

## Research Report

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# Prevalence of Comorbid Dementia in Late-life Depression and Bipolar Disorder: A Retrospective Inpatient Study

Shinichiro Ochi, Takaaki Mori, Jun-ichi Iga\* and Shu-ichi Ueno

*Department of Neuropsychiatry, Ehime University Graduate School of Medicine, Toon, Ehime, Japan*

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### Abstract.

**Background:** Dementia in patients with late-life mood disorders is clinically important.

**Objective:** We aimed to investigate the prevalence of dementia in patients with late-life major depressive disorder (MDD) or bipolar disorder (BD) and to clarify the clinical characteristics associated with the diagnosis of dementia.

**Methods:** The prevalence of dementia at hospital discharge and the clinical characteristics at hospitalization who are diagnosed with MDD or BD over 65 years of age, from the medical records of 684 patients who had been admitted from 2015 to 2020 were investigated.

**Results:** A total of 66 patients with MDD ( $n = 50$ ) and BD ( $n = 16$ ) were analyzed. The prevalence of dementia was significantly higher in MDD than in BD (24.0% versus 0%;  $p = 0.026$ ). The mean age at onset of MDD was significantly older in the MDD with dementia group than in the MDD without ( $76.9 \pm 6.3$  years versus  $62.2 \pm 14.0$  years;  $p < 0.001$ ). The rate of first depressive episode at this admission was significantly higher in the MDD with dementia group (91.7% versus 30.3%;  $p < 0.001$ ). The diagnosis of dementia was significantly associated with lower scores for “insomnia early” ( $p = 0.019$ ) and higher scores for “insight” ( $p = 0.049$ ) on the 17-item Hamilton Depression Rating (HAMD-17) subscales and lower scores for “recall” ( $p = 0.003$ ) on the MMSE subscales.

**Conclusion:** The older age of first onset of depression, “insomnia early”, “insight” and “recall” may be useful indicators for a diagnosis of dementia in late-life depression.

Keywords: Bipolar disorder, dementia, hospitalization, late-life depression, prevalence

## INTRODUCTION

The proportion of older people over the age of 65 years is rapidly increasing in most industrialized countries [1]. Older people often develop depressive episodes, referred to as late-life depression, as a common psychiatric disorder [2]. However, late-life

depression often presents with atypical symptoms. For example, a previous meta-analysis reported that patients with late-life depression showed significantly higher incidences of hypochondriasis, somatic symptoms, and agitation than did patients with early-life depression [3]. Compared with early-life depression, late-life depression is more frequently associated with complex factors such as physical illnesses and cognitive impairment [2, 4]. Furthermore, a recent meta-analysis reported finding no differences between antidepressant response compared

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\*Correspondence to: Jun-ichi Iga, MD, PhD, Department of Neuropsychiatry, Ehime University Graduate School of Medicine, Shitsukawa, Toon, Ehime 791-0295, Japan. Tel.: +81 89 960 5315; Fax: +81 89 960 5317; E-mail: igajunichi@hotmail.com.

with placebo in persons over 65 years of age [5]. Consequently, it is often difficult for clinicians to diagnose and treat late-life depression [6].

On the other hand, the prevalence of dementia is also increasing around the world. Over 40 million patients have been diagnosed with dementia, and it is predicted to increase to double that over the next 20 years [7]. A previous meta-analysis reported that late-life depression was associated with dementia [8], and a long-term cohort study reported that depressive symptoms increased 10 years before the diagnosis of dementia, although they were not a risk factor for dementia before middle age [9]. Furthermore, patients with late-life depression who did not respond to more than two antidepressant regimens have shown a significantly higher risk of developing dementia compared with those who responded well to antidepressants [10]. Another study reported that amyloid-negative patients with late-life depression showed a better response to antidepressant treatment than did amyloid-positive patients [11]. These studies suggest that the comorbidity of dementia in late-life depression could lead to a poor antidepressant response. Dementia itself is often associated with the development of depressive symptoms as one of the behavioral and psychological symptoms of dementia [12]. Therefore, it is important to assess clinical features to screen for the early detection of dementia in late-life depression.

