residence, Elixhauser comorbidity index score (a marker of mortality risk due to medical problems), number of suicide attempts, or principal diagnosis at admission (Table 1). However, compared to the control cohort, the ECT cohort had a higher number of psychiatric hospitalizations in the past 12 months ($P < .001$) and came from zip codes with higher median income ($P = .001$).

Functional Outcomes

In our bivariate analyses, 103 (70.1%) of 147 patients with ECT and 299 (72.0%) of 415 controls had both pre- and post-hospitalization scores for functional changes. When the exact matching approach was applied, the sociodemographic and clinical characteristics prior to hospitalization were not significantly different between ECT and control groups. ECT patients completed their assessments a mean (SD) of 41.6 (45.9) days prior to hospitalization, and the matched controls completed their assessments 44.8 (49.4) days prior to hospitalization. The post-hospitalization assessments were completed within a mean (SD) of 43.4 (63.1) days among ECT patients and within 51.8 (63.1) days among the matched controls.

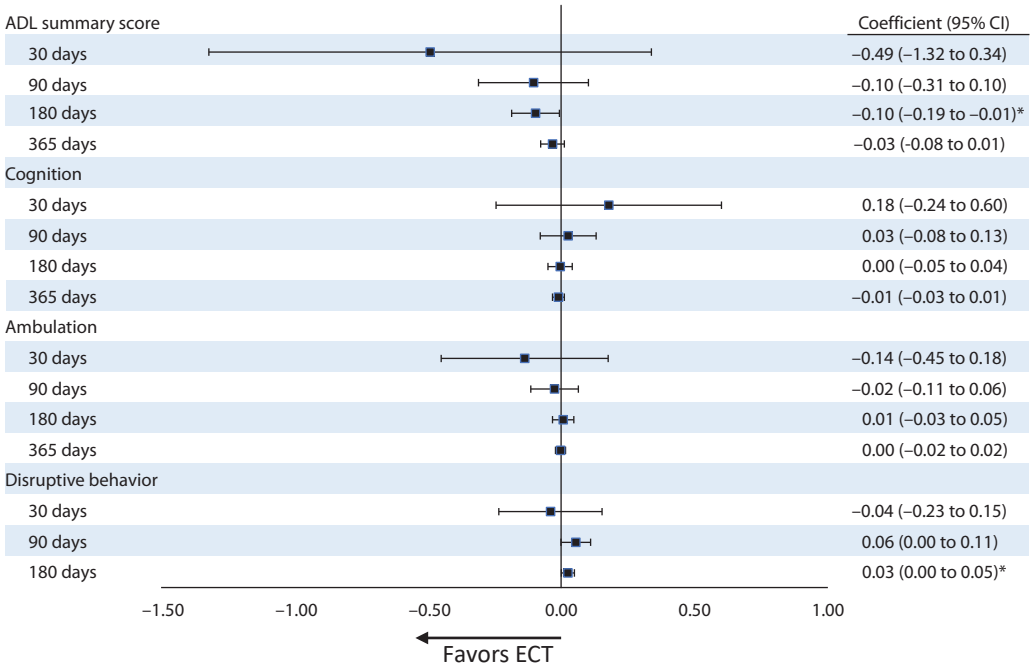
Figure 2 presents functional changes before and after hospitalizations using Cohen *d* by treatment arm. Both groups presented functional declines after hospitalizations. More positive effect sizes represent a worsening in functional outcomes. Overall, the effect sizes for functional changes before and after hospitalizations among ECT patients were small, ranging from −0.16 in housekeeping to 0.30 in the overall summary score. Among the matched controls,

Figure 2. Functional Changes Before and After Hospitalizations Using Cohen *d* by ECT and Control Groups[a]



[a]Data are from Medicare claims from 2013 to 2015. Bathing and transferring were significantly different between ECT and control groups ($P < .001$ and $P = .031$, respectively). More positive scores indicate worse functional outcomes.
Abbreviation: ECT = electroconvulsive therapy.

Figure 3. Forest Plot Summarizing the Associations of ECT With Functional, Cognitive, and Behavioral Outcomes Using Linear Mixed Models[a]



[a]For each outcome, all demographic and clinical factors shown in Table 1 were controlled for. For disruptive behavior, we could not quantify estimates for up to 365 days due to limited sample sizes (ie, convergence failed).
*$P < .05$.
Abbreviations: ADL = activities of daily living, ECT = electroconvulsive therapy.

the effect sizes were small to medium, ranging from 0.10 in housekeeping to 0.48 in lower body dressing. Of the 9 individual ADL items, ECT patients had a slower rate of functional decline in bathing ($d = -0.05$ vs 0.38; $P < .001$) and transferring ($d = 0.18$ vs 0.45; $P = .031$) compared to matched controls. No significant difference was detected in other individual items between ECT patents and their matched controls.