Given this background, the present study aimed to investigate the prevalence of dementia in patients with late-life major depressive disorder (MDD) or bipolar disorder (BD) with required hospitalization due to a severe depressive episode, and to clarify the clinical characteristics associated with the diagnosis of dementia.

## METHODS

### *Participants*

For this retrospective cohort study, information was collected from the medical records of patients with opt-out consent. All study procedures were carried out in accordance with the Declaration of Helsinki. This study was approved by the ethics committees of Ehime University Hospital (approval No.: 2108014). We collected data from the medical records of 684 patients who had been admitted to the Department of Neuropsychiatry at Ehime University Hospital from January 2015 to December 2020. We included patients who were over 65 years of age

who had been diagnosed with MDD or BD at hospitalization. MDD or BD was diagnosed according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition. We excluded all patients who had already been diagnosed with dementia at hospitalization. Regarding patients with multiple hospitalizations during the data collection period, we analyzed the data from their most recent, excluding those for the treatment of non-mental disorders, such as internal and surgical diseases, those for maintenance electroconvulsive therapy (ECT), and those having a diagnosis of dementia at the time of admission. Finally, we analyzed the data of 66 patients.

### *Study procedure*

We investigated the prevalence of dementia at discharge and the clinical characteristics at hospitalization due to MDD or BD. Alzheimer's disease (AD), vascular dementia (VaD), dementia with Lewy bodies (DLB), and idiopathic normal pressure hydrocephalus (iNPH) were diagnosed according to the diagnostic criteria of the National Institute of Neurological and Communicative Disorders and Stroke and Alzheimer's Disease and Related Disorders Association [13], the National Institute of Neurological Disorders and Stroke-Association International pour la Recherche et l'Enseignement en Neurosciences [14], the Consortium on DLB International Workshop 2005 or 2017 [15, 16], or the Guidelines for the Management of Idiopathic Normal Pressure Hydrocephalus, Second Edition [17]. Other neurodegenerative disorders were diagnosed by an expert neurologist based on clinical interviews, investigations, and a review of medical records. We investigated whether patients had undergone blood tests and imaging studies, such as brain computed tomography (CT)/magnetic resonance imaging (MRI), brain perfusion single-photon emission computed tomography (brain perfusion SPECT), <sup>123</sup>I-metaiodobenzylguanidine myocardial scintigraphy (MIBG), or dopamine transporter (DAT) scan for a differential diagnosis during hospitalization. To clarify the clinical characteristics associated with a diagnosis of dementia, we compared the subscales of the 17-item Hamilton Depression Rating Scale (HAM-D-17) and the Mini-Mental State Examination (MMSE) at hospitalization between patients with MDD with and without dementia at discharge. This is because HAM-D is well known as the rating scale for the late life depression or depression in dementia [18, 19], and recommended as the rating

tool in the guidelines for diagnosis and treatment of depression in older adults [6], and MMSE is the easy way to measure overall cognitive function, and often used a screening tool to detect a decline in cognitive function such as the differentiation of dementia [20–22].

### Statistical analysis

All statistical analyses were performed using SPSS 22.0 (IBM Co., Armonk, NY, USA). We analyzed all data for normality using the Shapiro–Wilk test. We used the chi-squared test to analyze categorical variables (such as sex) and Student's *t*-test or the Mann–Whitney *U* test to analyze continuous variables (such as years). We calculated adjusted odds ratios (ORs) with 95% confidence intervals (CIs) for the risk of dementia for the HAMD-17 and MMSE subscales using a logistic regression model. We defined significance at the 95% level ( $p < 0.05$ ).

## RESULTS

### Prevalence of dementia in late-life MDD and BD (Table 1)

In total, we analyzed 66 patients with late-life MDD ( $n = 50$ ) and BD ( $n = 16$ ). In BD, patients with the manic episode were 5 at the admission, and patients with the manic episode were 11 at the admission. No significant differences in sex, age, years of education, mean duration of hospital stay, HAMD-17 total score, MMSE total score, modified ECT during hospitalization, and average specific binding ratio (SBR) in DAT imaging were found between the two groups. All patients underwent blood tests and brain CT/MRI. The rates of brain perfusion SPECT, DAT, and MIBG were 66% ( $n = 33$ ), 52% ( $n = 26$ ), and 62% ( $n = 31$ ) in MDD and 50% ( $n = 8$ ), 37.5% ( $n = 6$ ), and 37.5% ( $n = 6$ ) in BD, respectively. The prevalence of dementia was significantly higher in MDD than in BD (24.0% versus 0%, respectively;  $p = 0.026$ ). The

Table 1  
Clinical characteristics of late-life major depressive disorder and bipolar disorder at hospitalization

Diagnosis at hospitalization	Major depressive disorder	Bipolar disorder	<i>p</i>
Total	50	16 (mania 5, depression 11)	
Sex (female) (%)	38 (76%)	12 (75%)	0.588
Age (range) (y)	74.4 ± 6.6 (65–87)	72.3 ± 4.7 (65–84)	0.232
Education (y)	12.1 ± 2.5	12.9 ± 2.2	0.264
Mean hospital stay (days)	119.9 ± 84.6	92.3 ± 41.9	0.095
HAMD-17 total (n)	23.2 ± 8.3 ( $n = 40$ )	18.3 ± 5.3 ( $n = 8$ )	0.116
MMSE total (n)	22.0 ± 5.8 ( $n = 33$ )	25.4 ± 4.4 ( $n = 10$ )	0.106
ECT during hospitalization (%)	18 (36%)	3 (18.8%)	0.197
Brain CT/MRI	50	16	
Brain perfusion SPECT	33 (66%)	8 (50%)	
MIBG	31 (62%)	6 (37.5%)	
DAT scan	26 (52%)	6 (37.5%)	
Mean SBR in DAT imaging	3.7 ± 1.5	4.2 ± 0.9	0.499
Diagnosis at discharge			
Mood disorder	33 (66%)	14 (87.5%)	
Neurodegenerative diseases (including dementia)	17 (34%)	2 (12.5%)	0.087
Dementia	12 (24%)	0	0.026*
Subtypes of dementia (n)	DLB (5) AD (3) VaD (1) AD+VaD (1) iNPH 1 Unspecified 1		
Subtypes of neurodegenerative disorders except dementia	PD 3 ALS 1 Anti-GAD antibody-positive cerebellar ataxia 1	PD 2	

Values are expressed as mean ± standard deviation. \* $p < 0.05$ . HAMD-17, 17-item Hamilton Depression Rating Scale; MMSE, Mini-Mental State Examination; ECT, electroconvulsive therapy; SPECT, single-photon emission computed tomography; MIBG,  $^{123}\text{I}$ -metaiodobenzylguanidine myocardial scintigraphy; DAT, dopamine transporter; SBR, specific binding ratio; DLB, dementia with Lewy bodies; AD, Alzheimer's disease; VaD, vascular dementia; iNPH, idiopathic normal pressure hydrocephalus; PD, Parkinson's disease; ALS, amyotrophic lateral sclerosis; GAD, glutamic acid decarboxylase.