Multivariable-Adjusted Analysis

Figure 3 presents a forest plot summarizing the association of ECT (vs matched controls) with 4 functional outcomes of interest (ie, overall ADL summary score, cognition, ambulation, and disruptive behavior) using linear mixed models. After 180 days from the index hospitalization, the overall ADL summary score (coefficient = −0.10; 95% CI, −0.19 to 0.01) Notably, these effects were small. ECT

did not have statistically significant effects on cognition or ambulation throughout the follow-up period.

DISCUSSION

This study is the largest cohort analysis to date examining the association between ECT and functional outcomes in patients with behavioral and psychological symptoms of dementia. The data show that, among patients with dementia who were admitted to the hospital for a psychiatric problem and followed for up to 1 year after discharge, all patients generally decline in their functional status following discharge. In measures of bathing and transferring, those patients receiving ECT declined at a slower rate compared to those not receiving ECT. Those patients receiving ECT also had more favorable ADL summary scores compared to the control cohort, though these effects were small. The study has several strengths that make a significant contribution to the limited literature examining ECT as a potential therapy for treating the behavioral and psychological symptoms of individuals with dementia. First, the study is the largest cohort analysis to date to examine this question. Second, the study includes functional outcome assessments as opposed to using only evaluations of symptom severity. Finally, the longitudinal nature of follow-up for up to 1 year after index hospitalization has not generally been reported in prior cohorts of patients with dementia receiving ECT.

ECT has long been associated with an impairment of cognition following an acute course of treatment.[30,31] Hence, there have been concerns about using ECT in patients who already have significant impairment independent of their depression. In the current analysis of Medicare recipients with comorbid depression and dementia, receipt of ECT was not associated with differential worsening of cognition compared to the control group that did not receive ECT. This finding is in line with a recent retrospective report[32] of 313 ECT patients with impaired cognitive function pretreatment who demonstrated an improvement on global cognitive functioning as measured by the Montreal Cognitive Assessment. The fact that both of these recent reports suggest there is no ECT-attributable worsening of baseline cognitive impairment in these populations is also in line with older reports.[22,33]

One of the strengths of this study is its focus on a wide array of functional outcomes (as opposed to using only evaluations of symptom severity), including measures of activities of daily living. Our findings show that ECT is not associated with worsened functional outcomes with respect to activities of daily living, cognitive functioning, ambulation, and/or disruptive behavior within 6 months of the index hospitalization. Notably, many previous studies used a within-group comparison; to the best of our knowledge, the current report is the first to compare across groups in this clinical context.

Another key strength of this report is the longitudinal nature of the data. Patients in this report were followed for up to 1 year following index hospitalization (median = 86 days), allowing for the assessment of longer-term functional outcomes in activities of daily living. Most prior reports of the use of ECT for the behavioral and psychological symptoms of dementia follow patients only through an acute course of ECT, lasting approximately 1–2 months.

There are several limitations to highlight. First, because the database is based on Current Procedural Terminology (CPT) and *International Classification of Diseases, Ninth Revision* (*ICD-9*) procedural codes, it cannot readily distinguish between different modalities of ECT (eg, bitemporal, bifrontal, and unilateral). Second, the nature of observational cohort studies is such that causality of the relationship cannot be assessed definitively; therefore, the purported relationship between ECT and a slower decline in a limited number of functional outcomes from this data set can be considered only an association at this point. A prospective study that randomly assigns participants to treatment groups is needed to definitively assess the potential causal nature of any relationship. Third, there may be residual confounding by indication even though we employed a matching technique to reduce this bias. Matching between ECT and non-ECT patients is extraordinarily difficult, and often patients in the ECT cohort are more severely ill on some measures; however, we point out that this would bias toward the null hypothesis and perhaps yield a more conservative analysis. Fourth, although there was no group difference in the mean time between pretreatment assessment and admission to hospital, the fact that there is individual variation in this time is a potential source of bias and weakness of the overall analysis. Fifth, due to the limited sample size, we did not conduct subgroup analyses based on differences in psychotropic medication patterns between the groups. Sixth, due to the limited sample size, we were not able to adequately investigate the effect that continuation/maintenance ECT may have on BPSD. Indeed, the antidepressant effects of ECT generally subside within a few months of an index course of ECT unless some form of continuation/maintenance therapy is instituted. Finally, it is not possible to ascertain the respective time of dementia and depression onset from the database used for this analysis.

The data from this report suggest that ECT may improve the trajectory of functional outcomes among older adults with dementia, though the effect may be small. Prospective, randomized trials are needed to more definitively examine the causal effect of ECT on behavioral and psychological symptoms as well as functional outcomes of individuals with dementia. Our data add to prior research[32] suggesting that cognitive impairment at baseline should not be viewed as a contraindication to ECT.

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Editor's Note: We encourage authors to submit papers for consideration as a part of our Focus on Geriatric Psychiatry section. Please contact Jordan F. Karp, MD, at jkarp@psychiatrist.com, or Gary W. Small, MD, at gsmall@psychiatrist.com.