Table 2  
Comparison of clinical characteristics between late-life depression (MDD) with and without dementia

	Dementia (+)	Dementia (-)	P
Total	12	33	
Sex (female)	10 (83.3%)	26 (78.8%)	0.55
Age (range) (y)	78.3 ± 6.6 (65–87)	73.4 ± 6.2 (65–85)	0.028*
Education (y)	11.8 ± 2.6	12.1 ± 2.4	0.789
Age at onset of depression (y)	76.9 ± 6.3	62.2 ± 14.0	<0.001***
First depressive episode at this admission	11 (91.7%)	10 (30.3%)	<0.001***
Length of hospital stay (days)	95.0 ± 80.3	125.2 ± 88.9	0.156
HAMD-17 total	20.0 ± 8.0 (n = 7)	23.8 ± 7.9 (n = 29)	0.276
MMSE total	17.9 ± 5.4 (n = 12)	24.7 ± 4.5 (n = 16)	0.002**
ECT while in the hospital	2 (16.7%)	14 (42.4%)	0.105
Brain CT/MRI	12	33	
Brain perfusion SPECT	11 (91.7%)	17 (51.5%)	
MIBG	11 (91.7%)	16 (48.5%)	
DAT scan	10 (83.3%)	12 (36.4%)	
Mean SBR in DAT imaging	2.9 ± 1.3	4.4 ± 1.3	0.017*

Values are expressed as mean ± standard deviation. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ . HAMD-17, 17-item Hamilton Depression Rating Scale; MMSE, Mini-Mental State Examination; ECT, electroconvulsive therapy; SPECT, single-photon emission computed tomography; MIBG,  $^{123}\text{I}$ -metaiodobenzylguanidine myocardial scintigraphy; DAT, dopamine transporter; SBR, specific binding ratio.

types of dementia were DLB ( $n = 5$ ), AD ( $n = 3$ ), VaD ( $n = 1$ ), AD with comorbid VaD ( $n = 1$ ), iNPH ( $n = 1$ ), and unspecified dementia ( $n = 1$ ). Other neurodegenerative diseases in MDD were Parkinson's disease (PD) ( $n = 3$ ), amyotrophic lateral sclerosis ( $n = 1$ ), and anti-glutamic acid decarboxylase antibody-positive cerebellar ataxia 1 ( $n = 1$ ) in MDD, and PD ( $n = 2$ ) in BD.

#### Comparisons of clinical characteristics between MDD with and without dementia (Table 2)

The numbers of patients with MDD with and without dementia at discharge were 12 and 33, respectively. The rates of brain perfusion SPECT, DAT, and MIBG were 91.7% ( $n = 11$ ), 83.3% ( $n = 10$ ), and 91.7% ( $n = 11$ ) in the MDD with dementia group and 51.5% ( $n = 17$ ), 36.4% ( $n = 12$ ), and 48.5% ( $n = 16$ ) in the MDD without dementia group, respectively. No significant differences in sex, years of education, mean duration of hospital stay, HAMD-17 total score, and ECT during hospitalization were found between the two groups. The mean age was significantly older in the MDD with dementia group compared with the without dementia group ( $78.3 \pm 6.6$  years versus  $73.4 \pm 6.2$  years, respectively;  $p = 0.028$ ). The mean age at onset of MDD was significantly older in the MDD with dementia group compared with the without dementia group ( $76.9 \pm 6.3$  years versus  $62.2 \pm 14.0$  years, respectively;  $p < 0.001$ ). The rate of first depressive episode at this admission was significantly higher in the MDD with dementia

group compared with the without dementia group (11 (91.7%) versus 10 (30.3%), respectively;  $p < 0.001$ ). The MMSE total score was significantly lower in the MDD with dementia group than in the MDD without dementia group ( $17.9 \pm 5.4$  versus  $24.7 \pm 4.5$ , respectively;  $p = 0.002$ ) (Table 2). The mean SBR in the MDD without dementia group was significantly higher than that in the MDD with dementia group ( $2.9 \pm 1.3$  versus  $4.4 \pm 1.3$ , respectively;  $p = 0.017$ ). The severity of dementia in the two patients who underwent ECT was moderate.

#### HAMD-17 and MMSE subscales associated with a diagnosis of dementia (Tables 3 and 4)

The results of univariate and multivariate logistic regression analyses between patients with MDD with and without dementia conducted to identify the association between the HAMD-17 and MMSE subscales and a diagnosis of dementia revealed lower scores for "insomnia early" (OR, 0.17; 95%CI, 0.039–0.74;  $p = 0.019$ ) and higher scores for "insight" (OR, 7.0; 95%CI, 1.0–49.4;  $p = 0.049$ ) on the HAMD-17 subscales (Table 3) and lower scores for "recall" (OR, 0.21; 95%CI, 0.074–0.587;  $p = 0.003$ ) on the MMSE subscales (Table 4).

## DISCUSSION

In this study, we investigated retrospectively the characteristics of inpatients with late-life MDD and BD and compared the clinical characteristics of

Table 3  
Subscales of the Hamilton Rating Scale 17 associated with diagnosis of dementia

HAMD-17 subscales	Univariate			Multivariate		
	Odds ratio	95% CI	<i>p</i>	Odds ratio	95% CI	<i>p</i>
Depressed mood	0.515	0.245–1.084	0.080			
Guilt	0.759	0.392–1.467	0.41			
Suicide	0.783	0.393–1.561	0.49			
Insomnia early	0.256	0.076–0.865	0.028*	0.169	0.039–0.743	0.019*
Insomnia middle	0.717	0.273–1.886	0.50			
Insomnia late	0.644	0.275–1.510	0.31			
Work and activities	0.656	0.360–1.195	0.17			
Psychomotor retardation	1.340	0.595–3.021	0.48			
Psychomotor agitation	1.026	0.399–2.642	0.96			
Anxiety, psychic	0.868	0.405–1.864	0.72			
Anxiety, somatic	1.048	0.518–2.118	0.90			
Loss of appetite (somatic symptoms, gastrointestinal)	1.245	0.443–3.500	0.68			
Somatic symptoms, general	0.414	0.134–1.280	0.13			
Sexual interest (genital symptoms)	1.021	0.313–3.331	0.97			
Hypochondriasis	1.032	0.497–2.143	0.93			
Weight loss	0.958	0.382–2.404	0.93			
Insight	2.91	0.675–12.538	0.152	7.049	1.005–49.433	0.049*

Table 4  
Subscales of the Mini-Mental State Examination associated with a diagnosis of dementia

MMSE subscales	Univariate			Multivariate		
	Odds ratio	95% CI	<i>p</i>	Odds ratio	95% CI	<i>p</i>
Orientation (time)	0.455	0.231–0.894	0.022*			
Orientation (place)	0.654	0.390–1.097	0.11			
Registration	0.00	0.00	1.0			
Attention and calculation	0.663	0.412–1.067	0.091			
Repetition	0.733	0.041–13.050	0.83			
Command	0.484	0.156–1.501	0.21			
Reading	0.00	0.00	1.0			
Recall	0.209	0.074–0.587	0.003**	0.209	0.074–0.587	0.003**
Language	0.00	0.00	1.0			
Writing	0.323	0.059–1.770	0.19			
Construction	0.257	0.042–1.573	0.14			

\* $p < 0.05$ , \*\* $p < 0.01$ . MMSE, Mini-Mental State Examination.

patients with late-life MDD with and without dementia at discharge. There were two major findings in this study.

First, we found that as many as 21% patients hospitalized as a result of late-life MDD had dementia. Furthermore, the prevalence of dementia at discharge was significantly higher in MDD than in BD. A recent meta-analysis reported that the prevalence of MDD with dementia was 15.9% [23], which was lower than that in the present study (24%). Another recent meta-analysis reported that late-life depression with psychotic symptoms showed more cognitive impairment than that without psychotic symptoms [24]. Another study reported that late-life depression (age over 65 years) and treatment-resistant depression were associated with significantly higher risks of developing dementia [10]. Those previous studies support our results because all patients with MDD

in the present study were hospitalized as a result of a severe episode, 36% of whom underwent ECT. Our findings suggest that a substantial number of patients with severe late-life depression might already have comorbid dementia. On the other hand, no patients with late-life BD in this study had comorbid dementia. A recent meta-analysis reported that BD also increased the risk of dementia compared with control [25], and another that BD increased the risk of dementia, and that this risk was higher than that for MDD [26]. Furthermore, in a previous population-based longitudinal study with a large sample size, the mean age of patients with BD with a diagnosis of dementia was 68.53 years, which was significantly younger than that of controls (75.47 years) [27]. These studies suggest that patients with BD may develop dementia at a younger age than patients with MDD. Therefore, the lower prevalence

of dementia in patients with BD in the present study may have been because of the higher mean age (72.3 years) compared with previous studies, and we might have excluded BD patients who had already been diagnosed with dementia. Interestingly, a recent population-based observational retrospective study reported that dementia was one of the top comorbidities for BD at admission, but the prevalence was only 0.96% [28]. Therefore, we might have not been able to identify patients with BD with dementia in this study because of the small sample size.

Second, we found that patients with late-life depression with dementia had a higher age, lower MMSE total scores, and a lower SBR in DAT scans than did those without dementia (Table 2). Moreover, we found that a lower score for “insomnia early” and a higher score for “insight” on the HAMD-17 (Table 3) and a lower score for “recall” on the MMSE (Table 4) were associated with a diagnosis of dementia. Regarding the lower SBR in DAT imaging in MDD with dementia, it may be a useful biological marker. However, higher age and the existence of patients with DLB in the MDD with dementia group may have affected these findings. Because the SBR is known to decrease with age [29], the differences of clinical symptoms after adjusting for age need to be clarified. To the best of our knowledge, this is the first study to show that specific clinical symptoms such as “insomnia early,” “insight,” and “recall” were associated with a diagnosis of dementia in late-life depression. To date, no easy and useful examinations have been available in clinical practice for a differential diagnosis between late-life depression with and without dementia based on specific depressive symptoms, although many previous studies have attempted to identify effective biological markers [30–34]. The results of the present study indicate that “insomnia early” and “insight” on the HAMD-17 and “recall” on the MMSE may be useful for differentiating late-life MDD with from that without dementia. Late-life depression often impairs cognitive function [35]. A previous study involving older people reported that depressive symptoms were associated with immediate, but not delayed recall [36]. On the other hand, another study reported that delayed recall (“recall” on the MMSE) was inversely associated with AD compared with mild cognitive impairment [20]. Those results support our finding that delayed recall was significantly associated with late-life depression with dementia compared with that without dementia. It is well known that patients with dementia not only had a lack of insight for cognitive function. In this

study, patients with dementia also had worse levels of insight for depression than patients without dementia. It is suggested that patients with dementia would be likely to have a lack of insight for depression, compared to the similar severity of depression without dementia. To the best of our knowledge, no studies have reported differences in HAMD-17 scores between late-life MDD with and without dementia. Previous studies have reported that anxiety is associated with an increased risk of dementia [37], and that suicide attempts are associated with dementia [38]. Those studies suggest that depressive symptoms in patients with dementia are sometimes severe, and that it is difficult to differentiate the symptoms of late-life depression from those of dementia. Therefore, our findings indicate that asking questions about both cognitive function and depressive symptoms, especially “recall,” “insomnia early,” and “insight,” could be helpful for detecting comorbid dementia in late-life depression in clinical practice.

On the other hand, in this study, age in patients with dementia was significantly higher than that in patients without dementia. This result is consistent that aging was a risk factor for dementia [39]. This result was consistent that aging was a risk factor for dementia. It is suggested that age was the risk factor regardless of severe depression. On the other hand, the rate of first depressive episode at this admission was significantly higher in the MDD with dementia group compared with the without dementia group. Thus, the mean age at onset of MDD was significantly older in the MDD with dementia group. To the best of our knowledge, no studies have reported differences of age at onset of MDD at the admission between late-life MDD with and without dementia. Previous studies reported that the cognitive function in the more than 60 years of the onset of late-life depression was significantly worse than less than 60 years of the onset of late-life depression and controls [40], and dopamine transporter binding in the striatum was significantly lower in more than 55 years of late-onset depression [41]. Furthermore, late-life MDD was associated with higher levels of comorbid medical illness, cognitive impairment and mortality, compared to younger-onset depression [42]. Our findings were consistent with those of these previous studies, and our findings suggest that the older the age of first onset of depression, the greater the possibility of comorbid dementia clinicians should be considered.

In this study, the prevalence of DLB (41.7%) was highest in the types of dementia. This prevalence

was higher than that of previous studies [21, 39, 43, 44]. However, previous studies reported that the severity of depression was higher in dementia with Lewy bodies than in AD [18, 45]. In this study, we focused on patients who had a diagnosis of severe depression. Furthermore, previous studies reported that DAT would be useful for not only diagnosis of prodromal DLB [46], but also differential diagnosis between late-life depression and DLB [47, 48]. almost all patients in dementia had undergone DAT. This may be associated to one of the reasons for the high prevalence of DLB. Thus, these would affect the high prevalence of DLB.

In this study, 36% of patients in late-life depression underwent ECT. Although ECT is effective for improvement of depression, temporal cognitive impairment is known as the acute adverse effect of ECT [49]. However, Osler et al. reported that ECT was not associated with risk of dementia in patients with mood disorders including late-life depression [49], and Lambrichts et al. also reported that ECT for severe late-life depression was not significantly increased with long-term outcome of cognitive impairment, compared to other treatments for severe late-life depression after five years [50]. Furthermore, Takahashi et al. reported the safety and effectiveness of ECT for depression in DLB [45]. These studies suggested that the risk of cognitive impairment as the acute adverse effect of ECT was limited to short term and ECT was safe and effective for late-life depression and/or dementia.

On the other hand, ECT was effective for depression in moderate dementia. It is suggested that ECT could be effective late-life depression even in the presence of relatively advanced dementia. Previous studies have reported the efficacy of ECT for depression in dementia [45, 51–57], but the number of studies is not large. Furthermore, most are case reports [52, 55–57], or most studies focused on relatively mild dementia, compared to this study [45, 51, 53]. Further studies should be needed to clarify the efficacy for depression in moderate or severe dementia.

This study had several limitations. First, the sample size was small, and the data were collected retrospectively. However, we investigated specific patients who were over 65 years of age who required hospitalization because of a severe depressive episode and had no history of a dementia diagnosis. Further studies with younger and less severe patients and a longer follow-up period are needed. Second, not all patients were examined using the HAMD-17 and MMSE during

hospitalization. Especially, only 7 cases had HAMD-17 assessment in patients with dementia. Third, we did not follow the patients for a long period after discharge. In the future, longer follow-up will be needed to clarify whether late-life patients with MDD or BD without dementia are more at risk of developing dementia. Fourth, this study was retrospective studies from medical records. Thus, we may not have had sufficient information on current medical history prior to admission from informants such as patients' family, because neurodegeneration disorders including dementia usually cause gradual onset. Fifth, this study was conducted at a single university hospital. Thus, the results may not be generalizable, as difficult-to-manage cases may have been admitted more selectively. Further studies at multiple institutions may be warranted.

### Conclusions

In conclusion, patients with late-life depression were diagnosed with dementia more frequently than those with late-life BD. Patients with late-life depression with dementia were associated with higher age, lower MMSE scores, and a lower SBR in DAT scans compared with those without dementia. Lower "insomnia early" and higher "insight" scores on the HAMD-17 and lower "recall" scores on the MMSE may be useful indicators for a diagnosis of dementia in late-life depression.

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### CONFLICT OF INTEREST

The authors have no conflict of interest to report.

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